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MEETING THE NUTRITIONAL NEEDS OF ELDERLY RESIDENTS IN AGED-CARE: ARE WE DOING ENOUGH?

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Abstract: *Objetives:* Institutionalized elderly are at high risk of malnutrition, including those residing in low-level aged-care and able to self-feed. We used comprehensive dietary intake assessments to determine the nutritional adequacy of food served to residents and if food waste contributed to insufficient nutrient intakes. *Design:* Cross sectional. *Setting*: 18 low-level aged care facilities. *Participants*: 199 residents (mean age 86.7 yrs, 76% females). *Measurements*: Dietary data using 3-6 day weighed food records. Foods were categorized into main food groups (grains, fruit, vegetables, meats, dairy and 'extra') and quantified based on recommended serving sizes. Chi squared test was used to determine sex differences in proportion of residents below recommended intake levels. *Results:* Residents were provided with sufficient serves of fruit (> 2) and meats (> 1), but not dairy (< 3), vegetables (< 5) and grain foods (women only, < 4), and excess serves of 'extra' foods (> 2). Mean dietary intakes did not meet recommendations for calcium, zinc, magnesium, potassium, folate and dietary fibre with many residents not meeting energy and protein requirements. Sodium intake was up to 3 times higher than recommended, and sugars consumed in excess. Food waste was 0-15% and resulted in men not consuming recommended serves of grain foods. 'Extra' foods contributed substantially to energy intake but provided few of the required nutrients. *Conclusion:* Substituting some 'extra' foods for serves of dairy, vegetables and wholegrain foods would improve the nutritional quality of foods, without altering food volume, so is feasible to improve nutritional status in elderly aged-care residents.

Key words: Aged-care, food intake, malnutrition, nutrient deficiencies.

Introduction

Up to 75% of institutionalized elderly are malnourished or at risk of malnutrition, which contributes to morbidity, mortality and reduced quality of life (1, 2). The cost of malnutrition in aged-care is estimated at €10,000 per resident (3). Contributors to malnutrition risk include intrinsic factors such as poor dentition and cognitive impairment, and extrinsic factors such as low staff numbers and inadequate staff training in nutritional care (4-7). Despite being able to self-feed, low-level aged-care residents (residential care in the UK and assisted care in the USA) are at risk of malnutrition (8, 9). Preventing malnutrition in these residents is beneficial, as delaying the progression to high-level (nursing home) care can effectively reduce the cost of care by 67% (10).

Elderly residents with limited appetites may have difficulties consuming enough food to meet nutrient needs, so providing high quality, nutrient dense foods to residents is important to prevent malnutrition (11). Recommendations exist indicating the number of food serves from the main food groups (e.g. grains, fruit, vegetables, meats, dairy) to help ensure food intake meets nutrient needs (12). Malnutrition may be reduced by, firstly ensuring residents are provided with the recommended serves from each food group, and secondly that foods served are consumed, as malnutrition risk increases if <75% of food offered is eaten (13). To address the issue of malnutrition in low-level aged-care residents we used comprehensive dietary assessments to determine the nutritional adequacy of food served and if food waste contributed to insufficient nutrient intakes.

Methods

Data was collected at baseline from 199 residents enrolled in a large intervention trial (16 facilities), or feasibility study (2 facilities), collectively involving >1500 residents (14). Residents provided consent for detailed nutritional and health assessments, including review of medical records. These residents did not differ by age, medication use, and disease types from the broader resident population. The ratio of female-to-male residents in these facilities was indicative of aged-care populations in Australia (15). The human research ethics committees of Austin Health and Monash University approved this study.

In Australia, care needs of residents are assessed prior to admission. Semi-independent, ambulatory elderly requiring some assistance with daily activities are accommodated in low-level care facilities. Participating facilities were equipped with commercial kitchens, with most meals and snacks prepared and served on-site. Meal service consisted of continental style (and occasionally hot) breakfasts, hot lunches (e.g. main meal and dessert), choice of hot or cold dinners (e.g. soup, light meal and dessert), and morning, afternoon and evening snacks. Drinks (usually cordial, water or tea or coffee) were served with meals and snacks. Menus were based on four-week cycles. Data was collected on 3-6 days (weekdays and weekends), at various times throughout the year to account for different menu cycles,

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seasonality and availability of some foods.

Dietitians collected dietary data based on weighed intake of all foods, beverages, and food supplements served and consumed at main meals and snacks. Foods were weighed to ±1g on digital scales (Soehnle Venezia, Switzerland). Brand names, preparation method and recipes for dishes were recorded. Individual dietary intakes were analyzed for macro- and micro-nutrients using FoodWorks (2009, Professional Edition XYRIS Software, Queensland, Australia). Total intake was divided by the number of days of data collection to represent mean daily intake. Proportion of recommended daily intake (RDI), adequate intakes (AI) and upper limit for sodium were based on Australian standards (16). Estimated energy requirements were based on Nutrient Reference Values equations (Shofield equation for BMR estimation based on height, weight and age x PAL) (16). Residents were very sedentary, with mobility generally restricted to the facilities.

Foods were categorised according to the Australian Guide to Healthy Eating (AGHE) (12). Recommended serving sizes were consistent with the AGHE, except for grain foods where serves were halved, so for example one slice of bread or equivalent was classified as one serve. Serves of foods provided to residents were expressed as a proportion of recommended sizes. Composite foods were separated into main ingredients and categorised within the relevant food group. Milk from dietary supplements was included in the 'dairy' group but powdered and ready-to-drink supplements were not included. Less than 5% of residents consumed supplements. Based on the AGHE fish is included in the 'Meat' category however, the consumption of fish is infrequent and usually consists of commercially prepared crumbed white fish, with deep-sea fish rarely consumed. 'Extra' foods included cakes, biscuits, confectionery, soft drinks, alcoholic beverages, takeaway foods and ice-cream (the latter contributing only approximately 13% to the 'extra' category).

Data are presented as mean ± standard deviations. The RDI was used to determine the proportion (%) of residents meeting requirements. Sex differences in proportion meeting recommended intakes were compared using the chi-square test. Differences in % waste between food categories were determined using ANOVA, with adjustments made for multiple comparisons. A $p < 0.05$ was considered statistically significant but values $p < 0.1$ are reported to indicate trends. Data were analysed using SPSS for Windows (Version 19.0, SPSS Australasia Ltd, Melbourne).

Results

Dietary data were collected on 199 residents (mean age 86.7±6.6 years, 76% females) from 18 low-level aged-care facilities. Health status and female to male ratio was indicative of aged-care populations in Australia (15). On average residents suffered from 5 chronic medical conditions and were on 9 long-term medications. Sixty-eight percent of residents had vascular disease, 50% suffered from arthritis, depression was reported in 27% and 25% had significant sight impairment. Men were taller (169.3±7.7 v 154.7±7.0cm) and heavier (70.8±12.1 v 60.7±12.5kg, both $p<0.001$) than women, but no different in age (85.3±8.1 v 87.1±6.1 years) or BMI (24.7±4.3 v 25.3±5.1). Fourteen percent of residents were classified as

Table 1
Food intake data (foods from each food group served and consumed) from 199 elderly aged-care residents from 18 low-level facilities

	Grains 4+	Fruit 2	Vegetables 5	Dairy 3	Meats 1	Extras 0-2
			Served (mean daily serves ± SD)			
All	3.6 ± 1.3	2.3 ± 1.5	2.9 ± 0.9	1.5 ± 0.7	1.5 ± 0.6	4.6 ± 1.8
Women	3.5 ± 1.2	2.3 ± 1.4	2.8 ± 0.8	1.4 ± 0.6	1.5 ± 0.5	4.3 ± 1.7
Men	4.1 ± 1.5*	2.5 ± 1.8	3.2 ± 1.0*	1.7 ± 0.9*	1.7 ± 0.8*	5.6 ± 1.8*
			Proportion (%) of residents provided with below recommended number of serves			
All	65.2	48.2	97.0	96.5	13.1	5.0
Women	69.3	47.7	98.7	99.3	13.2	6.0
Men	52.1*	50.0	91.7*	87.5*	12.5	2.1
			Consumed (mean daily ± SD)			
All	3.0 ± 1.2	2.1 ± 1.3	2.6 ± 0.9	1.3 ± 0.7	1.3 ± 0.6	4.2 ± 1.7
Women	2.9 ± 1.1	2.1 ± 1.3	2.5 ± 0.8	1.4 ± 0.6	1.2 ± 0.5	3.9 ± 1.5
Men	3.5 ± 1.3	2.3 ± 1.5	2.9 ± 1.0	1.6 ± 0.9	1.6 ± 0.7	5.1 ± 1.7
			Waste (mean daily ± SD)			
All	0.6 ± 0.8	0.2 ± 0.4	0.3 ± 0.4	0.1 ± 0.2	0.2 ± 0.3	0.4 ± 0.6
Women	0.6 ± 0.7	0.2 ± 0.4	0.3 ± 0.4	0.2 ± 0.2	0.3 ± 0.3	0.4 ± 0.6
Men	0.6 ± 0.8	0.2 ± 0.6	0.3 ± 0.4	0.1 ± 0.2	0.2 ± 0.2	0.5 ± 0.7
			Percent Waste (mean daily ± SD)			
All	15.4 ± 17.7~	7.4 ± 12.4	11.6 ± 13.4	9.2 ± 11.4	15.3 ± 18.6~	8.2 ± 10.9
Women	16.1 ± 18.3	7.3 ± 11.8	12.1 ± 13.9	10.1 ± 11.7	17.3 ± 19.8	8.4 ± 11.2
Men	13.3 ± 16.0	7.8 ± 14.2	9.9 ± 11.9	6.8 ± 10.1^	9.0 ± 12.6*	7.9 ± 10.1

*$p < 0.05$, ^$p < 0.1$; ~ $p < 0.0001$; % waste for grains & meat > fruit, extras, dairy

Table 2
Macronutrient intake and proportion below recommended levels for 199 aged-care residents

	Energy (kJ)	Protein (g)	Fats (g)	Sat Fats (g)	Carbohydrates (g)	Sugar (g)	Dietary Fibre (g)
Macronutrients (mean daily ± SD)							
All	6371 ± 1504	58 ± 16	63 ± 16	29 ± 8	184 ± 51	101 ± 32	17 ± 5
Women	6072 ± 1345	55 ± 14	60 ± 16	28 ± 8	174 ± 45	98 ± 31	16 ± 5
Men	7311 ± 1600	68 ± 19	71 ± 15	33 ± 8	213 ± 56	113 ± 33	20 ± 6
Percentage (%) of total energy (mean ± SD)*							
All	-	15.2 ± 2.5	36.6 ± 4.4	17.1 ± 3.4	47.7 ± 5.2	26.4 ± 5.5	-
Women	-	15.1 ± 2.4	36.6 ± 4.6	17.2 ± 3.4	47. 6 ± 5.5	26.7 ± 5.9	-
Men	-	15.5 ± 27	36.4 ± 3.7	16.7 ± 3.2	47.9 ± 4.2	25.5 ± 4.0	-
Proportion (%) below recommended							
All	72.2	61.0	3.6	4.5	79.9	0.0	-
Women	74.8	62.3	4.1	0.0	75.3	0.0	95.4
Men	63.8	56.3	2.1	2.0	89.6^	0.0	93.8

Proportion above# or below recommended for: Energy = energy intake >5% below EAR (16), Protein = protein intakes < 1g/kg body weight (16), Fat = > 30% of total energy, Saturated fat = >10% of total energy intake, Carbohydrates = ≥50% of total energy, Sugars = >10 % of total energy, Dietary fibre = males < 30g/day, females <25g/day, * Total displayed is < 100% due to small contribution from alcohol (<1%)

Table 3
Mean daily micro-nutrient intakes for 199 elderly aged-care residents from 18 low-level aged-care facilities

	A (µg)	B1 (mg)	B2 (mg)	B3 (mg)	Folate (µg)	C (mg)	D (µg)
Consumed (mean daily serves ± SD)							
Vitamins							
All	1066 ± 306	1.3 ± 0.7	1.9 ± 0.8	31 ± 9	257 ± 93	93 ± 60	2.9 ± 0.9
Women	1040 ± 305	1.1 ± 0.5	1.7 ± 0.6	29 ± 6	247 ± 87	89 ± 62	2.8 ± 0.9
Men	1157 ± 299	1.7 ± 1.0	2.3 ± 1.2	38 ± 12	292 ± 103	107 ± 51	3.3 ± 1.0
% of RDI (mean ± SD)							
All	-	-	-	-	65 ± 23	207 ± 133	19.3 ± 6.2
Women	149 ± 44	103 ± 43	132 ± 47	210 ± 46	62 ± 22	198 ± 137	18.5 ± 5.9
Men	129 ± 33	144 ± 81	146 ± 74	237 ± 72	73 ± 26	238 ± 113	22.0 ± 6.6
Proportion (%) below RDI (mean ± SD)							
All	14.3	46.7	21.6	0.8	93.2	19.6	100
Women	11.9	51.7	19.7	0.0	94.5	22.5	100
Men	29.6	31.3*	27.1	3.6	88.9	10.4^	100
Minerals							
	Ca (mg)	Fe (mg)	Iodine (µg)	K (mg)	Mg (mg)	P (mg)	Zn (mg)
All	635 ± 244	8.2 ± 2.8	97.3 ± 30.8	2275 ± 604	212 ± 63	1034 ± 306	7.5 ± 2.1
Women	597 ± 192	7.7 ± 2.2	92.1 ± 27.8	2140 ± 507	209 ± 53	988 ± 245	7.1 ± 1.8
Men	753 ± 340	9.7±3.9	114.7 ± 34.1	2698 ± 689	259 ± 75	1187 ± 415	8.8 ± 2.5
% of RDI (mean ± SD)							
All	49 ± 19	103 ± 35	64.89 ± 20.5	75 ± 18	65 ± 17	104 ± 31	-
Women	46 ± 15	96 ± 27	61.4 ± 18.4	76 ± 18	64 ± 17	99 ± 25	89 ± 23
Men	58 ± 26	122 ± 49	76.5 ± 22.7	71 ± 18	62 ± 18	119 ± 42	63 ± 18
Proportion (%) below RDI (mean ± SD)							
All	98.0	50.8	95.3	88.9	97.0	44.0	76.9
Women	99.3	53.6	97.9	87.4	97.4	50.3	70.2
Men	93.8*	41.7	86.4	93.8	95.8	35.4^	97.9*

*p < 0.05, ^p < 0.1; RDI = recommended dietary intake for elderly Australians RDI for vitamins; A (men = 900µg/d, women = 700 µg/d), B1 (men = 1.2mg/d, women = 1.1mg/d), B2 (men = 1.6mg/d, women = 1.3mg/d), B3 (men = 16mg/d, women = 14mg/d), Folate (400 µg/d), C (45mg/d). Adequate intake for vitamin D = 15µg, RDI; Ca (1300mg/d), Fe (8mg/d), Iodine (150 µg/d), Mg (420mg/d for men; 320mg/d for women), P (1000mg/d), Zn (men = 14mg/d, women = 8mg/d), Adequate intake for K= 3800mg/d for men; 2800mg/d for women

underweight based on BMI. Both men and women were given, and consumed adequate serves of meats and fruit, but did not receive recommended serves of dairy and vegetables, and had excess 'extra' foods (Table 1). Women (not men) did not receive recommended serves of grain foods, but neither men nor women consumed sufficient grain serves (Table 1). Food waste was 0-15%, with greater waste observed for grains and meat, than dairy, fruit and 'extras' (Table 1).

Mean energy intakes in men and women were ~1000kJ/day below mean estimated energy requirements of 8333±943 and 7105±680kJ/day (Table 2). A similar proportion of men and women consumed below recommended for protein, and above recommended for fat and saturated fat intakes. All residents consumed >10% of total energy from sugars (Table 2). Dietary

fibre intake was 64.6±19.3% and 66.6±19.8% of recommended for men and women. Males consumed more total energy and macronutrients, however did not differ from women for protein intake when expressed per kg body weight (1.0±0.3 v 0.9±0.3g/kgBW).

Mean intakes of calcium, zinc, magnesium, potassium and folate were below recommended for both sexes, while mean intakes of iron and phosphorus were below recommended for women (Table 3). A greater proportion of men than women were below recommended intakes for zinc however, more women than men were below recommended intakes for calcium and phosphorus (Table 3). Sodium intake in women (1935±670mg/d) and men (2600±0900mg/d) was up to 3 times higher than the recommended adequate intake (≤920mg/d).

Table 4
Contribution of food from the 'extra' category to total intake in 199 aged-care residents from 18 low level facilities

Nutrient	Amount	% of total intake
Energy (Kj)	2491 ± 1000	39.0 ± 12.5
	Macronutrients	
Protein (g)	10 ± 5	17.2 ± 8.6
Fat (g)	31 ± 12	49.3 ± 14.7
- saturated fats (g)	15 ± 6	52.9 ± 16.0
Carbohydrates (g)	77 ± 33	40.2 ± 14.7
- sugars (g)	48 ± 25	47.0 ± 24.5
Dietary fibre (g)	2 ± 1	14.3 ± 7.7
Mic	**ronutrients**	
Sodium (mg)	492 ± 258	24.3 ± 11.4
Zinc	1.0 ± 0.6	13.8 ± 7.6
Calcium (mg)	104 ± 57	17.3 ± 9.4
Magnesium	33 ± 17	15.0 ± 6.6
Iron	1.3 ± 0.8	16.2 ± 8.2
Phosphorus	209 ± 101	21.1 ± 10.6
Potassium	328 ± 190	14.5 ± 7.2
Vitamin A	294 ± 129	28.4 ± 12.6
Vitamin C	3.9 ± 4.0	5.8 ± 9.2
Thiamin	0.14 ± 0.09	11.8 ± 6.9
Riboflavin	0.25 ± 0.13	14.8 ± 8.2
Niacin	4.4 ± 2.8	12.6 ± 6.9
Folate	25.3 ± 17.2	10.7 ± 8.6

'Extra' foods provided 39% of energy intake, but only provided 14% of the dietary fibre, 11% folate, 17% calcium, 15% magnesium, and 14% zinc and potassium. Forty-nine percent of fat intake (53% of saturated fats) and 47% of sugar intake were derived from 'extra' foods, which contributed 17% to protein intake (Table 4). Based on food groups served relative to recommendations, substituting 4 serves of 'extra' foods for 0.4 serves of wholegrain foods, 2.1 serves of vegetables and 1.5 serves of dairy foods and maintaining current intakes of fruits and meats aligns the menu to one that fulfills dietary guidelines and where recommended intake of nutrients is more likely achieved (Table 5).

Discussion

Low-level aged-care, residents were provided with sufficient serves of fruit and meats, but not dairy, vegetables and grain foods (women only), and excess serves of 'extra' foods. Mean dietary intakes of residents did not meet recommended levels for calcium, zinc, magnesium, potassium, folate and dietary fibre, but sodium intake was up to 3 times higher than recommended, and excess sugars consumed. Dietary intakes in many residents did not meet energy or protein requirements. Food waste was a minor contributor to nutritional inadequacy. 'Extra' foods contributed substantially to energy intake but little to intake of nutrients consumed in sub-optimal levels. Substituting some 'extra' foods for serves of dairy, vegetables and wholegrain foods would improve the nutritional quality of foods offered, without substantially altering food volume so is a feasible option to prevent malnutrition in elderly aged-care residents.

High malnutrition rates increase care costs (3). Interventions have been undertaken to address malnutrition in aged-care (11, 17). Oral nutritional supplements (ONS) are effective in improving weight status in hospitalized elderly (6, 18). However, in aged-care ONS are frequently not administered as prescribed and regular food intake is compromised resulting in limited benefit to overall nutrient intake (19). Adding fats and oils to foods, augment energy intake but contributes little to nutritional content, and fortifying foods during cooking proved difficult for staff with limited time and food preparation skills (14). Furthermore, studies of food service in aged-care often focus on residents' satisfaction with food presentation, delivery, and dining ambiance, while nutritional quality goes un-scrutinized (20). We, and others have observed that aged-care residents consume suboptimal serves of vegetables, cereals, and dairy, fail to achieve recommended intakes of key nutrients and often consume excess fat and salt (21).

Fracture rates are highest in low-level aged-care residents, and insufficient intakes of protein, calcium and vitamin D contribute to fracture risk (22-25). Protein intake was near

Table 5
Suggested changes to number of serves of food groups offered to low-level aged-care residents based on current intake and that recommended for people > 60 years (19)

Grain foods	Fruits	Vegetables	Dairy	Meat / Fish	Extras	
Recommended	4+	2	5	3	1	0-2
Current	3.6	2.3	2.9	1.5	1.5	4.6
Suggested	3.6 + (0.4)4	2.3	2.9 + (2.1)5	1.5 + (1.5)3	1.5	4.6 – (0.4 + 2.1 + 1.5) 0.6

recommended, but calcium intake < half recommended levels (16). Sub-optimal 25(OH)D levels have been observed in institutionalized elderly (14, 26). Increasing dairy intake by 1.5 serves would improve protein (~13g), calcium (~380mg) and vitamin D (~80IU) intakes however, vitamin D supplementation would be required to achieve recommended levels (27).

Constipation is common in institutionalized elderly, and along with laxative use, is associated with malnutrition, so correcting constipation with dietary fibre is desirable to reduce laxative use (28-31). We observed that 95% of residents consumed below recommended levels for dietary fibre. Bermejo et al. observed fruit and vegetable (F&V) consumption in elderly residents correlated with fibre intake ($r=0.68$, $p<0.001$) and those in the highest tertile for F&V consumption consumed closer to recommended serves of key foods and recommended intakes of micro-nutrients (32). The suggested 2 vegetable serves and 0.5 serve of wholegrain cereals would provide ~ 5g fibre.

Sarcopenia or age related loss of muscle mass and function is exacerbated by protein-energy malnutrition (33). Consumption of adequate protein stimulates muscle protein synthesis and partially prevents sarcopenia (34). Mean protein intake was below 1g/kg body weight (35, 36). An increase of 1.5 serves of dairy would provide an additional 13g/day of high quality protein, which contains leucine that increases IGF-1 expression, lean muscle mass and muscle protein synthesis in older women (37, 38).

Cardiovascular disease is prevalent in aged-care residents (9). Sodium intake was up to 3 times higher than recommended, while potassium and calcium intakes were below recommended (16). 86% of residents were pre- or hypertensive (unpublished data). A high urinary sodium to potassium ratio (reflecting intakes) was positively associated with systolic blood pressure in older Australians (mean age 64 years) (39). Sacks et al suggested that the potassium and calcium content of the DASH (Dietary Approaches to Stopping Hypertension) diet either dampened hypertensive effects of sodium, or exerted their own hypotensive effects as partial explanations for observed reductions in blood pressure with DASH interventions (40). Increasing vegetable and dairy consumption would enhance potassium and calcium intakes and may have an anti-hypertensive effect, especially in salt sensitive residents (41). Using herbs and spices to enhance food flavours may further reduce the use of salt in cooking.

Adequate nutrition is important for immune function (42). The decline in immune function deemed part of ageing, relates more to nutritional deficiencies, as in healthy, well-nourished elderly, immune function does not deteriorate until advanced age (90+ years) (43). Protein energy malnutrition and deficiencies of vitamins A and E, folate, zinc, iron and magnesium have been linked with changes to the immune system such as reduced lymphocyte counts and proliferation, decreased cytokine production and natural killer cell activity, and impaired antibody response to antigens (43). Nutritional supplementation enhances immune function, although an adequate dietary intake would reduce the need for supplementation (42).

Enhancing taste and palatability of foods likely improve voluntary intake, and menus that are varied, attractive, high in protein and energy, and offered in small portions has been purported to assist compliance (44-47). Menu modifications such as vegetables in cheese sauce, custard served with desserts, or offering cheese with wholegrain crackers in place of plain biscuits are changes that would align menus with recommendations, while not compromising eating enjoyment. As energy intake was below the EER, in addition to the changes indicated, serving up to the suggested maximum of 3 'extra' foods daily would provide additional energy, not compromise nutritional adequacy and still maintain eating enjoyment.

This study is limited by its cross sectional design, use of a convenience sample of residents, and lack of exploration of reasons for inadequate food intakes. Strengths of the study are that facilities were representative of the wider community, and dietary intake was accurately measured. It is the first to report on food provision and consumption in elderly residing exclusively in low-level care.

Malnutrition risk is high in elderly who have special dietary needs or require feeding assistance (48). While it is acknowledged that those with special nutritional needs may require additional supplementation or food fortification, this study highlights that even for cognitively sound elderly residents capable of self-feeding, foods offered and consumed failed to meet recommended serves or intake levels. This occurred despite accreditation standards regarding nutrition in aged-care (49). The cost of malnutrition will be borne by health and aged care systems through greater care needs, increased risk of hospitalisation and premature transfer to high-level care (48). Re-structuring menus to at least contain the recommended number of serves from each food group will help ensure nutritional adequacy. Changing the quality of food offered, more than the quantity is a first step solution to reducing the risk of malnutrition in aged-care residents and in turn the associated cost that accompanies nutritional deprivation.

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