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Behavior changes by a buddy-style intervention including physical training, and nutritional and social support

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Aim: Previous research suggests that multicomponent interventions including physical training, and nutritional and social support are required to improve a person's behavior. As a pre-specified secondary outcome, this analysis aimed to ascertain whether a "buddy-style" intervention could produce physical activity and nutritional behavior changes in older adults.

Methods: A 12-week, home-based, randomized controlled trial was carried out with 80 older persons, who were randomly assigned to an intervention group (n = 39), including physical training and nutritional support, and a control group (n = 41). Trained non-professional volunteers visited the participants at home twice a week. Physical activity and nutritional behavior were assessed through validated questionnaires.

Results: In total, 36 participants in the intervention group and 26 participants in the control group completed the final questionnaire. The intervention group showed significant improvements in physical activity behavior, such as light sport activity (β = 9.13, 95% CI 0.90–17.37 min/day; P = 0.030), muscle strength exercise (β = 68.18, 95% CI 46.45–89.91 min/week; P < 0.001) and overall activities (β = 0.69, 95% CI 0.21–1.18 h/day; P = 0.006), compared with the control group. Nutritional behavior improvements for the intervention group were observed in the consumption of legumes/nuts (β = 0.18, 95% CI 0.00–0.35 portions/day; P = 0.047) and fluids (β = 0.48, 95% CI 0.01–0.98 portions/day; P = 0.050), relative to controls.

Conclusions: A "buddy-style" program in older adults living at home can produce effective physical activity changes and, to a lesser extent, changes in dietary behavior, and has the potential to be efficient and feasible. **Geriatr Gerontol Int 2019; 19: 323–329.**

Keywords: health behaviors, non-professional volunteers, nutrition, older persons, physical activity.

Introduction

Aging is accompanied by many changes in physiological (e.g. senses, mobility), social (e.g. loneliness) and psychological (e.g. cognitive performance) functioning that can make it more difficult for physical activity and nutritional needs to be met.[1] Indeed, older adults are more disposed to age-related conditions, including frailty, that might interfere with the maintenance of a good nutritional status.[2] Physical activity and nutritional behavior are factors closely related to the frailty syndrome.[3] Overall, the population is living longer with more chronic conditions than past generations.[4] Therefore, adequate protein intake, in conjunction with regular physical activity, is important to lessen the consequences of aging.

One approach for improving behavior might be through behavioral interventions, focusing on dietary and physical activity habits. In older adults, these interventions have shown improvements in physical activity patterns[5] and dietary habits.[6] However, these studies focused on one aspect alone, either physical activity or nutritional intervention, although studies combining physical activity and nutritional intervention appear to lead to better outcomes.[7–9] Furthermore, behavior interventions can be delivered in group-based or face-to-face settings. Both might be appealing, as they can provide social support in maintaining and/or initiating behavior change.[10,11] "Buddy-style" interventions, where persons are encouraged to carry out, for example, strength exercises, have been successful in both the general population[12] and in the older generally healthy population living in community centers.[13] A literature review reported that social support is a strong driver of health behaviors.[14] It is able to function as a pathway by helping individuals to regulate their own behavioral changes, which are derived from their specific chronic conditions; for example, frailty.[15]

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We developed a "buddy-style" program with the focus on social support, physical training and nutritional education, especially muscle strength exercises and protein intake. Although there is evidence that our program improves outcomes, such as nutritional and frailty status,[16] handgrip strength,[17] and fear of falling,[18] we also carried out a more detailed analysis in terms of behavioral change, which was a pre-specified secondary outcome. Thus, the aim of the present study was to determine the effectiveness of the combined home-based physical training, nutritional education and social support intervention, carried out by volunteers, on physical activity and nutritional behavior in community-dwelling older adults.

Methods

Study design

The present study was a 12-week randomized controlled trial comparing a physical training, nutritional and social support (PTN) group versus a social support (SoSu) group, carried out by lay non-professional volunteers with older persons at home. The data were collected at two time points.

Participants

Recruitment was undertaken between September 2013 and August 2014; the last follow-up assessment was carried out in February 2015. Participant selection criteria called for persons at risk of malnutrition or malnourished persons, which was assessed by the Mini Nutritional Assessment;[19] prefrail or frail persons, by using the Survey of Health, Aging and Retirement in Europe Frailty Instrument (SHARE-FI);[20] aged >65 years; living in Vienna; and signed informed consent. Persons were excluded for the following reasons: impaired cognitive function;[21] planned admission to a nursing home; undergoing or planned chemo- or radiotherapy; serious comorbidities, for example, insulin-treated diabetes mellitus; and requiring ≥180 h per month of care. Persons with a medical contraindication for carrying out strength training were also excluded.[22]

The non-professional volunteers were recruited in cooperation with a non-governmental organization in Vienna (Wiener Hilfswerk). The eligibility criterion for recruitment was persons aged >50 years.[22]

The study was approved by the local ethics committee of the Medical University of Vienna (reference number: 1416/2013) and complied with the Declaration of Helsinki.[23] The study methods were in accordance with the CONSORT guidelines for reporting randomized trials.[24]

Sample size and randomization of groups

On the basis of an assumed 20% dropout rate, we estimated that a total sample size of 80 persons (40 in each group) was required for 80% statistical power to detect a clinically relevant difference of 2 kg (standard deviation: 3) in handgrip strength between the PTN and SoSu groups at 12 weeks. In the present, we focused on changes in physical activity and nutritional behavior, which were prospectively defined as a secondary outcome.[22]

Intervention

The buddies were encouraged to carry out the physical activity and nutritional intervention with the prefrail or frail persons at home twice a week.

The main material of the intervention was a guidebook, which provided standardized physical activity exercises and nutritional recommendations, and encouraged goal setting to reinforce the self-efficacy. A warm-up with mobilization exercises was followed by six strength exercises carried out in circuit form, with two sets and 15 repetitions, until muscular exhaustion. The nutritional intervention focused on three main nutritional aspects: fluid intake, animal and plant protein intake, and energy intake. In addition to the guidebook, participants were provided with a Dyna-Band and recipes for protein- and energy-rich dishes. Details of the intervention have been previously published.[22]

The older persons were also instructed to carry out the strength exercises and the nutritional intervention on their own.

The SoSu group was designed as an active control group, but received no physical activity or nutritional intervention, to examine whether the additional physical training and nutritional intervention was more effective than social support alone.[22]

Instrument

The interview-assisted questionnaire consisted of validated instruments on physical activity and nutritional behavior, along with the main sociodemographic characteristics, including sex, age, education level and living arrangement. The interviewers were not blinded to the group. Cognitive function was assessed by the German version of the Mini-Mental State Examination.[21] The number of oral medications taken was assessed by participant self-reporting, and was verified by prescription forms, drug packages and medical records. The prevalence of comorbidities was determined by self-reporting. Body mass index was calculated from measured height and weight, as weight (kg) divided by height squared (m^2).

Physical activity and nutritional behavior outcomes

Physical activity behavior was assessed through the validated Physical Activity Scale for the Elderly questionnaire to measure self-reported physical activity in individuals aged >65 years as overall activities, walking time outside home, sitting, muscle strength, and balance exercises, light, moderate and strenuous sports.[25]

Nutritional behavior was assessed by the modified version of the European Prospective Investigation into Cancer and Nutrition Study Food-Frequency Questionnaire, using only the food groups containing proteins.[26] The participants indicated the number of times a given food item was consumed. One portion size corresponded to the size of one palm of the hand, for example, which was presented as an image on the questionnaire. A total of 21 food items corresponding to five food groups as "meat and meat products, fish and eggs" (five items), "legumes and nuts" (four items), "milk and dairy products" (four items), "grains" (five items) and "bread" (three items) were assessed. Each food item of the Food-Frequency Questionnaire represented an individual food; for example, "salmon". Extra questions were added to assess the frequency of fluid, vegetable and fruit intake. The frequency of food items enabled quantification of regular consumption of recommended portions, which was based on the Healthy-for-Life Plate guide. This is a modification of the Healthy Eating Plate of Harvard University.[27] Furthermore, the frequencies of food items were calculated as daily intake (portions per day).

Overall adherence rate

The adherence to the intervention was assessed by analyzing the documentation forms completed by the buddies. The number of home visits, number of exercise circuits carried out and number of nutrition-related messages per home visit were also assessed.

Statistical analysis

The results are expressed as mean (standard deviation) or median (minimum–maximum) for continuous variables, according to the distribution, and as percentages for categorical variables. Comparisons between the PTN and the SoSu groups at baseline were made using *t*-tests, Mann–Whitney *U*-tests or χ^2-tests. All the results were analyzed according to the per-protocol principle.

The intervention effects on physical activity and nutritional behavior outcomes were determined using analysis of covariance (ANCOVA) to assess the effect of the between-subject factor (PTN and SoSu groups). We tested the outcome variables for socioeconomic status variables, such as age, sex, income, education level, living

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arrangement and marital status, with the purposeful selection algorithm. Consequently, the models were adjusted for sex and baseline measures to provide an unbiased estimate of the mean group difference. Paired *t*-tests or Wilcoxon tests were used to assess the effect of the within-subject factor (from baseline to 12 weeks). All physical activity and nutritional behavior variables were recoded in binary form, indicating physical activity participation status (yes or no), for example, lack of physical activity participation means <10 min duration, and adherence to daily intake recommendations (yes or no), for example, consuming less of the recommended portion of legumes or nuts per day. The estimates of the prevalence of physical activity participation and adherence to daily intake recommendations for the PTN and SoSu groups over time were calculated using generalized estimating equations (GEE), with a logit link function for binary outcomes. Unstructured covariance matrices were used within the models. The GEE were used to examine the effects with time (from baseline to 12 weeks) and per group (PTN and SoSu group), with the prevalence of the outcome variable (yes, no) as the dependent variable. Therefore, the GEE were calculated to determine which of the physical activity and nutritional behavior outcomes were positively affected by the study intervention. Significance tests were carried out with Wald χ^2 ($\alpha = 0.05$). These models were also adjusted for sex and baseline value. The within-group effect size was calculated as d = (post intervention mean – baseline mean) / (baseline standard deviation). The between-group effect size was calculated as d = ([postintervention mean – baseline mean for the PTN group]–[post intervention mean – baseline mean for the SoSu group]) / (pooled baseline standard deviation). Using Cohen's effect sizes, d = 0.2 was considered a small effect, d = 0.5 a medium effect and d = 0.8 a large effect. All the statistical analyses were carried out with IBM SPSS Statistics for Windows version 23 software (IBM Corporation, Armonk, NY, USA). *P*-values of <0.05 were considered statistically significant, and all the tests were two-sided.

Results

Study population

Participants ($n = 285$) were assessed for eligibility by three hospitals in Vienna (Austria), and 73% did not meet the inclusion criteria, 19% declined to participate and 6% were excluded for other reasons. Eligible participants were also recruited through the media (newspaper article and television; $n = 197$), and 24% did not meet the inclusion criteria, 18% declined to participate and 19% were excluded for other reasons. Out of the 77 eligible patients recruited via the hospitals, four (2%) persons participated in the study. Out of the 150 eligible individuals recruited through the media, 76 (39%) participated in the study. Finally, the 80 persons were randomly assigned to the PTN group ($n = 39$) or the SoSu group ($n = 41$). In total, the dropout rate was 18% ($n = 14$), with 13% ($n = 5$) dropping out in the PTN group and 22% ($n = 9$) dropping out in the SoSu group. The reasons for discontinued intervention were death (PTN $n = 1$, SoSu $n = 2$), medical decision (PTN $n = 2$, SoSu $n = 2$), no time (PTN $n = 2$, SoSu $n = 5$), and the participant's statements "no longer interested" (PTN $n = 1$) and "did not want to be in the SoSu group" (SoSu $n = 2$). Of the 42 participants in the PTN group and the 38 in the SoSu group who completed the baseline questionnaire, 36 and 26 older adults, respectively, with complete data were available for analysis. The final response rate was 78%.

The characteristics of the study sample are summarized in Table 1.

Table 1 Baseline characteristics of the study population

Characteristic	Total ($n = 80$)	PTN group ($n = 39$)	SoSu group ($n = 41$)
Sex: female (%)	84	85	83
Age (years)	82.8 (8)	83.0 (8.1)	82.5 (8.0)
Education level			
Primary school (%)	54	62	46
Secondary school (%)	34	28	39
Tertiary (%)	13	10	15
Living arrangement: living alone (%)	84	82	85
Cognitive status (MMSE score)	26.5 (2.9)	26.7 (3)	26.2 (2.7)
No cognitive impairment (%)	78	80	76
Mild cognitive impairment (%)	23	21	24
No. drugs	7.7 (4.2)	7.5 (3.9)	7.9 (4.4)
Polypharmacy ≥4 drugs (%)	86	85	88
Comorbidity: yes (%)	99	100	98
BMI (kg/m^2)	27.2 (4.3)	26.9 (4.5)	27.4 (4.3)
Underweight (%)†	10	8	13
Normal weight (%)†	22	31	13
Overweight (%)†	47	41	53
Obese (%)†	22	21	23
Frailty status (SHARE-FI)			
Robust (%)	1	3	0
Prefrail (%)	35	36	34
Frail (%)	64	62	66
Nutritional status (MNA-LF)			
Normal nourished (%)	51	49	54
At risk of malnutrition (%)	45	46	44
Malnourished (%)	4	5	2

†Underweight: <20 kg/m^2 for <70 years or <22 kg/m^2 for >70 years; normal weight: 20 or 22–24.9 kg/m^2; overweight: 25–29.9 kg/m^2; obese: ≥30 kg/m^2. Data are presented as mean (standard deviation) for continuous variables and percentages for categorical variables. BMI, body mass index; MMSE, Mini-Mental State Examination; MNA-LF: Mini Nutritional Assessment long form; Primary school, elementary school/no degree or first to fourth grade of school level; PTN, physical training and nutritional intervention group; Secondary school, secondary school or fifth to eighth grade of school level; SHARE-FI, Frailty Instrument for Primary Care of the Survey of Health, Aging and Retirement in Europe; SoSu, social support group; Tertiary, university level/higher degree or over ninth grade of school level.

Physical activity and nutritional behavior outcomes

Table 2 summarizes the changes in physical activity outcomes between the PTN and SoSu groups across the two time points. There was no difference between the two groups at baseline in terms of physical activity variables. The PTN group showed a significant increase from baseline to 12 weeks in mean overall activity, walking time outside home, muscle strength exercises, and light and moderate sports, relative to the SoSu group. Within-subject effect sizes for the PTN group ranged from d = 0.5 to 2.1, which represents a moderate-to-large effect size in this physical activity outcome, whereas there were no or small effect sizes for the SoSu group, except for muscle strength exercises. Between-subject effect sizes were medium-to-large (d = 0.4–1.2) in the physical activity outcomes of overall activities, muscle strength exercises and light sports. Table 3 shows the participation in physical activity variables between the two groups across the two time points. Significant improvements were evident in the variables of walking time outside home, muscle strength and balance exercises, and light and moderate sports. The PTN group showed a significantly higher odds ratio in the physical activity participation outcome of muscle strength exercises, compared with the SoSu group.

In Table 4, the nutritional behavior outcomes between the PTN and SoSu groups across the two time points are compared. There were significant differences between the two groups at baseline

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Table 2 Physical activity behavior outcomes in both groups at baseline and after 12 weeks

Outcome	Group	Baseline		12 weeks		Change	Within-subject effect			Between-subject effect		
		Mean (95% CI)	*P*-value†	Mean (95% CI)	*P*-value†	Absolute	Mean (95% CI)	*P*-value‡	d	β (95% CI)	*P*-value§	d
Overall activities (h per day)	PTN	1.3 (0.9, 1.7)	0.714	2.3 (1.8, 2.7)	0.023	1.0	0.87 (0.42, 1.32)**	0.001	0.7	0.69 (0.21, 1.18)	0.006	0.6
	SoSu	1.4 (0.9, 1.8)		1.6 (1.1, 2)		0.2	0.16 (−0.23, 0.55)		0.1	1		
Walking time outside home (min per day)	PTN	31.7 (13.4, 50)	0.235	59.2 (36.7, 81.6)	0.625	27.5	27.10 (3.43, 50.77)*	0.039	0.5	23.30 (−2.46, 49.07)	0.075	0.4
	SoSu	44.6 (21, 68.2)		47.2 (27.2, 67.2)		2.6	−8.77 (−27.61, 10.07)		0.0	1		
Sitting activities (h per day)	PTN	10.4 (9.3, 11.4)	0.167	10.6 (10, 11.2)	0.233	0.2	−0.03 (−1.22, 1.17)	0.118	0.1	−0.69 (−1.59, 0.21)	0.131	0.2
	SoSu	11.7 (11, 12.3)		11.4 (10.7, 12.1)		−0.3	−0.33 (−1.22, 0.56)		−0.2	1		
Muscle strength exercise (min per week)	PTN	12.9 (−7.6, 33.3)	0.352	75 (57.9, 92.1)	<0.001	62.1	60.00 (30.08, 89.92)**	<0.001	1.0	68.18 (46.45, 89.91)	<0.001	1.2
	SoSu	1.6 (−1.6, 4.8)		6.9 (−3, 16.8)		5.3	6.92 (−2.96, 16.80)		0.5	1		
Balance exercises (min per week)	PTN	5.4 (−0.7, 11.5)	0.522	11.4 (6.1, 16.7)	0.007	6.0	5.54 (−0.72, 11.79)*	0.107	0.3	4.39 (−7.72, 16.50)	0.471	0.3
	SoSu	9.5 (2.3, 16.7)		9.6 (−5.3, 24.5)		0.1	−1.20 (−14.82, 12.42)		0.0	1		
Light sports (min per day)	PTN	6.1 (0.5, 11.6)	0.946	14.5 (6.3, 22.7)	0.067	8.4	10.78 (2.28, 19.28)*	0.015	0.5	9.13 (0.90, 17.37)	0.030	0.4
	SoSu	4.3 (0.2, 8.5)		6.1 (1.6, 10.6)		1.8	0.92 (−6.63, 8.48)		0.1	1		
Moderate sports (min per week)	PTN	1.9 (−1.1, 4.8)	0.841	21.5 (7.8, 35.1)	0.396	19.6	19.10 (6.48, 31.71)*	0.007	2.1	−10.35 (−41.42, 20.71)	0.507	0.0
	SoSu	12.6 (−6.9, 32.2)		31.2 (−6, 68.4)		18.6	12.00 (−30.30, 54.30)		0.3	1		
Strenuous sports (min per week)	PTN	5.7 (−3.3, 14.8)	0.939	8.2 (−1.9, 18.2)	0.315	2.5	0.91 (−12.52, 14.33)	0.581	0.1	1.46 (−12.28, 15.20)	0.832	0.1
	SoSu	3.9 (−2.6, 10.5)		4.4 (−4.7, 13.4)		0.5	4.38 (−4.68, 13.43)		0.0	1		

*$P < 0.05$. **$P < 0.001$. †*P*-values are based on Mann–Whitney *U*-tests. ‡*P*-values are based on Wilcoxon tests as within-subject factor (from baseline to 12 weeks). §*P*-values are based on analysis of covariance (ANCOVA) as between-subject factor (physical training and nutritional intervention group [PTN] and social support group [SoSu] groups). SoSu group as the reference group. Models are adjusted for sex and baseline value. Mean (95% confidence interval) for continuous variables at baseline and after 12 weeks. 95% CI, 95% confidence interval; d, Cohen's effect size; β, standardized coefficient.

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Table 3 Participation in physical activity variables in both groups at baseline and after 12 weeks

Participation of at least 10 min	Group	Baseline		12 weeks		Change	Within-subject effect		Between-subject effect	
		n (%)	*P*-value†	*n* (%)	*P*-value†	relative	OR (95% CI)	*P*-value‡	OR (95% CI)	*P*-value‡
Walking time outside home	PTN	15 (19.2)	0.365	26 (33.3)	0.915	14	4.18 (2.28, 7.67)	<0.001	1.58 (0.47, 5.29)	0.456
	SoSu	18 (23.1)		19 (24.4)		1			1	
Muscle strength exercise	PTN	3 (7.9)	0.617	31 (81.6)	<0.001	74	55.60 (12.56, 246.12)	<0.001	31.66 (6.55, 153.06)	<0.001
	SoSu	1 (2.6)		3 (7.9)		5			1	
Balance exercises	PTN	6 (16.7)	0.558	18 (50)	0.008	33	2.63 (1.28, 5.40)	0.009	1.82 (0.72, 4.60)	0.208
	SoSu	8 (22.2)		4 (11.1)		−11			1	
Light sports	PTN	5 (17.2)	0.866	13 (44.8)	0.403	28	3.05 (1.35, 6.92)	0.007	1.50 (0.61, 3.65)	0.376
	SoSu	5 (17.2)		6 (20.7)		3			1	
Moderate sports	PTN	2 (9.5)	0.664	11 (52.4)	0.375	43	7.48 (3.07, 18.19)	<0.001	1.46 (0.40, 5.36)	0.565
	SoSu	3 (14.3)		5 (23.8)		10			1	
Strenuous sports	PTN	2 (22.2)	0.918	4 (44.4)	0.385	22	1.78 (0.65, 4.89)	0.263	1.75 (0.65, 4.97)	0.257
	SoSu	2 (22.2)		1 (11.1)		−11			1	

†*P*-values are based on χ^2-tests. ‡*P*-values are based on generalized estimating equations to examine effects with time (from baseline to 12 weeks) as repeated factor and group (physical training and nutritional intervention group [PTN] and social support group [SoSu] groups) as between-subject factor, with prevalence of outcome parameters (yes, no) as dependent variable. Logit link function and an unstructured correlation matrix were used. Significance tests were carried out with Wald χ^2 ($\alpha = 0.05$). The models are adjusted for baseline value and sex. Baseline data and SoSu group as reference. Number and percentages (*n*, %) are reported for categorical variables at baseline and after 12 weeks. 95% CI, 95% confidence interval; OR, odds ratio.

Table 4 Nutritional behavior outcomes in both groups at baseline and 12 weeks

Portions of (per day)	Group	Baseline		12 weeks		Change	Within-subject effect			Between-subject effect		
		Mean (95% CI)	*P*-value†	Mean (95% CI)	*P*-value†	Absolute	Mean (95%-CI)	*P*-value‡	d	β (95% CI)	*P*-value§	d
Meat and meat products, fish or eggs	PTN	1.2 (1, 1.4)	0.262	1.2 (1, 1.4)	0.880	0.0	0.07 (−0.07, 0.22)	0.675	0.0	0.09 (−0.14, 0.32)	0.443	0.3
	SoSu	1.4 (1.1, 1.7)		1.2 (1.1, 1.4)		−0.2	−0.18 (−0.53, 0.17)		−0.2	1		
Milk or dairy products	PTN	2.2 (1.9, 2.5)	0.017	2.2 (1.8, 2.6)	0.024	0.0	−0.09 (−0.50, 0.33)	0.331	0.0	0.38 (−0.14, 0.90)	0.146	0.1
	SoSu	1.7 (1.4, 2)		1.6 (1.2, 1.9)		−0.1	−0.20 (−0.53, 0.14)		−0.1	1		
Legumes or nuts	PTN	0.4 (0.2, 0.6)	0.717	0.6 (0.4, 0.8)	0.345	0.2	0.27 (0.10, 0.43)**	0.001	0.4	0.18 (0.00, 0.35)	0.047	0.4
	SoSu	0.5 (0.3, 0.6)		0.5 (0.3, 0.7)		0.0	0.08 (−0.02, 0.19)		0.0	1		
Grains	PTN	0.9 (0.7, 1)	0.587	0.9 (0.8, 1)	0.635	0.0	0.04 (−0.11, 0.18)	0.187	0.0	0.01 (−0.16, 0.15)	0.969	−0.3
	SoSu	0.9 (0.8, 1)		1 (0.8, 1.1)		0.1	0.07 (−0.03, 0.17)		0.3	1		
Bread	PTN	1.7 (1.5, 1.9)	0.455	1.7 (1.4, 1.9)	0.867	0.0	0.01 (−0.35, 0.38)	0.655	0.0	0.03 (−0.32, 0.38)	0.867	0.0
	SoSu	1.6 (1.4, 1.8)		1.6 (1.4, 1.9)		0.0	0.11 (−0.21, 0.44)		0.0	1		
Fluids	PTN	5 (4.5, 5.4)	0.709	5.3 (5, 5.7)	0.075	0.3	0.44 (−0.07, 0.96)	0.240	0.2	0.48 (0.01, 0.98)	0.050	0.2
	SoSu	4.8 (4.4, 5.2)		4.8 (4.4, 5.3)		0.0	−0.08 (−0.66, 0.50)		0.0	1		

**$P < 0.001$. †*P*-values are based on independent *t*-tests. ‡*P*-values are based on paired *t*-tests as within-subject factor (from baseline to 12 weeks). §*P*-values are based on analysis of covariance (ANCOVA) as between-subject factor (physical training and nutritional intervention group [PTN] and social support group [SoSu] groups). SoSu group as the reference group. Models are adjusted for sex and baseline value. Mean (95% confidence interval) are reported for continuous variables at baseline and after 12 weeks. 95% CI, 95% confidence interval; d, Cohen's effect size; β, standardized coefficient.

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Table 5 Adherence to daily intake recommendation variables in both groups at baseline and 12 weeks

Adherence to recommended daily intake of	Group	Baseline		12 weeks		Change	Within-subject effect		Between-subject effect	
		n (%)	*P*-value†	*n* (%)	*P*-value†	relative	OR (95% CI)	*P*-value‡	OR (95% CI)	*P*-value‡
1 portion of meat and meat products, fish or eggs	PTN	28 (19.7)	0.810	25 (17.6)	0.575	−2	1.23 (0.69, 2.20)	0.485	0.76 (0.28, 2.08)	0.599
	SoSu	27 (19)		20 (14.1)		−5			1	
2 portions of milk or dairy products	PTN	27 (19)	0.043	20 (14.1)	0.072	−5	0.69 (0.39, 1.23)	0.209	1.98 (0.85, 4.60)	0.112
	SoSu	15 (10.6)		8 (5.6)		−5				
1 portion of legumes or nuts	PTN	5 (3.5)	0.866	6 (4.2)	0.794	1	1.62 (0.93, 2.85)	0.090	0.81 (0.21, 3.09)	0.759
	SoSu	5 (3.5)		5 (3.5)		0			1	
2 portions of grains	PTN	1 (0.7)	0.338	0 (0)	–	−1	–	–	–	–
	SoSu	0 (0)		0 (0)		0			1	
2 portions of bread	PTN	19 (13.4)	0.602	19 (13.4)	0.416	0	1.25 (0.64, 2.44)	0.512	1.28 (0.64, 2.55)	0.483
	SoSu	15 (10.6)		11 (7.7)		−3			1	
6 portions of fluids	PTN	25 (17.6)	0.370	25 (17.6)	0.040	0	1.18 (0.62, 2.25)	0.616	3.47 (1.38, 8.75)	0.008
	SoSu	18 (12.7)		11 (7.7)		−5			1	
3 portions of vegetables	PTN	6 (4.2)	0.269	5 (3.5)	0.689	−1	1.08 (0.40, 2.93)	0.879	1.32 (0.39, 4.49)	0.661
	SoSu	2 (1.4)		2 (1.4)		0			1	
2 portions of fruits	PTN	8 (5.6)	0.357	4 (2.8)	0.653	−3	0.58 (0.23, 1.47)	0.249	1.43 (0.46, 4.49)	0.538
	SoSu	4 (2.8)		2 (1.4)		−1			1	

†*P*-values are based on χ^2-tests. ‡*P*-values are based on generalized estimating equations to examine effects with time (from baseline to 12 weeks) as repeated factor and group (PTN, physical training and nutritional intervention group [PTN] and social support group [SoSu] group) as between-subject factor, with prevalence of outcome parameters (yes, no) as dependent variable. Logit link function and an unstructured correlation matrix were used. Significance tests were performed with Wald χ^2 ($\alpha = 0.05$). The models are adjusted for baseline value and sex. Baseline data and SoSu group as reference. Number and percentages (*n*, %) for categorical variables at baseline and after 12 weeks. 95% CI, 95% confidence interval; OR, odds ratio.

in portions of milk or dairy products per day. At 12 weeks, the PTN group significantly increased consumption of portions of legumes or nuts. Improvement in consumption of portions of fluids per day could also be observed in the PTN group, although the latter increase was marginal. Within-subject effect sizes and between-subject effect sizes were small (d = 0.2–0.4). No significant improvements from baseline to 12 weeks were evident in the adherence to daily intake recommendation outcomes (Table 5). The PTN group showed a significantly higher odds ratio in the adherence to recommended daily intake of six portions of fluids, compared with the SoSu group.

Overall adherence rate

The mean adherence rate for the home visits was 90% (18.0 [4.6] home visits) in the PTN group and 70% (14.1 [5.2] home visits; $P = 0.002$) in the SoSu group. During the home visits, the mean adherence rate for the exercise circuits and the nutrition-related message was 65% (1.3 [0.5] circuits) and 100% (1.0 [0.6] messages) in the PTN group.

Discussion

The present randomized controlled trial evaluated the effects of a home-based physical training and nutritional intervention compared with a social support program on physical activity and nutritional behavior in older persons. Such a "buddy-style" intervention was able to improve physical activity behavior and, to a lesser extent, nutritional behavior after 12 weeks in older persons living at home.

The present results indicate that the PTN group showed significant increases in the physical activity behaviors of light sport activity, muscle strength exercises and overall activities, compared with the SoSu group. It is not surprising that muscle strength exercises improved in the PTN group after 12 weeks, because carrying out strength exercises was a major part of the physical activity intervention. Nevertheless, the participants also improved other physical activity behavior, such as light sport activity and overall activities, which was not obvious and not expected.

The intervention also led to statistically significant increases in the consumption of legumes or nuts and fluids, compared with the SoSu group. The nutritional intervention encompassed a "food first" approach, which meant that the intervention focused on foods that are naturally high in protein; that is, animal- and plant-based protein-rich foods. However, the participants in the PTN group did not improve their consumption of animal-based protein-rich foods; that is, meat, fish and dairy products. Possible reasons for this could be, for example, a decrease in oral health,[28] which makes eating meat difficult because of its texture, not enjoying the taste, issues of cost or affordability,[29] or participants did not agree that animal-based foods are healthy. Furthermore, for very old persons, it is challenging to improve their nutritional behavior, as aging is associated with altered sensations of thirst, hunger and satiety.[30] This might also be a possible reason why nutritional behavior outcomes improved to a lesser extent.

In previously published studies, combined home-based volunteer-led physical activity and nutrition programs have been shown to be effective in terms of changing physical activity and nutrition-based behavior.[7–9] These studies reported a significant increase in carrying out strength exercises and moderate intensity sport participation. It is, however, noteworthy that these studies focused on nutritional behavior as consumption of fruit and vegetables, fat avoidance, fiber intake,[8] and adherence to fruit and vegetable intake recommendations. In the present study, we did not see a significant improvement in the consumption of fruit and vegetables or the adherence to the recommendations. A reason for this could be that the nutritional intervention in our study focused more on consumption of protein and fluid intake, as well as adherence to them.

The strength of the present study was the implementation of this "buddy-style" program, which might be a low-cost and practical way to increase physical activity and to stabilize or improve dietary behaviors among older adults living at home. This intervention also had in mind that the volunteers who delivered the program might also benefit in the near future, as they themselves were in retirement transition. Another strength of the study is that the outcomes were pre-specified.

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The study did have some limitations. First, because of the study design, recruitment process and the eligibility criteria, our sample size was relatively small and was relatively homogeneous. However, the results do indicate that such a "buddy-style" intervention can improve physical activity and nutritional behavior. Second, our attrition rate was 23% in total and is another limitation; however, this compares well with other studies.[31] Third, the study follow up after just 12 weeks was a relatively short period. Fourth, the data collected from the questionnaires were based on self-reporting, although similar inaccuracies could be expected between the PTN and SoSu groups. Fifth, trials of this type do not allow a blind approach, making participation bias a possibility and lead to inflation of type I error. However, the data management and statistical analysis were blind. Furthermore, residual confounding could not be ruled out, even though demographic and other factors were controlled for in the ANCOVA and GEE regression analyses.

In conclusion, the present findings indicate that a 12-week "buddy-style" program with the focus on physical training, nutritional education and social support can result in effective physical activity and, to a lesser extent, dietary behavioral changes towards higher vegetable protein consumption, but not animal protein, in older adults living at home. Such a program has the potential to be efficient and feasible, and could be used in addition to the services provided by health professionals.

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Disclosure statement

The authors declare no conflict of interest.

References

1 Amarya S, Singh K, Sabharwal M. Changes during aging and their association with malnutrition. *J Clin Gerontol Geriatr* 2015; **6**: 78–84.
2 Rowe JW, Kahn RL. Human aging: usual and successful. *Science* 1987; **237**: 143–149.
3 Bonnefoy M, Berrut G, Lesourd B *et al*. Frailty and nutrition: searching for evidence. *J Nutr Health Aging* 2015; **19**: 250–257.
4 Ward BW, Schiller JS. Prevalence of multiple chronic conditions among US adults: estimates from the National Health Interview Survey, 2010. *Prev Chronic Dis* 2013; **10**: E65.
5 Hobbs N, Godfrey A, Lara J *et al*. Are behavioral interventions effective in increasing physical activity at 12 to 36 months in adults aged 55 to 70 years? A systematic review and meta-analysis. *BMC Med* 2013; **11**: 75.
6 Bernstein A, Nelson ME, Tucker KL *et al*. A home-based nutrition intervention to increase consumption of fruits, vegetables, and calcium-rich foods in community dwelling elders. *J Am Diet Assoc* 2002; **102**: 1421–1427.
7 Burke L, Lee AH, Jancey J *et al*. Physical activity and nutrition behavioural outcomes of a home-based intervention program for seniors: a randomized controlled trial. *Int J Behav Nutr Phys Act* 2013; **10**: 14.
8 Jancey J, Holt AM, Lee A *et al*. Effects of a physical activity and nutrition program in retirement villages: a cluster randomised controlled trial. *Int J Behav Nutr Phys Act* 2017; **14**: 92.
9 Jih J, Le G, Woo K *et al*. Educational interventions to promote healthy nutrition and physical activity among older Chinese Americans: a cluster-randomized trial. *Am J Public Health* 2016; **106**: 1092–1098.
10 Schlaff RA, Baruth M, Adams VJ *et al*. Effects of a group-based behavioral intervention on dietary behaviors in older adults. *J Aging Health* 2016: 1–13.
11 Lindsay Smith G, Banting L, Eime R, O'Sullivan G, van Uffelen JGZ. The association between social support and physical activity in older adults: a systematic review. *Int J Behav Nutr Phys Act* 2017; **14**: 56.
12 Kahn EB, Ramsey LT, Brownson RC *et al*. The effectiveness of interventions to increase physical activity. A systematic review. *Am J Prev Med* 2002; **22** (4 Suppl): 73–107.
13 Thomas GN, Macfarlane DJ, Guo B *et al*. Health promotion in older Chinese: a 12-month cluster randomized controlled trial of pedometry and "peer support". *Med Sci Sports Exerc* 2012; **44**: 1157–1166.
14 Harvey IS, Alexander K. Perceived social support and preventive health behavioral outcomes among older women. *J Cross Cult Gerontol* 2012; **27**: 275–290.
15 Krause N, Borawski-Clark E. Clarifying the functions of social support in later life. *Res Aging* 1994; **16**: 251–279.
16 Luger E, Dorner TE, Haider S *et al*. Effects of a home-based and volunteer-administered physical training, nutritional, and social support program on malnutrition and frailty in older persons: a randomized controlled trial. *J Am Med Dir Assoc* 2016; **17** (7): 671 e679–671 e616.
17 Haider S, Dorner TE, Luger E *et al*. Impact of a home-based physical and nutritional intervention program conducted by lay-volunteers on handgrip strength in Prefrail and frail older adults: a randomized control trial. *PLoS One* 2017; **12**: e0169613.
18 Kapan A, Luger E, Haider S *et al*. Fear of falling reduced by a lay led home-based program in frail community-dwelling older adults: a randomised controlled trial. *Arch Gerontol Geriatr* 2017; **68**: 25–32.
19 Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: the mini nutritional assessment as part of the geriatric evaluation. *Nutr Rev* 1996; **54** (1 Pt 2): S59–S65.
20 Romero-Ortuno R, Walsh CD, Lawlor BA, Kenny RA. A frailty instrument for primary care: findings from the survey of health, ageing and retirement in Europe (SHARE). *BMC Geriatr* 2010; **10**: 1–12.
21 Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975; **12**: 189–198.
22 Dorner TE, Lackinger C, Haider S *et al*. Nutritional intervention and physical training in malnourished frail community-dwelling elderly persons carried out by trained lay "buddies": study protocol of a randomized controlled trial. *BMC Public Health* 2013; **13**: 1232.
23 World Medical A. World medical association declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA* 2013; **310**: 2191–2194.
24 Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *Int J Surg* 2011; **9**: 672–677.
25 Washburn RA, McAuley E, Katula J, Mihalko SL, Boileau RA. The physical activity scale for the elderly (PASE): evidence for validity. *J Clin Epidemiol* 1999; **52**: 643–651.
26 Kroke A, Klipstein-Grobusch K, Voss S *et al*. Validation of a self-administered food-frequency questionnaire administered in the European prospective investigation into cancer and nutrition (EPIC) study: comparison of energy, protein, and macronutrient intakes estimated with the doubly labeled water, urinary nitrogen, and repeated 24-h dietary recall methods. *Am J Clin Nutr* 1999; **70**: 439–447.
27 Department of Nutrition at Harvard School of Public Health. *The Healthy Eating Plate*. Boston: Harvard School of Public Health, 2011 [Cited 9 Jul 2018]. Available from URL: https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/.
28 Kossioni A, Bellou O. Eating habits in older people in Greece: the role of age, dental status and chewing difficulties. *Arch Gerontol Geriatr* 2011; **52**: 197–201.
29 Appleton KM. Barriers to and facilitators of the consumption of animal-based protein-rich foods in older adults. *Nutrients* 2016; **8**: 187.
30 Morley JE. Decreased food intake with aging. *J Gerontol A Biol Sci Med Sci* 2001; **56** Spec No 2: 81–88.
31 Jancey J, Lee A, Howat P *et al*. Reducing attrition in physical activity programs for older adults. *J Aging Phys Act* 2007; **15**: 152–165.

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