Original Article

Energy, protein, calcium, vitamin D and fibre intakes from meals in residential care establishments in Australia

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Residents from high level (nursing homes) and low-level care facilities (hostel) being served the three common diet texture modifications (full diet, soft/minced diet and pureed diet) were assessed. Individual plate waste was estimated at three meals on one day. Fifty-six males and 156 females, mean age 82.9 ± 9.5 (SD) years, of which 139 lived in nursing homes (NH) and 76 in hostels (H) were included. Mean total energy served from meals was 5.3 MJ/day, 5.1 to 5.6 MJ/day, 95% confidence intervals (CI), in NH which was less than in H, 5.9 MJ/day (CI 5.6 to 6.2 MJ/day) (*P* = 0.007). Protein and calcium intakes were lower in NH, 44.5g (CI 41.5 to 47.5g), 359.0mg (CI 333.2 to 384.8mg), versus 50.5g (CI 46.6 to 54.3g), 480.5mg (CI 444.3 to 516.7mg) in H (*P* = 0.017, *P* < 0.001 respectively). There was no difference in nutrient/energy ratios, except for protein/energy, which was higher in NH 11.7 (CI 11.3 to 12.2) than in H 9.8 (CI 9.4 to 10.3) (*P*< 0.001). Ability to self-feed had no significant effect on nutrient intakes in NH. The self fed group (N=63) had the following nutrient intakes: energy 4.0 MJ (CI 3.6 to 4.3 MJ), protein 44.6g (CI 40.3 to 48.9g), calcium 356.9mg (CI 316.3 to 397.4mg), fibre 14.9g (CI 13.2 to 16.5g). The assisted group (N=64) had the following nutrient intakes: energy 3.9MJ (CI 3.6 to 4.2MJ), protein 46.0g (CI 40.7 to 49.6), calcium 361.9mg (CI 327.8 to 396.1mg), fibre 14.9g (CI 13.2 to 16.1g). Of NH classified as eating impaired, 36% received no assistance with feeding and had lower intakes of protein 37.8g (CI 33.0 to 42.1g) compared to those receiving some assistance 46.1g (CI 41.3 to 50.9g) (*P*= 0.026). Reduced energy intake accounted for the differences in nutrient intakes between nursing homes and hostels, except for protein. Strategies to effectively monitor nutrient intakes and to identify those with eating impairment are required in order to ensure adequate nutrition of residents in nursing homes and hostels.

Key Words: Australia, elderly, nursing homes, hostels, energy intake, protein, vitamin D, calcium, fibre, eating impairment

Introduction

The proportion of older people in the population is increasing, with more than 12% of Australians aged 65 years and over in 1999, and 2% of the population is now over the age of 80 years.[1] Currently, 7% of older Australians live in aged care accommodation.[2] The predicted increase in the number of older people is likely to result in an increased number of elderly people living in residential care facilities. Adequate nutrition is necessary for good health, but can be difficult to achieve in the elderly population, who often have mental and physical disabilities.[3,4] Those who appear most at risk are residents receiving high level care i.e. those in nursing homes where weight loss is common and the incidence of undernutrition is high.[5,6]   Assessment of the nutrient intakes of people in residential care settings is an important step in monitoring and maintaining adequate nutrition standards in this population. Previous studies of elderly Australians in residential care have highlighted the need to improve the nutritional status of nursing home

residents,[7-9] but there have been no recent reports detailing actual nutrient intakes in residential care in Australia. Menu analysis has been used to assess the food and nutrition available to residents in institutions. Residents, however, may eat varying amounts of the nutrients offered because of factors such as impaired chewing and swallowing, the negative effect of stress and medical treatment on appetite and the manner in which food is prepared.[3,10]

Therefore there is a need to assess the actual dietary intake of elderly residents currently in residential care facilities. This study assessed macronutrients, fibre, calcium and vitamin D intake, as these are dietary factors important for

maintaining healthy muscular skeletal and bowel function, which may be sub-optimal in this population.

Nutrient intake assessment requires a special approach in this group. Techniques which require residents to respond to food related questions or to record food intake cannot be used in the institutionalised elderly population as the prevalence of dementia is 40% in hostels and 70% in nursing homes,[11] and the staff-carer may not be suitable as the residents' proxy due to insufficient knowledge of what each resident eats. We have previously used and validated visual estimation of plate waste as a means of assessing food intake in 75 residents living in residential care establishments.[12]

The aims of this study were (a) to estimate the intake of key nutrients consumed from meals on one day in residents receiving high level care (nursing home residents - NH) and lower level care (hostel residents - H) and (b) assess any differences in key nutrients in residents with and without eating impairments, and between three major texture modification groups: full, soft/minced and pureed.

Methods
Study sample and design
Fourteen eating sites (wards or dining rooms) from residential care institutions, which were recruited to a larger study investigating prevention of hip fractures with vitamin D supplementation, were invited and agreed to participate in this study. This was a convenience sample of institutions, which were situated in metropolitan Melbourne and regional Victoria. The sites and wards were chosen to include a sample of residents being served the three common diet texture modifications: full diet, soft/minced diet and pureed diet, and to include both high level care residents (nursing homes) and lower level care (hostels). All residents of one ward or a group of hostel residents eating in one dining room were surveyed on one day. Every resident in each ward or group was included, provided that they were present for the 3 meals. One-hundred-and-fifty-two nursing home residents were resident in selected wards: 13 of these were not present for all 3 meals on the sampling day. In hostels 95 were resident: 19 were not present for 3 meals. Seventy-five of the residents in this study were included in the previous study validating the visual plate waste assessment method.[12] The Clinical Research and Ethics Committee of the Royal Melbourne Hospital Research Foundation approved the study.

Assessment of dietary intake
Individual monitoring of plate waste was conducted on a single weekday for each group of residents at a particular site. It took five days to assess the one-day intake of 179 nursing home residents: two days spring/summer and two days in autumn/winter and three days to assess the one-day intake of 76 hostel residents (two days in spring/summer and two days in autumn). Actual nutrient intake from meals was calculated using the plate waste method, with one plate waste observer at each site.[12] Three meals were assessed for each resident: breakfast, lunch and the evening meal on one day. Information was collected from each institution on food

preparation procedures. The institutions supplied up to three sample serves of each of the most frequently consumed items (approximately 75% of all items used) and these were weighed to the nearest gram ("Arlec" electronic kitchen scales). Where samples were not available for particular items, estimates by dietitians (approximately 20% of all items) or standard weights cited by the institutions (approximately 5% of all items) were used. Where there were three serving sizes for each item (small, medium or large), each standard serving size was weighed, the serve size given to each resident was noted and the appropriate serve size was used to calculate waste. A dietitian visually scored the plate waste for each food item on each plate using a seven-point scale representing percent waste as in Table 1. Percent waste was then used with standard serve weights to calculate weight eaten. The visual estimates of weight eaten were then used to calculate nutrient intakes using the dietary analysis computer package Diet/1, version 4.22 (Xyris Software, Highgate Hill, Queensland) (Nuttab95, nutrient database for use in Australia). Values for vitamin D content were added to the nutrient database using data from British Food Composition Tables and US figures.[13-15] Recipes were used where available from the institution. Intake of beverages served with meals was assessed, but intake from food and beverages served between meals was not assessed. Three trained dietitians assessed the plate waste. We have demonstrated previously that the observer difference in estimated plate waste is minimal and the greatest difference for any food group noted between trained dietitians as observers was only 6% for vitamised vegetables.[12]

Table 1. Visual rating scale for plate waste

Score	0	+m	¼	½	¾	-m	All
Description	none left	Mouthful left	¼ left	½ left	¾ left	Mouthful eaten	All left
Percent Waste	0	10	25	50	75	90	100

Assessment of eating ability and diet texture
Staff provided information on age (from medical records) and were asked whether each resident's eating was impaired by eyesight loss, problems of the arms or hands, dentures, swallowing problems or dementia. Eating impairment was defined as the presence of one or more of the factors listed. Staff also assessed residents as being partially or fully fed by staff or as self-feeding. As this was a non-intrusive observational study, no other individual clinical information was sought.

Statistical Analysis
Statistical analysis was performed using SPSS for Windows (Chicago, Illinois, Release 10.0.0). Student t-tests and analysis of variance (ANOVA) and Tukey's honestly significant difference (HSD) post hoc tests were used to test

differences between groups, with $P<0.05$ considered to be significant.

Results
Table 2 shows the age and distribution of the residents. Age was unavailable for 5 residents. The majority of residents were female (73%) and the mean age for the group was

Table 2. Age and sex of residents (mean ± SD).

Group	N	Gender	Age (years)
All	215	59 M/156 F	82.9 ± 9.5
Nursing Home (nine sites)	139	35 M/104 F	83.3 ± 9.8
Hostel (five sites)	76	24 M/52 F	82.2 ± 8.7
Diet Type			
Full	114	33 M/81 F	82.1 ± 8.8
Soft/minced	48	16 M/32 F	82.2 ± 8.5
Pureed	53	10 M/43F	85.2 ±11.3

M =males, F=females; age excludes 5 subjects where age not available

82.9 ± 9.5 years. There was no difference in age between residents of the two types of facilities (NH and H) or between the consumers of the three different diet texture types: full, soft and pureed. The distribution of diet types differed between NH and H with 33% taking full diets, 29% taking soft and 38% taking pureed diets in NH, whereas in H 90% were taking full diets and 10% soft and none were taking pureed diets. Females had a mean energy intake of 4.2MJ (CI 4.0 to 4.5MJ, 95% confidence intervals) and males 4.6MJ (CI 4.2 to 5.0MJ). The amount of energy supplied for the three meals provided was lower in NH 5.3 MJ/day (CI 5.1 to 5.6) compared to H 5.9 MJ/day (CI 5.6 to 6.2, $P=0.007$). Similarly the amount of calcium and fibre served was lower

in NH (NH: calcium 480.0 mg/day (CI 450.0 to 503.9), fibre 19.8g/day (CI 18.8 to 20.8), compared to H: calcium 557.7 mg/day (CI 517.0 to 599.0), and fibre 25.8g/day (CI 23.2 to 28.2) ($P<0.001$). Protein and vitamin D served did not differ between institutions (NH: protein 61.0g/day (CI 58.4 to 63.6), vitamin D (square root) 1.1 µg/day (CI 1.0 to 1.2); H: protein 60.3 g/day (CI 56.4 to 64.2), vitamin D (square root) 1.0 µg/day (CI 0.9 to 1.1). The square root of vitamin D was calculated because the data were not normally distributed.

Pattern of nutrient consumption was assessed for the 3 meals. The amount of nutrients actually consumed at each meal generally followed the same pattern as the amount served, except for calcium. The least amount of protein in NH was served at breakfast, 10.7g (CI 9.8 to 11.5), followed by the evening meal, 19.8g (CI 18.2 to 21.4), and the most at lunch, 30.5g (CI 28.7 to 32.5) ($P <0.05$). In H there was no difference in protein intake between breakfast, 12.4g (CI 10.7 to 14.0) and the evening meal, 15.9g (CI 14.5 to 17.3). In H, most protein was served at lunch 32.0g (CI 28.7 to 35.3), with less served at breakfast 12.4g (CI 10.7 to 14.0), and evening 15.9g (CI 14.5 to 17.3) (ANOVA $P<0.0001$, Tukey HSD $P<0.05$). There was no indication that NH residents ate a greater percent of available energy at any particular meal, and the mean for each meal ranged from 77- 82%, although those in H ate a greater percentage of energy served at breakfast (92%) than at the evening meal (85 %) ($P=0.031$, Tukey HSD $P<0.05$). In H more energy was consumed at lunch compared with breakfast (lunch 2.2 MJ, breakfast 1.4 MJ), with an energy difference of 0.8 MJ (CI 0.5 to 1.2,) ($P<0.001$). Compared to the evening meal (1.4 MJ), the energy consumed at lunch was also greater by 0.8MJ (CI 0.4 to 1.2) ($P<0.0001$). In NH, less energy was consumed for breakfast, (1.0 MJ) compared with lunch, (1.5 MJ), a difference of 0.5MJ (CI 0.3 to 1.6) ($P<0.0001$) or the evening meal (1.4 MJ), a difference of 0.4 MJ (CI 0.3 to 1.6) ($P<0.0001$).

Table 3. Mean nutrient intakes from meals (95% confidence intervals)

	All	Nursing Home	Hostel	Full Diet	Soft Diet	Pureed Diet
N	215	139	76	114	48	53
Energy (MJ)	4.3 (4.1, 4.5)	3.9 (3.6, 4.10)***	5.2 (4.8, 5.5)	4.7 (4.4, 5.1)	3.9 (3.5, 4.3) †††	3.8 (3.5, 4.2) †††
% Energy Eaten	79.0 (76.3, 81.7)	74.2 (70.5, 77.8)***	87.7(85.1, 90.3)	82.2 (79.1, 85.3)	76.7 (69.6, 83.8)	74.1 (68.6, 79.5)
Protein (g)	46.7 (44.3, 49.1)	44.6 (41.7, 47.7)**	50.5 (46.6, 54.3)	48.9 (45.6, 52.2)	46.8 (41.4, 52.3)	41.7 (37.5, 45.9)
Calcium (mg)	401 (379.7, 424.5)	359.0 (333.0, 385.0)***	480.5 (444.3, 516.7)	437.9 (404.8, 471.1)	366.1 (320.9, 411.4)	356.8 (321.8, 391.9)
Fibre (g)	17.2 (16.1, 18.4)	14.6 (13.6, 15.7)	22.0 (19.6, 24.3)	19.2 (17.3, 21.1)	15.3 (13.4, 17.2)	14.6 (13.3, 16.0) ††
Vitamin D [a] (µg)	1.0 (0.9, 1.0)	1.0 (0.9, 1.0)	1.0 (0.9, 1.1)	1.0 (0.8, 1.1)	0.8 (0.7, 1.0)	1.9 (0.9, 1.2)
Protein/Energy	11.0 (10.7, 11.4)	11.7 (11.3, 12.2)***	9.8 (9.4, 10.3)	10.5 (10.1, 11.0)	12.0 (11.3, 12.7)	11.2 (10.5, 12.1)
Calcium/Energy	97.1 (92.0, 102.2)	98.8 (91.3, 105.8)	94.4 (88.6, 100.3)	95.3 (88.5, 102.0)	98.0 (88.1, 107.9)	100.8 (88.0, 112.5)
Fibre/Energy	4.0 (3.8, 4.1)	3.8 (3.7, 4.0)	4.2 (3.9, 4.5)	4.0 (3.7, 4.2)	4.0 (3.7, 4.3)	3.9 (3.7, 4.2)

[a] Square root of vitamin D
Significantly lower in nursing homes than in hostels, t-test, ** $P<0.01$, *** $P<0.001$
Significantly different from Full Diet (ANOVA, Tukeys HSD post hoc test, †† $P<0.01$, ††† $P<0.001$)

Table 3 shows the percent of energy consumed of that served, the amount of energy consumed and the nutrient density of foods eaten by residents of NH and H, split into the 3 different diet types. The percent of energy consumed of that served was 14% lower in NH compared to H. Similarly, the mean energy consumed from meals was 1.2 MJ lower in NH compared to H. Protein and calcium intakes were lower in NH: the protein/energy ratio was higher in NH, whereas the calcium/energy and fibre/energy ratios did not differ. Vitamin D intake was not normally distributed (NH: mean 1.2 ± 1.1µg, median 0.9; H: mean 1.1 ± 1.0 µg, median 0.9µg). There was no difference in vitamin D intake between NH and H. Those on soft or pureed diets consumed less energy, protein, calcium and fibre compared with those on a full diet. The nutrient density did not differ between diet types.

Diet textures and eating ability

Information on eating impairment was obtained from staff for 211 residents. Staff reported at least one eating impairment factor in 90 of the 139 individuals in NH and in 8 of the 76 individuals in H. To assess the effect of eating impairment, those with at least one eating impairment factor were compared within each diet group. As no individual in H was receiving a pureed diet only those residents in NH were assessed (N=135). Of those in NH, 67% had one or more eating impairments, including eyesight loss (9%), problems of the arms or hands (25%), dentures (10%), swallowing problems (19%) and dementia (53%). There was no difference in total daily nutrient intakes for those in NH with eating impairment and those with no impairment. Those taking a full diet, however, who had some eating impairment (N=22) did have lower intakes of energy, protein, fibre and vitamin D compared to those without impairment on a full diet (N=21). Those without an eating impairment on a pureed diet had a 97mg lower intake of calcium compared to those without impairment (Table 4).

Feeding assistance

Information on feeding assistance (partially or fully fed by staff or self-feeding) was provided by staff for 187 of the 215 residents. No hostel residents received assistance with feeding. In NH, 50% were fully self-fed, 37% partially self fed and 12% were fully fed by staff. Ability to self-feed had no significant effect on energy, protein, calcium or fibre intakes in nursing home residents overall. Among the self-fed (N=63), intakes were: energy 4.0MJ (CI 3.6 to 4.3), protein 44.6g (CI 40.3 to 48.9), calcium 356.9mg (CI 316.3 to 397.4), fibre 14.9g (CI 13.2 to 16.5). For the partially or fully fed by staff (N=64): energy 3.9MJ (CI 3.6 to 4.2), protein 46.0g (CI 40.7 to 49.6), calcium 361.9mg (CI 327.8 to 396.1), fibre 14.9g (CI 13.2 to 16.1). Thirty-six percent (N=31) of nursing home residents classified as eating impaired received no assistance with feeding. These residents had lower intakes of protein 37.8g (CI 33 to 42) compared to others with an eating impairment who were partially or fully fed by staff 46g (CI 41.3 to 50.9) (P= 0.026).

Discussion

People in residential care have been found to be at increased risk of malnutrition and those in nursing homes are at greater risk.[17] This study confirmed that those residents in higher-level care facilities (NH) were served less energy, calcium and fibre in one day at the three meals and consequently had lower intakes of energy, calcium and fibre. The proportion of food eaten from that served for the day was lower in NH, with NH residents consuming 74% of the energy served and H consuming 88%. It seems likely that the appetite of those in NH was less than those in H and that the staff responded to this by providing less food to residents. Moreover, the NH residents ate less of the food provided. The proportion of food consumed from that served was high, more than 70%. This

Table 4. Mean nutrient intake in Nursing Homes from meals, in the three diet texture groups, with and without ≥ 1 eating impairment (95% confidence intervals)

	N	Energy (MJ)	Protein (g)	Calcium (mg)	Fibre (g)	Vitamin D[a] (µg)
No Impairment	45	4.0 (3.5, 4.5)	47.0 (41.2, 52.8)	342.9 (285.5, 399.4)	14.8 (12.8, 14.9)	0.9 (0.8, 1.1)
Impaired	90	3.7 (3.5, 4.0)	43.2 (39.7, 46.6)	362.4 (334.3, 362.4)	14.4 (13.2, 15.6)	0.9 (0.8, 1.0)
Full Diet						
No Impairment	21	4.6 (3.9, 5.4)	52.6 (43.9, 61.3)	405.5 (312.7, 496.4)	17.3 (14.1, 20.3)	1.1 (0.9, 1.4)
Impaired	22	3.2 (2.6, 3.8)**	35.1 (29.0, 41.3)**	309.8 (241.9, 377.7)	11.3 (8.3, 14.2)**	0.8 (0.6, 0.9)*
Soft						
No Impairment	11	3.4 (2.0, 4.5)	41.7 (25.8, 57.5)	285.6 (150.7, 420.5)	12.6 (13.5, 17.7)	0.7 (0.4, 1.1)
Impaired	29	4.0 (3.5, 4.4)	50.6 (44.4, 56.8)	376.0 (327.2, 424.9)	15.6 (7.1, 18.2)	0.8 (0.6, 1.0)
Pureed						
No Impairment	13	3.7 (2.9, 4.4)	40.8 (33.5, 48.1)	292.0 (226.3, 357.7) *	12.5 (10.0, 15.1)	0.7 (0.5, 1.0) *
Impaired	39	3.9 (3.4, 4.3)	42.2 (37.0, 47.4)	382.0 (342.3, 421.6)	15.2 (13.6, 16.9)	1.1 (1.0, 1.2)

[a] Square root of vitamin D

Unpaired t-test: No impairment versus Impaired eating *P<0.05, **P<0.01

could indicate that residents generally enjoy the food provided. It could, however, also indicate that staff are well-skilled in assessing the amount of food each particular resident will eat and alter the serving sizes to suit. Determination of the correct serving size of a food for an individual resident is difficult, as providing too large a serve can reduce the amount of food eaten and too small a serve can mean the person goes hungry as there are limited opportunities to receive a "second helping".

There was no difference in the nutrient density of the food between NH and H, except for the protein/energy ratio which actually greater in NH, so a reduction in total food intake accounted for the reduction in energy intake, not a change to less nutritious foods. This reduced intake in NH is probably a function of the interacting effects of reduced physical activity, medical problems, depression and lack of interest in foods.

In the National Nutrition Survey (NNS),[16] the mean energy intake for females over the age of 64 years was 6.4MJ/day and this compares to only 3.9MJ/day in NH and 5.1 MJ/day in H. It must be noted that we measured only dietary intake from meals and did not measure mid-meal intake. For example, if a resident consumed 200mL of orange juice, 200 ml of milk, three sweet biscuits and one tomato sandwich throughout the day, this could add 1.2 MJ of energy, 6g protein, and 55 mg calcium to the daily intake. The total energy intake would then be raised to 5.0MJ/day (NH) and 5.4MJ/day (H). Anecdotal comments from the staff indicate that most residents consume much less than 1.2MJ between meals. On these low energy intakes it is very difficult to meet Recommended Daily Intakes (RDI) for a number of nutrients. Diets that consistently fail to meet the RDI are a cause for concern in an older group. Although these residents are likely to be sedentary they may also have increased energy requirements related to medications, which increase metabolism or dementia-related wandering.[6]

The calcium intake from meals was low. In nursing home residents 94% of residents consumed less than 75 % of the Australian RDI for calcium, which is currently 800 mg for men aged $\geq$ 64 years and 1000mg for women aged $\geq$ 54 years.[18] A recent study conducted in frail elderly persons implemented an exercise regime combined with nutrient dense foods containing a range of vitamins and minerals including 25% of the recommended daily allowance for calcium for 17 weeks. They demonstrated a preservation of lean mass and an indication of an increase in bone mineral density and bone mass, indicating that a combination of exercise and improved nutrition could improve health.[19] Another important nutrient with respect to bone health is vitamin D. It is now recognised that vitamin D deficiency is common in elderly groups, particularly those in residential care that and 22% of hostel and 45% of nursing home residents were frankly deficient.[20] In this population, 91% consumed less than 3 µg of vitamin D from daily meals, which would be insufficient in a population not receiving regular sunlight exposure. There is no RDI for vitamin D for the general population, but it is recommended that the elderly

receive a daily 5-10µg vitamin D supplement if they are not directly exposed to sunlight for 1-2 hours per week.[18]

Fibre intakes were also low, with 73% percent of residents consuming less than 20 g of fibre per day from meals. Although there is no Australian RDI for fibre it has been suggested that an intake of 35-45 g daily is a reasonable aim[21] and may reduce the incidence of constipation.[22]

When assessing the effect of different diet texture types on nutrient intake, those taking soft and pureed diets had lower intakes of energy, protein, calcium and fibre compared with those taking full diets. Those requiring a texture-modified diet are likely to have reduced ability to ambulate freely, have reduced energy expenditure and generally reside in nursing homes. Nutrient intake was lower in nursing homes compared to hostels. This difference was found despite there being no difference in age between those in nursing homes and those in hostels. Another nutritional survey conducted in Australian nursing home residents has also reported that nutrient intake was compromised because of low intakes of food energy.[8] Within the nursing homes, some groups were at further risk due to eating impairments. We found that when residents were assessed by diet texture type and eating impairment, those taking a full diet who had some eating impairment had lower intakes of energy, protein, calcium and vitamin D. This may be because those with some impairment experienced difficulty in eating a full diet and would potentially benefit from a more specific assessment of their dietary needs. There was no difference in nutrient intake resulting from eating impairment in those taking the soft diet. For those taking the pureed diet, however, those with some impairment to eating actually had a higher intake of calcium and this may have been due to nursing staff providing those impaired residents with more milk-based foods. The nutrient intake of 20 nursing home residents receiving a pureed diet was not found to be significantly different from those receiving a full diet (N=31) when dietary intake was assessed over 7 days, but many women in both groups had lower than recommended intakes of iron, zinc, calcium and vitamin D.[23] Allocation to a modified-texture diet suggests some kind of eating impairment and it is likely that all of these residents would have benefited from being identified as eating impaired by staff. Thirty-six percent of nursing home residents deemed eating-impaired received no assistance with feeding and had lower intakes of protein. It is possible that their intake could have been improved by providing assistance with eating. The early identification of eating impairment, and early provision of feeding assistance is a possible strategy to increase intake and prevent loss of weight in these vulnerable nursing home residents.

It should be acknowledged that there are limitations to this study. The institutions were not randomly selected since this study was only possible in cooperating institutions. Therefore, these institutions may not be representative of all nursing homes and hostels. In assessing nutrient intake some allowance must be made for foods and beverages taken between meals and from outside sources such as relatives. Measurement of body mass index (BMI) was outside the

scope of this study, but the relationship between dietary intake BMI should be evaluated in future studies.

This study has documented meal intake on one day in 215 residents, which provided a "snapshot" of the daily dietary intake from meals. It is acknowledged that it would take many days to accurately determine the intake of some nutrients for individuals. An assessed daily intake, however, indicating such low energy intakes, even allowing for errors in individual estimates, indicates that dietary intake as a whole in this group is a cause for concern. We found that at these low energy intakes, calcium and fibre intakes were exceptionally low, and that nursing home residents were particularly at risk of low intakes. In addition, those nursing home residents taking a pureed diet and not assessed as having an eating impairment, and those assessed as having an eating impairment but receiving no assistance with feeding, were also at increased risk of inadequate nutrition. Effective monitoring of nutrient intake, improved identification of those with eating impairment, and environmental changes to improve food access and availability are likely to improve the nutritional intake of all residents. This study provides a practical demonstration of the information that can be gained relatively easily and could be used as the basis of an effective monitoring tool. This approach has the potential to be used more widely in the monitoring of nutritional intake in the elderly in residential care.

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