The overlap of frailty and malnutrition in older hospitalised patients: An observational study

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ABSTRACT

Background and Objectives: Frailty and malnutrition are geriatric syndromes with common risk-factors. Limited studies have investigated these two conditions simultaneously in hospitalised patients. This study investigated the overlap of frailty and malnutrition in older hospitalised patients. **Methods and Study Design:** This prospective study enrolled 263 patients ≥65 years in a tertiary-teaching hospital in Australia. Frailty status was assessed by use of the Edmonton-Frail-Scale (EFS) and malnutrition risk was determined by use of the Malnutrition Universal Screening Tool (MUST). Patients were divided into four categories for comparison: normal, at malnutrition-risk only, frail-only and both frail and at malnutrition risk. Multivariate regression models compared clinical outcomes: length of hospital stay (LOS), in-hospital mortality, health-related quality of life (HRQoL) and 30-day readmissions after adjustment for age, sex, Charlson comorbidity index (CCI) and living-status. **Results:** The mean (SD) age was 84.1 (6.6) years and 51.2% were females. The prevalence of patients who were at malnutrition-risk only was 14.8%, frailty only 27.8% and 33.5% were both frail and malnutrition-risk. Frail-only patients were more likely to be older, from a nursing home and with a higher CCI than malnourished only patients. Frail patients had a worse HRQoL (coefficient –0.08, 95% -0.0132–-0.031, p=0.002) and were more likely to have a longer LOS (coefficient 5.91, 95% CI 0.77–11.14, p=0.024) than patients at-risk of malnutrition. Other clinical outcomes were similar between the two groups. **Conclusions:** There is a substantial overlap of frailty and malnutrition in older hospitalised patients and frailty is associated with worse clinical outcomes than malnutrition.

Key Words: older hospitalised patients, frailty screening, Malnutrition Universal Screening Tool, length of hospital stay, mortality

INTRODUCTION

Both frailty and malnutrition are widely prevalent in older people and are associated with poor health outcomes such as reduced mobility, falls, fractures, prolonged length of hospital stay (LOS) and high mortality.[1-3] Hospitalisation further increases these hazards because of the effects of acute illness, anorexia and immobility, which worsens deconditioning.[4,5] There has been a great variability in the reported prevalence rates of frailty and malnutrition (from 30 to more than 50%) because of the differences in the diagnostic tools used and the study settings.[6-8] Although numerous screening tools are available for both frailty and malnutrition, diagnosis of these two conditions is frequently missed in hospitalised patients.[9,10] This may be

because of a number of factors such as lack of knowledge among clinicians that these syndromes may be contributing to patients' underlying clinical problems, some tools are too difficult to apply in clinical practice for time pressured clinicians and a false belief among the clinicians that all older patients may be frail.[11,12]

Both frailty and malnutrition are associated with a loss of body tissue which, however, occurs variably in different tissues.[13] While in frailty there is a loss of fat free mass which mainly involves the skeletal muscle, malnutrition is associated with a loss of both fat mass as well as fat free mass.[14] Besides the changes in body composition, frailty in addition, is characterised by the presence of reduced muscle strength and function leading to exhaustion and a reduction in mobility.[14] Both these conditions also share common aetiopathological pathways which are differently pronounced in each condition, namely reduced food intake, inflammation, reduced physical activity and increased energy requirements.[13]

These two geriatric syndromes, thus, partly overlap because of the similarities in their aetiology and definitions. It is important to separate these two conditions because it may have potential implications on outcomes and treatment strategies. Although, there have been numerous studies.[7,8,15,16] on the prevalence of frailty and malnutrition individually, limited studies have examined their simultaneous occurrence and the relative importance of their shared predisposing factors in the same population. Studies in the community dwelling older subjects suggest not only under-diagnosis,[17,18] but also significant overlap between frailty and malnutrition[13] and experts suggest there is a need for similar studies in other settings including hospitalised older patients.[19] Thus the aims of the present study were to examine the prevalence and overlap of frailty and malnutrition and to determine the impact of these two syndromes on clinical outcomes in older hospitalised patients.

MATERIALS AND METHODS

All patients who needed medical admission to Flinders Medical Centre (FMC), Adelaide South Australia between 2019 to 2021 were considered for participation in this research. The exclusion criteria were age <65 years, lack of a valid consent, terminally ill patients with a limited life expectancy and refusal to participate in research. A member of the research team obtained written informed consent and performed assessments. Ethical approval was granted by the Southern Adelaide Human Research Ethics Committee (SA HREC) and this study was registered with the Australia and New Zealand Clinical Trial Registry (ANZCTR).

Data regarding the risk of malnutrition were obtained by the use of the Malnutrition Universal Screening tool.[20] In FMC, it is a mandatory requirement that all hospitalised patients undergo the MUST screening within 48 hours of their admission. The MUST has been previously validated for malnutrition screening in hospitalised patients and includes a scoring system based upon the body mass index (BMI), history of recent weight loss, and the effect of acute disease[21,22] A MUST score of 0 indicates low risk, 1 moderate risk and ≥2 high risk of malnutrition. The MUST has been designed to identify the need for nutritional treatment as well as establishing nutritional risk on the basis of knowledge about the association between impaired nutritional status and impaired function.[22] This tool has an excellent inter-rater reliability with other nutritional screening tools (k ≥0.783), and has predictive validity for hospital outcomes such as (LOS), mortality, discharge destination and 30-days readmissions.[23,24]

Frailty status of the patients was assessed by the use of the Edmonton Frail Scale (EFS)[25] within 48 hours of hospital admission. EFS is a valid and reliable instrument for identification of frailty in hospitalised patients and predicts clinical outcomes.[26,27] The EFS contains nine components and is scored out of 17. Individual components include: cognition, general health status, self-reported health, functional independence, social support, polypharmacy, mood, continence and functional performance. The component scores are summed and the following cut-off scores are used to classify the severity of frailty: not frail (0-5), apparently vulnerable (6-7), mild frailty (8-9), moderate frailty (10-11) and severe frailty (12-17).

We determined the following socio-demographic variables all previously suggested as predisposing risk factors for malnutrition and/or for frailty: living status (whether alone or with family), education level, smoking status and history of significant alcohol intake (>2 standard drinks/day). The number of comorbidities was assessed by use of the Charlson comorbidity index (CCI)[28] and principal admission diagnosis was noted. We also recorded the total number of medications and whether patients were on vitamin D supplementation at the time of hospital admission. We assessed the health-related quality of life (HRQoL) using the EuroQol-5D-5 Level (EQ-5D-5L) questionnaire. In addition, we determined the following clinical outcomes: LOS, in-hospital mortality, nursing home placement and unplanned readmissions within 30 days following hospital discharge.

Ethical approval and consent to participate

Ethical approval for this study was granted by the Southern Adelaide Human Research Clinical Ethics Committee (SA HREC) no 3.19 and a written informed consent was obtained from the participants.

Statistical analyses

The normality of data was assessed through visual inspection of the histograms and use of the Kolmogorov-Smirnov test. Continuous data are presented as mean (SD) or median (IQR) and categorical data as proportions. Patients with the EFS score ≤7 were classified as non-frail and those with the EFS score >8 as frail. Similarly, patients with the MUST score of 0 were classified as 'not at risk of malnutrition' and those with score ≥1 as at 'risk of malnutrition'. Patients were divided into four groups based on their malnutrition risk and frailty status: neither frail nor at risk of malnutrition, at risk of malnutrition, frail only and both frail and at risk of malnutrition.

The continuous variables were analysed using the one-way analysis of variance (ANOVA) or the Kruskal Wallis H test, as appropriate while categorical variables were assessed by the χ^2 statistics. In case of significant differences, post-hoc pairwise comparisons were made using the Bonferroni correction. A Venn diagram was constructed to assess the degree of overlap between frailty and malnutrition. Multivariable regression models were used to compare clinical outcomes according to the nutritional and frailty status. The models were adjusted for the following variables: age, gender, CCI and living status (whether living alone or with the family). All statistical analyses were conducted by using STATA software version 16. A *p* value of <0.05 was considered as statistically significant.

RESULTS

Three hundred and twenty patients were approached for participation in this research and 263 patients were included in this study. Fifty-seven patients were excluded due to various reasons: lack of a valid consent (n=33), terminally ill patients (n=13) and unable to perform assessments (n=11) (Figure 1). The mean (SD) age was 84.1 (6.6) years (range 65–103 years) and 140 (51.8%) were females. The majority of patients 239 (90.8%) came from home and were living alone 131 (52.6%) and were independent 112 (42.8%) in mobility. The mean (SD) CCI was 5.6 (3.5) and the majority of patients were on polypharmacy, mean (SD) number of medications 8.1 (4.2). The most common diagnosis at the time of admission was an acute respiratory illness 69 (26.2) followed by cardiovascular disease 60 (22.8%) and miscellaneous

causes (such as sepsis, gastrointestinal diseases etc.) in (59; 22.4%) of patients. The mean (SD) MUST score and EFS scores were 0.75 (0.94) and 8.2 (3.2), respectively.

Patient characteristics

Sixty-three (23.9%) patients were classified as neither frail nor at risk of malnutrition, 39 (14.8%) were at risk only of malnutrition, 73 (27.8%) were judged frail only and not at risk of malnutrition, and 88 (33.5%) were both frail and at risk of malnutrition. Table 1 shows characteristics of patients according to malnutrition risk and frailty status. Patients who were both frail and at risk of malnutrition were significantly older than those without these conditions, however, age was not significantly different between other groups. The CCI was significantly higher among frail and frail and malnourished patients when compared to those who were only at risk of malnutrition ($p<0.001$) but not significantly different among malnourished and normal patients ($p>0.05$). A significantly higher number of patients who were both frail and malnourished or frail alone were from nursing home and were using a walking aid for mobility when compared to patients who were at risk of malnutrition, while more patients at risk of malnutrition were living alone when compared to frail patients. There was no difference in the mean number of medications and the proportion of patients who were receiving vitamin D supplementation was not significantly different between different groups. Similarly, no differences were observed in terms of significant alcohol consumption or smoking status between the four groups.

Overlap between frailty and malnutrition

Overall, 200 (76%) patients were either frail or malnourished or had a combination of the two geriatric syndromes. The overlap between frailty and malnutrition is shown in the Venn diagram (Figure 2). Frailty and malnutrition occurred concurrently in 88 (54.7%) of 161 patients who were deemed frail and 73 (45.3%) frail patients had a normal nutritional status.

Clinical outcomes

Clinical outcomes measured in terms of LOS, 30-day readmissions and HRQoL (Figure 3) were significantly worse among frail patients when compared to those who were at risk of malnutrition, however, there were no differences in the in-hospital mortality and nursing home placement between different groups (Table 2). After adjusted analyses, frailty was more likely to be associated with a prolonged LOS (coefficient 5.91, 95% CI 0.77–11.14, *p* value=0.024) and poor HRQoL (coefficient -0.08, 95% -0.0132–-0.031, *p* value = 0.002) than

malnutrition. However, in-hospital mortality, nursing home placement or 30-day readmissions were not significantly different between the two groups (Table 3).

DISCUSSION

The results of this study indicate that almost one-third of the older hospitalised patients were frail only and 15% percent at risk of malnutrition only, while more than 30% percent had both frailty and were at risk of malnutrition. There was a significant overlap between frailty and malnutrition. Frail patients were more likely to be older with a higher comorbidity burden and were more likely to be from residential care facility than those at risk of malnutrition. Clinical outcomes were relatively worse in frail patients when compared to those who were at risk of malnutrition.

The findings of this study assumes significance because frailty is not routinely or systematically assessed in older medical inpatients.[11,29] Similarly, malnutrition is commonly missed in hospitalised patients with a recent Australian study[30] suggesting that only 16.2% of adult inpatients underwent MUST screening and there is a poor adherence to nutritional screening guidelines.[31]

The prevalence of different geriatric syndromes depends upon the definitions used and can vary because of the differences in the measurement tools used and the selection of patients in different settings. The prevalence of frailty in our study was 30% which corresponds to a recent study by Gingrich et al[32] who assessed frailty according to the criteria defined by Fried et al in older hospitalised patients. This proportion is also the same as has been reported previously by others in older inpatient populations.[33,34]

The prevalence of patients being at significant risk of malnutrition in this study was 15% and matches a recent study[32] which used the European Society for Clinical Nutrition and Metabolism (ESPEN) criteria[35] to assess the nutritional status of the participants. Other studies have reported a variable prevalence of malnutrition in hospitalised patients (ranging from 11-50%) likely due to the differences in screening tools employed in different clinical settings, with higher rates recorded, especially in the geriatric rehabilitation units.[7,36-38]

There was a significant overlap between frailty and malnutrition according to this study. Our findings are concordant with another study, which suggests that malnutrition increases the risk of frailty by almost 4-fold and there is high concordance between these two conditions especially in individuals over the age of 65 years.[39] Similarly, a study in the community dwelling older individuals found that 98% of non-frail individuals were well nourished, however, only 50% of frail individuals had a normal nutrition status.[40] The

significant overlap between frailty and malnutrition is likely related to the fact that both these conditions share common sociodemographic, physical and cognitive risk factors.[39] In addition, malnutrition is associated with muscle wasting which leads to reduced function, exhaustion and fatigue; all which are cardinal parameters in different tools designed to detect frailty. Evidence also indicates that these two conditions have a potential to complement each other resulting in further worsening of disability with poorer health outcomes.[41]

The clinical outcomes, according to this study, were significantly worse among frail patients when compared to the malnourished older patients. The results of this study are similar to a study by Wilson et al[42] who included patients hospitalised with a hip fracture (mean age 73.7 years, range 50-98 years) and found that frailty outperforms malnutrition in predicting post-operative complications such as delirium, infections, admission to the intensive care unit (ICU) and unplanned hospital readmissions. This study also found that there is a synergistic effect between frailty and malnutrition and combination of the two creates a powerful index which can be used to predict both mortality and post-operative complications in hospitalised patients. Sze et al[43] in their study in UK involving 265 older patients (median (IQR) age 80 (72-86) years) admitted with a diagnosis of heart failure with reduced ejection fraction (HFrEF), found that there was a significant overlap between frailty and malnutrition and patients who were both frail and malnourished had a significantly higher one year mortality when compared to those who were frail or malnourished alone (65% vs 15% respectively, $p<0.001$)). Similarly, a Chinese study[44] in older patients (mean (SD) age 60.8 (10.8) years) on peritoneal dialysis found that frailty plays an additive role in worsening nutritional status and is associated with worse clinical outcomes including increased risk of hospitalisation, prolonged LOS and increased mortality at 24 months when compared to non-frail patients.

Limitations

A major limitation of this study is that there were only a few cognitively impaired patients because dementia is a major contributing factor for both frailty and malnutrition.[45] Another limitation is the use of the MUST tool for screening malnutrition which has a sensitivity of around 70% to detect malnutrition,[22] so the proportion of malnourished patients could have been underrepresented.

Conclusions

This study confirms significant overlap between frailty and malnutrition in older hospitalised patients. In future, considering frailty and malnutrition together may be the way forward by development of screening tools which are sensitive enough to detect both conditions simultaneously.

AUTHOR DISCLOSURE

The authors declare no conflict of interest.

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Table 1. The characteristics of participating restaurants (n=90)

Variable	Neither frail nor at malnutrition risk	At malnutrition risk	Frail only	Both frail and at malnutrition risk	*p* value
N (%)	63 (23.9)	39 (14.8)	73 (27.8)	88 (33.5)	
Age, years, mean (SD)	82.2 (6.5)	83.4 (7.5)	84.5 (6.4)	85.3 (6.0)	0.0266
Sex female, n (%)	34 (53.9)	21 (53.9)	39 (53.4)	46 (52.3)	0.997
Charlson index, mean (SD)	4.5 (2.7)	4.0 (3.2)	6.8 (3.5)	6.2 (3.6)	<0.001
Living status alone, n (%)	31 (50.0)	22 (56.4)	29 (41.4)	49 (62.8)	0.041
From home, n (%)	63 (100)	38 (97.4)	65 (89.0)	73 (82.9)	0.002
Mobility without aid, n (%)	38 (60.3)	27 (71.1)	19 (26.0)	28 (31.8)	<0.001
Dementia, n (%)	2 (3.2)	4 (10.5)	18 (24.7)	25 (28.7)	<0.001
Medications, mean (SD)	7.0 (4.4)	7.1 (3.9)	8.9 (4.1)	8.6 (3.9)	0.0146
On Vitamin D supplements, n (%)	18 (29.0)	12 (33.3)	27 (36.9)	46 (52.8)	0.018
Smokers, n (%)	31 (50)	16 (47.1)	38 (52.1)	38 (45.2)	0.847
Alcohol, n (%)	22 (34.9)	13 (37.1)	30 (41.1)	26 (30.6)	0.584
MUST score, mean (SD)	0	1.6 (0.7)	0	1.7 (0.6)	<0.001
EFS score, mean (SD)	5.0 (1.7)	5.0 (1.6)	9.9 (2.0)	10.5 (1.9)	<0.001

SD: standard deviation; MUST: malnutrition universal screening tool; EFS: Edmonton frail scale.

Table 2. Clinical outcomes according to malnutrition risk and frailty status

Variable	Neither frail nor at malnutrition risk	At malnutrition risk	Frail only	Both frail and at malnutrition risk	*p* value
LOS, median (IQR)[†]	3.9 (10.3)	6.5 (8.1)	2.8 (4.5)	6.8 (8.9)	0.0008
In-hospital mortality, n (%)	0	3 (4.2)	0	3 (3.5)	0.341
Nursing home placement, n (%)	4 (6.4)	7 (9.7)	2 (5.2)	12 (13.8)	0.397
30-day readmissions n (%)	4 (6.4)	13 (17.8)	2 (5.2)	13 (14.9)	0.091
EQ5D index, mean (SD)	0.893 (0.109)	0.824 (0.142)	0.936 (0.066)	0.797 (0.144)	<0.001
VAS, mean (SD)	60.0 (20.2)	51.1 (17.4)	61.2 (19.4)	47.6 (18.8)	<0.001

LOS: length of hospital stay; IQR: interquartile range; EQ5D: European quality of life 5 dimension questionnaire; SD: standard deviation; VAS: visual analogue scale.
[†]LOS adjusted for in-hospital mortality.

Table 3. Clinical outcomes according to malnutrition risk and frailty status

Clinical outcome	[†]Coefficient	95% CI	*p* value
LOS	5.91	0.77–11.14	0.024
In-hospital mortality	1.30	0.19–8.75	0.786
Nursing home placement	1.02	0.17–6.02	0.980
30-day readmissions	3.14	0.63–15.50	0.160
EQ5D index	-0.08	-.0132– -0.031	0.002
VAS	-7.80	-0.154– -0.080	0.040

CI: confidence interval; LOS: length of hospital stay; EQ5D: European quality of life 5 dimension questionnaire; VAS: visual analogue scale.
[†]Model adjusted for age, sex, Charlson index and living status (alone or with family).

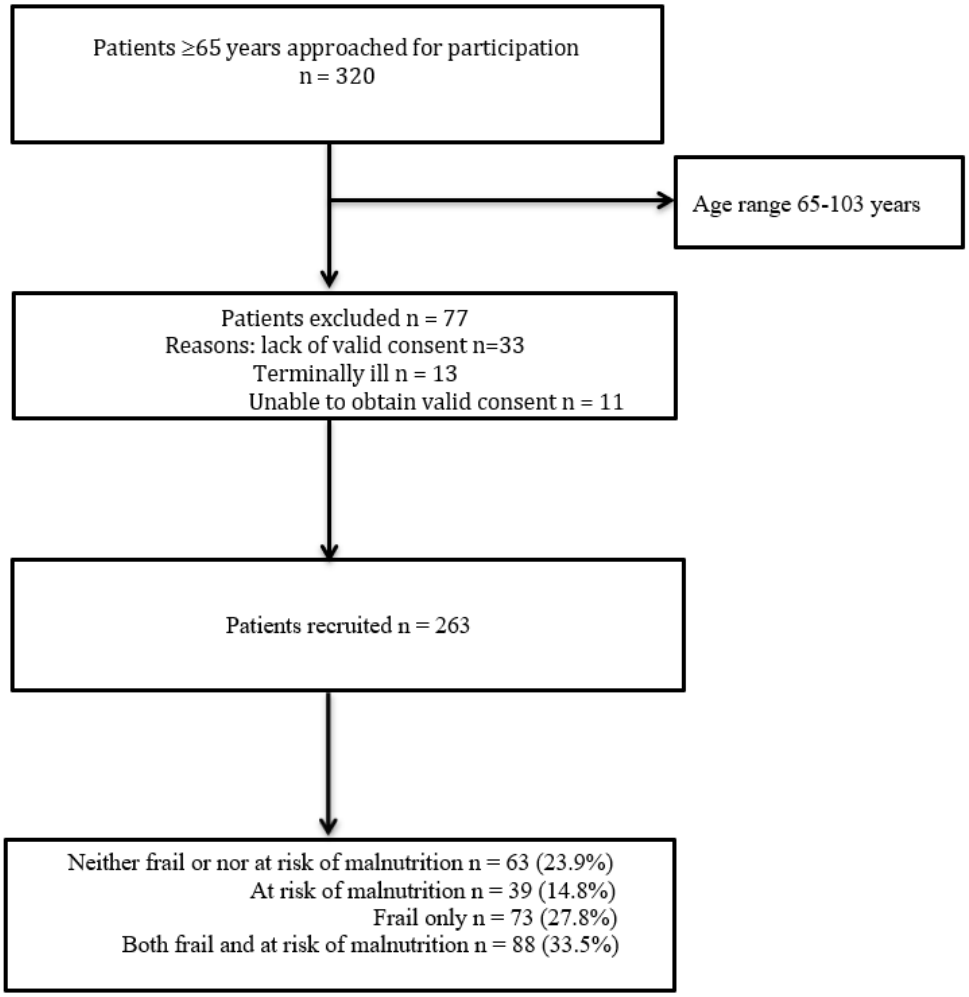

Figure 1. Study flow diagram.

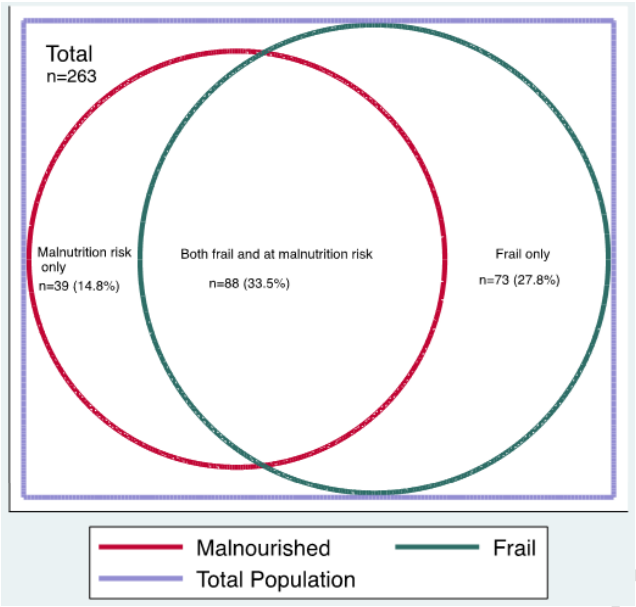

Figure 2. Venn diagram showing overlap of frailty and malnutrition in older medical inpatients.

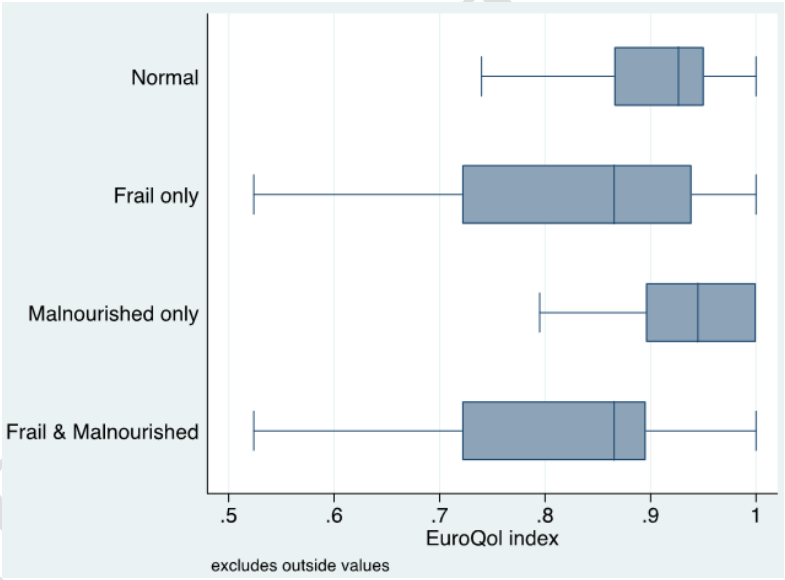

Figure 3. Health related Quality of Life measured by EQ-5D-5L according to frailty and nutritional status.