Clinical Nutrition ESPEN 55 (2023) 440–446

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Nutritional risk, nutrition plan and risk of death in older health care service users with chronic diseases: A register-based cohort study

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ARTICLE INFO

Article history:
Received 22 September 2022
Accepted 25 April 2023

Keywords:
Nutrition assessment
Nutrition therapy
Aged
Mortality
Primary health care
Community health services

SUMMARY

Background and aims: Nutritional risk in older health care service users is a well-known challenge. Nutritional risk screening and individualised nutrition plans are common strategies for preventing and treating malnutrition. The aim of the current study was to investigate whether nutritional risk is associated with an increased risk of death and whether a nutrition plan to those at nutritional risk could reduce this potential risk of death in community health care service users over 65 years of age.

Methods: We conducted a register-based, prospective cohort study on older health care service users with chronic diseases. The study included persons ≥65 years of age receiving health care services from all municipalities in Norway from 2017 to 2018 (n = 45,656). Data on diagnoses, nutritional risk, nutrition plan and death were obtained from the Norwegian Registry for Primary Health Care (NRPHC) and the Norwegian Patient Registry (NPR). We used Cox regression models to estimate the associations of nutritional risk and use of a nutrition plan with the risk of death within three and six months. Analyses were performed within the following diagnostic strata: chronic obstructive pulmonary disease (COPD), dementia, type 2 diabetes, stroke, osteoporosis and heart failure. The analyses were adjusted for age, gender, living situation and comorbidity.

Results: Of the 45,656 health care service users, 27,160 (60%) were at nutritional risk, and 4437 (10%) and 7262 (16%) died within three and six months, respectively. Among those at nutritional risk, 82% received a nutrition plan. Health care service users at nutritional risk had an increased risk of death compared to health care service users not at nutritional risk (13% vs 5% and 20% vs 10% at three and six months). Adjusted hazard ratios (HRs) for death within six months were 2.26 (95% confidence interval (CI): 1.95, 2.61) for health care service users with COPD, 2.15 (1.93, 2.41) for those with heart failure, 2.37 (1.99, 2.84) for those with osteoporosis, 2.07 (1.80, 2.38) for those with stroke, 2.65 (2.30, 3.06) for those with type 2 diabetes and 1.94 (1.74, 2.16) for those with dementia. The adjusted HRs were larger for death within three months than death within six months for all diagnoses. Nutrition plans were not associated with the risk of death for health care service users at nutritional risk with COPD, dementia or stroke. For health care service users at nutritional risk with type 2 diabetes, osteoporosis or heart failure, nutrition plans were associated with an increased risk of death within both three and six months (adjusted HR 1.56 (95% CI: 1.10, 2.21) and 1.45 (1.11, 1.88) for type 2 diabetes; 2.20 (1.38, 3.51) and 1.71 (1.25, 2.36) for osteoporosis and 1.37 (1.05, 1.78) and 1.39 (1.13, 1.72) for heart failure).

Conclusions: Nutritional risk was associated with the risk of earlier death in older health care service users with common chronic diseases in the community. Nutrition plans were associated with a higher risk of death in some groups in our study. This may be because we could not control sufficiently for

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https://doi.org/10.1016/j.clnesp.2023.04.021

disease severity, the indication for providing a nutrition plan or the degree of implementation of nutrition plans in community health care.

1. Introduction

Nutritional risk is common in older adults receiving health care services [1]. A multi-national study found that half of nursing home residents and one-third of older adults in the community are at nutritional risk [2]. Nutritional risk identified by screening is associated with adverse health outcomes in older persons [3,4]. Further, in hospitals and acute care settings, malnutrition is associated with an increased risk of death [5–7]. However, this association is not as clear in the community setting [5].

Measures taken by community health care services to identify and counteract malnutrition among health care service users include nutritional risk screening and individualised nutrition plans. Nutritional risk screening is based on validated tools and identifies persons as malnourished, at nutritional risk or not at nutritional risk [8]. Nutrition plans are individually tailored care plans for persons identified as being at nutritional risk or malnourished and should include nutritional status, nutritional needs, nutritional support and an evaluation plan [8,9]. The availability of dieticians in Norwegian municipalities is low. In the period 2016 to 2018 there were a total of 50–70 dieticians working in Norwegian municipalities. Hence, most of the nutritional interventions included in nutrition plans are handled by non-dietetic health care professionals. However, there is a lack of evidence regarding the effectiveness of such individualised nutrition plans provided by nursing staff in attenuating negative health outcomes [10,11]. Nutrition plans often include supportive interventions for enhancing dietary intake, such as changes in the feeding environment, food fortification or additional supplementation. A Cochrane review published in 2016, based on moderate-quality evidence, concluded that supportive dietary interventions targeting malnourished or at-risk adults reduce mortality [12]. However, most of the evidence for this lower mortality risk comes from studies in hospital settings [12]. Thus, it is interesting to know whether individualised nutrition plans provided by nursing staff in the community can reduce the risk of death. This is of particular importance because most long term follow up on nutritional risk takes place in municipalities, not in acute care settings [13].

Accordingly, we aimed to investigate whether nutritional risk and nutrition plans were associated with the risk of death of health care service users aged 65 years or older in the community. To the best of our knowledge, this is the first study to investigate the association of nutritional risk and nutrition plans provided by nursing staff with the risk of death in a large cohort of older patients with chronic diseases in a community context.

2. Materials and methods

2.1. Study design and setting

This is a prospective cohort study on older community health care service users with common chronic diseases. The study is based on data from mandatory national registries within public Norwegian health care services. The public services serve a population of approximately 5.4 million people living in Norway and include primary health care and specialised health care [14].

2.2. Study cohort

The current study was based on data from all persons ≥65 years of age with chronic diseases receiving health care services from municipalities in Norway from 2017 to 2018 (n = 45,656). The health care services included home health services and short- or long-term stays in nursing homes. Figure 1 gives an overview of the health care service users included in the study. The inclusion criteria were as follows.

- ≥65 years
- receiving health care services from a municipality
- a diagnosis of chronic obstructive pulmonary disease (COPD), dementia, type 2 diabetes, stroke, osteoporosis or heart failure before the first registration of nutrition risk screening

Data were obtained from two national registries on health care use in Norway: the Norwegian Registry for Primary Health Care (NRPHC) and the Norwegian Patient Registry (NPR) [15]. NRPHC is a mandatory health registry for municipalities and includes demographic, administrative and clinical data on persons who have received or are currently receiving health care services. NPR includes demographic, administrative and clinical information on all patients who have received treatment or consultations in specialised health care services (hospitals and outpatient clinics). The Norwegian Directorate of Health is responsible for both registries. The NPR has existed since 2008, while the NRPHC was established in 2017 based on the two existing national registries (Norwegian Information System for the Nursing and Care Sector [IPLOS] and Control and Payment of Health Refunds [KUHR]).

Available data on diagnoses from both registries were used for inclusion. Data on nutritional risk, nutrition plan, date of death, diagnoses and sociodemographic factors were obtained from the NRPHC, and additional diagnostic data were obtained from the NPR. The raw data consisted of four files containing information on all adults ≥65 years of age receiving some form of primary health care service in Norway from 2017 to 2018 (N = 270,560). The four files contained information on: 1) nutritional risk, nutrition plan and sociodemographic factors from the NRPHC; 2) diagnoses from the NRPHC; 3) date of death from NRPHC; and 4) all DRG-coded diagnoses from contact with specialist services (i.e. hospital stays or out-patient consultations) from the NPR. Data were delivered as one record per contact with health care services. From the four delivered files, we retrieved all records for health care service users with one or more of the following diagnoses: COPD, dementia, type 2 diabetes, stroke, osteoporosis or heart failure (details on diagnostic codes are given in Supporting information, Table S1). These diagnoses were chosen because they are prevalent, chronic and relevant from a primary health care service perspective. Strata were not mutually exclusive (i.e. health care service users with comorbidities could be included in several strata).

Using each health care service user's national identity number, information on the relevant variables from all four files were merged according to the timeline shown in Fig. 2.

For a health care service user to be included in the analyses, his or her diagnosis had to be registered in the NRPHC or NPR prior to

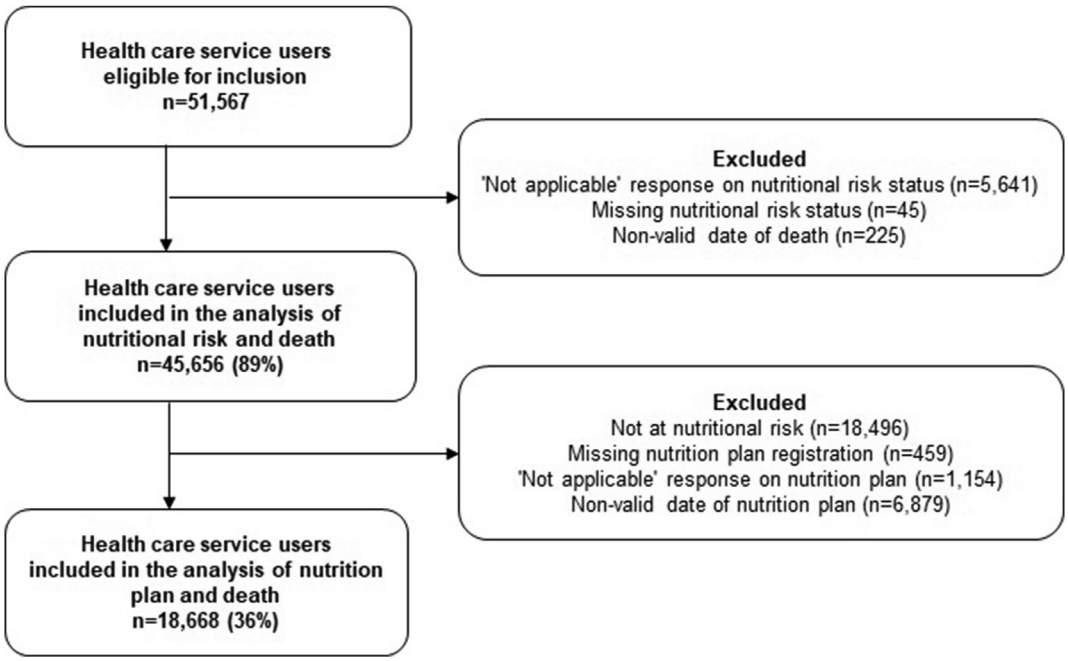

Fig. 1. Flow chart describing the inclusion of health care service users.

the date of nutritional risk screening. If there were multiple records with nutritional screening results for a health care service user, the record that was created closest to but after the registered date of diagnosis was used (allowing a 30-day lag). Nutrition plans were linked to the chosen record of nutritional risk for each individual health care service user, but with a unique date for the nutrition plan.

Of the 45,656 service users included in the analyses of the association of nutritional risk with death, 18,668 service users at nutritional risk were further analysed regarding the association of nutritional plans with death (see Fig. 1).

2.3. Exposure and outcome variables

In the NRPHC, health care service staff registered information on whether the health care service user had been screened for and was at nutritional risk (yes/no/not relevant) and whether health personnel had developed an individual nutrition plan (yes/no/not relevant). In the municipalities' health care services, health personnel registered dates for the respective nutrition screening and nutrition plan. The registration of yes/no with regard to nutritional screening and whether a nutrition plan had been developed was based on the Norwegian National Guidelines for Prevention and Treatment of Undernutrition from 2009 [9]. The guidelines state that the Mini Nutritional Assessment (MNA) and Malnutrition Universal Screening Tool (MUST) are the preferred screening tools, while the Nutrition Risk Screening 2002 (NRS2002), Subjective Global Assessment (SGA) and Nutritional Journal are secondary alternatives [9]. The group of health care service users 'at nutritional risk' thus include both service users at risk of malnutrition (ungraded, moderate or high) and mildly/moderately or severely malnourished. Health care service users 'not at risk' are those classified with low risk, normal nutritional status or well-nourished according to the respective nutritional risk screening tools. Furthermore, the guidelines state that the minimum content of an individual nutrition plan includes documentation of nutritional status, nutritional needs, intake and measures to improve nutrition [9].

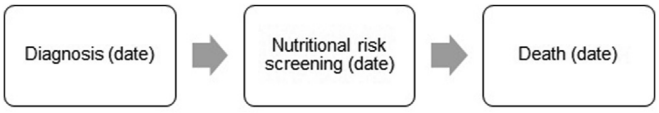

Fig. 2. Timeline of events in the study population.

The outcome measure, time from nutritional screening/nutrition plan to death, was obtained from the NRPHC. Based on the date of death, two dichotomous dummy variables representing death within three or six months, respectively, were constructed. For both of these variables, any death occurring within the follow-up period was recorded as 1, and no death registered during the follow-up period or a date of death after the end of the follow-up period was recorded as 0. We computed survival time variables based on the difference in the number of days between the date of nutrition risk/nutrition plan and the date of death, with the maximum number of days set to the length of follow-up (three or six months).

2.4. Statistics

We used Cox proportional hazards regression models to estimate the associations between nutritional risk and risk of death in the total sample (n = 45,656). We also used Cox proportional hazards regression models with the sample of health care service users at nutritional risk (n = 18,668) to examine whether nutrition plans were associated with the risk of death. All analyses were performed within each diagnosis stratum separately. Associations were reported as hazard ratios (HR) with 95% confidence intervals (CI).

Analyses were performed in Stata 17.0 (StataCorp, College Station, Texas, US). The proportional hazard assumption was checked by assessing log-minus-log survival plots (*stphplot*). Model fit was assessed by inspecting the Cox Snell residuals/Nelson–Aalen cumulative hazard. A p-value less than 0.05 was considered statistically significant.

The prospective associations of nutritional risk and nutrition plan with the risk of death were adjusted for age, gender, living situation (i.e. whether or not the health care service user was living with others) and comorbidity (i.e the number of reported diagnoses). These adjustment variables were defined as relevant using the online DAGitty tool [16].

In the NRPHC, diagnoses most relevant to the health care service users' needs are registered. The NPR included available information on additional diagnoses (limited to 20 for each health care service user). To be able to adjust for comorbidity, we analysed the associations of nutritional risk and nutrition plan with death in a subsample of health care service users who were registered in the NPR (n = 20,789, 46% of the total included for nutritional risk analysis, and n = 8,078, 43% of the total included for nutrition plan analysis).

2.5. Ethics

The study was approved by the Regional Committee for Medical and Health Research Ethics (REC North, Ref. no. 2018/1136). The approval included exemptions from both patient consent and information requirements. The Norwegian Centre for Research Data performed a data protection impact assessment (DPIA). Data were de-identified by the registries before they were disclosed to the researchers.

3. Results

3.1. Cohort characteristics

Table 1 summarises the characteristics of the included services users. Of the 45,656 health care service users, 34% were men and 45% lived alone. The mean age ranged from 80 years for health care service users with COPD to 86 years for health care service users with heart failure. A total of 27,160 (60%) service users were at nutritional risk. A nutrition plan had been provided for 82% of the health care service users at nutritional risk with valid information on nutrition plans (n = 18,668).

3.2. Nutritional risk and risk of death

Of the 27,160 health care service users at nutritional risk, 13% and 20% died within three and six months, respectively. For health care service users not at risk, 5% and 10% died within three and six months respectively. Health care service users at nutritional risk had a higher risk of death at three and six months in all diagnosis strata (see Table 2). The adjusted HRs varied from 2.17 to 3.16 for death within three months and from 1.94 to 2.65 for death within six months (all $p < 0.05$). The strongest association was found for diabetes, followed by osteoporosis, COPD and heart failure.

3.3. Nutrition plan and risk of death in health care service users at nutritional risk

Health care service users with type 2 diabetes, osteoporosis or heart failure at nutritional risk with a nutrition plan had an increased risk of death compared to health care service users without a nutrition plan within both three and six months (adjusted HR 1.56 (95% CI: 1.10, 2.21) and 1.45 (1.11, 1.88) for type 2 diabetes; 2.20 (1.38, 3.51) and 1.71 (1.25, 2.36) for osteoporosis and 1.37 (1.05, 1.78) and 1.39 (1.13, 1.72) for heart failure). For the older health care service users at nutritional risk with COPD, stroke or dementia, having a nutrition plan was not associated with the risk of death within three and six months (Table 2). In the COPD and stroke group there was a trend towards increased risk of death in those who received nutrition plans, however, this did not reach statistical significance in the adjusted models.

3.4. Additional adjustment for comorbidity

The HRs did not change substantially when analyses in the subsample with diagnosis information from the NPR were performed and adjusted for comorbidity (see Table S3). In the subsample with diagnosis information from the NPR (n = 20,789), adjusted HRs ranged from 1.98 to 3.44 and 1.92 to 2.95 for the associations of nutritional risk with death at three and six months, respectively. The adjusted HRs for the associations of nutrition plans with the risk of death ranged from 1.20 to 2.25 and 1.32 to 1.61 at three and six months, respectively.

4. Discussion

In this study of older health care service users ≥65 years with chronic diseases, we found that nutritional risk increased the risk of earlier death. Further, nutrition plans provided by nursing staff had no apparent beneficial effect on this risk increase.

4.1. Nutritional risk and risk of death

The association of nutritional risk with the risk of death is consistent with the findings of a systematic review including 28 studies, which reported that worse scores on nutritional screening tools were associated with increased mortality [5]. The review suggests that the associations of nutritional risk with death are lower for community-dwelling older persons than for those receiving higher levels of care. However, our study found more than a twofold increase in the risk of death for health care service users at nutritional risk with chronic diseases compared to those who were not at nutritional risk. These findings remained strong after adjusting for comorbidity and warrant increased attention to nutritional risk in older community health care service users. In line with our findings, a recent cohort study of 534 community-dwelling older adults reported a higher mortality risk for older adults identified as malnourished based on GLIM and ESPEN criteria [17]. Further, a larger population-based longitudinal study (n = 3041) using MNA-SF found shorter survival times in community-dwelling aged persons at nutritional risk compared to persons with normal nutritional statuses [18]. In contrast, Bloom et al. did not find an association between the nutrition risk score and mortality in 88 community-dwelling older adults [19]. The latter study, however, used the 'Determine your Nutritional Health' (DETERMINE) checklist, a tool previously shown not to predict mortality [20]. Both the limited number of participants and the nutrition screening tools applied may explain the difference between our results and those of Bloom et al.

4.2. Nutrition plan and risk of death

Nutrition plans did not reduce the risk of death in older health care service users with chronic diseases at nutritional risk in this study. Unexpectedly, the use of a nutrition plan was associated with an increased risk of death in health care service users with type 2 diabetes, osteoporosis or heart failure. This finding may be due to factors that we were not able to control. Certain characteristics associated with the risk of death may make it more likely that these health care service users were given a nutrition plan. For example, disease severity may affect the likelihood of receiving a nutrition plan and hence explain the increased risk of death seen in our study. Such an effect could also have affected the results in other diagnosis strata, masking any possible positive effects of the use of

Table 1
Health care service users' characteristics according to diagnosis, nutritional risk and nutrition plan status (n = 45,656).

Health care service users' characteristics	Nutritional risk status			Nutrition plan		
	Total health care service users	Health care service users at nutritional risk	Health care service users not at nutritional risk	Total health care service users	Health care service users with a nutrition plan	Health care service users without a nutrition plan
All strata (n, %)	45,656	27,160 (59.5%)	18,496 (40.5%)	18,668	15,352 (82.2%)	3316 (17.8%)
Type 2 Diabetes (n, %)	6534	3144 (48.1%)	3390 (51.9%)	2072	1627 (78.5%)	445 (21.5%)
Age, yr (mean ± SD (range))	81.6 ± 8.0 (63–104)	82.1 ± 8.0 (63–104)	81.2 ± 8.0 (63–103)	82.5 ± 8.0 (63–104)	82.6 ± 8.0 (63–100)	82.0 ± 8.1 (64–104)
Gender, male (%)	42.8	43.5	42.2	41.1	41.5	39.8
Living alone (%)	48.2	41.3	54.5	40.4	38.4	47.6
Number of diagnoses (median, 25th, 75th percentile)	3 (2, 5)	4 (2, 6)	3 (2, 5)	4 (2, 6)	4 (2, 6)	4 (2, 6)
Died within three months (%)	9.1	14.1	4.4	12.4	13.5	8.3
Died within six months (%)	14.5	21.2	8.3	20.1	21.5	15.1
COPD (n, %)	5704	3584 (62.8%)	2120 (37.1%)	2290	1775 (77.5%)	515 (22.5%)
Age, yr (mean ± SD (range))	79.9 ± 7.9 (63–104)	80.1 ± 7.8 (63–101)	79.6 ± 7.9 (63–104)	80.5 ± 7.9 (63–101)	80.6 ± 8.0 (63–101)	80.3 ± 7.5 (63–99)
Gender, male (%)	41.3	39.4	44.4	37.7	37.0	40.2
Living alone (%)	54.0	51.1	59.0	51.0	50.0	54.5
Number of diagnoses (median, 25th, 75th percentile)	4 (2, 5)	4 (2, 6)	3 (2, 5)	4 (2, 6)	4 (2, 6)	4 (2, 6)
Died within three months (%)	12.0	15.2	6.6	13.3	13.4	12.8
Died within six months (%)	19.1	23.6	11.4	21.2	21.9	18.5
Osteoporosis (n)	5642	3555 (63%)	2087 (37%)	2477	2013 (81.3%)	464 (18.7%)
Age, yr (mean ± SD (range))	84.9 ± 7.6 (63–106)	85.1 ± 7.7 (63–106)	84.4 ± 7.6 (63–104)	85.4 ± 7.7 (63–104)	85.5 ± 7.7 (63–102)	84.7 ± 7.6 (64–104)
Gender, male (%)	10.9	10.9	10.8	10.6	10.8	9.7
Living alone (%)	52.9	50.2	57.5	48.4	44.9	63.4
Number of diagnoses (median, 25th, 75th percentile)	3 (1, 5)	4 (1, 5)	3 (1, 5)	4 (2, 6)	4 (2, 5)	3 (1, 6)
Died within three months (%)	7.5	9.6	3.8	8.1	9.0	4.3
Died within six months (%)	13.0	16.4	7.1	14.2	15.3	9.5
Stroke (n, %)	7255	4164 (57.4%)	3091 (42.6%)	2830	2358 (83.3%)	472 (16.7%)
Age, yr (mean ± SD (range))	82.8 ± 8.3 (63–104)	83.3 ± 8.3 (63–104)	82.0 ± 8.2 (63–104)	83.5 ± 8.3 (63–104)	83.7 ± 8.2 (63–104)	82.5 ± 8.6 (63–101)
Gender, male (%)	42.7	39.9	46.6	38.0	37.7	39.4
Living alone (%)	43.9	40.0	49.1	38.6	36.2	50.2
Number of diagnoses (median, 25th, 75th percentile)	4 (3, 6)	4 (3, 6)	4 (2, 6)	4 (3, 6)	4 (3, 6)	4 (3, 6)
Died within three months (%)	8.9	11.6	5.4	9.3	9.8	6.8
Died within six months (%)	14.4	18.3	9.1	16.2	16.8	13.1
Dementia (n, %)	13,724	8871 (64.6%)	4853 (35.4%)	6460	5560 (86.1%)	900 (13.9%)
Age, yr (mean ± SD (range))	84.2 ± 7.5 (63–106)	84.5 ± 7.6 (63–106)	83.7 ± 7.3 (63–104)	84.7 ± 7.6 (63–106)	84.7 ± 7.6 (63–106)	84.1 ± 7.5 (63–101)
Gender, male (%)	30.0	28.1	33.4	27.3	26.7	30.9
Living alone (%)	32.4	30.1	36.5	28.6	27.1	38.0
Number of diagnoses (median, 25th, 75th percentile)	3 (2, 4)	3 (2, 4)	2 (2, 4)	3 (2, 5)	3 (2, 5)	3 (2, 5)
Died within three months (%)	8.1	10.1	4.3	8.6	8.5	9.6
Died within six months (%)	13.9	16.6	8.8	14.7	14.7	14.4
Heart failure (n)	6797	3842 (56.5%)	2955 (43.5%)	2539	2019 (79.5%)	520 (20.5%)
Age, yr (mean ± SD (range)	85.5 ± 7.6 (63–105)	85.8 ± 7.6 (63–105)	85.3 ± 7.7 (63–104)	86.2 ± 7.5 (64–104)	86.2 ± 7.6 (64–104)	86.1 ± 7.2 (65–104)
Gender, male (%)	38.3	36.7	40.4	34.5	33.9	36.9
Living alone (%)	51.9	48.2	56.8	47.7	44.0	62.1
Number of diagnoses (median, 25th, 75th percentile)	5 (3, 7)	5 (3, 7)	4 (3, 6)	5 (3, 7)	5 (3, 7)	5 (3, 7)
Died within three months (%)	14.5	19.1	8.5	16.2	16.8	13.9
Died within six months (%)	22.8	28.8	15.1	26.0	27.1	21.7

Table 2
Risk of death for older health care service users according to nutritional risk status, nutrition plan and diagnosis.

	n	Three-month risk of death		Six-month risk of death	
		Crude HR (95% CI)	Adjusted HR (95% CI)	Crude HR (95% CI)	Adjusted HR (95% CI)
At nutritional risk					
vs not at risk	**45,597**[¤]				
Type 2 Diabetes	6526	3.27 (2.80, 4.06)*	3.16 (2.61, 3.81)*	2.82 (2.45, 3.24)*	2.65 (2.30, 3.06)*
COPD	5697	2.44 (2.03, 2.94)*	2.42 (2.00, 2.92)*	2.29 (1.98, 2.64)*	2.26 (1.95, 2.61)*
Osteoporosis	5632	2.60 (2.03, 3.33)*	2.55 (1.99, 3.27)*	2.44 (2.03, 2.92)*	2.37 (1.99, 2.84)*
Stroke	7250	2.20 (1.85, 2.63)*	2.17 (1.82, 2.59)*	2.14 (1.87, 2.45)*	2.07 (1.80, 2.38)*
Dementia	13,714	2.41 (2.07, 2.80)*	2.34 (2.01, 2.73)*	1.99 (1.79, 2.22)*	1.94 (1.74, 2.16)*
Heart failure	6778	2.44 (2.11, 2.82)*	2.46 (2.13, 2.85)*	2.15 (1.93, 2.41)*	2.15 (1.93, 2.41)*
Nutrition plan					
vs no plan	**18,665**[¤]				
Type 2 Diabetes	2073	1.68 (1.18, 2.37)*	1.56 (1.10, 2.21)*	1.54 (1.19, 2.01)*	1.45 (1.11, 1.88)*
COPD	2290	1.07 (0.81, 1.40)	1.07 (0.81, 1,40)	1.25 (1.00, 1.56)*	1.24 (0.99, 1.55)
Osteoporosis	2475	2.16 (1.36, 3.43)*	2.20 (1.38, 3.51)*	1.73 (1.26, 2.37)*	1.71 (1.25, 2.36)*
Stroke	2832	1.47 (1.02, 2.13)*	1.43 (0.99, 2.07)	1.35 (1.03, 1.76)*	1.29 (0.98, 1.68)
Dementia	6460	0.88 (0.70, 1.11)	0.86 (0.68, 1.08)	1.03 (0.85, 1.24)	1.00 (0.83, 1.21)
Heart failure	2535	1.33 (1.03, 1.73)*	1.37 (1.05, 1.78)*	1.38 (1.12, 1.70)*	1.39 (1.13, 1.72)*

HR = Hazard Ratio. CI = Confidence Interval. COPD = Chronic Obstructive Pulmonary Disease. [¤]Some individuals were lost to analysis due to death at day 0 of follow-up or missing data on 'Living situation'.*Statistically significant ($p < 0.05$). Adjusted for age, gender and living situation (living alone vs living with others). Reference group was 'Not at risk' and 'No nutrition plan' for nutritional risk and nutrition plan, respectively.

nutrition plans. However, in line with our findings, a systematic scoping review on the effectiveness of individualised nutritional care plans after hospital discharge found four studies indicating that nutritional care plans do not reduce mortality [21]. In contrast, both a systematic review and meta-analysis and a recent randomised controlled trial found that individualised nutritional support increases the survival of hospital inpatients [22,23]. Studies on multi-component nutritional interventions, such as oral nutritional supplements in combination with telephone counselling or home visits from dieticians after discharge from the hospital, showed conflicting results [24–26]. Furthermore, a study on a multimodal nutritional intervention including an individual nutrition plan after discharge found a non-significant reduction of all-cause mortality in the intervention group [27]. We have yet to identify any studies comparable to ours investigating the effect of individualised nutrition plans provided by nursing staff on the risk of death in a community setting. Further studies on possible associations between nutrition plans and the risk of death using designs that control for disease severity are needed to clarify whether nutrition plans improve the survival of community health care service users. This is of particular importance since previous studies on nutritional interventions have involved dietetic support, whereas the nutritional support for health care service users in municipalities is mainly delivered by non-dietetic health care professionals [11].

4.3. Strengths and limitations

The strengths of the current study include the large number of participants. Furthermore, the study did not rely on self-reported data or recall, as municipality staff recorded data on the health care service users. This implies that participants with reduced cognition or functioning were included (a common exclusion criteria in similar studies), suggesting increased representativity and generalisability of the findings.

The lack of completeness in registrations of the date variable for nutritional screening and the diagnosis variable limited the number of participants in this study, and biases may have arisen since many health care service users were not included in the analysis files for this reason. However, the fact that the included health care service users did not differ substantially from the overall population of health care service users with the six diagnoses in the registries with regard to age, gender, living situation and number of diagnoses (see Table S2 in Supporting information) supports the generalisability of the findings for older health care service users in the community. Further, because the diagnosis preceded both exposure and outcome in our study, we do not believe that the missing diagnosis information introduced serious selection bias in the exposure–outcome associations studied [28].

The NRPHC registry does not provide information on which of the screening tools recommended by the national guidelines [9] are used in different municipalities. Although there is variation in the psychometric properties of different screening tools, the findings from the analyses of the associations between nutritional risk and the risk of death in this study were very consistent. Thus, any effect of the diversity of screening methods on the associations is likely to be low.

A nutrition plan is a complex, tailored intervention with individual measures. In the current study, we did not have information on the content of the nutrition plans or the degree to which they were implemented and followed up. Deviations from the recommendations for nutrition plans, low availability of dietetic professionals and varying degrees of implementation, may have contributed to the lack of a protective effect on death seen in this study. Thus, the question of whether nutrition plans provided by nursing staff can attenuate the increased risk of death in older health care service users at nutritional risk requires further investigation in more standardised settings.

5. Conclusions

In conclusion, nutritional risk was associated with earlier death in older community health care service users in this large, national register-based cohort study. The main measure for treating and preventing malnutrition, individual nutrition plans, was not found to be associated with a reduced risk of death in health care service users at nutritional risk. The association of nutrition plans with an increased risk of death in some diagnosis groups seen in this study may be because we could not control for disease severity, the indication for providing a nutrition plan or the degree of implementation of nutrition plans. Future research should investigate the active components of nutrition plans and identify which subgroups of older health care service users benefit from having them. Further, future research designs should sufficiently control for disease severity, which may impact the associations between nutrition

plans and outcomes. Finally, our study points to the need for more knowledge on the degree of implementation of nutrition plans in community health care.

Authors' contribution

KI Folven: Conceptualisation, Formal analysis, Investigation, Writing – Original Draft. E Biringer: Conceptualisation, Methodology, Formal analysis, Investigation, Writing – Review & Editing, Supervision, Project administration. RJ Tangvik: Conceptualisation, Writing – Review & Editing, Supervision. RM Nilsen: Methodology, Formal analysis, Investigation, Data Curation, Writing – Review & Editing. AM Beck: Conceptualisation, Writing – Review & Editing, Supervision. Ø Hetlevik: Conceptualisation, Writing – Review & Editing, Supervision.

Funding statement

This work was supported by Helse Fonna Local Health Authority.

Declaration of competing interest

All authors declare no conflict of interest.

Acknowledgements

We are grateful to research assistant Signe Marie Parlati for assistance with data handling and Doris Gundersen, PhD, for advice on scientific writing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2023.04.021.

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