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Family caregivers' better nutritional status is associated with care recipients' better nutritional status

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SUMMARY

Background and aims: A high proportion of older care recipients (CRs) face malnutrition and risk of malnutrition, affecting their functional abilities and posing challenges for caregiving. The aim of this study was to assess the risk for malnutrition among older CRs and the associated characteristics of both CRs and family caregivers (FCs) with nutritional status of CRs.
Methods: A cross-sectional study consisted of 120 CRs (≥65 years) and their 118 FCs (≥60 years). Nutritional status was assessed with the Mini Nutritional Assessment (MNA).
Results: The majority (63%) of the CRs had a risk of malnutrition (MNA score 17–23.5), and 7% had malnutrition (MNA score <17). The CRs had significantly lower MNA scores compared to their FCs ($p < 0.001$). The multivariate linear regression analysis showed that CRs' higher number of comorbidities ($B = -0.37$, $p = 0.013$) and higher P-hs-CRP ($B = -0.10$, $p = 0.047$) were associated with their decreased MNA scores. There was a positive association between CRs' hand grip strength ($B = 0.11$, $p = 0.004$) and FCs' MNA scores ($B = 0.41$, $p = 0.004$) with MNA scores of the CRs.
Conclusion: Malnutrition and risk of malnutrition are common concerns in older CRs, especially those with a higher number of comorbidities and low-grade inflammation. Regular assessment of the nutritional status of both older CRs and FCs is justified, as FCs' better nutritional status is associated with better nutritional status of CR.
Clinical trial registration number: ClinicalTrials.gov NCT04003493.

1. Introduction

Aging population challenges societies to provide care for older people globally. In Finland, the number of older people (≥65 years) reached 1.68 million in 2023, comprising almost a third of the total population, with projections indicating a further rise in the coming decades [1]. Family caregiving is an increasing form of care for older people in Finland. Over the past two decades, the number of older care recipients (CRs) (≥65 years of age) has nearly doubled to over 30 thousand [2]. These older CRs continue to reside in their own homes, receiving daily care from a family caregiver (FC), typically a spouse, child, or other relative, who receives a care allowance (CA) provided by the municipality, and nowadays by wellbeing services counties.

CRs experience various health concerns, including a higher presence of comorbidities and/or disability, poorer self-perceived health and/or psychological wellbeing, all of which contribute to an increased subjective burden of their FCs [3]. Moreover, older CRs face increased risk of malnutrition compared to the general older population [4–6], which not only compromises their health but also increases the number of comorbidities [6,7] and reduces their functional abilities, including physical [4,5,8,9], psychological [4,8],

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and cognitive functions [10–12]. Additionally, poor nutritional status of a CR further intensifies the caregiver burden [13].

As FCs of older CRs are commonly older themselves, they also face health concerns, such as depressive symptoms, which may increase during the caregiving period [14]. Moreover, social determinants such as higher age and lower financial satisfaction are associated with FC's health concerns including comorbidity, prevalence of diabetes, and depression [15]. Additionally, older FCs in Finland are usually not educated for their demanding task, which may result in deficient knowledge regarding older people's nutritional needs. For example, since FCs are commonly spouses of the CRs, their eating habits and dietary intake may have become similar over the years. This similarity can be seen in the association between the impaired nutritional status of CRs and FCs [4,5], as well as lower-than-recommended intake of energy and nutrients [16,17]. All these factors challenge the wellbeing of both the CRs, FCs, and the success of the caregiving.

When examining the nutritional status of older CRs, it is essential to understand the broader context of family caregiving, encompassing both CRs' and FCs' characteristics that contribute to the poor nutritional status of CRs. This understanding is crucial for identifying appropriate interventions or providing resources to support FCs, thereby enhancing the overall health, well-being, and functionality of CRs. The aim of this study was to assess the risk for malnutrition among older CRs and the associated characteristics of both CRs and FCs with nutritional status of CRs.

2. Material and methods

2.1. Study design and participants

The present study is secondary, and cross-sectional analysis of the baseline data of older CRs (≥65 years of age) participating in a randomized controlled Lifestyle, Nutrition, and Oral Health in Caregivers (LENTO), study involving older FCs (≥60 years of age) and CRs (≥65 years of age) living in the town of Kuopio and the municipality of Vesanto (Eastern Finland) [18]. The study was conducted in accordance with the guidelines of the Declaration of Helsinki, and the protocol was approved by the Hospital District of Northern Savo ethics committee (No. 171/2019). Written informed consent was obtained from all participants. Additionally, the present study was registered at ClinicalTrials.gov (NCT04003493).

The study participants consisted of 120 CRs and 118 FCs (Fig. 1). The participants were recruited in cooperation with the service managers for older people in the municipalities between June 2019 and October 2019. Recruitment was conducted through invitation letters, utilizing FC registers of Kuopio and Vesanto. The recruitment targeted FCs whose CR was 65 years old or older, and all CRs had a FC with a valid care allowance (CA) granted by the municipality. The CA includes benefits for the FC, such as a taxable fee and a 3-day leave per month. In Kuopio, the invitation letters were sent to all FCs meeting the inclusion criteria of having a CR (≥65 years) and the valid CA. In Vesanto, invitations were extended only to FCs who met the inclusion criteria and had given their consent to the service manager. CRs receiving end-of-life care at the baseline were excluded from the study.

The sample size was based on the effectiveness of the intervention by plasma albumin concentration, with a 20% difference in plasma albumin concentration between the intervention group (receiving individually tailored nutritional and oral health guidance by a clinical nutritionist and a dental hygienist) and the control group (power 0.80 and p value 0.05). Therefore, a sample size of 128 (n = 64 per group) was needed to demonstrate a statistically significant difference between the intervention and control groups.

2.2. Measurements

The CRs and the FCs were interviewed and evaluated during two home visits at the baseline. The FC provided the interview details for the CR, and in some cases, the CR participated in the interviews if CR was able and willing. Initially, a study nurse conducted interviews and took blood samples, as described below. Subsequently, a week later, a visit by a clinical nutritionist and a dental hygienist was scheduled. This visit included assessment of nutritional status, measurements of anthropometrics and physical function, clinical examination of oral health, and an interview on perceived oral health.

The primary outcome was nutritional status assessed from both CRs and their FCs with the Mini Nutritional Assessment (MNA) tool by the clinical nutritionist. The MNA is a valid and simple tool for screening malnutrition or the risk of malnutrition in older people [19,20]. The MNA consists of 18 brief questions and simple measurements about global assessment, self-assessment, dietary intake, and anthropometrics, including body mass index (BMI), mid-arm circumference (MAC), and calf circumference (CC). MNA scores range from 0 to 30, with scores <17 indicating malnutrition, scores between 17 and 23.5 indicating risk of malnutrition, and scores ≥24 indicating normal nutritional status.

The study nurse interviewed CRs and their FCs background information (sex, age, FC's years of education, FC's household's net income, CR's relationship with the FC), and comorbidities were assessed with modified Functional Comorbidity Index (FCI) [21,22]. The FCI identifies several diagnosed conditions (range 0–13): rheumatoid arthritis and other inflammatory connective tissue diseases; osteoporosis; diabetes type I or II; chronic asthma or chronic obstructive pulmonary disease; coronary artery disease; heart failure; myocardial infarction; stroke; depressive disorder; visual impairment; hearing impairment; dementia; and Parkinson's disease. A higher FCI score indicates a greater number of comorbidities. Additionally, the study nurse recorded the use of medication. The study nurse took non-fasting blood samples. Blood hemoglobin (B-Hb), plasma albumin (P-Alb), plasma prealbumin (P-Prealb), and plasma high-sensitivity C-reactive protein (P-hs-CRP) concentrations were analyzed from CRs and FCs using standard protocols at the Eastern Finland Laboratory Centre (ISLAB). B-Hb, P-Alb, and P-Prealb provide information about nutritional status; however, inflammation status should be considered when using P-Alb and P-Prealb to exclude an acute inflammatory state [23]. The study nurse assessed FCs' cognitive function with Mini-Mental State Examination (MMSE) (range 0–30, with higher scores indicating better cognitive function) [24], depressive symptoms with Geriatric Depression Scale (GDS-15) (range from 0 to 15, with higher scores indicating higher number of depressive symptoms) [25], functional ability with activities of daily living (ADL) by Barthel Index (range 0–100, with higher scores indicating better functional ability) [26] and instrumental activities of daily living (IADL) by Lawton & Brody Scale (range 0–8, with higher scores indicating better functional ability) [27]. MMSE, GDS-15, ADL and IADL were assessed only from FCs because they were main target group of the LENTO intervention and were examined in more detail [18]. The clinical nutritionist measured CRs and FCs physical function with a hand grip strength (Saehan Hydraulic Hand Dynamometer) [28].

The dental hygienist performed a clinical examination for CRs and FCs (number of teeth and use of removable dentures) and interviewed their perception of dry mouth, swallowing, and chewing problems. A scale was formed from three dental hygienist's questions “Do you have a feeling of dry mouth?”, no problem with the answer “no”, and one problem with the answer “yes, sometimes” or “yes, continuously”; “Can you chew hard or tough

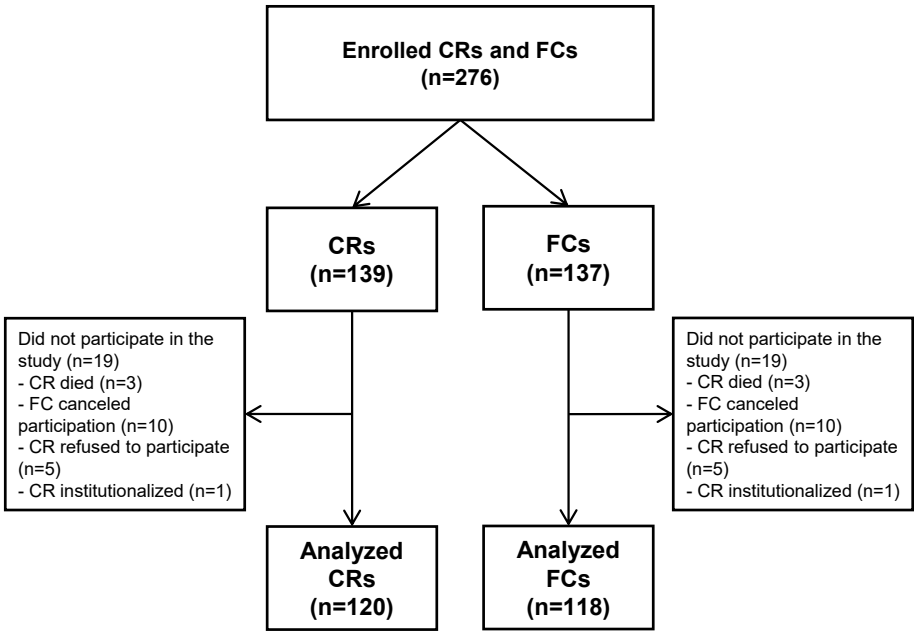

Fig. 1. Flow chart of the study population.

food, for example, rye bread, meat or apple?", no problem with the answer "without difficulties", and one problem with the answer "yes, but chewing is difficult" or "not at all"; and "Can you eat dry bread or biscuit without drinking at the same time?", no problem with the answer "yes", and one problem with the answer "no". From these, a four-point scale (0–3) was calculated for self-reported problems in mouth, indicating the number of problems.

2.3. Statistical analyses

The IBM SPSS Statistics software (v27, IBM Corp., Armonk, NY, USA) was used in statistical analyses. Means with standard deviations (SDs) or numbers with percentages were calculated from the baseline characteristics of the CRs and their FCs. Differences between the FCs and CRs in categorized MNA were analyzed with Pearson Chi–Square test. Univariate linear regression analysis was first used to separately analyze the independent factors (Table 1), described in the measurements section, of continuous MNA of CRs. The variables independently associated with MNA scores in the univariate linear regression analyses were selected for multivariate linear regression analysis using a stepwise procedure to analyze the independent factors of nutritional status. A P-value less than 0.05 was considered statistically significant.

3. Results

3.1. Characteristics of the study population

Characteristics of the CRs (42 (35%) females and 78 (65%) males) and their FCs (85 (72%) females and 33 (28%) males) are presented in Table 1. The mean age of the CRs was 80 ± 8 years, and the majority of them had dementia 62%, and 73% of them had Alzheimer's disease. Every third had diabetes (type 1 or 2), 30% had chronic heart failure, and 30% had coronary heart disease. In most cases, the FC was a spouse or partner of the CR (89%), and two had two CRs. The mean age of the FCs was 74 ± 7 years.

The majority (63%) of the CRs were at risk of malnutrition (MNA score 17–23.5), 7% had malnutrition (MNA score <17), and 31% were well-nourished (MNA score ≥24). The FCs had significantly better nutritional status compared to the CRs ($p < 0.001$); 20% of the FCs were at risk of malnutrition, and 80% were well-nourished.

3.2. Characteristics of CRs and FCs associated with CRs' MNA

In the univariate linear regression analyses with CRs characteristics, male sex ($p = 0.044$), higher B-Hb ($p = 0.017$), higher P-Alb ($p = 0.003$), larger MAC ($p = 0.044$), larger CC ($p = 0.001$), and better hand grip strength ($p = 0.009$) were associated with increased MNA scores of the CRs. Moreover, higher FCI ($p = 0.028$) and higher P-hs-CRP ($p = 0.032$) were associated with decreased MNA scores of the CRs (Table 2). No other characteristics of CRs were found to be associated with their MNA scores. The multivariate linear regression analysis with independently associated characteristics of the CRs (Model 1) showed that higher FCI ($p = 0.019$) and higher P-hs-CRP ($p = 0.043$) were associated with decreased MNA scores of the CRs, and better hand grip strength ($p = 0.002$) with increased MNA scores of the CRs (Table 2).

In the univariate linear regression analyses with FCs characteristics, FCs' higher MNA scores ($p = 0.013$) were associated with increased MNA scores of the CRs, and FCs' higher GDS-15 scores ($p = 0.047$) were associated with decreased MNA scores of the CRs (Table 2). No other characteristics of FCs were found to be associated with the MNA scores of CRs.

The multivariate linear regression analysis with all independently associated CRs' and FCs' characteristics (Model 2) showed that CRs' higher FCI ($p = 0.013$) and higher P-hs-CRP ($p = 0.047$) were associated with decreased MNA scores of the CRs, and CRs' better hand grip strength ($p = 0.004$) and FCs' higher MNA scores ($p = 0.004$) were associated with increased MNA scores of the CRs (Table 2).

4. Discussion

This study aimed to assess the risk for malnutrition among older CRs and the associated characteristics of both CRs and their FCs with the nutritional status of CRs. The prevalence of malnutrition or

Table 1
Characteristics of older care recipients (CRs) and their family caregivers (FCs).

Variable	CRs (n = 120)	FCs (n = 118)
	Mean ± SD or n (%)	Mean ± SD or n (%)
Demographics		
Females	42 (35)	85 (72)
Age, y	79.5 ± 7.7	74.3 ± 7.3
Education, y		11.0 ± 3.3
Household's net income, €/m[a]		3153.7 ± 929.1
Clinical characteristics		
FCI	3.5 ± 2.0	1.9 ± 1.5
Number of medications	8.7 ± 4.2	5.3 ± 3.7
B-Hb, g/L	135.7 ± 14.6[b]	135.3 ± 10.4[d]
P-Alb, g/L	34.4 ± 3.5[c]	37.7 ± 2.3[a]
P-Prealb, g/L	0.23 ± 0.04[b]	0.25 ± 0.04
P-hs-CRP, g/L	3.3 ± 7.0[d]	2.0 ± 2.4
MNA scores	21.7 ± 3.3	25.5 ± 1.9
Malnutrition (<17 points)	8 (6.7)	0 (0)
Risk of malnutrition (17–23.5 points)	75 (62.5)	24 (20.3)
Normal nutritional status (≥24 points)	37 (30.8)	94 (79.7)
BMI, kg/cm^2	28.5 ± 5.8[e]	28.4 ± 5.7
MAC, cm	31.9 ± 5.6	32.5 ± 4.5
CC, cm	37.1 ± 4.4	38.5 ± 3.9
Functional characteristics		
MMSE scores		26.4 ± 3.1
GDS-15 scores		3.0 ± 2.5
ADL scores		98.1 ± 3.4
IADL scores		6.8 ± 0.5
Hand grip strength, kg	20.6 ± 8.0[f]	25.0 ± 8.6
Oral health characteristics		
Number of teeth	13.6 ± 9.7[g]	17.2 ± 9.6
Use of removable dentures, yes	57 (51.4)[h]	51 (45.1)[j]
Self-reported problems in mouth	1.4 ± 1.0[i]	0.9 ± 0.9

CR = care recipient, FC = family caregiver, SD = standard deviation, FCI = Functional Comorbidity Index (range 0–13, higher scores indicating higher number of comorbidities), B-Hb = blood hemoglobin concentration, P-Alb = plasma albumin concentration, P-Prealb = plasma prealbumin concentration, P-hs-CRP = plasma high-sensitivity C-reactive protein concentration, MNA = Mini Nutritional Assessment (range from 0 to 30, higher scores indicating better nutritional status), BMI = body mass index, MAC = mid-arm circumference, CC = calf circumference, MMSE = Mini-Mental State Examination (range 0–30, higher scores indicating better cognitive function), GDS-15 = Geriatric Depression Scale (range from 0 to 15, higher scores indicating higher number of depressive symptoms), ADL = activities of daily living (Barthel Index) (range 0–100, higher scores indicating better functional ability), IADL = instrumental activities of daily Living (Lawton & Brody scale) (range 0–8, higher scores indicating better functional ability).
[a] n = 117.
[b] n = 115.
[c] n = 118.
[d] n = 116.
[e] n = 109.
[f] n = 103.
[g] n = 114.
[h] n = 111.
[i] n = 119.
[j] n = 113.

risk of malnutrition was 69% in older CRs, whose FCs had significantly better nutritional status based on the MNA. CRs' higher comorbidity and low-grade inflammation were associated with poorer nutritional status, and CRs' better hand grip strength, and better nutritional status of the FCs were associated with a nutritional status of the CRs.

The present study showed a significantly higher prevalence of malnutrition or risk for malnutrition among CRs compared to their FCs, consistent with findings from earlier studies [4,5]. This result is not surprising considering that being a CR signifies a greater need for care and higher morbidity, of which higher comorbidity was also associated with decreased nutritional status among CRs in the present study. Moreover, both factors are associated with poorer nutritional status [6,7]. Among individuals with higher comorbidities, older people may experience various deficiencies in physical [29], cognitive [30,31] and psychological abilities [9,32,33]. In the present study, the prevalence of well-nourished CRs was 31%, nearly double or even eight times higher compared to earlier studies [4,5]. The nutritional status of older FCs in the present study has been discussed previously [17]. Earlier studies reported the nutritional status of Alzheimer's disease or dementia CRs [4,5], which could explain the higher prevalence of malnutrition or risk of malnutrition compared to the present study, where CRs had diverse disease backgrounds. Additionally, the present study presents baseline findings from an intervention study, and it is possible that CRs with stressed or demanded FCs chose not to participate, potentially leading to a bias where participating FCs may have had better health and life situations as those who did not volunteer to participate in the study. This may have had a positive effect on the nutritional status of CRs. Studies by Tombini et al. [4], and Rullier et al. [5] have similarly found an association between the nutritional statuses of CRs and FCs. This association could be explained by similar eating behaviors and habits developed during their long cohabitation, particularly given that 89% of the FCs were married or unmarried partners of the CRs.

Low-grade inflammation was found to be associated with decreased nutritional status in older CRs in the present study. A prior review by Stumpf et al. [34] demonstrated that stressors, such

Table 2
Significantly ($p < 0.05$) associated independent variables of MNA scores of the older care recipients (CR) by univariate (n = 120) and multivariate linear regression analyses (n = 98).

Variable	Univariate			Multivariate Model 1[a]			Multivariate Model 2[b]		
	B (SE)	95% CI	p-value	B (SE)	95% CI	p-value	B (SE)	95% CI	p-value
Sex, ref. female	1.277 (0.629)	0.032, 2.523	0.044						
FCI	−0.342 (0.154)	−0.646, −0.037	0.028	−0.361 (0.151)	−0.662, −0.61	0.019	−0.366 (0.145)	−0.654, −0.077	0.013
B-Hb, g/L[c]	0.050 (0.021)	0.009, 0.091	0.017						
P-Alb, g/L[d]	0.263 (0.086)	0.092, 0.434	0.003						
P-hs-CRP, g/L[e]	−0.095 (0.044)	−0.182, −0.008	0.032	−0.100 (0.049)	−0.197, −0.003	0.043	−0.094 (0.047)	−0.187, −0.001	0.047
MAC, cm	0.136 (0.066)	0.004, 0.267	0.044						
CC, cm	0.222 (0.068)	0.088, 0.356	0.001						
Hand grip strength, kg[f]	0.096 (0.036)	0.025, 0.167	0.009	0.116 (0.037)	0.043, 0.189	0.002	0.106 (0.035)	0.035, 0.176	0.004
FCs' MNA scores	0.390 (0.154)	0.085, 0.695	0.013				0.411 (0.411)	0.137, 0.684	0.004
FCs' GDS-15 scores	−0.246 (−0.246)	−0.488, −0.003	0.047						

B = beta, SE = standard error, CI = confidence interval. FCI = Functional Comorbidity Index, B-Hb = blood hemoglobin concentration, P-Alb = plasma albumin concentration, P-hs-CRP = plasma high-sensitivity C-reactive protein concentration, FC = family caregiver, MNA = Mini Nutritional Assessment, GDS-15 = Geriatric Depression Scale.
[a] Multivariate linear regression analysis by stepwise procedure with independently associated variables of the CRs (sex, FCI, B-Hb, P-Alb, P-hs-CRP, MAC, CC, and hand grip strength), n = 98, R2 = 0.135, F = 6.061, p = 0.001.
[b] Multivariate linear regression analysis by stepwise procedure with variables in model 1, FCs' MNA scores, and FCs' GDS-15 scores, n = 98, R2 = 0.202, F = 7.148, $p < 0.001$.
[c] n = 115.
[d] n = 118.
[e] n = 116.
[f] n = 103.

as acute illness and increased inflammation, could impair appetite and food intake, slow down gastric emptying, and compromise nutrition. Furthermore, acute illness and increased inflammation may increase protein degradation, reduce protein synthesis, increase the resting metabolic rate, and increase immobilization and fatigue [34]. The cumulative impact of these factors, due to inflammation, can lead to muscle mass loss, weight loss, and finally to malnutrition [34]. Conversely, nutrition also influences inflammation; for instance, dietary changes such as increased intake of omega-3 fatty acids and fiber, coupled with decreased sugar intake, may have a beneficial effect on inflammation [34]. Therefore, healthy eating habits that meet energy requirements are important in preventing and treating the nutritional status of older CRs.

In the present study, better hand grip strength among CRs was found to predict a better nutritional status, aligning with previous evidence [11,35]. Good physical function observed in CRs supports their daily functional abilities and consequently facilitates successful family caregiving. Previous research has demonstrated that older CRs' poor functional ability in ADL is associated with decreased nutritional status [4,5].

Given the prevalence of malnutrition and the risk thereof, regular assessment and improvement of the nutrition of the CRs should be integrated in healthcare practices. Additionally, attention should be directed towards the nutritional status of FCs by healthcare professionals, as better nutritional status of FCs has been shown to correlate with better nutritional status of CRs, facilitating more feasible adjustments to shared eating habits. For example, targeted nutritional guidance and counseling for FCs have shown positive effects, including improved dietary intake and nutritional status for CRs [36,37]. Furthermore, evidence suggests that dietary improvements can lead to improvements in the nutritional, functional, mental, and cognitive status of older people [38–41]. Moreover, improving nutritional status of CRs can also prevent the caregiver burden, as indicated by associations between these factors [13]. Timely interventions aimed at preventing decrease in nutritional status among CRs, particularly during acute illness, due to effect of inflammation on nutritional status [23], are crucial in preventing impairment in CRs' functional abilities and overall health. It is imperative for all healthcare professionals interacting with older CRs and their FCs to recognize the board impact of nutrition and to regularly monitor and guide both CRs and FCs in improving their nutrition. Additionally, raising awareness among older FCs regarding the nutritional needs of older people is essential in early time identifying factors contributing to malnutrition and its risk, enabling timely referrals to healthcare services if necessary [42]. Further multiprofessional research is needed to demonstrate successful practices to prevent malnutrition in older CRs.

The strengths of this study are the population-based design and validated methods tailored for older people described in the methods. This data was collected by professionals, thereby enhancing reliability. Consequently, the findings hold direct applicability to real-life scenarios and clinical practice, owing to the study's population-based approach. However, the study has some limitations. The approach of the LENTO study may have limited the sample size, potentially some FCs finding participation in the intervention study overly burdensome. However, conducting the study through home visits could have increased participation rates. Moreover, the functional characteristics of the CRs are limited, as measurements such as MMSE, GDS-15, ADL, and IADL were not assessed in these secondary analyses [18]. This omission stems from the primary focus of the RCT on FCs, with efforts made to avoid the research burden on FCs to facilitate their participation in the study.

5. Conclusion

Malnutrition and risk of malnutrition are common concerns in older CRs, especially those with a higher number of comorbidities and low-grade inflammation. Regular assessment of the nutritional status of both older CRs and FCs is justified, as FCs' better nutritional status was associated with better nutritional status of CR.

Author contributions

Sohvi Koponen: formal analysis, investigation, and writing – original draft preparation. **Irma Nykänen**: conceptualization, methodology, investigation, data curation, writing – review and editing, and funding acquisition. **Roosa-Maria Savela**: investigation, and writing – review and editing. **Tarja Välimäki**: methodology, writing – review and editing, and funding acquisition. **Anna Liisa Suominen**: methodology, writing – review and editing, and

funding acquisition. **Ursula Schwab**: conceptualization, methodology, writing – review and editing, project administration, and funding acquisition.

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Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT in order to improve language. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of competing interest

The funder had no role in any of the following: study design; data collection, analyses, or interpretation; manuscript composition; or decision to publish the results.

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