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SUMMARY WITH CRITICAL APPRAISAL

Meal Delivery Programs for Community Seniors: A Review of Clinical Effectiveness

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Authors: Casey Gray, Charlene Argáez

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About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

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Questions or requests for information about this report can be directed to Requests@CADTH.ca

Abbreviations

BMI	Body mass index
DDM	daily delivered meals
EQ-5D-3L	EuroQoL Group-5 dimension-3 level questionnaire
EQ-VAS	EuroQoL Group visual analogue scale
GARS	Groningen activity restriction scale
GQoL	global quality of life
HRQoL	health related quality of life
IQR	interquartile ratio
Kg/m^2	kilogram per square metre
MD	meal delivery
n	sample size
RCT	randomized controlled trial
SD	standard deviation
T1	baseline
T2	first follow-up
T3	second follow-up
UCLA	University of California Las Angeles
WDM	weekly delivered meals
WHO-5	World Health Organization 5-Item Well-Being Index

Context and Policy Issues

The proportion of older adults in Canada has been growing steadily since the 1970s.[1] In 1986, older adults (aged ≥65 years) made up 10% of the Canadian population.[2] By 2016, 16.5% of Canadians were aged 65 years and older and 13% (of those 65 and older) were aged 85 or older.[3] Generally, the health status of older adults indicates Canadians are living longer and are healthier than those from previous generations.[4] However, it has been raised that the health care system will not be able to meet the health care needs of Canada's growing population of older adults.[4]

Canada's Federal, Provincial, and Territorial Ministers Responsible for Seniors included social connectedness and healthy eating among five key areas of focus in 2005.[5] Social connectedness can become an issue when older adults lose a spouse or co-resident. This can lead to feelings of isolation and reduced well-being.[5] Loss of a spouse or co-resident can also affect the financial status of older adults.[5] Taken together with physical health declines, nutrition needs can become an issue. While 41% of older adults rate their own health as very good or excellent,[4] age can be accompanied by challenges in the ability to carry out activities of daily living like eating and functional activities such as preparing food, as well as increasing chronic health concerns.[4]

Nevertheless, most adults aged 55 years or older want to remain in their homes as they age, and most older adults (93%) have remained living in private households.[4] To remain in their homes, some older adults require support.[4] A 2011 CADTH environmental scan of initiatives for healthy aging underway in Canada indicated that supporting older adults to remain in community is an important target of interventions.[6]

Related to this review, a previous CADTH rapid response review on the clinical effectiveness of congregate meal programs for older adults living in the community did not

identify any relevant studies.[7] The purpose of the current report is to review the clinical effectiveness of meal-delivery nutrition programs for older adults living in the community.

Research Question

What is the clinical effectiveness of meal delivery nutrition programs for older adults living in the community?

Key Findings

One randomized controlled trial (RCT) and two non-randomized studies were identified regarding the clinical effectiveness of meal delivery nutrition programs for community-dwelling older adults. Low quality evidence from one RCT and one single-arm non-randomized study showed that meal delivery nutrition programs may improve loneliness among older adults. The same single-arm study showed a positive association between meal delivery nutrition programs and self-reported well-being. Frequency of meal delivery does not appear to be a factor. Low quality evidence from one controlled non-randomized study showed that a meal delivery nutrition program was not associated with perceived improvement in quality of life among community-dwelling older adults. No evidence regarding independence or other mental health or psychosocial outcomes was identified.

Methods

Literature Search Methods

A limited literature search was conducted on key resources including PubMed, the Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No methodological filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2008 and December 17, 2018.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Older adults aged ≥65 years who are living in community
Intervention	Meal-delivery nutrition programs
Comparator	Any comparator; no comparator
Outcomes	Independence, psychosocial outcomes, mental health outcomes
Study Designs	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies

Exclusion Criteria

Articles were excluded if they did not meet the selection criteria outlined in Table 1, they were duplicate publications, or were published prior to 2008.

Critical Appraisal of Individual Studies

The included randomized studies were critically appraised by one reviewer using the Revised Cochrane Risk of Bias Tool for Randomized Studies (RoB 2),[8] and non-randomized studies were critically appraised using the Downs and Black Checklist.[9] Summary scores were not calculated for the included studies; rather, a review of the strengths and limitations of each included study were described narratively.

Summary of Evidence

Quantity of Research Available

A total of 517 citations were identified in the literature search. Following screening of titles and abstracts, 505 citations were excluded and 12 potentially relevant reports from the electronic search were retrieved for full-text review. No potentially relevant publications were retrieved from the grey literature search for full text review. Of the potentially relevant articles, nine publications were excluded for various reasons, and three publications met the inclusion criteria and were included in this report. These comprised one RCT and two non-randomized studies. Appendix 1 presents the PRISMA[10] flowchart of the study selection.

Additional references of potential interest are provided in Appendix 5.

Summary of Study Characteristics

Additional details regarding the characteristics of included publications are provided in Appendix 2.

Study Design

Three clinical studies were identified for inclusion in this report.[11,12] One three-arm, parallel, unblended pragmatic RCT that was published in 2016 was identified. Investigators of the RCT recruited older adults (not defined) from waitlists for home meal delivery at eight Meals-On-Wheels America sites between the winter of 2013 and spring of 2014. Participants were randomized to one of three arms and there was no mention of allocation concealment.[12]

One two-arm, non-randomized controlled trial published in 2017[11] and one single-arm before-and-after study published in 2015[13] were identified. The controlled study recruited home-dwelling older adults with functional disability who were clients of a home care organization.[11] Nurses from the organization screened all clients for eligibility and invited those eligible to participate in the study.[11]The single-arm study was less strict and did not limit participants to those with functional disability.[13] The program intake coordinator screened participants for eligibility as they enrolled in the meal delivery program and invited those eligible to participate.[13] Participants of the non-randomized studies were recruited between November 2013 and April 2014.[11,13]

Country of Origin

The included RCT was conducted in the US[12] and the non-randomized studies were conducted in the US[13] and the Netherlands.[11]

Patient Population

Participants in the clinical studies were older adults living in the community.[11-13] In the RCT, authors reported open eligibility as this was a pragmatic study. Participants were 376 Meals-on-Wheels waitlisted customers at one of the eight participating sites and were home-bound (not defined) older adults.[12] There were no differences between groups for most baseline characteristics assessed at baseline.[12] Mean ages ranged from 75.7 to 77.4 years across groups, participants' self-ratings of loneliness did not differ across groups (scores ranged from 3.1 to 3.5 out of 9).[12] However, a significantly greater proportion of participants in the waitlist group were married (31.5% of the comparator vs. 18.9% and 21.9% in the intervention groups) and reported participating in groups (e.g., seniors centre, community group, public service) (34.9% of the comparator vs. 22.5% and 21.7% of the intervention, both *P* values < 0.05.[12]

Participants in the controlled non-randomized study were eligible if they were not able to prepare their own healthy meals as a result of functional impairment.[11] Those with a partner at home were eligible if their partner was not able to prepare meals for them.[11] Participants were excluded if they had problems with chewing, had severe malnutrition, had cancer or another serious condition, or had a life expectancy of < 6 months.[11] Participants in the single-arm trial were not required to have functional disability and inclusion was quite broad.[13] There were a total of 44 participants in the two-arm study and 62 in the single-arm study.[11,13] Participants mean ages ranged from 74.11 to 84 years.[11,13] Most participants in both studies were female (66% to 78.9%).[11,13] In the controlled study, most participants did not live with a partner (intervention, 72% and control, 84.2%),[11] and were receiving home care visits for assistance with self-care and medical tasks for an average of 5.6 (intervention) and 4.1 (control) hours per week.[11] Participant self-reports of disability (mean of disability in activities of daily living and instrumental activities of daily living) were 44.1 (intervention) and 40.6 (control), where higher scores reflect greater activity restriction.[11] At baseline, 36% of intervention participants and 47.4% of participants in the control group were already receiving a meal delivery service; control group participants were able to continue receiving their meals from the other service through the duration of the intervention period.[11] Details on cohabitation, disability, and previous meal delivery service were not collected in the single-arm study.[13]

Interventions and Comparators

There were two intervention conditions in the RCT and one control group.[12] The interventions both consisted of 15 weeks of home meal delivery by program staff or volunteers.[12] In the daily delivered meals condition, hot or chilled prepared meals (never frozen) were delivered once per day on week days (five days per week).[12] In the weekly delivered meals condition, five frozen meals were delivered once per week.[12] The comparator consisted of waitlist only.[12]

Intervention duration ranged from two[13] to three[11] months in the non-randomized studies. Both interventions consisted of a single meal delivered once daily on at least four days per week.[11,13] Participants in the controlled trial were given a simple, portable convection oven to re-heat meals, which was intended to improve taste compared with microwave.[11] The

comparator in the controlled trial consisted of usual diet, which may have included use of an alternate meal delivery service.[11]

Outcomes

Loneliness was assessed in the RCT and single-arm non-randomized study.[12,13] In the RCT, loneliness was assessed at baseline and 15-week follow-up using the 3-item University of California, Las Angeles (UCLA) Scale.[12] Responses were selected on a scale ranging from 0 to 3, and summed. Potential overall scores range from 0 to 9, with higher scores reflecting greater feelings of loneliness.[12] The scale had acceptable reliability. Scale validity and minimal clinically important difference were not reported.[12] In the single-arm non-randomized study,[13] loneliness was assessed at baseline and two-month follow-up using the 3-item Loneliness Scale.[13] Responses were recording on a scale ranging from 0 (never) to 3 (often) and summed.[13] Potential overall scores ranged from 3 (no social isolation) to 12 (worse levels of loneliness).[13] Measurement properties were not reported.[13]

Well-being was assessed in the single-arm non-randomized study using the World Health Organization 5-item questionnaire (WHO-5).[13] Responses were recorded on a scale ranging from 0 (at no time) to 5 (all the time).[13] Summed scores ranged from 0 (worst possible) to 25 (good).[13] Measurement properties were not reported. [13]

Quality of Life (QoL) was assessed in the controlled non-randomized study as health-related QoL and Global QoL.[11] Health-related QoL was assessed with the EuroQoL visual analogue scale (EQ-VAS), a subscale of the EQ 5-dimension, 3-level questionnaire (EQ-5D-3L).[11] Participants rated their current health state from 0 to 100 (worst- to best-imaginable health state).[11] Measurement properties and minimal clinically important difference were not reported.[11] Global QoL was assessed with the overall valuation of life subscale of the Rotterdam Symptom Checklist.[11] Participants rated how well they felt during the past week on a scale ranging from 0 to 6 (very bad to very good).[11] Scores were transformed to a 100-point scale, with higher scores reflecting better global QoL.[11] Measurement properties and minimal clinically important difference were not reported.[11]

Summary of Critical Appraisal

The critical appraisal of the included clinical studies is summarized here. Additional details regarding the strengths and limitations of included publications are provided in Appendix 5.

Randomized Study

The randomized study was assessed using the Revised Cochrane Risk of Bias Tool for Randomized Studies.[8] Several strengths and limitations were identified. Strengths included few deviations from the intended interventions and use of an outcome measure that has demonstrated acceptable reliability in previous research. There were also several important limitations. For example, although authors describe the study as an RCT, it seems unlikely that participants were actually randomly assigned to conditions, elevating the risk of selection bias. Authors described alphabetizing participant last names and assigning them to the three groups in sequential order. Although alphabetizing is associated with less bias than many methods, it may have been possible to predict group assignment. The risk of selection bias may have been further elevated, as it is unknown if allocation concealment took place. Finally, there was high risk of bias due to measurement of the loneliness outcome. Participants and outcome assessors were not blinded to intervention assignment. Participants were selected from a waitlist of potential future clients who wished to receive home delivered meals. Loneliness is a subjective outcome for which responses could

reasonably be assumed to be at risk of bias if participants felt their ability to continue with the service- or gain access to the service at the conclusion of the study would be influenced. For example, waitlisted participants may have reported higher levels of loneliness if they believed doing so would lead to being prioritized for the service. In contrast, intervention recipients may have reported reduced loneliness as a means of emphasizing their gratitude and desire to continue receiving the service.

Non-Randomized Study

The non-randomized studies[11,13] were assessed using the Downs and Black Checklist[9] and several strengths and limitations were identified. First, it was considered a strength that the study characteristics, main findings, and funding sources were all clearly reported in the controlled study.[11] Reporting was less clear in the single arm study, where main outcomes were described differently throughout the manuscript and funding sources were not disclosed.[13]

Regarding external validity, it was a strength of both non-randomized studies that all eligible participants within the participating organization or region were invited to participate.[11,13] Nonetheless, this may still be considered a convenience sampling strategy. Furthermore, only 27% of eligible participants in the controlled study consented to participate,[11] and it is unclear whether participants were representative of the entire population and therefore, whether findings generalize to the population from which the sample was drawn. It is unclear how many potential participants were approached to participate, raising similar issues.[13] In terms of internal validity, the controlled study[11] appears to have been generally well conducted. However, blinding did not take place, reducing our certainty that participant responses to questionnaires and analysis of data were not biased. There is a low likelihood that selection bias was an issue. Although participants were not randomized to intervention or control groups, baseline characteristics were similar between groups and potential confounders were examined and found not to be a factor during analysis.[11] The exclusion of participants lost to follow-up from analyses further reducing our certainty that study findings can be generalized to the entire population being examined. An important limitation pertains to the instructions to those in the comparator condition regarding following their usual diet. Many participants were already using a meal-delivery service at the time of baseline assessments. Intervention participants were instructed to stop the other meal delivery service, while control group participants were invited to continue.[11] This affected nine participants (47.4%) in the control group.[11] It is unclear how the various meal-delivery services would have been run, and to what extent face-to-face socialization time would have differed between groups. The continuance of home meal delivery in the control group could have hidden or reduced the magnitude of any differences in outcomes between the intervention and control groups.

Summary of Findings

Clinical Effectiveness of Meal Delivery Nutrition Programs

Loneliness

Loneliness was examined in one RCT[12] and one non-randomized study.[13] In the RCT, after the 15 week intervention period, the waitlist comparator group reported higher loneliness than the combined daily and weekly meal delivery group when baseline loneliness scores were adjusted for (P = 0.018).[12] Adjusted loneliness scores did not differ significantly between daily and weekly meal delivery groups (P = 0.359).[12] Study authors concluded that home-delivered meals reduce feelings of loneliness in older adults.[12] Consistent with this

finding, loneliness scores were significantly reduced from baseline to follow-up in the non-randomized single arm study.[13]

Well-Being

Wellbeing was examined in one single-arm non-randomized study. After a two-month intervention, well-being was significantly improved.[13]

Quality of Life

QoL was examined in one non-randomized study as health-related and global QoL.[11] After a three month intervention, there was no difference in health related QoL between the intervention and comparator groups immediately following the intervention (three-month follow-up) or three months later (six-month follow-up).[11] Similarly, there was no difference in global QoL at three-month follow-up.[11] However, there was a statistically significant difference between intervention and comparator in the change from baseline to 6 month follow-up, favouring the comparator group (P = 0.003).[11] Authors concluded there were no favourable QoL effects of a three-month high-quality home delivered meal service for functionally disabled older adults living in community.[11]

Appendix 4 presents a table of the main study findings and authors' conclusions.

Limitations

There were a number of limitations of the current body of evidence. To begin with, each study featured a relatively short intervention period (ranged from two to three months). It would be useful to know if greater improvements would be seen over time as participants remain in a home meal-delivery program. Second, no information was provided regarding the interaction between the delivery person and the meal recipient. Finally, while the included studies provide information about QoL, well-being, and loneliness, they do not provide any information about the effect of meal delivery nutrition programs on independence or other mental and social health outcomes.

The findings of this report may be generalizable to the Canadian context and provide useful information for policy makers about the utility of offering a meal delivery nutrition service to older adults living in the community in this country.

Conclusions and Implications for Decision or Policy Making

One RCT and two non-randomized studies were identified to address the effectiveness of meal delivery nutrition programs for older adults living in the community. Overall, findings suggest receiving home-meal delivery for two to three months was associated with reduced feelings of loneliness, improved well-being and was not related to QoL. It is possible the short intervention period was not sufficient to change participant ratings of QoL.

Conclusions are tenuous due to being based on a small number of included studies, with small sample sizes, and data collected using outcome assessment tools for which there was a lack of information about the measurement properties. It is unclear whether improvements in loneliness ratings were clinically meaningful, as this information was not provided. Given that the control condition in the RCT was permitted to continue with another meal delivery service if one was being used, it is important to determine the benefits of meal delivery against no-meal delivery. Further research comparing meal

delivery nutrition programs against not receiving meal delivery or versus other nutrition program comparators may help to reduce uncertainty.

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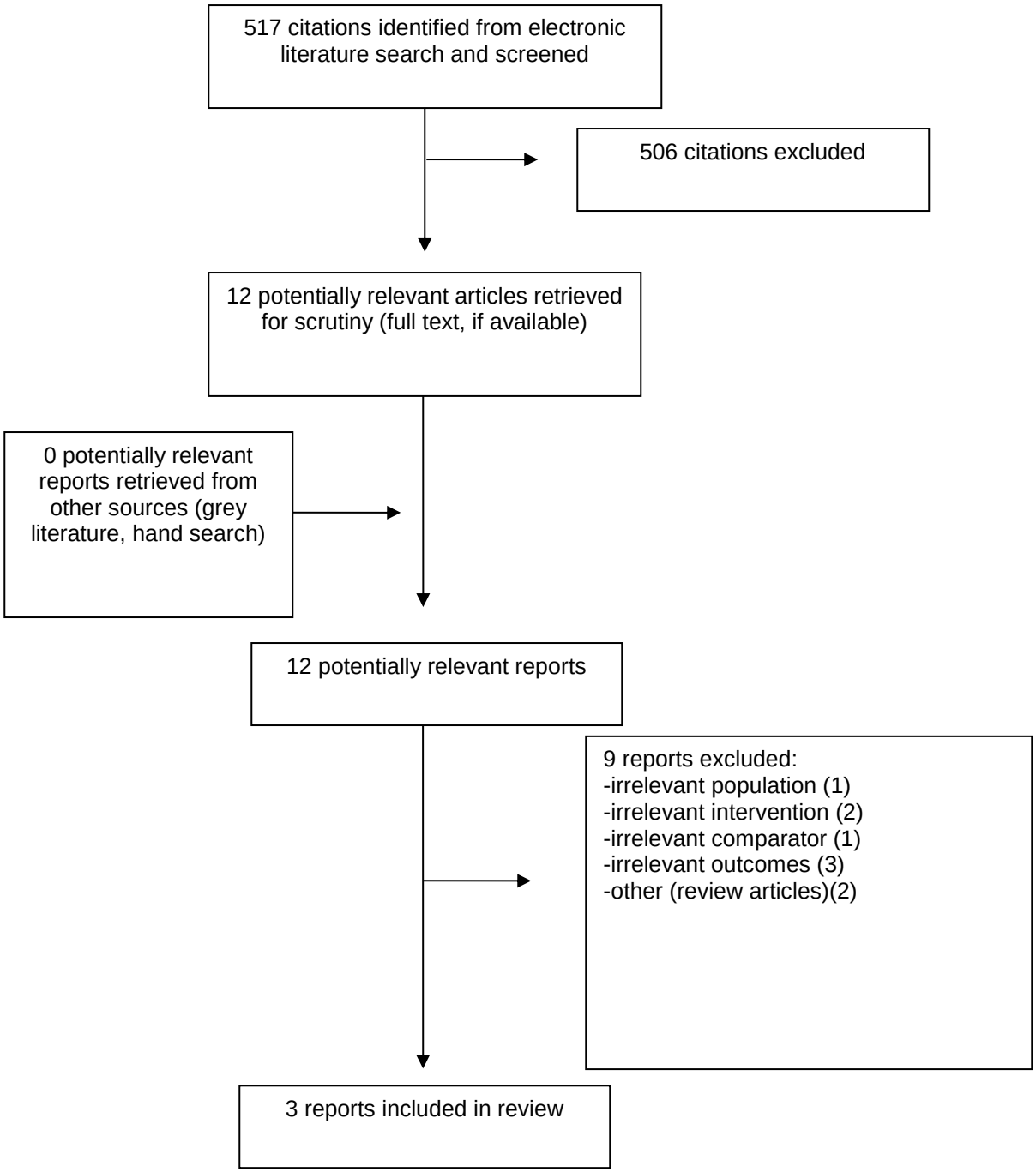
Appendix 1: Selection of Included Studies



Appendix 2: Characteristics of Included Publications

Table 2: Characteristics of Included Primary3 Clinical Studies

First Author, Publication Year, Country	Study Design	Population Characteristics	Intervention and Comparator(s)	Clinical Outcomes, Length of Follow-Up
Randomized Study				
Thomas 2016[12] US	Three-arm, parallel, unblinded RCT Participants recruited between winter 2013 and spring 2014 from Meals-on-Wheels waitlists at eight sites	**Eligibility criteria** None **Exclusion criteria** None N = 376 **baseline characteristics** **Age (Mean)** Waitlist = 75.7 years DDM= 77.4 years WDM = 76.2 years *P* > 0.05 **Married (%)** Waitlist = 31.5 DDM= 18.9 WDM = 21.9 *P* < 0.05 **Participates in groups (%)** Waitlist = 34.9 DDM = 22.5 WDM = 21.7 P < 0.05 **Loneliness (Mean)** Waitlist = 3.5 (2.9) DDM = 3.5 (2.7) WDM = 3.1 (2.6) *P* > 0.05	Interventions: **DDM** 15 weeks of once daily (on weekdays) delivery of hot or chilled meals by program staff/ volunteers **WDM** 15 weeks of once-weekly delivery of 5 frozen meals by program staff/ volunteers Comparator: **Waitlist** Contact with Meals on Wheels staff or volunteers for T1 and T2 assessments. 15 weeks from T1 to follow-up call to schedule T2 assessment	**Loneliness** Assessed with the 3-item UCLA Scale, which is a subset of items from the Revised UCLA Loneliness scale. Responses range from 0 to 3, with higher numbers reflecting greater frequency of feeling lonely. Responses were summed. Potential scores range from 0 to 9 The 3-item scale had acceptable reliability, as reported by the study authors (α =0.72) **Length of follow-up** 15 weeks
Non-Randomized Studies				
Denissen, 2017[11] The Netherlands	2-arm, non-randomized, controlled trial Participants were recruited between November 2013 and	**Eligibility criteria** Clients of Proteion; Aged ≥70 years; Home-dwelling; "unable to prepare their own dinners due to functional impairment"	Intervention: **MD** 3 months of once daily meal delivery on 4 to 7 days / week delivered by staff	**HRQoL** Assessed with the EQ-VAS subscale of the EQ-5D-3L Participants rate their current health state

First Author, Publication Year, Country	Study Design	Population Characteristics	Intervention and Comparator(s)	Clinical Outcomes, Length of Follow-Up
	December 2013 from home care organization Proteion	(p.371); consented to eat ≥4 delivered dinners per week **Exclusion criteria** Partner able to prepare healthy meals; chewing problems; severe malnutrition based on BMI (<18.5 kg/m^2), "cancer or other serious conditions" (p.371), life expectancy < 6 months N = 44 n = 25 intervention n = 19 comparator **baseline characteristics** Unclear if statistically analyzed **Age (M years, (IQR))** MD = 83 (79, 89) Control = 84 (81, 88) **Gender (n (%))** MD = female, 19 (76%); male, 6 (24%) Control = female, 15 (78.9%); male, 4 (21.05%) **Partner (n (% yes))** MD = 7 (28.0%) Control = 3 (15.8%) **Previous meal service** (n (% yes) MD = 9 (36.0%) Control = 9 (47.4%) **Home care (self-care , medical) assistance (hours/week), mean (SD)** MD = 5.6 (3.6) Control (4.1 (3.0) **Disability in, and**	Comparator: **Usual diet** "Participants in the control group were invited for an observational trajectory within the context of a care improvement project of the home care organization, and sustained their usual diet, also when they already used a meal service." (p.371)	from 0 (worst imaginable health state) to 100 (best imaginable health state) Measurement properties were not reported. **GQoL** Assessed with the overall valuation of life subscale of the Rotterdam Symptom Checklist. Participants indicated how well they felt during the past week on a scale ranging from 0 (very bad) to 6 (very good). Scores were transformed to a 100-point scale. Higher scores reflected better GQoL. Measurement properties were not reported. **Length of follow-up** 3 months (T2) and 6 months (T3)

First Author, Publication Year, Country	Study Design	Population Characteristics	Intervention and Comparator(s)	Clinical Outcomes, Length of Follow-Up
		instrumental activities of daily living; GARS-score, mean (SD) MD = 44.1 (10.6) Control = 40.6 (8.8) Higher scores reflect greater disability Scale range: 18-72		
Wright 2015[13] US	Single-arm pretest–posttest design Participants were recruited from Meals-on-Wheels enrollment list between January and April 2014	**Eligibility criteria** Aged ≥55 years; Received ≥3 home-delivered meals / week; Spoke English; Telephone access; Able to consent and answer survey questions **Exclusion criteria** none N = 62 **Baseline characteristics** **Age (years)** Mean= 74.11 **Gender (%))** female, 666; male, 34 **Nutrition status (%)** Normal = 8.1 At nutritional risk = 58.1 Malnourished = 33.9	Intervention: 2 months of once / day, ≥ 4 times / week single meal delivery	**Well-Being** Assessed with the WHO-5 questionnaire. Participants recorded responses on a scale from 0 (at no time) to 5 (all the time). Summed scores ranged from 0 (worst possible) to 25 (good). Measurement properties were not reported. **Loneliness and social isolation** Assessed with the 3-Item Loneliness Scale. Participants recorded their feelings on a scale from 0 (never) to 3 (often). Summed scores range from 3 (no social isolation) to 12 (worst levels of loneliness). Measurement properties were not reported. **Length of follow-up** 2 months

BMI = body mass index; DDM = daily delivered meals; EQ-5D-3L = EuroQoL Group-5 dimension-3 level questionnaire; EQ-VAS = EuroQoL Group visual analogue scale; GARS = Groningen activity restriction scale; GQoL = global quality of life; HRQoL = health related quality of life; IQR = interquartile ratio); kg/m^2 = kilogram per square metre; MD = meal delivery; RCT = randomized controlled trial; T2 = first follow-up; T3 = second follow-up; UCLA = University of California Las Angeles; WDM = weekly delivered meals; WHO-5 = World Health Organization 5-Item Well-Being Index;

Appendix 3: Critical Appraisal of Included Publications

Table 3: Strengths and Limitations of RCT using Cochrane RoB 2[8]

Strengths	Limitations
Thomas, 2016[12]	
Risk of bias due to deviations from the intended intervention There were very few deviations from the intended intervention that arose because of the experimental context. Eighteen of 626 participants assigned to an intervention condition no longer wanted to receive meals and the reasons were not reported. These few deviations are not expected to have affected the outcome. **Risk of bias in measurement of the outcome** The three-item UCLA loneliness scale has been shown to have acceptable reliability in previous research, as reported in the current study. Methods for the assessment of loneliness were unlikely to have differed between groups **Risk of bias in selection of the reported result** The trial appears to have been analyzed in accordance with a pre-specified plan that was finalized before outcome data were collected. This is not certain as the study protocol was registered or published.	**Risk of bias arising from the randomization process** Unclear if allocation sequence generation process was actually random: “sites randomized participants by alphabetizing participants last names and sequentially assigning them to one of three groups.” (p1051) There is no information about concealment of the allocation sequence. Significant baseline differences between groups suggest a potential problem with the randomization process. I.e., for ‘Participates in groups’ and ‘Married’ suggest less baseline isolation among those in the waitlist control condition compared with the DDM and WDM intervention conditions. Study authors indicated that all but one sites normally prioritize waiting lists to serve those who most need services. Without allocation it is possible for those with different baseline needs to have been prioritized differently. **Risk of bias due to deviations from the intended intervention** Due to the nature of dietary interventions, participants, care givers, and people delivering the interventions were aware of group assignment. An appropriate analysis (e.g., intention to treat) was no used to estimate the effect of assignment to intervention. **Risk of bias due to missing outcome data** 60.06% (376 of 626 randomized) of participants were excluded from the analysis: All participants at one site (n = 83) were removed from analyses because staff did not collect data on living arrangement. There were no significant differences between included and removed participants in baseline loneliness scores (N not reported, other outcomes not reported); 18 participants no longer wanted to receive meals; 17 died; 24 moved; 11 were in hospital at T2; 15 refused T2 survey; 45 unable to be reached at T2. Proportion of overall missing outcome data did not differ significantly across groups. It was not reported if missingness for the various reasons differed across groups. It is not known if reasons missing could depend on the true value of the loneliness value.

Strengths	Limitations
	There were no significant differences between included and removed participants in baseline loneliness scores (N not reported, other outcomes not reported) Risk of bias in measurement of the outcome Outcome assessors were not blinded to intervention status. It is plausible that knowledge of assigned intervention could influence participant-reported outcomes

DDM = daily delivered meals; n = sample size; T1 = baseline; T2 = first follow-up period; T3 = second follow-up period; UCLA = University of California, Las Angeles; WDM = weekly delivered meals

Table 4: Strengths and Limitations of Non-Randomized Studies using Downs and Black Checklist[9]

Strengths	Limitations
Denissen, 2017[11]	
Reporting • Study objective was clearly reported • Main outcomes were clearly described in the Methods • Participant characteristics were clearly described • Intervention was clearly described • Distributions of principal confounders in each group were clearly described • Main findings of the study were clearly described • Actual probability values were only reported for significant results • Random variability in data was estimated for main outcomes • The source of funding was clearly stated with a statement that funders were not involved in the design, analysis or writing of the article. **External Validity** • All 161 eligible adults were invited to participate, representing the entire population recruited. **Internal Validity** • There is no evidence that results were based on data dredging • The time period between T1 and the outcome assessments was the same for both groups. • Statistical tests used to assess main outcomes were appropriate • Study authors did not report compliance in terms of whether participants accepted meals delivered. However, dietary intake was reported, and authors did not suggest meals were not being consumed. Four participants chose not to use the provided convection oven due to warming time, and instead used another method to heat their meals. The effect of this on QoL outcomes is expected to be negligible to small. • Patients in different intervention groups were recruited from	**Reporting** • Characteristics of participants lost to follow-up were not described • Information on adverse events was not systematically collected **External Validity** • Participants were selected from a convenience sample of a select few Meals-on-Wheels sites. • Of those invited, 44 consented. It is unclear whether those who consented to participate were representative of the entire population recruited, as no demographic data exist for those who declined to participate. • Patients remained in their homes and received delivery meals from staff or volunteers, as would be the case with any person receiving meals from a home-delivery service **Internal Validity** • Participants were not blinded to the intervention • Outcome assessors were not blinded to the intervention • Measurement properties for study outcomes were not reported by study authors • Participants were not randomized to intervention groups; allocation was according to municipality of residence • Participants lost to follow-up were excluded from analyses **Power** • A formal power analysis was not performed. Authors discussed that the small study may have lacked power to detect significant differences for small intervention effects, if any differences existed. **Other** • Many participants were already receiving a different meal-delivery service at baseline: Intervention n = 9, 36%; control n = 9, 47.4%. Intervention participants cancelled their previous meal delivery service for the study duration, but control participants did not.

Strengths	Limitations
two different cities (cluster assignment). It is unclear if significant was analyzed, but authors reported “No substantial differences were observed between the intervention and control group.” (p374) • Intervention and control group participants were recruited over the same period of time • Potential confounders were examined using a linear regression model. “Since none of the potential confounders changed the regression coefficient for the treatment group by more than 10%, only unadjusted analyses are presented.” (p.373)	
Wright, 2015[13]	
Reporting • Study objective was clearly reported • Participant characteristics were clearly described • Intervention was clearly described • Main findings of the study were clearly described • Actual probability values were reported • Random variability in data was estimated for main outcomes **External validity** • All eligible adults in the local Meals-on-Wheels program were invited to participate. • Patients remained in their homes and received delivery meals from staff or volunteers, as would be the case with any person receiving meals from a home-delivery service **Internal validity** • Statistical tests were appropriate • Results do not appear to have been based on data dredging	**Reporting** • One main outcome was described differently throughout the manuscript as QoL well-being and emotional-wellbeing and global wellbeing. • Principal confounders were not examined • The source of funding was not stated • Information on adverse events was not systematically collected • Characteristics of patients lost to follow-up were not described **External validity** • Participants were selected from a convenience sample of a local Meals-on-Wheels program. It is unclear if this sample or those invited were representative of the entire population • Of those invited 62 were enrolled. It is unclear how many were eligible to participate **Internal validity** • Unclear if non-compliance was an issue as it was not mentioned • Measurement properties of outcome measures were not reported • A control group was not included • Confounding was not adjusted for in the analyses • 11 (18%) participants were lost to follow-up for various reasons. It is not clear how many were lost for identified reasons that may be related to the true result (e.g., no longer receiving home-delivered meals or refusal to complete follow up survey). Losses to follow-up were excluded from the analysis. **Power** • A power analysis was not reported

N = sample size; QoL = Quality of Life; T1 = baseline

Appendix 4: Main Study Findings and Authors' Conclusions

Table 5: Summary of Findings of Included Primary Clinical Studies

Main Study Findings	Authors' Conclusion
Randomized Study	
Thomas, 2016[12]	
T1 and Unadjusted T2 Loneliness Scores [Mean (SD)] Control, T1 =3.5 (2.9), T2 = 4.2 (2.7) DMD, T1 = 3.5 (2.7); T2 = 3.7 (2.9) WMD, T1 = 3.1 (2.6); T2 = 3.2 (2.6) **ANCOVA (adjusted for T1 loneliness score)** Waitlist (Mean = 4.17) vs. meal delivery (DDM + WDM) (Mean = 3.44) Mean difference = 0.73, SE = 0.31, *P* = 0.018 WMD (Mean = 3.23) vs. DMD (Mean = 3.62) Mean difference = –0.39, SE = 0.42, *P* = 0.359	"*Our study suggests that home-delivered meals improve the well-being of older adults, specifically by reducing feelings of loneliness*." (p1057)
Non-Randomized Study	
Denissen, 2017[11]	
T1, T2, and T3 HRQol [Mean (SD)] Intervention T1 = 57.4 (17.1), T2 = 64.6 (16.3), T3 = 65.8 (22.4) Control T1 = 59.6 (14.9), T2 = 62.0 (17.9), T3 = 64.3 (19.3) *P* > 0.05 **T1, T2, and T3 GQoL** Intervention, T1 = 71.3 (20.1); T2 = 70.6 (18.2); T3 = 60.4 (23.5) Control, T1 = 52.0 (24.9); T2 = 63.3 (24.6); T3 = 60.7 (26.6) GQoL significant better in intervention than control at T1 Between groups difference in change from baseline to T3 (6 months) *P* = 0.003.	"*In conclusion, a 3-month high-quality meal service program targeted towards functionally disabled home-dwelling elderly… No favorable effect of the intervention was found for handgrip strength and perceived quality of life*." (p379)
Wright, 2015[13]	
χ^2 (T1 and T2 Loneliness Scores [Mean (SD)] T1 = 4.05 (3.03); T2 = 2.69 (5.34); χ^2 = 156.52, *P* < 0.0005 **χ^2 (T1 and T2 Well-Being Scores [Mean (SD)]** T1 = 13.13 (6.41); T2 = 16.87 (5.34); χ^2 = 10.51; *P* < 0.002	"*Quality of emotional functioning also improved. Taken together, participants improved on both the loneliness/social isolation factor and on global well-being. The aim of the MOW program includes the improvement of life outcomes. Because these emotional needs are met less well in elder populations, this outcome is particularly clinically significant*." (p224) "Receiving home-delivered meals for a short duration significantly improved… loneliness, and mental well-being." (p225)

DDM = daily delivered meals; GQoL = global quality of life; HRQoL = health-related quality of life; SD = standard deviation; T1 = baseline; T2 = first follow-up; T3 = second follow-up; UCLA = University of California, Las Angeles; WDM = weekly delivered meals

Appendix 5: Additional References of Potential Interest

Other Outcomes

Thomas KS, Parikh RB, Zullo AR, Dosa D. Home-delivered meals and risk of self-reported falls: results from a randomized trial. *J Appl Gerontol*. 2018 Jan;37(1):41-57.