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Multidisciplinary nutritional support for undernutrition in nursing home and home-care: A cluster randomized controlled trial

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ABSTRACT

Objective: To assess the effect of multidisciplinary nutritional support for undernutrition in older adults in nursing home and home-care identified with the validated Eating Validation Scheme (EVS).

Methods: An 11 wk cluster randomized trial with a home-care (3 clusters) or nursing home (3 clusters) setting as the unit of randomization. Before starting the study, a train-the-trainer course was performed to educate the nutrition coordinators. In addition to the nutrition coordinator, the participants assigned to the intervention group strategy received multidisciplinary nutrition support. Focus was on treatment of the potentially modifiable nutritional risk factors identified with the EVS, by involving the physiotherapist, registered dietitian, and occupational therapist, as relevant and independent of the municipality's ordinary assessment and referral system. Outcome parameters were quality of life (by means of EuroQol-5D-3L), physical performance (30-seconds chair stand), nutritional status (weight and hand-grip strength), oral care, fall incidents, hospital admissions, rehabilitation stay, moving to nursing homes (participants from home-care), and mortality.

Results: Respectively, 55 (46 from 2 home-care clusters) and 40 (18 from 1 home-care cluster) were identified with the EVS and comprised the intervention and control group. A difference after 11 wk in quality of life (0.758 [0.222] versus 0.534 [0.355], $P = 0.001$), 30-seconds chair stand (47% versus 17% improved, $P = 0.005$) and oral care (1.1 [0.3] versus 1.3 [0.5], $P = 0.021$) was observed. There was a almost significant difference in mortality (2% versus 13%, $P = 0.079$).

Conclusions: Multidisciplinary nutritional support in older adults in nursing home and home-care could have a positive effect on quality of life, muscle strength, and oral care.

Introduction

Elderly adults in nursing home and home-care are a particularly high-risk population for weight loss or poor nutrition [1]. In Denmark, as many as 50% of elderly adults in nursing homes suffer from unintended weight loss and reduction of appetite. 20% of the nursing home residents and 12% of the home care clients have a body mass index (BMI) below 18.5 [2,3].

The negative consequences of undernutrition are numerous, i.e. increased risk for morbidity and mortality, impaired cognitive, physical, and social function and hence, reduced quality of life, increased health care costs, hospital stays, more general practitioner visits, more intensive nursing care, and increased requirement of nursing home-care [1].

Several potentially modifiable nutritional risk factors increase the likelihood of weight loss or poor nutrition [4,5]. Even though there is increasing evidence that the use of oral

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nutritional support (ONS) among nursing home residents improves weight and reduces mortality [6], the evidence for a benefit among elderly adults in home-care is very limited [6]. In addition, a more structured and multidisciplinary approach, focusing on the significant modifiable nutritional risk factors that includes involving dietitians, occupational therapists, and physiotherapist, to achieve additional nutritional benefits. Recently, the Danish National Board of Social Services developed a nutritional tool, Eating Validation Scheme (EVS), which is designed for use among nursing home residents and home-care clients, which includes eating habits, recent weight loss, and the potentially modifiable nutritional risk factors, including eating dependency, leaving 25% or more of food uneaten at most meals, and chewing and swallowing problems, with the aim of using this information in a multidisciplinary approach as needed [7]. In contrast to other nutritional tools developed for elderly people, EVS includes both a screening part and an intervention part. EVS has been validated based on a literature search and seemed capable of distinguishing those clients and residents with a positive benefit from those that showed no benefit of nutritional intervention [7]. These results need to be confirmed by a proper randomized controlled trial, where the benefits of a multidisciplinary nutritional intervention aimed at residents and clients, who are identified by means of EVS, are assessed. In addition, a recent systematic review of the effect of multidisciplinary interventions identified only two studies performed among nursing home residents (none among home-care clients), with very few relevant outcomes reported, making it impossible to conclude if multidisciplinary interventions were effective [8].

The aim of this study was to assess the effect of multidisciplinary nutritional support for undernutrition in elderly adults in nursing home and home-care, identified with the EVS. The study was part of a cost-effectiveness study funded by the Danish National Board of Social Services.

Materials and methods

Design and randomization

This study was designed as an 11 wk randomized controlled trial assessing the benefits of a new model for multidisciplinary nutritional support. To avoid contamination from the intervention, the participants were randomized in clusters, with home-care or nursing home as the unit of randomization (16). Hence, the clusters consisted of the participating nursing homes (3 clusters, see below) and home-care areas (3 clusters). Due to the limited knowledge about the benefit of nutritional support among home-care clients, the aim was to randomly assign 2 of the 3 home-care clusters to the intervention group. Randomization was performed by a researcher not involved in the study. The researchers for this study included the research assistants (AGC, BSH, SD-S, and TKSM) and the primary investigator (AB), who were not blinded for the intervention. Before starting the analysis the primary investigator (AB) was reblinded for participants' group assignment.

Population, inclusion, and exclusion criteria

The study comprised all three home-care areas in the municipality of Frederiksberg, with specific focus on participants receiving assistance with meals. Furthermore, two nursing homes had accepted an invitation to participate. One of these was very large and was therefore divided in two clusters. Elderly people (65 + years of age) receiving home-care or living in the two nursing homes with an EVS (see below) made by the nursing staff caregivers and, according to the staff caregivers, able to complete the planned tests were invited to participate. Participants were excluded from the study when they were not able or willing to give informed consent. The protocol for this study was sent to the Danish Ethical Board, which concluded that approval was not needed from the study participants and that the project could be carried on as described. Still, informed consent was obtained from all participants.

Nutritional status

Participants were eligible for this study if they were identified with 2 points according to EVS [7]. EVS contains information about eating habits, recent unintended weight loss, and the presence or absence of potentially modifiable nutritional risk factors (eating dependency, chewing, and swallowing problems, acute disease, or acute change in chronic disease). The information is combined to give a total number of points, 0 point (no risk), 1 point (at risk), and 2 points (benefit from intervention) (see Appendix 1).

Control group

Before starting the intervention, a nutrition education program was performed during the autumn and winter of 2012, educating selected staff members from the participating home-care and nursing homes to accept the role as nutrition coordinator. The education of the nutrition coordinator included three whole-day courses plus train-the-trainer sessions with other staff members (based on [9]) and local study circles in-between [10]. The overall aim was to learn how to work with EVS and specifically how to use the gathered information in a multidisciplinary approach as needed. The nutrition coordinators were present in both the control and the intervention group. Also, in both groups', standard interventions from physiotherapist, registered dietitian, occupational therapist, and care dentistry was requested through the municipality's normal assessment, and referral system was maintained.

Intervention group

In addition to the educated nutrition coordinator, the participants assigned to the intervention group strategy received the new model for multidisciplinary nutrition support during the 11 wk study. Focus was on individual treatment of the potentially modifiable nutritional risk factors identified by the EVS, by involving physiotherapist, registered dietitian, and occupational therapist, as relevant according to the EVS and independent of the municipality's ordinary assessment and referral system. The intervention was coordinated by the principal investigator (AB) and the four research assistants (AGC, BSH, SD-S, and TKSM) and contained a formalized multidisciplinary collaboration, including a meeting once a week to discuss, evaluate, and adjust the multidisciplinary support of each of the participants (Fig. 1).

Physiotherapist intervention

All participants in the intervention group were offered 30 to 45 min exercise programs of moderate intensity twice a week. Focus was on strength and balance [11,12] supervised by physiotherapists affiliated to the study. The intervention group received one bottle (125 mL) of an oral training supplement immediately after the two weekly exercise bouts. The oral training supplement provided an average of 1010 kJ and 14.4 g of protein per 100 mL and there were different flavors to choose from. If a participant did not attend the group exercise, the supplement was offered when possible.

Registered dietitian intervention

The registered dietitian affiliated to the study was asked to consult the participants in the intervention group with unintended weight loss according to the EVS or the weekly assessment of weight. The nutritional support was documented in a treatment protocol and based on the official recommendations [13]. The individual follow-up was in participant's home, during group exercise, or by telephone. In addition, contact was made with the caregivers, food service supplier, general practitioner, and other care providers as required.

Occupational therapist intervention

The occupational therapist affiliated with the study was asked to consult the participants who suffered from eating dependency (i.e. needed assistance from staff or special cutlery) or chewing and swallowing problems, according to the EVS. The task of the occupational therapist was to determine if the participant actually had swallowing or chewing problems [14,15], or if any help during meals was needed, and initiate intervention to solve these problems. There was follow-up as needed, in participant's home, during the group exercise, or by telephone. In addition, contact was made to caregivers, food service suppliers, dental hygienists, the visitation for the referral of eating aids, and other care providers as required.

Compliance with intervention strategies

The physiotherapists documented the consumption of ONS (recorded as 1, ¾, ½, or ¼ portion consumed). After each exercise bout, the physiotherapist recorded each participant's attendance, training intensity, and potential adverse

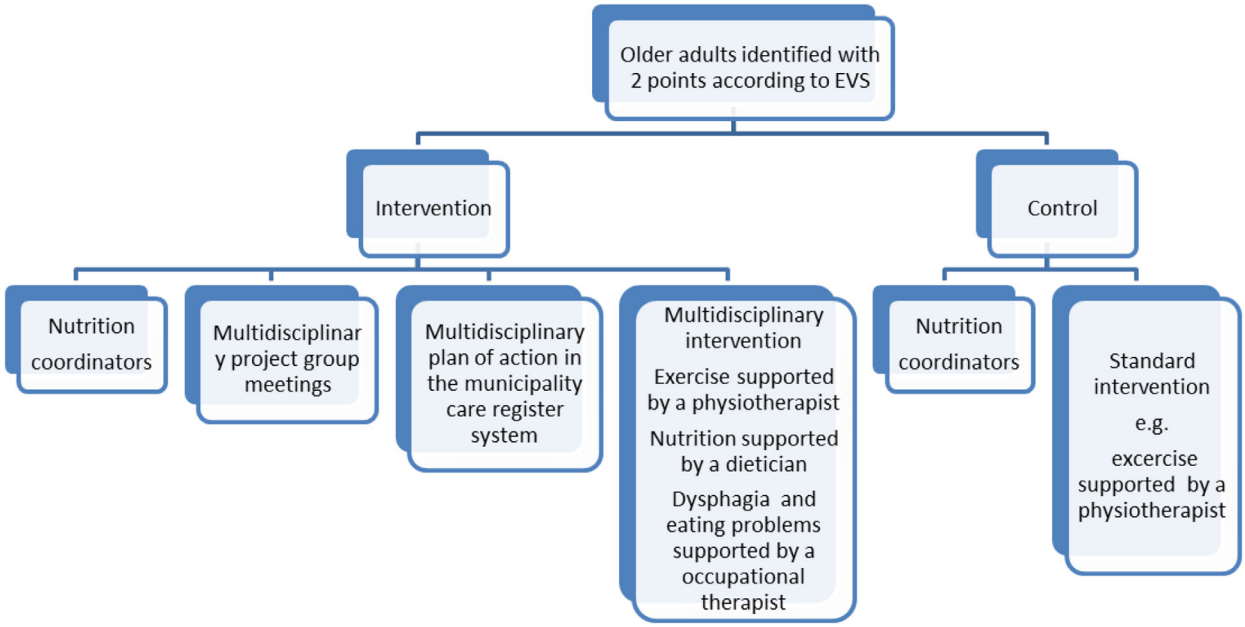

Fig. 1. The study design. (EVS, Eating Validation Scheme).

events. The registered dietitian and occupational therapist documented number of visits, reasons for cancelling appointments, and possible problems with the suggested intervention strategies.

Procedure for baseline assessment

After obtaining participants' informed consent, an inventory was made of possible confounders. This included the following baseline characteristics:

- Socio-demographic data (age, sex, and living conditions, i.e. in a nursing home or private home)
- Social services, i.e. hours and type of home help and home nursing (for home-care clients) from the municipality care register system.
- Functional, nutritional, medical, cognitive, psychological, and social status by means of the Resident Assessment Instrument (RAI), respectively, for home-care (RAI-HC version 2.0) and nursing home (RAI-NH version 2.0). RAI is a comprehensive and standardized assessment system and both methods have been used in former Danish studies [3,11].

Trained nurses involved in the studies above, and affiliated with the present study, assessed participant's performance. All collected information was discussed and crosschecked with the attending caregivers and medical records. This data was also collected at the end of the intervention period (see outcome parameters section).

Outcome parameters

All outcome parameters described below were assessed after inclusion ($t = 0$) and after 11 wk ($t = 11$) with participants who scored 2 points, according to EVS. If nothing else is stated in the EVS, then data was gathered by the research assistants or the caregivers.

Quality of life by means of EuroQol-5D-3L

EuroQol-5D-3L (EQ-5D-3L) is a standardized instrument for use as a measure of health outcome. The EQ-5 D-3 L descriptive system comprises the following 5 dimensions (5 D): mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has three levels (3 L): no problems, some problems, and extreme problems. The raw score must be converted to an EQ-5 D-3 L score ranging from 1.000 to -0.624 [16]. Data was collected by nurses affiliated with the study.

Physical performance by means of a 30-second chair-stand

Participants were asked to fold their arms across their chest and stand up and sit down on a chair without pushing off with arms, as many times as possible during 30 seconds. The arms could be used for assistance or for safety if need [17]. The mode of chair stand, that is whether arms were used or not, was registered.

Nutritional status by means of weight and hand-grip strength

Weight (in kg to the nearest decimal) was measured (with participants wearing light indoor clothes, i.e., a night dress) on calibrated weights. Data about height was retrieved from self-reported height. BMI was calculated as actual weight in kilograms divided by the square of height in meters.

Hand grip strength was measured (in kg) with a Jamar 5030 J1 Hydraulic Hand Dynamometer (Jamar Technologies, Hatfield, PA, USA). Participants were seated with forearms rested on the arms of the chair. They were asked to perform three maximum force trials with their dominant hand and using the second handle position. The maximal grip score from the three values was used.

Oral care by means of RAI-NH, RAI-HC and observation

The RAI-NH version 2.0 and RAI-HC version 2.0 contain information about oral care. The data were supplied by grading the hygienic level based on three pictures of dental plaque: no plaque, plaque covers less than half of the tooth surface, and plaque covers more than half of the tooth surface. The scale was from 1 to 3, with 3 being the worst.

Fall incidents, hospital admissions, rehabilitation stay, moving to nursing homes, and mortality

The information was gathered by means of data from the RAI-NH version 2.0 and RAI-HC version 2.0 assessments and the municipality care register system. For each participant, the same trained nurse collected RAI-NH version 2.0 and RAI-HC version 2.0 data at $t = 0$ and $t = 11$.

Statistical analysis

We calculated the sample size based on a study of multidisciplinary nutritional support among another frail group of older adults, patients with hip fractures [18], which found a significant difference between the intervention and control groups in the EuroQol-5D-3L follow-up score of 0.145 ($P = 0.004$). Hence, with a statistical significance level of 0.05 and a power of 80%, two groups of 65 elderly adults was calculated to be sufficient. Based

on the results of a former study measuring quality of life among nursing home residents, we estimated that the effect on quality of life of living conditions, i.e. in a nursing home or private home, were limited [19]. This was confirmed in a post study one-way analysis of variance, which resulted in an intracorrelation coefficient (ICC) of 0.2627. Hence the main factor setting (home-care or nursing home) contributed with 26% to the variance in quality of life. Thus the impact of setting was relatively limited.

Taking into account an expected loss to follow up of 10 % during the 11 wk of intervention, based on a former multidisciplinary study among nursing home residents [11], we aimed to include a total of 145 elderly clients and residents with two points in EVS.

All statistical analysis was performed using SPSS for Windows (IBM Corporation, Armonk, NY, USA). Data was entered in Microsoft Excel and exported into SPSS software for analysis. Data was analyzed by the primary investigator who was reblinded for the results of randomization. All participants were included in the analysis, regardless of whether they had completed the study or not. T test, Mann-Whitney U test, Kruskal-Wallis test, Pearson's Chi-square, or Fishers exact test was used to compare changes within and between the groups. We estimated that the participants from the nursing homes would have more cognitive and ADL-related problems, and therefore made the comparisons also according to living conditions.

Table 1
Characteristics of participants at baseline with two points according to eating validation scheme

Data	Intervention	Control	*P*-value
Women, n (%)	41 (75)	30 (75)	0.960
Age, year, mean (±SD)	86.0 (8.4)	87.3 (7.6)	0.678
Living in a nursing home n (%)	9 (16)	22 (55)	<0.001
Weight, kg, mean (±SD)	56.9 (11.5)	57.1 (11.1)	0.762
Height, m, mean (±SD)	1.66 (0.08)	1.64 (0.1)	0.181
BMI mean (±SD)	20.7 (4.0)	21.1 (3.3)	0.445
BMI <18.5, n (%)	18 (33)	10 (26)	0.494
Hand-grip strength, max. kg mean (±SD)	16.0 (8.6)	13.5 (6.3)	0.244
30-seconds chair-stand mean (±SD)	3.6 (5.0)	2 (3.8)	0.181
30-seconds chair-stand modified, mean (±SD)	4.9 (3.3)	2.5 (2.7)	0.004
Quality of life, mean (±SD)	0.6856 (0.2408)	0.6282 (0.3324)	0.646
Oral care (scale 1-3 (worst)), mean (±SD)	1.13 (0.40)	1.21 (0.41)	0.265
Cognitive problem, N (%)*	29 (56)	31 (78)	0.030
Activities of daily living problem, n (%)*	30 (56)	29 (73)	0.093
Number of social services, mean (±SD)			
Home help	9.3 (3.1)	8.9 (3.4)	0.674
Home nursing	2.4 (2.0)	2.9 (2.0)	0.275

* Based on data from the Resident Assessment Instrument. *P*-value, Pearson's Chi-square, Fishers exact test, or *t* test/Mann-Whitney; SD, standard deviation

Results

Before starting the intervention, 389 elderly adults (221 from home-care) had been screened with the EVS. Of these 143 were excluded, because they were not able to complete the planned tests according to the staff caregivers (n = 75), they were hospitalized at the start of the study (n = 9), they died before starting (n = 14), the result of the EVS was missing (n = 9), or no reason given (n = 1). A total of 25 declined the invitation to participate. Hence 246 elderly people (106 from home-care) were included in the study. The participants differed from the non-participants because there were more women, they had higher age, had less home nursing, and fewer had two points in EVS (data not shown).

All participants

After the cluster randomization, the intervention clusters consisted of a total of 119 elderly people from two home-care areas and one nursing home, and the control clusters consisted of a total of 127 elderly people from one home-care area and two nursing homes. Due to the cluster randomization, there was a higher prevalence of participants from nursing homes in the control group (70 versus 43%, $P < 000.1$), and hence also a tendency to a higher prevalence of ADL (69 versus 57%, $P = 0.074$) and cognitive (71 versus 59%, $P = 0.094$) problems. There was no difference in prevalence of women, nutritional status, or use of social services (data not shown).

Participants who scored 2 points according to EVS

Respectively, 55 (46 from 2 home-care clusters) and 40 (18 from 1 home-care cluster) of these elderly participants were identified with 2 points according to EVS and their baseline characteristics are presented in Table 1. Due to the cluster randomization, there was a higher prevalence of participants from nursing homes in the control group, and hence, also a higher prevalence of ADL and cognitive problems (Table 1).

When comparing the participating nursing homes and home-care participants, the only difference observed was in the prevalence of cognitive problems in the nursing homes (67 versus 96%, $P = 0.03$). When comparing all the clusters, the only difference observed was in the EVS score, where a *P*-value below 0.001 was found (data not shown).

The control group received more standard interventions from the physiotherapists (25 versus 5%, $P = 0.013$), and occupational therapist (10 versus 0%, $P = 0.028$), but not from the registered dietitians (5 versus 2%, $P = 0.569$) or the dentists (4 versus 2%, $P = 0.547$) as requested through the municipality's normal assessment and referral system, than the intervention group.

The most frequent multidisciplinary approaches involved all three groups (26%), or registered dietitians and physiotherapists together (26 %).

A total of 32 (58%) of the participants received the physiotherapist intervention, 10 (18%) received group exercise, and 22 (40%) received individual exercise at home. Participants completed 12 (71%) of the offered exercise sessions, and after these training bouts, drank $^3/_4$ or more of the training supplement. The primary cause for not participating in the exercise was acute disease. No one dropped out and no adverse events were reported.

A total of 41 (75%) participants received the dietitian intervention and had on average 4.5 home-visits or contacts by telephone with the dietitian. ONS were recommended for 26 (63%). No visits were cancelled.

A total of 21 (38%) received the occupational therapist intervention and had on average three home-visits or contacts by telephone with the occupational therapist. No visits were cancelled.

A significant difference after 11 wk in quality of life, 30-seconds chair stand, and oral care was observed between the intervention and control group (Table 2). No other differences were observed, however there was a tendency to a difference in

Table 2
Quality of life, physical performance, nutritional status, oral care, fall incidents, hospitalization, rehabilitation stay, moving to nursing homes, drop outs, and mortality at 11 wk

Data	Intervention	Control	*P*-value
Quality of life, mean (±SD)	0.758 (0.222)	0.534 (0.355)	0.001
Change in quality of life, mean (±SD)	0.0638 (0.187)	-0.089 (0.346)	0.017
30-seconds chair stand, mean (±SD)	3.9 (5.4)	1.6 (3.6)	0.048
30-seconds, chair stand, modified, mean (±SD)	4.9 (3.7)	2.3 (2.9)	0.005
Improved chair-stand, n (%)	25 (47)	6 (17)	0.005
Weight, kg, mean (±SD)	57.4 (11.4)	56.9 (11.0)	0.959
Change in weight, kg. mean (±SD)	0.12 (1.94)	-0.36 (3.89)	0.817
Change in weight, percent, mean (±SD)	0.22 (3.46)	-0.32 (7.2)	0.820
Hand-grip strength max, kg, mean (±SD)	15.8 (7.9)	12.9 (6.7)	0.169
Change in hand-grip strength max. kg mean (±SD)	-0.73 (3.00)	-0.64 (3.59)	0.757
Oral care (scale 1–3 (worst)), mean (±SD)	1.1 (0.3)	1.3 (0.5)	0.021
Change in oral care, mean (±SD)	-0.02 (0.4)	0.1 (0.5)	0.257
Number of rehabilitation stay, n (%)*	1 (2)	1 (6)	0.483
Moving to a nursing home, n (%)*	2 (5)	0 (0)	1.000
Number of fall incidents, n (%)	4 (8)	4 (11)	0.710
Number of hospitalizations, n (%)	10 (16)	10 (28)	0.323
Drop outs, n (%)	1 (2)	0 (0)	1.000
Died, n (%)	1 (2)	5 (13)	0.079

* For participants in home-care. *P*-value Pearson's Chi-squared test/Fishers exact or *t* test/Mann-Whitney U-test; SD, standard deviation

mortality, which appeared lower in the intervention group (Table 2).

The results from the total group were reflected in the results found for, respectively, the nursing homes (Table 3), the home-care (Table 4), and the individual clusters (data not shown).

Table 3
Quality of life, physical performance, nutritional status, oral care, fall incidents, hospitalization, drop outs and mortality at 11 wk for participants with two points according to eating validation scheme in nursing homes

Data	Intervention	Control	*P*-value
Quality of life, mean (±SD)	0.573 (0.360)	0.434 (0.353)	0.279
Change in quality of life, mean (±SD)	0.096 (0.290)	-0.042 (0.343)	0.423
30-seconds chair stand, mean (±SD)	0.7 (2.0)	0.2 (0.9)	0.571
30-seconds, chair stand, modified, mean (±SD)	2.3 (3.2)	1.5 (2.8)	0.550
Improved chair-stand, n (%)	2 (25)	0 (0)	0.027
Weight, kg, mean (±SD)	55.6 (10.4)	57.5 (12.1)	0.719
Change in weight, kg, mean (±SD)	-0.3 (2.6)	-0.6 (3.6)	0.698
Change in weight, percent, mean (±SD)	-0.4 (4.6)	-0.7 (6.8)	0.758
Hand-grip strength max, kg, mean (±SD)	8.4 (7.7)	10.3 (6.8)	0.465
Change in hand-grip strength max, kg mean (±SD)	-0.4 (1.3)	-1.0 (2.7)	0.523
Oral care (scale 1-3 (worst)), mean (±SD)	1.0 (0.0)	1.17 (0.38)	0.229
Change in oral care, mean (±SD)	0.0 (0.0)	-0.1 (0.5)	0.478
Number of fall incidents, n (%)	0 (0)	2 (11)	0.471
Number of hospitalizations, n (%)	2 (25)	3 (17)	0.498
Drop outs, n (%)	0 (0)	0 (0)	1.000
Died, n (%)	1 (11)	5 (22)	0.648

P-value, Pearson's Chi-squared test, Fishers exact, or *t* test/Mann-Whitney U-test; SD, standard deviation.

Table 4
Quality of life, physical performance, nutritional status, oral care, fall incidents, hospitalization, rehabilitation stay, moving to nursing homes, drop outs, and mortality at 11 wk for participants receiving home-care with two points according to eating validation scheme

Data	Intervention	Control	*P*-value
Quality of life, mean (±SD)	0.792 (0.172)	0.663 (0.324)	0.153
Change in quality of life, mean (±SD)	0.058 (0.166)	-0.150 (0.350)	0.014
30-seconds chair stand, mean (±SD)	4.5 (5.7)	3.1 (4.7)	0.466
30-seconds, chair stand, modified, mean (±SD)	5.7 (3.5)	3.6 (2.7)	0.094
Improved chair-stand, n (%)	23 (51)	6 (38)	0.349
Weight, kg, mean (±SD)	57.8 (11.6)	56.2 (10.0)	0.799
Change in weight, kg, mean (±SD)	0.5 (1.5)	0.2 (3.1)	0.556
Change in weight, percent, mean (±SD)	1.0 (2.7)	0.4 (4.9)	0.556
Hand-grip strength max kg, mean (±SD)	14.3 (6.6)	17.8 (9.3)	0.659
Change in hand-grip strength max kg, mean (±SD)	-0.8 (3.2)	-0.3 (4.3)	0.950
Oral care (scale 1–3 (worst)), mean (±SD)	1.12 (0.32)	1.44 (0.51)	0.007
Change in oral care, mean (±SD)	-0.0 (0.4)	0.3 (0.5)	0.010
Number of rehabilitation stay, n (%)	1 (2)	1 (6)	0.490
Moving to a nursing home, N (%)	2 (5)	0 (0)	1.000
Number of fall incidents, n (%)	4 (9)	2 (11)	1.000
Number of hospitalizations, n (%)	8 (18)	7 (39)	0.076
Drop outs, n (%)	1 (2)	0 (0)	0.719
Died, n (%)	0 (0)	1 (6)	0.281

P-value, Pearson's Chi-squared test/Fishers exact or *t* test/Mann-Whitney U-test; SD, standard deviation.

Discussion

The present study suggests a positive effect of multidisciplinary nutritional support for undernutrition in elderly adults in nursing homes and home-care, identified with 2 points according to EVS on quality of life, muscle strength, and oral care. According to our research, no other study has examined such an intervention.

However, in a former Danish study among nursing home residents using multidisciplinary nutritional support consisting of energy- and protein dense home-made oral supplements, exercise and oral health care were found to have a positive effect on nutritional status, muscle strength, physical health, and social functional abilities [11,20].

The study by Beck et al. is among the studies in a recent systematic review, looking at multidisciplinary intervention among undernourished adults [8]. Unfortunately, the 15 studies included in the systematic review had reported very few patient-relevant outcomes and it was not possible to conclude if multidisciplinary interventions were effective [8]. Only one other study included in the systematic review was performed among nursing home residents and found that a multidisciplinary intervention consisting of educating nutrition coordinators, including train-the-trainer sessions, was able to maintain nutritional status [9].

Due to the limited knowledge about the benefit of nutritional support among home-care clients, the aim was to assign randomly 2 of the 3 home-care clusters to the intervention group. As a result, there were not unexpected differences between the baseline characteristics of the intervention and the control group (Table 1). This is the main limitation of our study.

However, our primary outcome, EQ-5 D-3 L, was the same in both groups at baseline and the positive effect on EQ-5 D-3 L was seen in the final data and the change (Table 2). In addition, a post stud one-way analysis of variance resulted in an intracorrelation coefficient (ICC) of 0.2627. Hence, the main factor setting (home-care or nursing home) contributed with 26% to the variance in quality of life. Thus, the impact of setting was relatively limited.

Finally, the higher prevalence of subjects from nursing homes in the control group, and the higher prevalence of ADLs and cognitive impairment, was probably the reason why the control group received more standard interventions from physiotherapist and occupational therapist requested through the municipality's normal assessment and referral system, than the intervention group. However, these interventions did not seem to have a positive effect on the outcomes (Table 2).

A multimodal intervention was carried out, including not only nutrition, but also exercise and support for dysphagia and other eating problems. The most frequent multidisciplinary approaches involved all three groups (26 %) or registered dietitian and physiotherapist together (26 %). Due to the limited number of participants, it is not possible to assess whether the benefits observed are attributed to nutrition or to physical training. Again, looking at the limited effect of the standard interventions (Table 2), one may assume that it was the multidisciplinary approach which achieved the most benefit.

We have chosen to include participants who scored 2 points in EVS, instead of using the Mini Nutritional Assessment (MNA), which might limit the comparability with other studies. The reason for choosing EVS is that this tool, in contrast to the MNA, is developed and validated to identify older adults in home-care and nursing home who could benefit from nutritional support, specifically in relation to functional abilities. However, whether this is actually true has only been examined in a literature review [7]. This result has now been confirmed in our randomized controlled trial. Furthermore, as part of the project, the reliability and time taken to complete the EVS was assessed among different staff members. Kappa values obtained were from 0.9 to 1.0 and time averaged 5 to 20 min (data only published in Danish). Still EVS has only been included in a very limited amount of research, compared to e.g. the MNA. A suggestion could be to use both tools in a more comprehensive intervention study.

The participants included in the present study had to be able to complete the planned tests and to give informed consent. The criteria might have excluded demented and functionally impaired persons, and hence reduce the reliability of our findings.

We decided to use quality of life as the primary outcome, choosing EQ-5 D-3 L, which has apparently not been used in this population before. However, the decision to use the EQ-5 D-3 L was based on the possibility of using the results from the EQ-5 D-3 L to estimate the cost-effectiveness of the intervention (the results of these calculations is presented elsewhere) [21].

While some positive results were observed in some patient-relevant outcomes, our sample size lacked power to be able to detect a significant difference in these outcomes.

According to our literature search, there have only been a few randomized controlled studies of nutritional support among home-care clients, and none using a multidisciplinary approach [8]. The present study, therefore contributes significantly to the knowledge about interventions in this setting.

We observed very few drop-outs during the intervention period, which indicates that the intervention was well-received by the participants. Also, registered dietitians, physiotherapists, and occupational therapists are currently available in the Danish municipalities. Finally, there is a lot of focus on rehabilitation, which also involves a multidisciplinary approach, even though this currently is often without nutritional support. This means that the positive results obtained in our study justify a wide implementation in the Danish municipalities.

Conclusion

Multidisciplinary nutritional support in Danish elderly adults in nursing home and home-care focusing on individual treatment of potentially modifiable nutritional risk factors identified with the EVS, and involving physiotherapists, registered dietitians, and occupational therapists, as required, could have a positive effect on quality of life, muscle strength, and oral care.

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Appendix 1. Eating Validation Scheme (EVS)

Eating habits.

OK→ = "acceptable intake", OBS→ = "at risk", OBS ↓ = check next question.

1. How many meals do you eat each day?	
3 or more	OK→
2 or less	OBS→
2. How many slices of bread do you eat each day?	
(1 slice of bread is e.g. ½ slice of rye bread, 1 slice of wheat bread, ½ of a bun).	
4 or more	OK→
2 or less	OBS→
Between 2 and 4	OBS ↓
How many potatoes do you eat at a hot meal?	
More than 2	OK→
(rice or spaghetti in equal amounts)	
2 or less	OBS→
3. How many glasses of milk do you drink each day (incl. cacao)?	
(An intake of more than 2 glasses of milk every day could result in a sufficient intake of energy – in spite of an OBS→ obtained in Item 1 or 2).	
More than 1 glass	OK→
1 glass or less	OBS ↓
How often do you have cheese or fermented milk products?	
2 slices/portions or more every day	OK→
Less than 2 slices/portions every day	OBS→
4. Leaves 25% or more of food uneaten at most meals	
No	OK→
Yes	OBS→

Registration of body weight and points.

Ideal body weight_____

Date	Body weight	Any OBS in eating habits and/or has the elderly had an unintended weight loss within the last month? State the reason and point below Yes (1 point) No (0 point) Don't know (1 point)	Are any of the listed nutritional risk factors present? 1. Chewing or swallowing problems 2. Eating dependency 3. Acute disease or acute change in chronic disease State the reason and point below Yes (1 point) No (0 point) Don't know (1 point)	Total points State the total points below No risk (0 point) At risk (1 point) Benefit from intervention (2 points)