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Evaluation of the impact of a post-hospital discharge Transitional Aged Care Service on frailty, malnutrition and functional ability

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Aim: To investigate the relationship between nutritional status, functional ability and frailty in older adults participating in a 12-week Transitional Aged Care Service program.

Methods: A retrospective analysis of a clinical cohort of older adults aged 65+ years after hospital discharge. At entry into the program and at completion, nutritional status was measured using the Mini Nutritional Assessment (MNA), frailty status was measured using the Groningen Frailty Indicator and functional ability was measured using the Modified Barthel Index (MBI). Demographic data were obtained from electronic medical records.

Results: Baseline data were available for 115 participants (mean age = 81.7 (SD =7.9) years; 20.9% classified as malnourished and 89.6% as frail). A positive association was found between nutritional status and frailty ($r = 0.298$; $P = 0.001$), and frailty and functional ability ($r = 0.204$; $P = 0.029$). Multiple regression analysis, accounting for the cofounders of baseline MNA, MBI, age, gender, length of hospital stay and living situation, found that nutritional status and functional ability were able to indicate the presence of frailty on admission to the program ($P = 0.002$, $P = 0.007$, respectively). In those program completers ($n = 79$), significant improvements were found in nutritional status, frailty and functional ability ($P < 0.0005$).

Conclusions: Nutrition status, frailty and functional ability are closely and positively related, and should therefore be considered simultaneously in rehabilitation for older adults. A post-hospital transitional program with a multidisciplinary approach significantly improved all three outcomes, suggesting its value in enabling frail older people to remain independent for as long as possible.

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Key Words: Mini Nutritional Assessment, frail, functional ability, post-hospital discharge, transitional program, older adults

Introduction

Globally, populations are ageing resulting in increased prevalence of malnutrition, frailty and functional impairment.[1] These conditions typically co-exist, and impact significantly on related morbidity and independence in older adults, placing an unprecedented burden on health care systems. It is estimated that health care expenditure is four times higher in adults aged 65 years+ compared to their younger counterparts. [2] Thus, growing interest in how to treat and prevent manifestation of these three conditions.

Causes of malnutrition are multifaceted and may result from inadequate dietary intake, inability to meet energy requirements or underlying illness.[3] Rates of malnutrition in community-dwelling older adults typically range between 24% and 56% [1, 4, 5]. Malnutrition in older adults is related to a myriad of adverse health outcomes including reduced quality of life, longer and recurrent hospital admissions, diminished cognitive function, depressive symptomatology and mortality.[6, 7]

Frailty, is a medical syndrome with multiple causes and contributors that leads to diminished strength, endurance and reduced physiologic functions, increasing an individual's vulnerability to adverse health outcomes.[8]. Due to a lack of consistency in the definition of frailty, its estimated prevalence varies between studies, and is reported to range from 4 % to 59% in older adults.[9, 10]

The extent to which the conditions malnutrition, frailty and functional impairment overlap has not been extensively researched.[8] Although the conditions are distinctive, they present with similar observable characteristics including weight loss, loss of muscle mass, exhaustion, weakness and slowness, regardless of their aetiology.[8] These conditions not only have the potential to exacerbate each other, but also to contribute to other adverse health outcomes. Due to these associations and an overlap in manifestation, it has been suggested that these conditions should be considered together and could be treated collectively.[8]

Malnutrition, frailty and functional impairment adversely impact on both individuals and associated health care costs.[11] Nutritional interventions tailored to meet individual's needs in community-dwelling older adults were found to decrease demand for health services.[1, 11, 12]

Following discharge from a hospital admission, many older patients require ongoing care, before becoming independent in their own home.[13] Studies have found most patients remain in the same nutritional state they were at the time of hospital admission or decline further while in hospital, with a similar pattern observed 30 days post discharge.[14] The *removed for blinding* Transitional Aged Care Service is a 12-week multidisciplinary transitional program for clients over the age of 65 years old that have recently been discharged from hospital. The program offers therapeutic and care services, including a dietitian, to work with clients to improve their independence and confidence after hospital. Transitional care services aim to assist community-dwelling older adults to return to optimal

independence, thereby preventing re-admission to hospital or placement into residential aged care facilities.[4, 11]

This study aimed to explore the relationship between nutritional status, frailty and functional ability in community-dwelling older adults discharged from hospital, and to evaluate the effect of a 12-week transitional program on these three conditions.

Methods

An analysis of a clinical cohort was undertaken, allowing for observation of a group of individuals at two time points, receiving similar care. The relationship between frailty, malnutrition and functional ability of participants at baseline and after completion of 12 weeks on the program was investigated.

The sample population included in this study were all consenting clients entering the *removed for blinding* program between October 2016 and August 2017, immediately following hospital discharge. To be eligible, the participant needed to be willing to work towards rehabilitation goals with assistance from a multidisciplinary team.

Data on nutritional status, frailty and functional ability was collected at two time points, at initial assessment (baseline) and at discharge from the program. Nutritional status was assessed using the Mini Nutritional Assessment (MNA) [6] which includes 18 items according to four domains (anthropometric

measurements, global assessment, diet information and subjective assessment). A maximum score is 30.0, with less than 17.0 points regarded as malnourished, 17.0 to 23.5 points as “at risk of malnutrition” and 24.0+ points as “well nourished”. The MNA is validated with high demonstrated specificity and reliability.[15] At baseline, all participants were weighed using the same scales (Seca 803 flat scale) and heights were either reported by the participants or estimated using ulna length.[16]

Frailty was measured using the validated Groeningen Frailty Index (GFI) [17] that considers physical, cognitive, social and psychological factors with a score ≥4 indicating the presence of frailty. Frailty was measured by the case manager or the dietitian during the initial home visit.

Functional independence was measured by an occupational therapist during the initial home visit using a Modified Bartel Index (MBI).[18, 19] The MBI is a highly valid and reliable tool, that is used to assess functional ability, through measurement of activities of daily living (bowel and bladder control, grooming, toilet use, feeding, transfers, walking, climbing stairs, dressing and bathing).[20] Scores range from zero to 100, with 100 indicating total independence, while zero indicates total dependency. [18]

In addition, age, gender and length of hospital stay were collected from electronic medical records (eMR), whilst information on living arrangements was obtained from the participant.

Data was collected and collated by health district clinicians and a de-identified dataset made available on the *removed for blinding* Local Health District nutrition server for further analysis (see Figure 1). Participants on the transitional program received support from a multidisciplinary team, of dietitians, physiotherapists, occupational therapists, social workers, speech pathologists, nurses and psychologists. Participants received individualised dietetic support depending on their needs and requirements. If a client met their goal earlier than 12 weeks the final assessment was brought forward and completed for an early discharge, as is recommended by the NSW Transitional Aged Care Program Guidelines.

Data analysis was performed using SPSS, version 23.0[21] A significance level of $p<0.05$ was used. Categorical variables were presented as frequencies and percentages, while continuous variables were shown as means and standard deviation or medians and 25^{th} and 75^{th} interquartile ranges. The estimated sample size required was 49, bringing it to 59 to account for a potential 20% dropout rate. The overall relationship between nutritional status, functional ability and frailty at baseline of the program was determined using Spearman's rank-order correlations. To analyse whether nutritional status and/or functional ability predicted the co-existence of frailty at initial assessment at baseline, multiple regression analyses were performed, adjusting for baseline MNA, baseline MBI, age, gender, length of hospital stay, and whether the participant lived alone or with others.

To assess change in indicators after completion of the program, pre-post comparison was conducted using Wilcoxon signed rank tests for non-parametric continuous variables. In a subsample of those that completed the program and had both discharge MNA and GFI scores (n=79), an exact McNemar's test was run to determine a change in nutritional status classification, expressed as a proportion, while a McNemar's test with continuity correction assessed change in proportion of those considered frail at baseline. Improvements in functional ability were assessed using a paired t in those who had discharge MBI scores (n=84).

The *removed for blinding* Human Research Ethics Committee granted ethical approval for this study. As part of standard protocol for the transitional program, all participants signed a client agreement, which includes written consent for information to be used for research purposes.

Results

One hundred and twenty two participants were recruited to the study. Of these 122 participants, 7 were duplicate clients that had been re-admitted to the program twice during the study period, thus their second admission on the program was not included in the analysis, leaving a total of 115 participants, all of which had an initial assessment at baseline for the MNA, GFI and MBI. Some participants were discharged early from the program, therefore not all nutritional, frailty, and functional ability assessments were able to be completed, resulting in missing data for 45 of the participants. The reasons for early discharge were re-admission to hospital, participants' declining further treatment, entering respite or

care, or data missing for unknown reasons. Seventy participants had complete data for MNA, GFI and MBI, while n=79 had both an initial and discharge MNA and GFI score, and n = 84 had complete MBI assessments, as shown in Figure 1.

Demographic characteristics of the study are shown in Table 1. Mean age of the participants was 81.7 years (SD=7.9), ranging from 53 to 96 years. Over two thirds (64.3%) were female, over half (52.2%) lived alone and 47.8% co-resided with others such as their spouse, family or friends. The average length of hospital stay was 43.2 days (SD= 31.3), while twenty four (21.0%) participants did not complete the study due to being readmitted back to hospital.

At baseline, 24 participants were malnourished (20.9%), 70 were at risk of malnutrition (60.9%) and 21 were well nourished (18.3%). Mean MNA score was 20.2 out of a possible 30.0 (SD = 3.7). The number of participants who were malnourished following the completion of the transitional program decreased to six participants (7.6%), with reductions also seen in the percentage at risk of malnutrition (n = 29; 36.7%), accompanied by an increase in the well-nourished category to 44 participants (55.7%; (χ^2 test 22.4; P=0.000) as shown in Figure 2. The mean MNA score favourably increased by a mean of 3 points to 23.0 (SD = 3.9).

Most of the participants were characterised as being frail on admission (n = 103; 89.6%). Mean GFI score at baseline was 6.6 (SD = 2.4) with a range from 1.0-

12.0 out of a possible score of 15.0; this mean score decreased (mean = 4.8 (SD= 2.6)) following the intervention, with a subsequent decrease in frailty prevalence to 64.6%; n = 51; P=0.000), as shown in Figure 2.

Mean MBI score increased from 81.7 (SD= 12.5), with a range from 38-99 (score closer to 100.0 indicates a more favourable independent state) to 90.1 (SD = 10.8) at follow-up, which represented a significant increase of 7.3 points (95% CI, 5.9 to 8.7; P<0.01). Three outliers were detected, but were not considered extreme and kept in the analysis.

Using the non-parametric Spearman's rank-order test, [22], a weak-moderate inverse was demonstrated between baseline MNA and GFI scores (*r* = 0.298; P=0.001). Similarly, a weak-moderate inverse association between MBI and GFI scores at baseline (r = 0.204; P=0.029). No association between baseline MNA and functional ability (MBI) was found (*r* = -0.069, P=0.465).

Of the 79 participants with an MNA pre and post intervention, 64 experienced a positive increase in mean MNA score whereas nine participants experienced a decline in nutritional status and six participants remained in the same nutritional state. There was a statistically significant median increase in MNA score (2.0 points) from pre (21.0; IQR: 18.0, 23.0) compared to post intervention (24.0; IQR: 21.0, 25.5) (Wilcoxon signed rank test z = 6.278, P< .0005).

Of the 79 participants who completed both pre and post intervention GFI assessments, 63 had improved their frailty status after the ITACS intervention, shown by a favourable decrease in mean GFI score. Eight participants experienced an increase in GFI score at the end of the intervention, presenting with a worsened frailty status compared to the beginning of the intervention, while eight remained frail throughout. Median change in GFI score was significant at -2.0 points (pre = 7.0 points; IQR: 5.0, 8.0) compared to post (4.0 points; IQR: 3.0, 7.0); Wilcoxon signed rank test z = -5.737, p< .0005.).

Of the 84 participants with both initial and discharge MBI score, 72 had increased their functional independence, with their MBI scores being closer to 100. The functional ability of seven participants decreased throughout the study, while five participants did not experience improvement in functional ability after the intervention. Median increase in MBI score (6.0 points) was significant (z = 7.373, P< .0005.) from pre (86.0; IQR: 76.0, 89.0) to post intervention (92.0; IQR: 87.0, 98.0).

A multiple regression model was performed to indicate the co-existence of frailty using variables of initial assessment at baseline of MNA, MBI, gender, age, length of hospital stay and social situation. All assumptions were met. The multiple regression model was statistically significantly (F(6,108) = 3.508, p=0.003, adj. R^2 = 0.117), but b Baseline MNA and MBI were the only variables that statistically significantly added to the indication, (P=0.002 and P=0.007 respectively). Regression coefficients and standard errors can be found in Table 2.

Discussion

This study showed that frailty status was associated with both nutritional status and functional ability in community-dwelling older adults who have been discharged from hospital. Participation in a 12-week multidisciplinary transitional programme resulted in improvements in indicators of nutritional status, frailty and functional ability.

Transitional care programs result in multiple benefits including lowering the rate of hospital readmission and improvements in patient satisfaction.[23] Although the current study found beneficial improvements in all three outcomes indicators investigated, the lack of a control group limits interpretation of the role of the specific dietetic component of the transitional program.

As malnutrition may be considered a subset of those who are nutritionally at risk, these two groups may be considered together.[15] A prevalence of 81.8% of malnutrition identified in the current sample of community-dwelling transitional program participants is much higher than the range of 24 – 56% that has been reported in the literature [6, 24] Similarly, 90 % of participants entering the current transitional program were classified as being frail, a figure much higher than the reported range of 17 – 59% found in other similar populations.[10] The advanced age of study participants (81.7y) may explain reasons for widespread malnutrition and frailty [25-27], along with the vulnerability of those who live alone.[1, 28] Lastly, as a result of immediate discharge from hospital, it is unknown whether participants' nutritional status had worsened during their admission, or related to the cause of

underlying illness.[29] It has been reported that most older inpatients remain in the same nutritional state after discharge as when they were an inpatient.[4, 14]

The favourable decrease in frailty status as nutritional status improved on the program is extensively supported by the literature.[8, 9, 25, 30] For example, Abellan et al. (2017), concluded that older adults who are at risk of malnutrition, or malnourished, should also be considered to be frail.[30] Boulos et al. (2016) found that as frailty level increased, so did the proportion of individuals suffering from poor nutritional status.[9] Other studies have suggested that if an individual is malnourished or at risk of malnutrition, they have a 90.0% chance of being pre-frail or frail, however on the other hand only 50% of those who are frail tend to be at risk of malnutrition.[25]

Studies have found that a shortened version of the MNA (MNA-SF) predicted both malnutrition and frailty,[31] whilst others report a significant association between domains included in the MNA and frailty.[25, 27] The association between malnutrition and frailty is becoming increasingly recognized[8] and although these conditions differ in their aetiology, there is overlap in concepts and measures.[8] Baseline functional ability was also an indicator of frailty in this high-risk group. Frailty can be described as a deterioration in activities of independence,[32] therefore it is unsurprising that our findings indicated individuals classified as functionally impaired using the MBI scale were also at increased risk of frailty. The association between functional ability and frailty is well explored, in particular, regarding the phenotype of frailty.[27] The definition of frailty includes decreased physical functioning, while other components such as decreased strength and

energy, can lead to reduced functional ability.[27, 33] Studies by Bollwein et al. (2013) and Montero et al. (2011), have found that pre-frail and frail participants have increased dependency, whilst low mobility has found to be a risk factor for frailty.[25, 34] Our findings, together with others, suggest that the MNA and MBI be used as screening tools to identify those at risk of frailty, and in older adults discharged from hospital, to identify earlier and initiate treatment accordingly.

Other transitional programs that include dietitians, not only reduced length of hospital stay and increased individual's confidence after hospital, but also resulted in improvements in nutritional status, frailty and functional ability in participants.[23, 35, 36] In the current study, a large number of participants remained frail after the intervention. This may be due to the intervention not being designed specifically to address the frailty syndrome, the advanced age of the participants and/or their recent hospital admissions. This suggests that individualised dietetic support may need to be combined with other interventions, such as resistance exercise training (RET), to successfully address frailty and malnutrition simultaneously.[37]

This study confirms an intricate relationship between nutritional status, frailty and functional impairment, and thus nutrition interventions need to consider all three conditions when treating older adults on transitional programs. Further studies are needed to ascertain the most effective components of such programs, for maximum benefit to the target group.

Conclusion

This study demonstrated that participation in a multidisciplinary transitional care program following hospital discharge in frail older adults resulted in improvements in nutritional status, accompanied by improvements in functional ability and a decreased frailty state.

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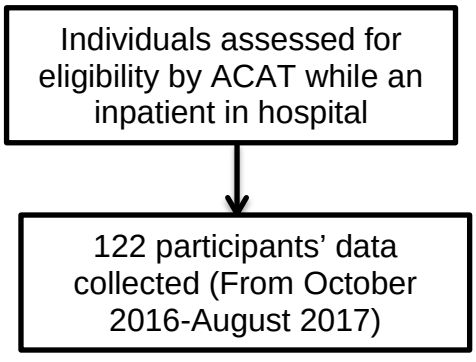
Appendices

Figures



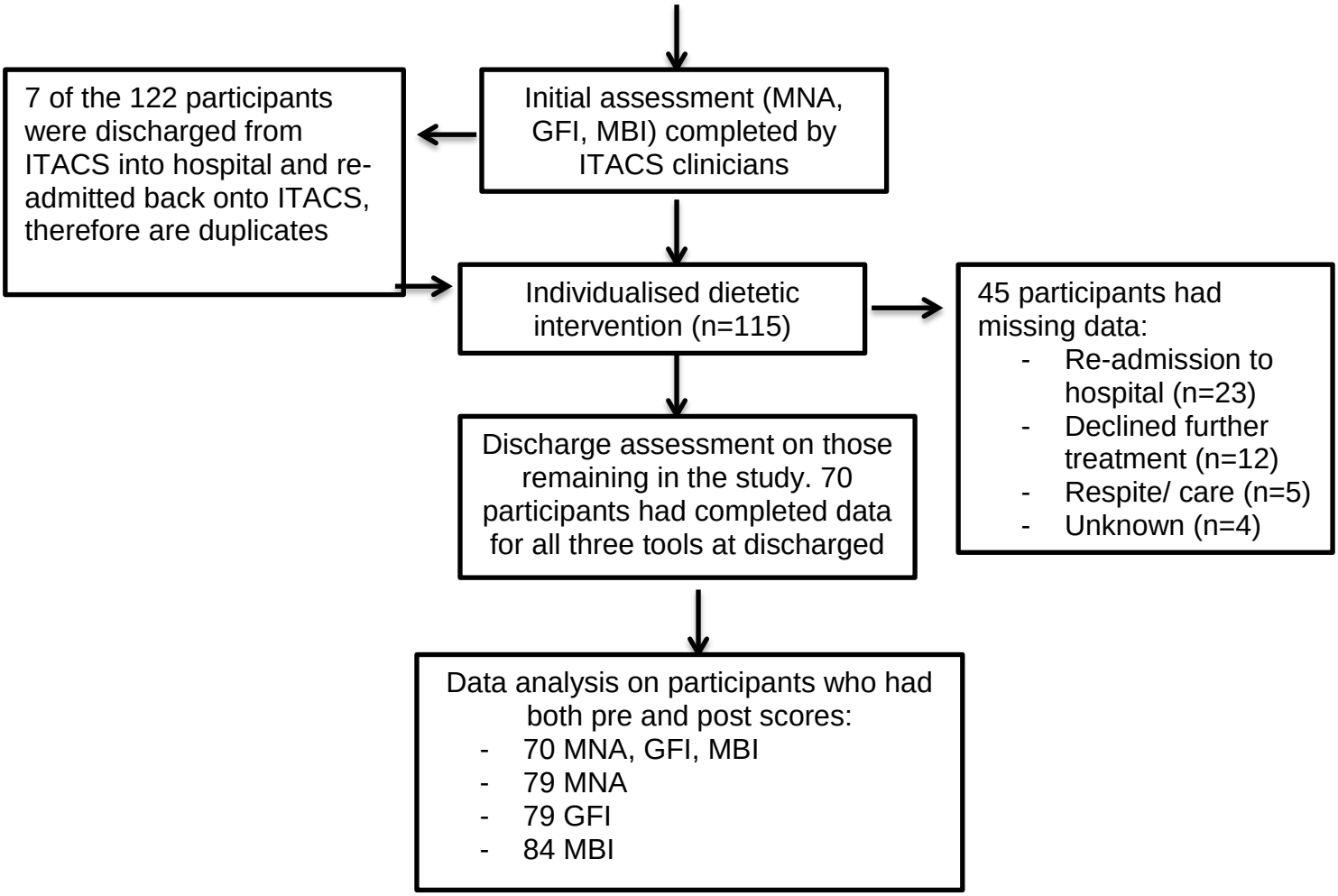


Figure 1: Flow-chart of participants throughout the study

Abbreviations: ACAT; Aged Care Assessment Team, MNA: Mini Nutritional Assessment, GFI: Groningen Frailty Indicator, MBI: Modified Barthel Index

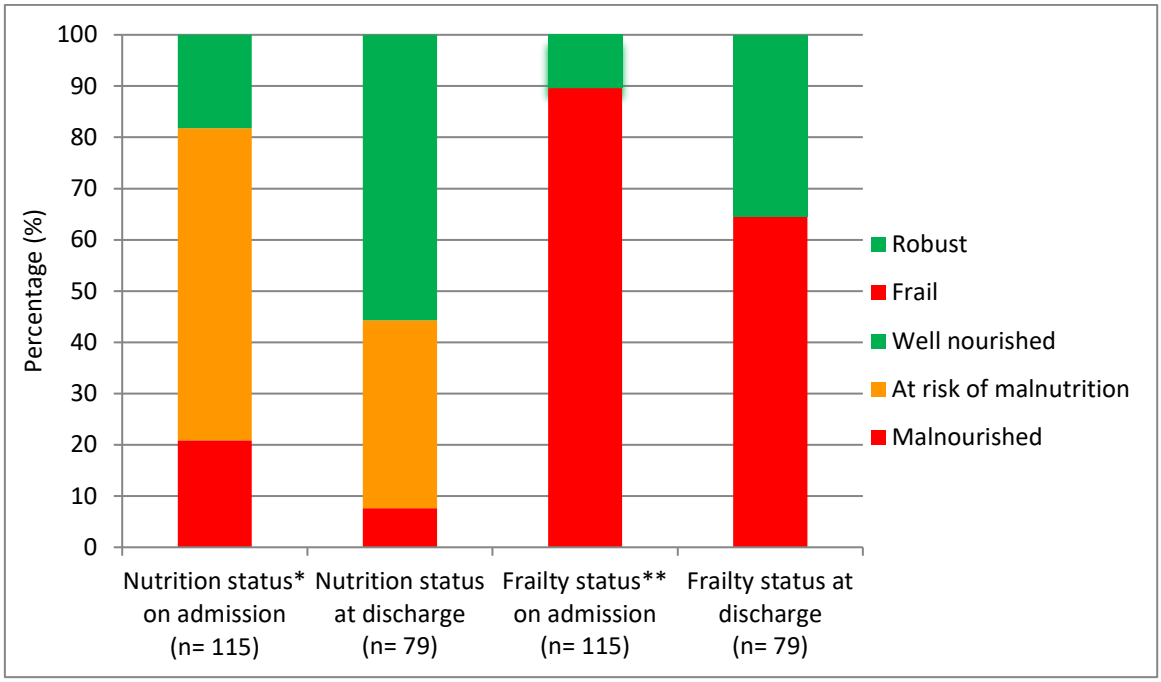


Figure 2: Change in proportion of Mini Nutrition Assessment categories and Groningen Frailty Indicator categories following a nutrition intervention

Note: Nutrition status measured by the Mini Nutritional Assessment, **frailty measured by the Groningen Frailty Indicator

Tables

Table 1: Baseline characteristics of participants on ITACS

Variable	Result
Age (years), mean ± SD	81.7 ± 7.9
Male, n (%)	41 (35.7%)
Female, n (%)	74 (64.3%)
Malnourished*, n (%)	24 (20.9%)
At risk of malnutrition*, n (%)	70 (60.9%)
Well-nourished*, n (%)	21 (18.3%)
Frail**, n (%)	103 (89.6%)
Robust**, n (%)	12 (10.4%)
Cognitively impaired***, n (%)	20 (17%)
Normal cognition, n (%)	33, (29%)
Cognition unknown, n (%)	62 (54%)
Lives alone	60 (52.2%)
Lives with others	55 (47.8%)
Length of hospital stay, mean ± SD	43.16 ± 31.3

Note: *Mini nutritional assessment: malnourished <17/30, at risk of malnutrition 17-23.5/30, well-nourished 23.5-30/30. **Groningen frailty indicator: robust <4/15, frail >4/15. ***As assessed by the mini-mental state examination or the Rowland Universal Dementia Assessment Scale or the Montreal Cognitive Assessment.

Abbreviation: SD: standard deviation

Table 1: Summary of multiple regression analysis

Variable	Unstandardised B	SE_B	Standardised B	Sig
Intercept	14.435	3.305		0.00
Baseline MNA	-0.186	0.057	-.293	0.002*
Baseline MBI	-0.052	0.019	-.276	0.007*
LOS	0.001	0.007	0.015	0.869
Social situation**	0.080	0.466	0.017	0.865
Age	0.003	0.027	0.011	0.903
Gender	-0.145	0.441	-0.030	0.743

Note: * p<.05, ** social situation refers to living alone or with others

Abbreviations: B : Unstandardised regression coefficient, SE_B : Standard error of the coefficient , B : standardised coefficient , LOS: length of stay, sig; significance