ARTICLE IN PRESS

JAMDA xxx (2017) 1–7

JAMDA

journal homepage: www.jamda.com

Original Study

An Even Distribution of Protein Intake Daily Promotes Protein Adequacy but Does Not Influence Nutritional Status in Institutionalized Elderly

Michael Tieland PhD [a], Janne Beelen PhD [b], Anna C.M. Laan MSc [b], Shirley Poon BASc [c], Lisette C.P.G.M. de Groot PhD [b], Ego Seeman MD [c,d], Xiaofang Wang PhD [c], Sandra Iuliano PhD [c,*]

[a] Faculty of Sports and Nutrition, Amsterdam University of Applied Sciences, Amsterdam, The Netherlands
[b] Division of Human Nutrition, Wageningen University and Research, Wageningen, The Netherlands
[c] Department of Endocrinology/Medicine, University of Melbourne/Austin Health, West Heidelberg, Australia
[d] Institute of Health and Ageing, Australian Catholic University, Melbourne, Australia

Keywords:
Elderly
energy intake
protein distribution
malnutrition

A B S T R A C T

Objective: Although it has been established that sufficient protein is required to maintain good nutritional status and support healthy aging, it is not clear if the pattern of protein consumption may also influence nutritional status, especially in institutionalized elderly who are at risk of malnutrition. Therefore, we aim to determine the association between protein intake distribution and nutritional status in institutionalized elderly people.
Design: Cross-sectional study among 481 institutionalized older adults.
Methods: Dietary data from 481 ambulant elderly people (68.8% female, mean age 87.5 ± 6.3 years) residing in 52 aged-care facilities in Victoria, Australia, were assessed over 2 days using plate waste analysis. Nutritional status was determined using the Mini-Nutritional Assessment tool and serum (n = 208) analyzed for albumin, hemoglobin, and IGF-1. Protein intake distribution was classified as: spread (even distribution across 3 meals, n = 65), pulse (most protein consumed in one meal, n = 72) or intermediate (n = 344). Regression analysis was used to investigate associations.
Results: Mean protein intakes were higher in the spread (60.5 ± 2.0 g/d) than intermediate group (56.0 ± 0.8 g/d, *P* = .037), and tended to be higher than those in the pulse group (55.9 ± 1.9 g/d, *P* = .097). Residents with an even distribution of protein intake achieved a higher level of the recommended daily intake for protein (96.2 ± 30.0%) than the intermediate (86.3 ± 26.2%, *P* = .008) and pulse (87.4 ± 30.5%, *P* = .06) groups, and also achieved a greater level of their estimated energy requirements (intermediate; *P* = .039, pulse; *P* = .001). Nutritional status (Mini-Nutritional Assessment score) did not differ between groups (pulse; 20.5 ± 4.5, intermediate; 21.0 ± 2.5, spread; 20.5 ± 3.5), nor did any other indices of nutritional status.
Conclusions: Meeting protein requirements is required before protein distribution may influence nutritional status in institutionalized elderly. Achieving adequate protein and energy intakes is more likely when protein is distributed evenly throughout the day. Provision of high protein foods especially at breakfast, and in the evening, may support protein adequacy and healthy aging, especially for institutionalized elderly.

Insufficient protein intake contributes to poor health and sarcopenia or the aged-related loss of muscle mass and strength.[1,2] Institutionalized elderly, in whom protein-energy malnutrition is common, have a high prevalence of sarcopenia.[3] Malnutrition is a risk factor for sarcopenia.[4] Recent evidence suggests that adults >65 years of age have higher protein needs than the current recommended intake levels of 0.8 g protein per kg bodyweight per day (g/kg BW/d), extrapolated from

The authors declare no conflicts of interest.

* Address correspondence to Sandra Iuliano, PhD, Department of Endocrinology/Medicine, University of Melbourne, Austin Health, Level 2 Centaur Building, Heidelberg Repatriation Hospital, West Heidelberg, Victoria, Australia.
E-mail address: sandraib@unimelb.edu.au (S. Iuliano).

http://dx.doi.org/10.1016/j.jamda.2017.07.007

adult balance studies, to adequately support muscle and overall health, and to maintain physical function and independence.[5–7] Protein intakes of 1.0–1.2 g/kg BW/d are considered more appropriate for healthy older adults, with levels of between 1.2 and 1.5 g/kg BW/d suggested for those with acute or chronic illnesses.[5] Despite these recommendations, institutionalized elderly commonly have inadequate protein intakes, with levels below 0.8 g/kg/d observed.[8,9]

Additional to total protein intake, the timing of protein consumption may also influence nutritional status and muscle health. While some short-term studies in both younger and older adults indicate enhanced muscle protein synthesis with an even distribution of protein across 3 main meals,[10–12] others have reported that the consumption of the majority of protein in 1 meal stimulates muscle protein synthesis more than an even distribution.[13,14] However, the suitability of a single high protein meal for more frail elderly such as those in institutionalized care, and the long-term feasibility of each dietary strategy to slow muscle loss and reduce malnutrition risk, remains unknown.

As there is limited data describing protein intake distribution in institutionalized elderly people and its relationship with nutritional status, we conducted a cross-sectional study in elderly aged-care residents. We hypothesized that an even distribution of protein across 3 meals would be associated with better nutritional status than if the majority of protein was consumed in 1 meal.

Methods

Study Design and Participants

Data were collected from a convenience sample of 481 ambulant elderly from 52 aged-care facilities in metropolitan Melbourne and regional Victoria, Australia, between December 2014 and September 2015, as part of baseline assessments for a cluster-randomized placebo-controlled trial. Inclusion criteria for the trial were (1) facilities required accreditation by the Australian Aged-Care Quality Agency and (2) they accommodated ambulant residents. The inclusion criteria for this study were being ambulant and older than 70 years of age, as recommendations for protein and energy intake differ for elderly above or below 70 years of age.[15] The overall study was approved by the Human Research Ethics Committee of Austin Health (Project No. 04958) and is registered with the Australian and New Zealand Clinical Trials Registry (ACTRN 12613000228785). Written informed consent was obtained from all participants, or their next of kin.

Dietary Assessment

Food provision in residential aged-care follow 4-week menu cycles, with foods prepared on-site. Meal service typically consisted of a continental-style breakfast (occasional hot breakfast), a mid-day meal providing a hot dish and dessert, an evening meal consisting of soup and choice of a hot or cold dish and dessert, and morning, afternoon and evening snacks. Dairy was consumed at breakfast if cereal/porridge was provided, main meals tended to contain a serving of meat, and dairy if a dairy-based dessert is offered, and snacks tended to consist of plant-based proteins (grain), often consisting of cakes and biscuits.

Trained dietitians determined dietary intake on 2 random days using the validated method of visual estimation of plate waste.[16] All foods and beverages were compared against a weighed, “standard” serving size using a 7-point scale that represents portions of each food remaining; 0 = no food remaining, +M = mouthful remaining, 1/4 = ¼ remaining, 1/2 = ½ remaining, 3/4 = $^3/_4$ remaining, −M = 1 mouthful consumed, 1 = no food eaten. Meals served were rated against the standard meal (medium given the value of 100%); small serving = 75%, large serving = 125%, extra-large serving = 150%. All components of standard serves were weighed on a digital food scale (±1g) (Sohnele Page Profi, Nassau, Germany). Mean dietary intake of protein and energy was calculated per day and per meal using Foodworks v 7 (Xyris Software, Brisbane, Australia). The food composition values used to calculate nutrient intakes were derived from product-specific nutritional information on packaging. When packaging information was not available, nutrient values were obtained from Nutrient Tables for use in Australia 2010 and Food Standards Australia New Zealand 2010.[17]

Proportion of recommended dietary intake (RDI) for protein were based on Australian standards and calculated separately for men and women using the weight of residents (ie, RDI; men >70 years; 1.07 g/kg and women >70 years; 0.94 g/kg). These levels are higher than the internationally recognized RDA of 0.8 g/kg BW.[15] Estimated energy requirements (EER) were based on nutrient reference values equations.[15] Energy intake was calculated as total energy intake per day (kJ/d), and as the percentage of EER achieved (%EER).

Analysis of Protein Intake and Distribution

Total protein intake was calculated for residents in whom accurate data was obtained for all 3 main meals (breakfast, lunch, dinner) and 3 between-meal snacks (including intentionally missed meals/snacks) on at least 1 of the 2 assessment days. Protein intake per meal occasion was calculated as the mean of both meals when both assessment days were available, otherwise the observed meal intake of the single day was used.

Dietary protein intake was expressed as total protein intake (g/d), per kilogram body weight (g/kg/d), and percentage of the RDI for protein. The number of residents reaching the RDI for protein was also calculated. Furthermore, protein intakes (g) per meal occasion (breakfast, lunch, dinner) and snack (morning and afternoon teas and supper) were calculated.

The study population was divided into 3 groups: a spread, intermediate, or pulse group. The spread diet is defined as a diet providing protein in equal amounts over 3 main meals (breakfast, lunch, dinner) with a maximum difference of 10% of protein intake between each meal. The pulse diet is defined as a diet providing 50% or more of the daily protein intake in 1 meal (breakfast, lunch, or dinner). The intermediate group had a protein intake distribution between these 2 criteria.

Nutritional Status

A trained dietitian assessed each participant to determine nutritional status using the Mini-Nutritional Assessment (MNA) tool (Nestlé Nutrition Institute, Vevey, Switzerland). The MNA involves 18 questions, with a maximum total score of 30 points. The MNA categorizes older adults into 3 categories: malnourished (score below 17); at risk of malnutrition (score between 17 and 23.5); or normal nutritional status (score between 24 and 30).

Anthropometric Measurements

Body weight was obtained from facility documentation as it is measured monthly in residents. Ulna length (UL) was used to estimate height using the following equation; males, height (cm) = 4.605UL+1.308age+28.003 (R^2 = 0.96); female, height (cm) = 4.459UL+1.315age+31.485 (R^2 = 0.94).[18,19] UL has been validated for use in elderly populations as it is less affected by aging than standing height.[18,20] Body mass index was calculated; weight (kg)/height^2 (m^2). A BMI score of <18.5 was used as the cut-off for underweight.