# Feasibility of home-based dietetic intervention to improve the nutritional status of older adults post-hospital discharge

Aliza Haslinda Hamirudin
*University of Wollongong*, ahh308@uowmail.edu.au

Karen L. Walton
*University of Wollongong*, kwalton@uow.edu.au

Karen E. Charlton
*University of Wollongong*, karenc@uow.edu.au

Amanda Carrie
*Illawarra Shoalhaven Local Health District*

Linda C. Tapsell
*University of Wollongong*, ltapsell@uow.edu.au

***See next page for additional authors***

## Publication Details

Hamirudin, A., Walton, K., Charlton, K., Carrie, A., Tapsell, L., Milosavljevic, M., Pang, G. & Potter, J. (2016). Feasibility of home-based dietetic intervention to improve the nutritional status of older adults post-hospital discharge. Nutrition and Dietetics, Online First 1-7.

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**Abstract**

**Aim** To determine if a model of home-based dietetic care improves dietary intake and weight status in a specific group of older adults post-hospitalisation.

**Methods** The Department of Veterans' Affairs clients aged 65 years and over were recruited from hospitals in a regional area of New South Wales, Australia (n = 32 men, n = 36 women). Nutritional status was assessed at home at baseline (within two weeks post-discharge) and three months post-discharge using a diet history, a food frequency checklist and Mini Nutritional Assessment (MNA). Personalised dietary advice was provided by a single dietitian according to participants' nutritional status.

**Results** Mean body weight improved significantly ($P = 0.048$), as well as mean MNA score (21.9 ± 3.5 vs 25.2 ± 3.1) ($P < 0.001$). Mean energy, protein and micronutrient intakes were adequate at baseline and three months, except for vitamin D. At three months, the underweight group (body mass index (BMI) < 23 kg/$m^2$) had significantly higher mean protein intake per body weight (1.7 ± 0.4 g/kg) compared to those who were a desirable weight (BMI 23-27 kg/$m^2$) (1.4 ± 0.3 g/kg) or overweight (BMI>27 kg/$m^2$) (1.1 ± 0.3 g/kg) peers ($P < 0.001$). There was significant improvement in energy intake contributed from oral nutrition supplements (+95.5 ± 388.2 kJ/day) and milk (+259.6 ± 659.8 kJ/day).

**Conclusions** Dietetic intervention improved nutritional status 3 months after hospital discharge in older adults living in the community.



**Keywords**

discharge, feasibility, dietetic, intervention, improve, nutritional, status, older, adults, post-hospital, home-based

**Disciplines**

Medicine and Health Sciences

**Publication Details**

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**Authors**

Aliza Haslinda Hamirudin, Karen L. Walton, Karen E. Charlton, Amanda Carrie, Linda C. Tapsell, Marianna Milosavljevic, Glen Pang, and Jan M. Potter

**Title:** Feasibility of Home-Based Dietetic Intervention to Improve the Nutritional Status of Older Adults Post Hospital Discharge

**Abstract**

**Aim:** To determine if a model of home-based dietetic care improves dietary intake and weight status in a specific group of older adults post hospitalisation.

**Methods:** Department of Veterans' Affairs (DVA) patients aged 65 years and over were recruited from hospitals in a regional area of New South Wales, Australia (n=32 men, n=36 women). Nutritional status was assessed at home at baseline (within 2 weeks post discharge) and 3 months post discharge using a diet history, food frequency checklist and Mini Nutrition Assessment (MNA®). Personalised dietary advice was provided by a single dietitian according to participant's nutritional status.

**Results:** Mean body weight improved significantly ($p=0.048$), as well as mean MNA® score (21.9 ± 3.5 vs 25.2 ± 3.1) ($p<0.001$). Mean energy, protein and micronutrient intakes were adequate at baseline and 3 months, except for vitamin D. At 3 months, the underweight group (BMI<23 kg/$m^2$) had significantly higher mean protein intake per body weight (1.7±0.4g/kg) compared to those who were a desirable weight (BMI 23-27 kg/$m^2$) (1.4±0.3g/kg) or overweight (BMI>27 kg/$m^2$) (1.1±0.3g/kg) peers ($p<0.001$). There was a significant improvement in energy intake contributed from oral nutrition supplements (+95.5±388.2kJ/day) and milk (+259.6±659.8 kJ/day).

**Conclusions:** Dietetic intervention improved nutritional status 3 months after hospital discharge in older adults living in the community.

**Keywords**: malnutrition, older adult, nutrition assessment, nutrition intervention, nutritional status

## Introduction

Malnutrition is common in hospitalised patients around the world especially among older adults. It is estimated that in the Australian hospital setting, approximately 85% of patients aged 65 years and older who are admitted to acute or rehabilitation hospitals are either malnourished or are at risk of malnutrition;[1, 2] according to the Mini Nutritional Assessment criteria.[3] Globally, the prevalence in these settings is reported to be 86%.[4]

Deterioration of nutritional status during hospital admission has been demonstrated in older adults, regardless of their nutritional status upon admission.[5] The majority of malnourished patients are discharged home, and they experience a greater mortality rate over 12 – 18 months, as compared to their well-nourished counterparts, even taking into account underlying illness and age.[1, 6] Over the longer term, mortality rates at 10 years of follow up have been reported to be twofold higher in older women identified to be 'at risk of malnutrition' compared to those that were well-nourished.[7] A compromised nutritional status, without adequate support at home is associated with a downward spiral in health that often results in an increased risk of readmission to hospital[8] and a longer length of hospital stay,[1] resulting in overall higher health care costs.[9] Estimates from the UK indicate that malnutrition-related costs are £19.6 billion each year.[10] Malnourished patients make up approximately 30% of hospital admissions, 35% of aged care admissions, followed by 15% of outpatient clinic presentations and 10% of GP visits.[10]

For optimal outcomes, nutrition intervention strategies in high risk groups should be seamless between hospital and home.[11] There is a growing body of evidence that home-based dietetic intervention is effective in improving dietary intake, nutritional status and quality of life.[12, 13] However, in practice, such patients often fall between the cracks during their period of convalescence, a time that may be critical to the prevention of further nutritional decline. Models of care that facilitate smooth transition from hospital to home or residential aged care through improved communication between health service providers, community-based services and family are required. Even in older adults who have access to regular services such as home nursing, malnutrition remains a significant issue.[14] This may be the case, for example, with clients of the Department of Veterans' Affairs (DVA).

In Australia, DVA clients have different access to services than other groups of older adults.[15] A DVA health card provides unique and specific access to various health care services for DVA clients,[16] whilst the remaining older adults in the community have access to health services through Medicare or private health insurance.[17] Similarly, Department of Veterans Affairs in Canada and the United States also provide exclusive services for veterans through specific schemes.[18-20] Despite having better access to care, it remains to be seen whether additional benefits would be obtained from a home-based dietetic intervention.

This study aimed to determine if a model of home-based dietetic care improves nutritional status and weight in a sample of DVA patients over a 3 month period following hospital discharge. A secondary aim was to identify how changes in food choices over time influenced nutrient intake. Further insights into dietary practices and the influence of additional types of nutrition support were simultaneously evaluated.

## Methods

This study was conducted within a regional area of New South Wales, Australia. Eligible participants were those that were clients of the DVA, aged 65 years and older, community living, non-institutionalised and had been admitted to hospitals within the Illawarra Shoalhaven Local Health District between December 2010 and December 2011. Exclusion criteria included being discharged to high level nursing home care, being enterally fed or being terminally ill. Patients' nutritional status was routinely assessed in the ward using the 18 item Mini Nutritional Assessment (MNA®). The MNA® has been specifically developed to identify older adults' nutritional risk status and is a validated tool for this age group.[21] Nutritional status was categorised according to three cut-offs for total score; < 17: malnourished; 17 to 23.5: 'at risk of malnutrition'; and 24 to 30: well-nourished. Prospective participants were provided with a copy of a participant information sheet and consent form by ward dietitians and given time to make an informed decision regarding participation.

Nutrition assessment and intervention for this study started post hospital discharge. Consenting participants were visited at home by a single dietitian within two weeks of discharge from hospital. A diet history was performed and a food frequency checklist completed. Nutritional status was assessed using the MNA®. This was repeated at three months post discharge by the same dietitian to minimise risk of inter-observer bias, unless participants had been readmitted to hospital, withdrew or had deceased. The key nutrition intervention approach used to enhance patients' nutritional status in this model of care was personalised dietetic advice from the dietitian. Other strategies included individualised prescription of oral nutrition supplements (ONS) and/or referral to a

Meals on Wheels (MOW) service. Patients were referred to various community services if appropriate, as per usual practice.

A body mass index (BMI) below 23 kg/$m^2$ indicates higher risk of mortality in older adults.[22] In this study, underweight was defined as BMI <23 kg/$m^2$, desirable weight status was considered as BMI 23-27 kg/$m^2$; whilst overweight was categorised as BMI> 27 kg/$m^2$.

Dietary intake data was analysed for nutrient assessment using the computerised dietary assessment package FoodWorks 2009 (Xyris Software, version 6.0) using the AUSNUT 2007 database. Adequacy of dietary intakes was assessed against the age and sex-appropriate estimated average requirement (EAR) or adequate intake (AI), where appropriate.[23] The contribution of Meals on Wheels (MOW) towards patients' dietary intake was also evaluated. Protein foods were categorised based on AUSNUT 2007 codes.

Differences in weight, BMI, dietary intakes of macronutrients and micronutrients, risk of malnutrition, protein food group and MOW contributions were compared using paired t-tests for normally distributed data and the Wilcoxon Signed Rank tests for non-parametric data. A two-way ANOVA was used to examine the impact of BMI and gender on daily protein intake, expressed per kilogram of body weight (g/kg). Missing information and data of participants who did not complete follow up at three months were excluded from analysis. Significant differences were defined as $p < 0.05$. Analyses were performed using IBM SPSS statistics software version 19 (SPSS Inc., Chicago, IL, USA).

Ethics approval was granted by the University of Wollongong Human Research Ethics Committee (HE10/413).

**Results**

A convenience sample of 79 participants was recruited, of whom 68 (86.1%) were available at 3-months, with 7 having withdrawn from the study and 4 deceased. According to the MNA® classification, those who did not complete the 3 month assessment were either 'at risk' (n=8) or 'malnourished' (n=3) at baseline.

The mean age was 85.5 ± 5.8 years, with men being significantly older than women (87.1 (6.3) vs 84.0 (5.1) years), respectively ($p = 0.028$). Mean body weight increased from 67.1 ± 13.5 kg to 68.0 ± 13.7 kg ($p=0.048$), while mean MNA® score improved significantly from being in the 'at risk of malnutrition' category (21.9 ± 3.5) to the 'well-nourished' category (25.2 ± 3.1) ($p<0.001$) (Table 1). The total percentage of participants who were identified as 'at risk' and malnourished was 61.8% at baseline, and reduced to 23.5% at 3 months. No significant change was detected for BMI at 3 months. When analysed by gender, MNA® score showed significant improvements for both genders ($p<0.001$), but changes in weight and BMI were no longer significant.

At 3 months a significant difference was identified for mean MNA® scores (SD) among the underweight (23.7 ± 3.7), desirable weight (26.5 ± 2.1) and the overweight group (25.8 ± 2.6) ($p=0.004$). All BMI groups had a mean MNA® score in the well-nourished categories (score ≥24) except for the underweight group.

No significant changes were detected in intake of energy and macronutrient distribution after 3 months (Table 2). Mean energy, protein and micronutrient intakes were adequate at both time points, with no change over time except for vitamin D which remained below the EAR despite a significant increase at 3 months (Table 2). At baseline, energy intake was below EAR among 18.8% (n=6) men and 30.6% (n=11) women participants; while none of the participants had protein intakes (in gram/day) lower than EAR. Vitamin D intake was below the EAR for all participants at baseline except for two women participants. Improvement in Vitamin D intake was related to vitamin D supplementation rather than dietary sources.

At 3 months, a two way ANOVA showed that those who were in the underweight group (BMI<23 kg/m$^2$) (n = 26, 38.8%) had significantly higher mean protein intakes per body weight (g/kg) (1.7±0.4g/kg) compared to desirable weight (n= 25, 37.3%) (BMI 23-27 kg/m$^2$) (1.4±0.3g/kg) and overweight participants (n= 16, 23.9%) (BMI>27 kg/m$^2$) (1.1±0.3g/kg) (p<0.001).

There was a significant improvement in energy intake contributed from ONS (+95.5±388.2kJ/day) and milk (+259.6±659.8 kJ/day) (Table 3), but no changes in other protein sources. The preferred food sources of protein were fish, beef and milk. A total of seven participants (10.3%) were receiving Meals on Wheels at both time points, with 5 participants using a MOW service at both occasions, while 2 participants had discontinued at 3 months and another 2 participants were new MOW clients at 3 months and the use of ONS increased from 11.8% (n=8) at baseline to 14.7% (n=10).

**Discussion**

An in-home, post discharge nutrition intervention that included dietetic home visits resulted in improvements in the nutritional status of older DVA patients after three months, although these patients already have unique access to a range of clinical and social services. The model of home-based dietetic care was based on a previous hospital to home six month program that was conducted in the same health district.[24] The Comprehensive Ongoing Management of Malnutrition using Individualised Therapy (COMMIT) Program demonstrated that extended community care can reduce the length of future hospital stays and improve patient satisfaction.[24] Our findings are consistent with those from a Danish study that provided a similar intervention[13] and another study that provided dietetic home visits with tailored individual dietary advice over a period of 6 months after hospital discharge.[25] The latter study highlighted the effectiveness of dietetic home visits compared to usual care that included in-patient dietetic intervention before discharge. Nutritional intervention should be a primary goal for the management of malnutrition.[26] Early attention to improving dietary intakes when patients go home to convalesce may prevent further decline in their already compromised nutritional status.[27]

A high protein, high energy diet is fundamental to improve the nutritional status of malnourished older adults post hospitalisation. Surprisingly, although 61.8% of participants were classified as malnourished or at risk after hospital discharge, mean dietary energy intakes in this study exceeded the age-appropriate recommended intakes of approximately 7400 kJ/day and 8300 kJ/day for women and men, respectively, based on a physical activity level of 1.6.[23] Energy intakes above the EAR have also been reported in the Australian Longitudinal Study of Ageing that included 1000 community-dwelling older adults aged 70 years and older.[28] That study also demonstrated that dietary intakes by Australian older adults met most macronutrients and micronutrients requirements,[28] which is consistent with our findings except for vitamin D. Inadequate vitamin D intake in older adults has also been reported by others.[29, 30] Vitamin D supplementation is considered as an intervention strategy to improve older adults' vitamin D intake; as lower intake contributes to loss of muscle mass and an increased risk of falls.[31]

Adequate protein intake in older adults is particularly important during the recovery process after episodes of illness in order to prevent further loss of muscle mass and to improve functionality.[32] Dietary protein intakes were more than adequate in our sample; however participants who were underweight at follow up had improved intakes of protein per kilogram body weight. This demonstrates that our nutritional intervention strategy achieved appropriate protein intake in those most in need. The recommended level for protein intake of 0.8 g/kg day, regardless of age, has been questioned.[21, 33] Recent consensus guidelines on protein intake in old age recommended by the PROT-AGE study group indicate an average daily intake in the range of at least 1.0 to 1.2 gram protein/kg/day for maintenance and/or regain of lean body mass, and 2.0 g/kg/day for overtly malnourished older adults.[34] For those with chronic illness, the recommended protein intake is up to 1.5 g/kg/day or equivalent to 15-20% of total energy intake (% E).[33, 34] A study of older women has demonstrated that a protein intake of between 1.2-1.76 g/kg/day resulted in less health issues than in women with intakes of <0.8 g/kg/day.[35]

Healthy body weight through desirable BMI status is an indicator for positive health outcomes of adults. This was confirmed in a recent meta-analysis that demonstrated an increased mortality risk in older adults with a BMI< 23 kg/m$^2$, but not in the overweight group.[22] However, the use of BMI in older adults as the only indicator of nutrition risk should be used with caution as overweight older adults were also at risk of malnutrition according to MNA® classification as reported by others.[36] Preventing weight loss through provision of additional energy and protein using oral nutrition supplements is an effective strategy in older adults who have difficulties in achieving adequate food intake.[37] Our study participants had an increased intake of high protein beverages as demonstrated by significant changes in intake of milk and ONS. This may reflect the convenience of using these ready-to-consume beverages, rather than having to prepare meals themselves. A USA study identified that 81% of older adults have difficulties in meal preparation post hospital discharge and that 40% of this group experienced a poor or fair appetite.[38] According to recorded baseline diet histories, participants in our study had already started consuming ONS prior to the first home visit by the dietitian. A meta-analysis has shown that oral nutrition supplementation helps malnourished older adults to gain weight in hospital and institutional care, but not in the community setting.[39] However, the impact of its continued use between hospital and home in the early discharge period is unclear in the meta-analysis. A home-based trial that prescribed a daily intake of 500 kcal/day of high energy and high protein ONS for two months post hospitalisation identified weight increment and improved MNA® scores among the at risk group,[40] whilst another home-based study also reported significant weight gain post intervention.[13]

Another strategy to enhance dietary intake is referral to the Meals on Wheels (MOW) home meal delivery service. MOW services have been shown to be effective in improving older adults' nutritional status, and offering a good alternative for older adults who have limited ability to cook and prepare meals.[41] Charlton et al[42] reported increased energy and protein intakes as well as an improved MNA® score with MOW clients after four weeks of receiving nutrient dense snacks provided through the existing service. In the present study, meals provided by the MOW service made a significant contribution (approximately 20%) to total dietary protein intake among clients. The focus on DVA patients to a certain extent provides a case study of a defined group, but also limits generalisability of the findings considered because of the non-representative nature of the group. DVA clients enjoy extensive governmental support with access to various medical and allied health services, as well as other exclusive support services.[15] Similarly, in the United States, extensive support for veterans is available through Home Based Primary Care (HBPC), a preventive scheme to support DVA clients to live independently at home whilst reducing their risk of hospital admission.[18]

Other study limitations include the small sample size and a relatively short period of low intensity intervention. The lack of a control group and non-randomised nature of the intervention are considered major limitations. While the pre-post study design limits scientific quality, we consider it to be unethical to have a control group of at risk, or malnourished people who did not receive active interventions. All participants received tailored interventions to meet their needs, but the study is considered largely descriptive and exploratory although it is feasible for this age group. We have demonstrated that this model of care is potentially beneficial to older patients who are discharged home from hospital, but further evaluation is required to evaluate patient acceptability of the home-based intervention.

Costing of the ambulatory model of care piloted in the current study was not undertaken, however on average discharged patients received four hours of dietetic care. Nevertheless, in addition to the usual range of services that can be accessed, the provision of home-based individualised dietetic care resulted in an improved nutritional status after 3 months. This suggests that non-DVA clients may get greater benefits from this kind of service, but further investigation is warranted. Previous findings from the same region highlighted the fact that most older inpatients that were identified as malnourished or at risk of malnutrition are discharged home.[43] This makes a strong case for the need for nutrition intervention in the community.[43] A strength of the study is that all measurements and individualised dietary interventions were performed by a single dietitian, thereby limiting inter-observer bias. Further qualitative evaluations are also needed to identify factors that influence older adults' food choices and eating behaviours in the period post hospital discharge.

An individualised home based dietetic service improved the MNA® score and body weight of a group of older people discharged from hospital; with evidence of adequate energy and nutrient intake, except for vitamin D. This model of care warrants further demonstration of its effectiveness.

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***Table 1 Anthropometric data and MNA score of study participants***

| | **Baseline** | | **3 months** | | **P value** |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| **All participants (n=68)** | | | | | |
| Weight (kg)** | 67.1 | 13.5 | 68.0 | 13.7 | 0.048*[1] |
| BMI ($kg/m^2$)** | 24.3 | 4.2 | 24.7 | 4.5 | 0.088[1] |
| MNA score | 21.9 | 3.5 | 25.2 | 3.1 | 0.000*[1] |
| **Men (n=32)** | | | | | |
| Weight (kg) | 71.8 | 14.0 | 72.7 | 13.9 | 0.167[2] |
| BMI ($kg/m^2$) | 24.0 | 4.3 | 24.3 | 4.3 | 0.281[2] |
| MNA score | 21.5 | 3.3 | 25.5 | 3.0 | 0.000[1*] |
| **Women ( n=36)** | | | | | |
| Weight (kg)*** | 62.7 | 11.6 | 63.8 | 12.3 | 0.074[1] |
| BMI ($kg/m^2$)*** | 24.6 | 4.2 | 25.1 | 4.6 | 0.065[1] |
| MNA score*** | 22.3 | 3.6 | 25.0 | 3.3 | 0.000[1*] |

***n = 67 due to unavailable data on weight, ***n = 35 due to unavailable data on weight*

*[1] Paired t-test, [2] Wilcoxon signed rank test * p value<0.05*

*Table 2 Mean energy, macro and micronutrients intake of participants*

| Nutrients | All participants (n=68) | | | Men (n=32) | | | | Women (n=36) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | 3 months | P value | Baseline | 3 months | EAR (>70) | P value | Baseline | 3 months | EAR (>70) | P value |
| Energy (kJ) | 9366 ± 2069 | 9627 ± 2389 | 0.358[1] | 10222.8 ±1896.0 | 10588.4 ± 2265.0 | 8300 | 0.837[2] | 8605.2 ±1935.5 | 8773.0 ±2188.7 | 7400 | 0.665[1] |
| Protein (g) | 95.2 ± 22.4 | 97.1 ± 23.7 | 0.472[1] | 103.9 ±20.7 | 108.0 ± 22.0 | 65 | 0.317[1] | 87.5 ±21.2 | 87.3 ±20.9 | 46 | 0.943[1] |
| Protein (g/kg body wt)** | 1.5 ± 0.4 | 1.5 ± 0.4 | 0.991[1] | 1.5 ±0.4 | 1.5 ± 0.4 | 0.86 g/kg | 0.531[1] | 1.4 ±0.5 | 1.4 ±0.4 | 0.75 g/kg | 0.948[2] |
| Protein (% E) | 17.5 ± 2.8 | 17.4 ± 2.8 | 0.822[1] | 17.5 ± 2.7 | 17.6 ± 2.8 | - | 0.818[1] | 17.4 ± 2.9 | 17.1 ± 2.8 | - | 0.526[1] |
| CHO (% E) | 47.2 ± 6.2 | 46.6 ±6.8 | 0.567[1] | 46.6 ± 7.2 | 46.0 ± 4.7 | - | 0.616[1] | 47.7 ± 5.3 | 47.2 ± 8.3 | - | 0.738[1] |
| Total fat (% E) | 32.6 ± 5.2 | 33.7 ± 6.1 | 0.130[1] | 32.2 ± 5.6 | 33.2 ± 4.9 | - | 0.275[1] | 32.9 ± 4.9 | 34.1 ± 7.0 | - | 0.287[1] |
| Alcohol (% E) | 1.2 ± 3.3 | 0.9 ± 1.6 | 0.422[1] | 2.1 ± 4.4 | 1.6 ± 2.1 | - | 0.765[2] | 0.4 ± 1.5 | 0.3 ± 0.7 | - | 0.889[2] |
| Water (g) | 2560.8 ± 658.2 | 2530.1 ± 635.9 | 0.693[1] | 2664.6 ±798.5 | 2729.1 ± 746.0 | 3.4 L (AI) | 0.576[1] | 2468.4 ±495.9 | 2353.3 ±461.4 | 2.8 L (AI) | 0.280[1] |
| Dietary-fibre (g) | 31.0 ± 11.2 | 29.3 ± 9.2 | 0.197[1] | 33.8 ± 12.2 | 32.2 ± 9.5 | 30 (AI) | 0.513[1] | 28.6 ±9.7 | 26.7 ±8.2 | 25 (AI) | 0.178[1] |
| Thiamine (mg) | 1.9 ± 0.9 | 1.8 ± 0.9 | 0.253[2] | 2.0 ± 1.0 | 2.0 ± 1.1 | 1.0 | 0.667[2] | 1.9 ±0.9 | 1.7 ±0.7 | 0.9 | 0.246[1] |
| Riboflavin (mg) | 3.0 ± 1.1 | 3.1 ± 1.4 | 0.845[2] | 3.1 ± 1.1 | 3.3 ± 1.7 | 1.3 | 0.852[2] | 2.9 ±1.1 | 2.8 ±1.1 | 1.1 | 0.807[1] |
| Vitamin C (mg) | 145.8 ± 98.2 | 161.1 ± 163.3 | 0.525[2] | 147.8 ± 81.1 | 172.9 ± 172.8 | 30 | 0.985[2] | 144.0 ±112.5 | 150.7 ±156.1 | 30 | 0.354[2] |
| Vitamin D (ug) | 6.4 ± 10.5 | 11.8 ± 23.8 | 0.001*[2] | 5.0 ± 1.7 | 13.2 ± 28.9 | 15 (AI) | 0.004[2*] | 7.6 ±14.3 | 10.5 ±18.5 | 15 (AI) | 0.071[2] |
| Folate (ug) | 582.8 ± 289.9 | 570.0 ± 292.8 | 0.153[2] | 567.4 ± 254.6 | 612.6 ± 337.4 | 320 | 0.881[2] | 596.4 ±321.0 | 532.0 ±245.3 | 320 | 0.076[2] |
| Magnesium(mg) | 403.0 ± 122.4 | 395.5 ± 104.9 | 0.638[1] | 437.1 ± 143.1 | 413.5 ± 99.9 | 350 | 0.525[2] | 372.7 ±92.5 | 379.5 ±107.9 | 265 | 0.700[1] |
| Calcium (mg) | 1174.0 ± 385.4 | 1246.8 ± 473.4 | 0.169[1] | 1203.2 ± 346.4 | 1290.8 ± 442.3 | 1100 | 0.260[1] | 1148.0 ±420.2 | 1207.7 ±502.4 | 1100 | 0.418[1] |
| Iron (mg) | 13.9 ± 4.8 | 13.9 ± 4.5 | 0.755[2] | 15.4 ± 5.6 | 15.4 ± 4.9 | 6.0 | 0.943[1] | 12.6 ±3.6 | 12.5 ±3.8 | 5.0 | 0.960[1] |

***n = 67 due to unavailable data on weight*

*[1] Paired t-test, [2] Wilcoxon signed rank test * p<0.05*

***Table 3 Main dietary sources contributing to total dietary protein intake, according to food groups and MOW contributions***

| **Food sources** | **Energy (kJ/day)** | | | **Protein** | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | **Baseline** | | **3 months** | | |
| | **Baseline** | **3 months** | **P value** | **gram per day (% total protein per day)** | **Protein exchange** | **gram per day (% total protein per day)** | **Protein exchange** | **P value** |
| **Oral nutrition supplement^** | 57.3 ± 374.5 | 152.8 ± 564.8 | 0.042[1]* | 6.2 ± 10.7 (5%) | - | 16.9 ± 7.7 (23%) | - | 0.02[1]* |
| **Egg** | 186.6 ± 279.0 | 219.2 ± 286.3 | 0.658[1] | 3.9 ± 6.4 (4.1%) | 0.6 | 4.5 ± 6.6 (4.6%) | 0.6 | 0.629[1] |
| **Fish** | 295.2 ± 450.5 | 320.9 ± 434.6 | 0.361[1] | 10.0 ± 12.2 (10.5%) | 1.4 | 10.9 ± 12.0 (11.2%) | 1.6 | 0.516[1] |
| **Beef** | 230.7 ± 188.6 | 194.2 ± 138.2 | 0.115[1] | 8.8 ± 6.9 (9.2%) | 1.3 | 7.3 ± 5.0 (7.5%) | 1.1 | 0.109[1] |
| **Lamb** | 194.2 ± 123.7 | 173.3 ± 129.9 | 0.279[1] | 5.4 ± 3.2 (5.7%) | 0.8 | 4.7 ± 3.6 (4.8%) | 0.7 | 0.422[1] |
| **Pork** | 169.6 ± 113.4 | 136.8 ± 88.0 | 0.508[1] | 5.7 ± 3.5 (6.0%) | 0.8 | 5.1 ± 2.8 (5.3%) | 0.7 | 0.575[1] |
| **Milk** | 818.5 ± 490.2 | 1078.1 ± 715.2 | 0.004[1]* | 12.8 ± 7.9 (13.4%) | 1.6 | 14.8 ± 9.2 (15.2%) | 1.9 | 0.024[1]* |
| **MOW** | 1187.4 ± 596.8 | 1166.7 ± 523.3 | 0.924[2] | 18.6 ± 6.1 (19.5%) | 2.7 | 18.8 ± 7.7 (19.4%) | 2.7 | 0.978[2] |

*[1] Wilcoxon signed rank test, [2]Paired t-test, *p value <0.05*

*^Oral nutrition supplement brands: Ensure, Sustagen*

*1 exchange for egg, fish, beef, lamb, pork and MOW = 7 gram protein, 1 exchange for milk= 8 gram protein*