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Cost benefit analysis of an intervention to improve the nutritional status of community dwelling older Australians

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Australian Meals on Wheels Association

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Glossary

ABS	Australian Bureau of Statistics
ADL	activities of daily living
AE-DEM	Access Economics demographic model
AIHW	Australian Institute of Health and Welfare
AMOWA	Australian Meals on Wheels Association
BMI	body mass index
CBA	cost benefit analysis
DOHA	Department of Health and Ageing
MOW	Meals on Wheels
MNA	Mini Nutritional Assessment
MNA-SF	Mini Nutritional Assessment – Short Form
NA	not applicable
NPV	net present value
NWN	not well nourished
RAC	residential aged care
RR	relative risk
SD	standard deviation
WN	well nourished

Executive Summary

This study reports the findings of a cost benefit analysis (CBA) of a proposed intervention to ameliorate under-nourishment among older Australians living in the community who are at risk of malnutrition or who are malnourished and who receive MOW. The analysis was commissioned by the Australian Meals on Wheels Association (AMOWA).

The analysis aims to inform and support a pilot study which AMOWA intends to undertake examining the effectiveness and feasibility of interventions to avoid malnutrition among MOW clients who may be at risk. Given the paucity of research in this area, the AMOWA study is important and should be welcomed.

Inadequate nutrition is potentially common among older people living in the community — ranging between 30 and 47%. However, there are few Australian studies of the prevalence of undernourishment among those living in the community and sample sizes are small.

Serious illness and disease have been linked to poor nutrition including coronary heart disease, cancer, stroke and non-insulin-dependent diabetes mellitus (World Health Organisation 2002). Ageing increases the risk of malnutrition and thus the propensity for nutrition-related disease (Kamp et al, 2010). Limited quantitative evidence suggests malnutrition among older Home and Community Care clients leads to poor outcomes such as greater risk of admission to hospital, lengthy hospital stays (greater than the average), greater risk of falls and premature admission to residential aged care (RAC). These poor outcomes are associated with high financial costs, for example, the average cost of an admission to hospital in 2010 is around $4,735, a fracture that resulted from a fall is $92,660, and the average annual cost of RAC is $67,116 more expensive than average home care costs. Other benefits of improved nutrition include wellness, added vitality and increased ability to enjoy life.

Effective interventions to improve nutrition have significant potential to save costs to the healthcare system. Research on the effectiveness of nutritional interventions is however scarce, and generally focused on older people already in hospital. Findings from the research currently available suggest the effectiveness of MOW in improving and maintaining client nutrition is affected by frequent meal splitting by older people and the fact that meal supplements may be associated with a reduction in the usual dietary intake.

The target group for the intervention analysed here is individuals receiving MOW who are aged 70 years and above and who may be malnourished, or at risk of malnourishment. Approximately 5% of community dwelling people aged 70 years or over receive MOW. Most MOW clients are well nourished. However, we estimate that in Australia in 2010, of the nearly 93,000 people aged 70 or over who receive MOW, there were 14,805 males and 25,208 females who were malnourished, or at risk of malnourishment. In 2010 the potential financial cost to the health and aged care systems of under-nutrition in this population was approximately $1.7 billion (noting the limited evidence base for these estimates).

- Of this, costs associated with hospitalisation due to malnourishment are around at $12.4 million.
- Longer hospital stays (of more than 14 days) accounted for around $25.8 million (representing the cost of the part of a 14 day stay which is greater than the average length of stay).

- The cost of treating fractures resulting from falls is approximately $120 million (excluding the hospitalisation costs so as not to double count with above).
- The costs of admission to RAC as a result of malnourishment were estimated at $1.6 billion.

Note that the base line for these financial estimates is the average rate of hospitalisation, fracture and admission to RAC among older people who are well nourished. The estimates therefore reflect the costs that could potentially be avoided by alleviating under nourishment.

A CBA comparing costs and benefits over a ten year period, with future benefits and costs discounted to the present using a 7% discount rate was undertaken. A benefit cost ratio greater than one in this study signals the proposed intervention is associated with cost savings to the health and aged care system.

Taking into account the costs of supplementing meals (over and above the cost of the meal itself) estimated by AMOWA, and based on conservative assumptions about efficacy (supplementation is effective in eliminating or avoiding undernourishment in 50% of those eating the full meal, but 72% of clients split their meals), we estimated a mean benefit:cost ratio of 2.07 (95% confidence interval 0.66 to 3.89, standard deviation 0.99) — a return to investment of around 100%. Probabilistic sensitivity analysis using a Monte Carlo simulation found that the benefit:cost ratio was greater than one 85% of the time, **suggesting the intervention is highly likely to be cost saving**. Regression analysis showed that the effectiveness of the intervention has the greatest impact on the results. Given the uncertainty around this and other parameters, further research should be prioritised.

The cost benefit analysis in this report shows that — even with conservative assumptions about the effectiveness of the intervention — meal supplements for under-nourished MOW clients are highly likely to result in significant savings to the health and aged care system — reducing hospitalisations, falls and premature admission to RAC. A benefit:cost ratio of 2.07 implies the net present value of savings to the health system would be more than $463 million over 10 years. Moreover, the results of this study do not take account of the potential additional benefits likely to flow from improved nutrition levels in the elderly — improved quality of life resulting from better health/wellness and vitality.

Given the potential benefits of nutritional interventions and the likely prevalence of undernourishment among older Australians living at home, studies to improve the evidence base would be very valuable and should be pursued as a high priority.

Access Economics 2010

1 Background

The Australian Meals on Wheels Association (AMOWA) commissioned Access Economics to conduct a cost benefit analysis of an intervention to ameliorate under-nourishment among older Australians living in the community who are at risk of undernourishment or who are undernourished and who receive Meals on Wheels (MOW). The potential benefits include preventing admission to hospital and stays in hospital of long duration, avoiding falls, and reducing admissions to residential aged care (RAC). This report also estimates the financial costs of malnutrition among older Australians receiving low level community care.

The analysis predates a pilot study which AMOWA intends to undertake examining the effectiveness and feasibility of interventions to avoid malnutrition among MOW clients. Given the paucity of research in this area, the AMOWA study is welcomed.

AMOWA aims to assist older Australians to remain at home through the provision of affordable, nutritious meals and friendly personal contact. Over 100,000 individuals access the service each year, most aged over 75 years (personal communication, AMOWA, 13 August 2010). MOW operates Monday to Friday, delivering a nutritionally balanced, three course midday meal at a cost of approximately $10 (including client contribution and subsidy) or $2,600 per client per annum in 2010 (personal communication, AMOWA).

Without assistance with meal preparation some older Australians would need to enter RAC. Institutionalised care is costly; the average Australian Government payment (subsidy plus supplements) for each permanent residential aged care recipient in 2008-09 was $48,550 for high care, $17,750 for low care, or $40,100 on average overall (Department of Health and Ageing (DoHA) 2009a).

In addition, MOW delivered meals are nutritious. Poor nutrition has been linked to a myriad of diseases including cancer, heart disease and diabetes (Worth Health Organisation 2002). Ageing increases the risk of malnutrition and thus the propensity for nutrition-related disease (Kamp et al, 2010). A US review of older adults receiving home-delivered meals found these individuals have higher daily intakes of key nutrients compared to those who do not receive MOW and the recipients' weekday nutrient intake was significantly higher than on the weekend when meals were not provided (Department of Health and Human Services, Administration on Aging 2006).

Reasons for malnutrition in the aged community include (Lipski 2005):

- poor health causing reduced mobility, fatigue, and frailty;
- polypharmacy leading to decreased appetite;
- dentition, chewing and swallowing disorders for example, following a stroke;
- lack of social support;
- reduced ability to shop;
- low income;
- poor food and nutrition knowledge; and

- lack of interest and motivation, particularly when alone.

1.1 Report structure

This report is structured as follows:

- the aim, methods, and limitations of the analysis are covered in Section 2;
- in Section 3, the effectiveness of the proposed intervention is discussed;
- the target group is outlined in Section 4;
- potential benefits of improving the nutritional status of older Australians are presented in Section 5 such as reduced hospital and aged care costs;
- Section 6 covers the CBA including a summary of the sensitivity analysis performed; and
- concluding remarks are contained within Section 7.

2 Aim, methods and limitations

2.1 Aim

The aim of this study is to analyse the costs and benefits of providing additional nutrition to not well nourished (NWN) MOW clients to improve their nutritional status.

2.2 Methods

2.2.1 Literature search

A literature search for medical journal articles reporting studies of the impact on utilisation of health services of malnutrition and the effectiveness of nutritional supplementation programs was conducted through the US National Library of Medicine Gateway[1] in August and September 2010. Search terms are listed in Appendix A, Table A.1. Most studies focused on older people in hospital or nursing homes. Information relating to older people living in the community was scant.

In particular, there was a paucity of literature examining the use of health care resources by older people who are malnourished or at risk of malnourishment and who live in the community.

Luscombe-Marsh et al (unpublished)

Most of the parameters for the analysis are drawn from a retrospective analysis by Luscombe-Marsh et al (unpublished) of data from an Australian study (Visvanathan et al, 2003) of elderly individuals living in the community. The earlier study by Visvanathan et al, recruited 250 domiciliary care clients in South Australia, assessed their nutritional status at baseline and collected information about hospitalisation and other outcomes at follow-up 12 months later. Rates of admission to hospital and length of stay, falls and weight loss were compared between well nourished (WN), and NWN at follow-up. The mini nutritional assessment (MNA) tool was used to assess the nutritional status of participants.

Luscombe-Marsh et al (unpublished) further split the participants into those receiving MOW and others, and examined the outcomes of poor nutritional status (undernourishment). More specifically, there were three groups in the analysis — individuals who were NWN and received 'Meals on Wheels' (MOW), individuals who were not NWN and who did not receive MOW, and individuals who were WN (whether receiving MOW or not) (Table 2.1). It is worth noting that:

- The MOW NWN group were significantly older than the non-MOW NWN group.
- Amongst other differences, the MOW NWN group compared to the WN group were significantly older and had significantly lower body mass index (BMI).

In making comparisons across the three groups, Luscombe-Marsh et al therefore adjusted for these differences.

[1] http://gateway.nlm.nih.gov/gw/Cmd

Table 2.1: Sample of older Australians living in the community

Characteristic	Not well nourished		Well nourished
	MOW	Non-MOW	
Total subjects (n)	28	80	142
Female (n (%))	22 (78.6)	57 (71.3)	94 (66.2)
Age (yrs) mean ± SD	83 ± 6 ‡ §	78 ± 7	78 ± 6

Source: Luscombe-Marsh et al (unpublished)

The authors concluded that under-nutrition is common among community-dwelling older people but tends to be under-recognized by healthcare professionals. The limitations of the study as noted by Luscombe-Marsh et al included its retrospective nature, lack of randomisation of subjects to treatment groups, and the smaller number of subjects in the MOW compared to the Non-MOW group.

2.2.2 Intervention

A supplemented midday meal containing at least 60% of the calculated daily energy requirements of individuals aged 70 or more and 1.4 g of dietary protein per kg body weight would be provided 5 days a week. A literature review was undertaken to identify the effectiveness of nutrition supplementation in the target group.

2.2.3 Target group

The intervention is provided to Australians with malnourishment or at risk of malnourishment aged 70 or more, living at home and receiving MOW. The population data were drawn from Home and Community Care demographic data (DoHA 2009) combined with population estimates from Access Economics' demographic model (AE Dem) and information from AMOWA concerning the age and gender spread of clients (personal communication with C Pearce, August 2010). The prevalence of under-nutrition has been referenced from Visvanathan et al (2003) and further analyses by Luscombe-Marsh et al (unpublished).

2.2.4 Comparator

The NWN MOW group has been compared to the WN population as defined by having a MNA score above 24. This group included those who did, and did not, receive MOW.

2.2.5 Benefits

The hypothesis is that the intervention may prevent or delay poor outcomes including admission to hospital, longer than average length of stay in hospital, falls and premature admission to residential aged care. The costs of these outcomes avoided represent the estimated benefits in this study. Other benefits such as improved quality of life are not in scope.

The data for estimating the costs which could be avoided were drawn from the most recent government report on public hospital performance and spending (DoHA 2010a), aged care

reports (DoHA 2009a), and (unpublished) Access Economics estimations (from The Report of the Operation of the Aged Care Act, DoHA data)

In the absence of other evidence, the results from Luscombe-Marsh et al (unpublished) were used to indicate the outcomes attributable to poor nutrition among MOW clients. The outcomes reported by this study (and used here) included hospital admission, length of stay, and falls. An adjusted odds ratio (OR) was reported for each outcome measuring the difference between the odds for MOW NWN and WN participants.

The adjusted OR was used to approximate the relative risk (RR). However, for outcomes which are not rare, an OR of more than one leads to an overestimate of the RR (Indrayan 2008). Sensitivity analysis was therefore very important (see section 2.2.8).

Most of the differences between the groups in Luscombe-Marsh et al (unpublished) were not statistically significant (p value greater than 0.05). The authors did not indicate the sample size required for specific level of confidence.

2.2.6 Costs

The costs of the intervention were estimated using data supplied by AMOWA (personal communication with L Holmes) concerning start up costs and average wage of MOW employees, and upon advice from clinical expert N Luscombe-Marsh (personal communication, September 2010).

2.2.7 Economic modelling

A model was constructed in Microsoft Excel (2007) to analyse the costs and benefits of the proposed intervention.

2.2.8 Sensitivity analysis

In view of the lack of research in this area and the small sample sizes underlying some of the parameters, there was a great deal of uncertainty surrounding many of the estimates. Probabilistic sensitivity analysis was therefore undertaken using @RISK software.

3 Intervention and efficacy

Several approaches to improving the nutritional status of NWN older Australians receiving MOW have been suggested (Hourigan 2010):

- increase energy and protein density of meals;
- increase amount of food provided;
- provide more flexible and snack options;
- address low appetite and promote normal eating habits; and
- develop new modes of service delivery.

Any intervention needs to be achievable across MOW groups nationwide, each with diverse capabilities and capacities for meal preparation. Groups have wide ranging (paid) staff and volunteer bases, funding arrangements and governance. Individual client needs also differ, for instance, the culturally and linguistically diverse populations and those with co-morbidities such as dementia.

The AMOWA has proposed the use of nutritional supplements in the undernourished, older MOW population. A pilot study is planned to assess the effectiveness of this approach. The pilot study will include 330 individuals aged 70 years and above who will have their body weight, height and body mass index accurately measured. A MNA will be administered and those found to meet the 'at risk of malnutrition/malnourished' criteria will be provided with a midday meal containing at least 60 % of their calculated daily energy requirements and 1.4 g of dietary protein per kg body weight, on 5 days of the week. The intervention will be assessed in relation to multiple health outcomes over 12 months or more.

3.1 Efficacy and compliance

The efficacy of a daily nutritional supplement is measured in its ability to bring about adequate nutritional levels after daily consumption for a period of time.

Compliance is calculated using the frequency with which MOW clients consume their meal supplement as directed in the study protocol. A 50% compliance rate is equal to half the study participants consuming their midday meal plus nutritional supplement before the evening meal.

Efficacy

Most studies assessing the efficacy of nutritional interventions have been conducted in a hospital setting. Milne et al (2009) concluded that supplementation in elderly 'at risk' (including hospitalised) produces a small but consistent weight gain but with no improvement in overall function or a reduction in the length of hospital stay. Supplementation may however reduce the number of complications encountered during a hospital stay according to Milne et al (2009) although the authors noted, of the reviewed studies, many had problems with study design and were of questionable quality.

According to discussions with a clinical expert (N Luscombe-Marsh, 05 October 2010), the efficacy of the proposed MOW intervention is unknown as a research study involving the provision of protein at 1.4g/kg to this population has not been undertaken previously.

Compliance

About 70% of MOW clients split their delivered, midday meal between lunch and dinner (de Rohan et al 2003) and this is more common in older clients. Reasons include poor appetite, convenience and a perception the three course meal is too big to eat all at once (AMOWA 2009). There is also a risk that providing supplements may reduce the usual dietary intake even further (Bastow 1983, and Fiatrone 1994). Milne et al (2009) reported the acceptance of supplements was variable between trials and nausea and diarrhoea were recorded.

Parameters used in this report

In this analysis, an intervention effectiveness parameter of 14% has been used. This was based on an average of 28% clients aged 70 years and above consuming their entire delivered meal at lunchtime (Rohan et al 2003) and an estimated efficacy rate of the intervention (at improving nutrition status) of 50%. Sensitivity analysis was critical given the degree of uncertainty surrounding this parameter. Clearly, more evidence of benefit from oral nutritional supplementation for older people at risk in the community is still required.

In the pilot study (described above) it is intended participants are phoned regularly to encourage consumption of the entire meal (including the supplement) before the evening. This may result in a higher compliance rate, but also increases the intervention cost. The costs of phone calls of this nature to MOW clients are not incorporated into the analysis.

4 The target group

In this chapter, the method for deriving the number of people in the target population who may benefit from the nutritional intervention is described — that is, those with malnourishment or at risk of malnourishment aged 70 or more living at home and receiving MOW.

4.1.1 Number of Australians receiving HACC

Most older people, particularly those of non-English speaking backgrounds, wish to remain independent in their own home for as long as possible (DoHA 2010). A survey of almost 9,000 New South Wales residents aged 65 years and over found that, after the fear of losing one's physical health, 20% of males and 35% of females feared losing their independence – with a specific fear of nursing home admission (5% males, 10% females) (Quine and Morrell, 2007).

Almost all individuals aged below 75 years live at home with institutionalisation more likely with advancing years (Access Economics 2010) (Table 4.1).

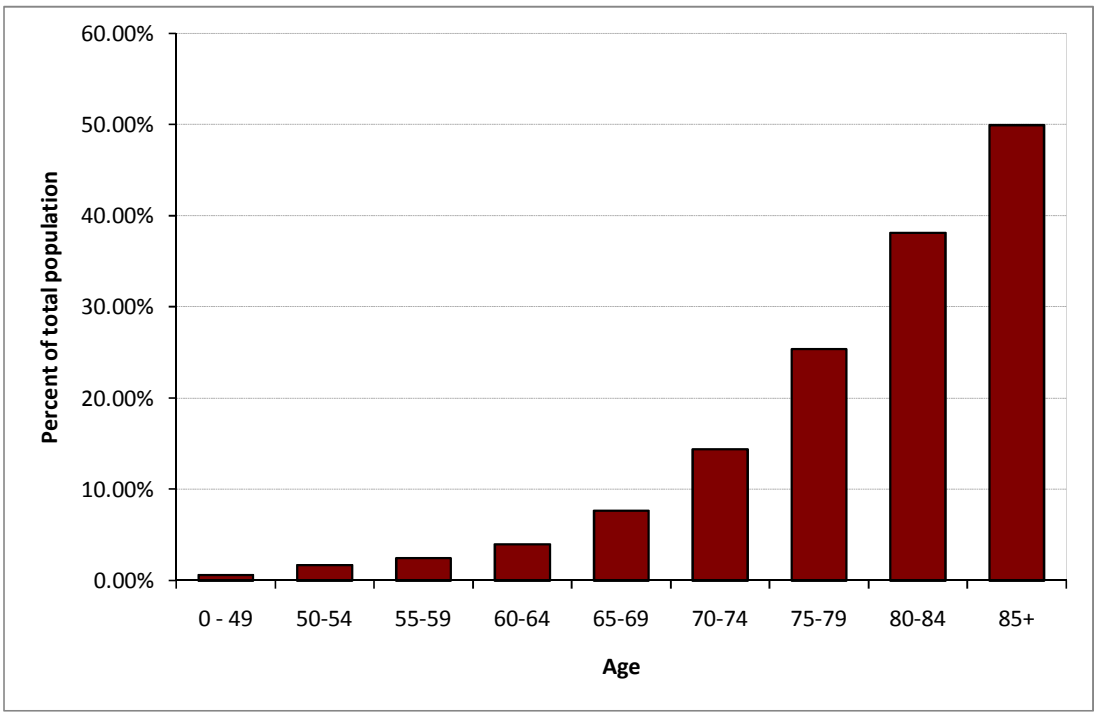
Table 4.1: Older Australian population, 2010

Age	Male (% living in the community)	Female (% living in the community)
70-74	343,996 (99%)	366,939 (99%)
75-79	255,315 (97%)	295,065 (96%)
80-84	189,208 (94%)	250,206 (89%)
85+	140,775 (83%)	264,024(70%)
Total	**929,294**	**1,176,234**

Source: AE Dem, Access Economics (2010)

The assistance provided by MOW in conjunction with other types of care provided by government and non-government agencies (such as Home and Community Care) helps older people remain in their homes and maintain independence. The demand for services rises significantly with age (Chart 4.1).

Chart 4.1: Proportion of the population accessing Home and Community Care, 2008-09



Source: DoHA 2009

4.1.2 HACC clients receiving Meals on Wheels

It is estimated 105,769 individuals received assistance with meals in the 2008-09 financial year (DoHA 2009). Extrapolating to 2010 using population growth from Access Economics' demographic model (AE Dem) suggests almost 109,000 MOW clients in total, or almost 93,000 aged 70 years and above. This equates to about 5% in of the community residing population aged 70 years and above (ABS 2010, Access Economics 2010). The age and gender structure of MOW clients was based on South Australian data provided by the AMOWA on special request (personal communication, AMOWA, 12 August 2010). Females are more likely to utilise the service (Table 4.2).

Table 4.2: Meals on Wheels clients by age and gender, 2010

Age group	Males	Females	Total
70-75	1,822	3,103	**4,925**
76-85	16,248	27,665	**43,913**
>85	16,200	27,583	**43,783**

Source: DoHA (2009), special request data from AMOWA (2010), AE Dem

4.1.3 The number of people who are malnourished or at risk of malnourishment

Malnutrition is common in hospitalised patients. Norman et al (2008) averaged the rate of hospital malnutrition reported in 20 studies worldwide (after 1990) across different groups of study participants (for example, patients with respiratory disease, general medical, or surgical

patients) and found it to be 42%, or 31% of the hospitalised in the US and Europe. Rates for the older population are higher (Norman et al 2008).

There are few Australian studies of the prevalence of malnutrition among older people living in the community, and those that are available use various different methods to identify malnutrition.

A validated tool for assessing the nutritional status of the older population is the Mini Nutritional Assessment (MNA). The tool was developed by Nestlé® and geriatricians (Guigoz et al 1994) and has a high level of specificity and sensitivity. It is commonly used in Australia and is referenced on the DoHA website[2].

Mini Nutritional Assessment (MNA)

The MNA is a screening tool used to identify elderly persons who are malnourished, or at risk of malnourishment. The tool consists of a number of questions about eating habits, mobility, comorbidities and living status. It can detect individuals at risk, before severe changes in weight or serum protein levels occur facilitating clinical interventions. The MNA is inexpensive and training requirements of assessors are minimal. The MNA takes about 30 minutes to complete and assessors require training. Scoring is detailed in Table 4.3.

Table 4.3: Mini Nutritonal Assessment (MNA) scoring

Score	Interpretation
24+	Normal nutritional status
<24	At risk of malnutrition
<17	Malnourished

Source: Nestlé® 2006

An abbreviated form is also available, the MNA Short Form (MNA-SF). This version consists of seven questions and takes just five minutes to complete. The MNA®-SF has been validated as a stand alone screening tool which can be used by non health professionals following minimal training.

Australian studies of the prevalence of malnutrition among older people

A review of the MOW database suggests 6-7% of clients are malnourished as defined by unintentional weight loss, reduced appetite, frailty and at least one unmet need (such as unable to shop for or prepare food, problems with feeding) (AMOWA 2009). The MNA was not used.

A much higher proportion of MOW clients and the overall community dwelling older population is described as nutritionally 'at risk'. Estimates vary (Table 4.4) due to many definitions of, and ways to assess, malnutrition. Notably, there are few studies of the prevalence of malnutrition among older Australians living in the community and the sample

2 http://www.health.gov.au/internet/main/publishing.nsf/Content/A8A176FA544B102DCA2571AB00155EC0/$File/09reference.pdf

sizes of available studies are small (Table 4.4). All studies except Burge and Gazibarich (1999) utilised the MNA when assessing participants.

Table 4.4: Estimates of the prevalence of older Australians at risk of malnutrition

Author (year)	Population studied	Proportion 'at risk'
Burge and Gazibarich (1999)	92 elderly senior citizens	30%
Visvanathan et al (2003)	250 elderly domiciliary care	38%
Visvanathan et al (2004)	65 sub-acute elderly	35-43%
Neumann et al (2005)	133 elderly, rehabilitation	47%

Source: Banks 2006

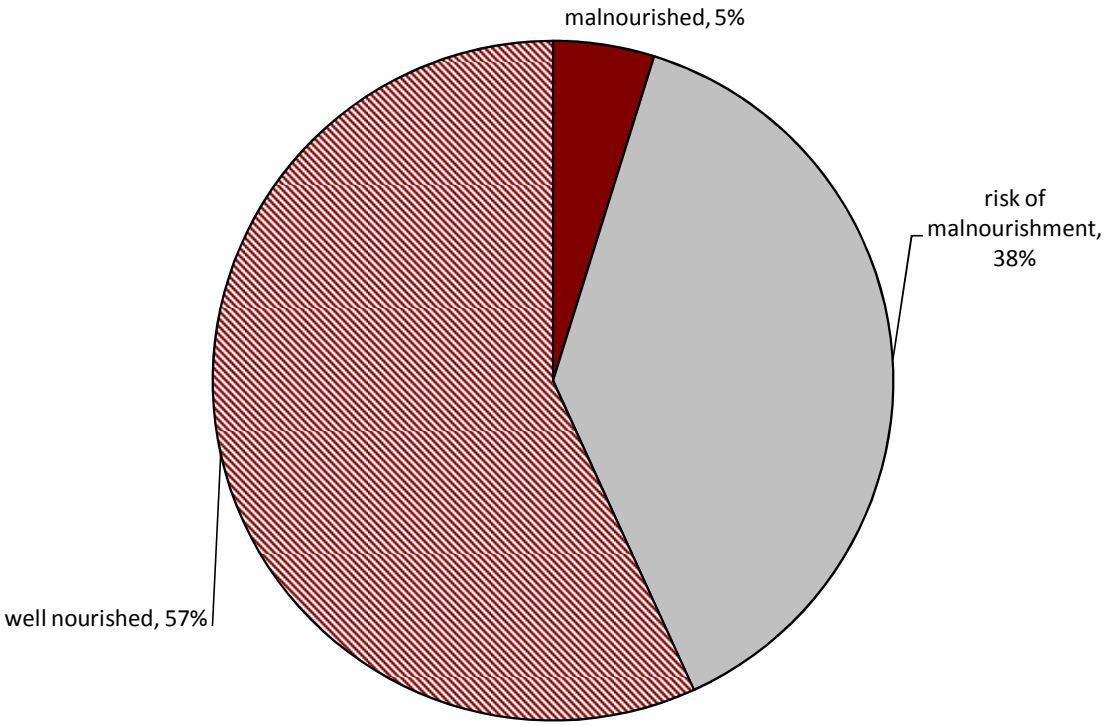
4.1.4 Estimates used in this report

Prevalence estimates included in this report have been based on Visvanathan et al (2003, cited above) because this is the most relevant, up to date figure based on older Australians living in the community. Malnourishment was identified using the MNA. Visvanathan et al (2003) investigated the association between nutritional status in older Australians aged 67 years and above receiving home help, and health outcomes 12 months later.

Of those contacted, just under 30% or 250 individuals agreed to participate. Participants were more likely to live alone and were younger, and the analysis was adjusted for this. About 70% were women and almost all were Caucasian. Individuals who did not speak English or had dementia were excluded. Dementia is known to be associated with poor nutritional status (Mayo Clinic 2009) and so the exclusion of this group may underestimate the prevalence of under-nutrition in the community.

Visvanathan et al (2003) found 38.4% of study participants were 'at risk' of malnourishment and 4.8% were classified as malnourished.

Chart 4.2: Nutrition levels of older Australians receiving home help, 2003



Source: Visvanathan et al 2003

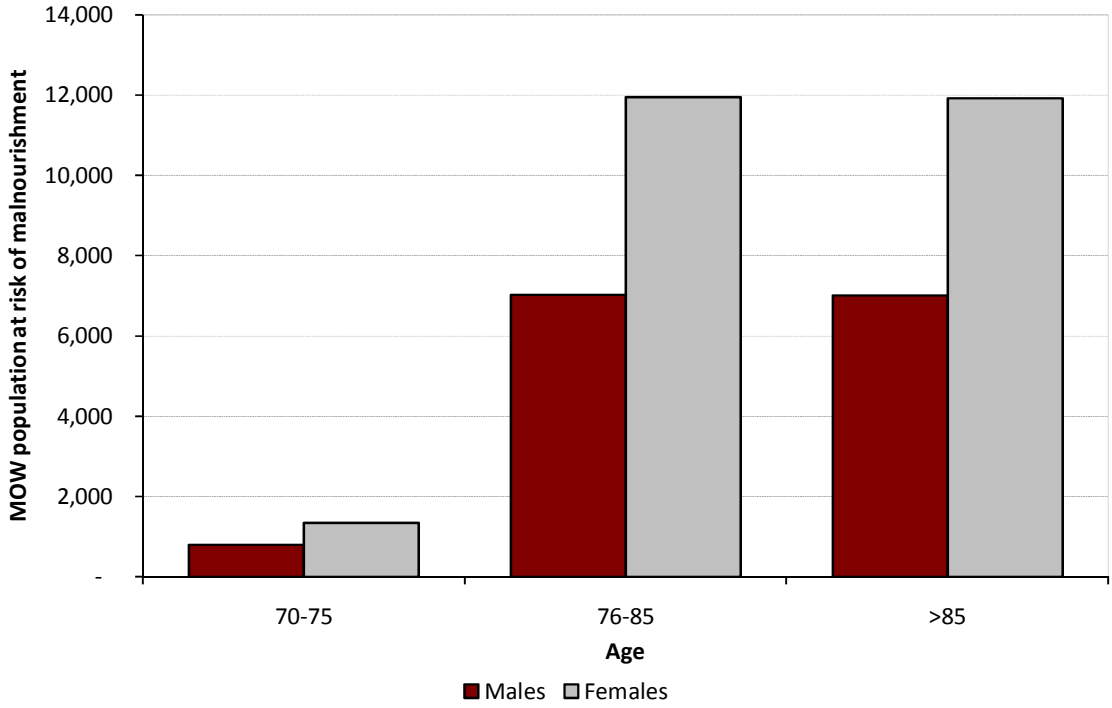
Even given the very small sample (250), these results are similar to other published estimates in Table 4.4. Applying these prevalence rates to the MOW population suggests around 40,000 MOW clients aged 70 years and above in 2010 with, or at risk of, malnourishment.

Table 4.5: Estimated number of undernourished MOW clients, 2010

Age group	Males	Females
70-75	787	1,340
76-85	7,019	11,951
>85	6,998	11,916

Source: Visvanathan et al 2003, DoHA 2009, AMOWA special request data

Chart 4.3: Estimated proportion of MOW population who are malnourished, or at risk of malnourishment, 2010

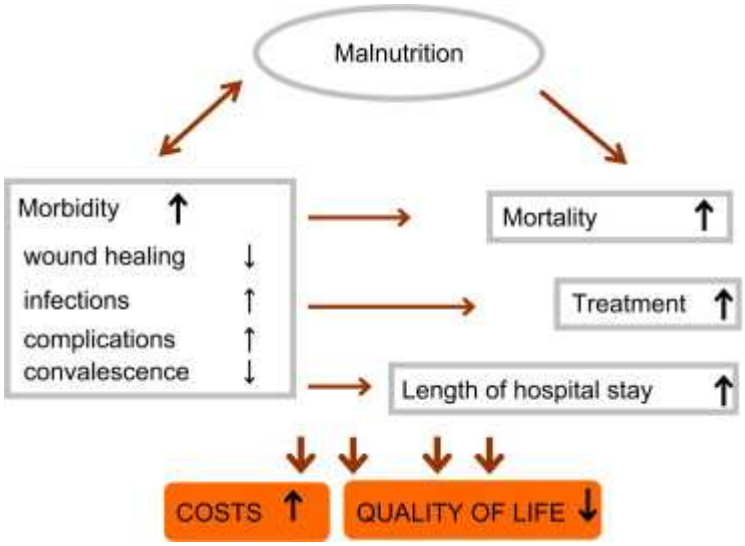


Source: Visvanathan et al 2003, DoHA 2009, AMOWA special request data

5 Potential benefits of avoiding poor nutrition

The outcomes of poor nutrition are well known. Some are described in Figure 5.1. The World Health Organisation (2002) has linked poor nutrition with chronic diseases including coronary heart disease, cancer, stroke and non-insulin-dependent diabetes mellitus. Other outcomes specifically related to older people include slow wound healing, falls and reduced immune function leading to increased susceptibility of disease (Visvanathan et al 2004).

Figure 5.1: Prognostic impact of malnutrition



Source: Norman et al (2008)

Disease leads to the utilisation of health resources and increases the likelihood of entering institutionalised care. Stratton et al (2002) analysed (British) National Diet and Nutrition Survey data (1,355 records in total) from people aged 65 years and over. Those with an increased risk of malnutrition had greater utilisation of health care resources.

5.2 Admission to hospital

Individuals aged 70 years and above are more likely to be hospitalised than younger people. In 2007-08 (most recent data available) around 30% of hospital admissions were for individuals aged 70 years and above (AIHW 2010) while this group represented just 9% of the population overall (ABS 2009).

Rates of hospital admission in Australia specifically for malnutrition are outlined in Table 5.2 and are relatively low. Separations for malnutrition are likely to substantially underestimate hospitalisations resulting from poor nutrition in the elderly. Such admissions are more likely to be linked to other primary and secondary diagnoses. Amaral et al (2007) found 42% hospital patients in Portugal were nutritionally 'at risk' but only 0.4% had a primary diagnosis of cachexy and just 2% had a secondary diagnosis of malnutrition.

Table 5.2: Hospital separations for malnutrition diagnosis, by age, 2007-08

	Malnutrition diagnosis			
Age group	Nutritional marasmus	Unspecified severe protein-energy malnutrition	Protein-energy malnutrition of moderate and mild degree	Unspecified protein-energy malnutrition
70 – 74	2	3	0	33
75 – 79	3	6	1	40
80 – 84	7	5	3	39
85+	4	8	2	42
Total	**16**	**22**	**6**	**154**

Source: AIHW (2010)

5.2.2 Impact of malnutrition on admission to hospital and duration of stay

Visvanathan et al (2003) found NWN, community dwelling Australians aged 65 years and above were 1.5 times more likely (RR stated, statistically significant) to be admitted to hospital in the past 12 months than those who displayed adequate nutritional status. The analysis was adjusted for age and living status. Emergency Department visits were 1.94 (again, RR stated, statistically significant) more likely with poor nutrition.

As noted above, Luscombe-Marsh et al (unpublished) split the Visvanathan et al analysis further based on whether participants received MOW. The adjusted odds of the not well nourished MOW participants being admitted to hospital was 1.4 that of the well nourished population[3]. The difference was not significant. Adjustment of the OR was important because of differences in age across comparison groups. The adjusted OR and raw data by age and gender from Luscombe-Marsh et al (unpublished) for the rate of hospitalisations in each group were used to approximate the number of hospital admissions which could potentially be avoided with improved nutrition.[4]

In 2010, up to 2,600 hospital admissions among MOW clients could potentially result from poor nutrition. Applying a cost per hospital stay from DoHA (2010) and factoring up for health inflation (ABS 2010), the cost of these potentially avoidable hospitalisations is approximately $12.4 million.

Higher than average length of stay in hospital

Robinson et al (1987) reported individuals in North America with low nutritional status on admission to hospital had a 30% increase in length of hospital stay and this was associated with a doubling of costs. Amaral et al (2007) found on average, the hospitalisation cost in

[3] whether receiving MOW or not.

[4] It is important to note that the analysis is constrained by the available data. An adjusted OR was used to approximate a relative risk (RR) — potentially leading to an overestimate of the hospitalisations which can be avoided. Probabilistic sensitivity analysis has been used to mitigate the impact on the results of some of the uncertainty surrounding the parameters.

Portugal of treating nutritionally at risk patients was 19% higher. This was calculated taking into consideration confounding factors such as age, gender, disease severity.

Luscombe-Marsh et al (unpublished) found that the adjusted odds of the NWN MOW population staying in hospital for more than 14 days was 2.1 times that of the well nourished population. The difference was not statistically significant.

Using raw data from Luscombe-Marsh et al (unpublished) on the rate of extended hospital stays by age and gender and applying the adjusted OR, suggests up to 4,460 hospital stays of 14 days or more could have been averted with adequate nutrition.[5]

The costs of longer hospital stays were calculated by establishing the average cost per day of hospitalisation and applying the per diem cost to each extra day over the average stay to 14 days. The average length of stay in 2008-09 was 6.3 days (DoHA 2010). The per diem cost (using DOHA 2010 factored up for health inflation from above) is $752 and this was multiplied by [14 days minus 6.3 days] equalling an additional spend of $5,787 per long stay or $25.8 million in total in 2010. An important assumption is that the cost per day in hospital is the same, whereas the costs of hospital stays may fall over time so that the costs of each additional day is lower than the previous one. This cost estimate may therefore overstate the potential costs that could be avoided with adequate nutrition. On the other hand, we estimated the cost for 14 days in hospital, whereas the indicator is for stay of more than 14 days.

5.3 Falls resulting fracture

Luscombe-Marsh et al (unpublished) found that NWN MOW participants reported a higher odds of experiencing a fall than the WN group. The difference was not significant. The adjusted OR (2.2) was applied to the raw data for falls by age and gender suggesting up to 9,750 falls in the not well nourished group resulted from inadequate nutrition.

According to Bradley and Harrison (2007), 20% of falls in older Australians result in hospitalisation and of these, two thirds involve fracture. Recent research by Access Economics (2010) suggests the total financial cost of treating a fracture is $98,453. This includes hospital costs, aged care contributions, informal care costs and so forth. As hospital costs (estimated at $5,792 in Access Economics (2010)) have been accounted for here already, an adjusted cost of $92,660 was used. The approximate cost of fracture due to inadequate nutrition among MOW clients was $120.4 million in 2010.

5.4 Admission to a Residential Aged Care facility

Moving into RAC is a significant life event and likely to result from a number of contributing factors. The top six reasons to recommend nursing home admission as identified by members of Aged Care Assessment Teams (DoHA 2003) were:

- dementia/cognitive function;

[5] It is important to note that the analysis is constrained by the available data. An adjusted OR was used to approximate a relative risk (RR) — potentially leading to an overestimate of the hospitalisations which can be avoided. Probabilistic sensitivity analysis has been used to mitigate the impact on the results of some of the uncertainty surrounding the parameters.

- poor mobility;
- incontinence;
- capacity of support networks;
- carer stress/ability to cope; and
- diminished functional ability and help needed with activities of daily living (ADL).

Eating is an ADL and so an inability to prepare or consume nutritious meals can contribute to an increased likelihood of RAC admission. Andrieu et al (2001) found the risk of RAC placement in the short term for Alzheimer Disease sufferers is related to nutritional status, as measured by the MNA.

Visvanathan et al (2003) however found there was no appreciable difference in the need to move to supportive accommodation between the WN and NWN groups. Further, more recent, unpublished analysis by Luscombe-Marsh et al also found rates of RAC admission were similar amongst the WN and NWN MOW populations.

Several studies have demonstrated a link between weight loss or body mass index (BMI) and admission to RAC. Payette et al (2000) investigated the nutritional risk factors for (Canadian) RAC admission in community residing elderly people aged 60 to 94 years, of which, 22% received MOW or home help for meal preparation. Weight loss was significantly more prevalent among those who were institutionalised during the study compared with those who remained at home during the study. A drop in weight of 5kg or more resulted in an increased likelihood of institutionalisation of 1.7 after controlling for social network, health, and functional status.

A report from the Melbourne Longitudinal Studies on Healthy Ageing Program by Kendig et al (2010) found having a BMI in the acceptable range as compared to being underweight was a protective factor for transitioning into RAC. Those in the acceptable range (BMI between 20 and 25) had about half the risk of admission to RAC than the underweight. For men, having a healthy nutrition score reduced the chance of RAC admission (RR 0.91) and being within the healthy weight range likewise reduced the risk of institutionalisation in women (RR 0.49). The follow-up was 12 years.

Reported weight loss between WN and NWN groups in Visvanathan et al (2003) was however quite significant – unpublished data provided by Luscombe-Marsh et al (unpublished) suggested a *significant* OR of 7 when comparing (patient reported) weight loss in the NWN MOW and WN populations. Published studies described above measured weight throughout the study and therefore estimates are likely to be more reliable than patient report data.

Table 5.3: Estimated number of NWN MOW population reporting weight loss, 2010

Age	Males	Females	Total
70-75	945	596	**1,540**
76-85	9,572	7,629	**17,200**
85+	-	14,299	**14,299**
Total	**10,516**	**22,523**	**33,040**

Source: Visvanathan et al 2003, DoHA 2009, AMOWA special request data, Luscombe-Marsh special request data,

The annual cost of RAC (high and low care averaged) in 2007-08 was $58,263 (unpublished Access Economics estimation from The Report of the Operation of the Aged Care Act, DoHA data). This includes federal, state, and private contributions. In 2010 dollars this is equal to $69,317 (health inflation between 2007 and 2010 applied, ABS (2010)). This compares to the average Home and Community Care cost of $2,078 per client in 2008-09 (Steering Committee for the Review of Government Service Provision 2010) or $2,201 in 2010 (health inflation between 2008 and 2010 applied, ABS (2010). Remaining at home is therefore $67,116 less expensive ($69,317 minus $2,201) on average per annum than institutionalisation.

The ratio of 1.7 reported by Payette et al (2000) and described above (signifying the increased risk individuals who lost weight will enter a RAC facility) was applied to the population reporting weight loss and the increased cost of institutionalisation ($67,116). The resulting cost estimate is substantial, $1.6 billion.

Table 5.4: Estimated cost of RAC admission attributed to weight loss resulting from poor nutrition in the MOW population, ($) 2010

Age	Males	Females	Total
70-75	45,015,847	28,388,372	**73,404,219**
76-85	456,102,659	363,518,278	**819,620,937**
85+	-	681,381,903	**681,381,903**
Total	**501,118,506**	**1,073,288,554**	**1,574,407,060**

Source: Visvanathan et al 2003, DoHA 2009, AMOWA special request data, Luscombe-Marsh special request data, ABS 2010a, Access Economics (unpublished) estimation, Steering Committee for the Review of Government Service Provision 2010

Maintaining adequate nutrition and therefore weight is likely to extend the time older Australians are able to live in the community thus reducing the need for (expensive) institutionalisation.

5.4.2 Summary of costs

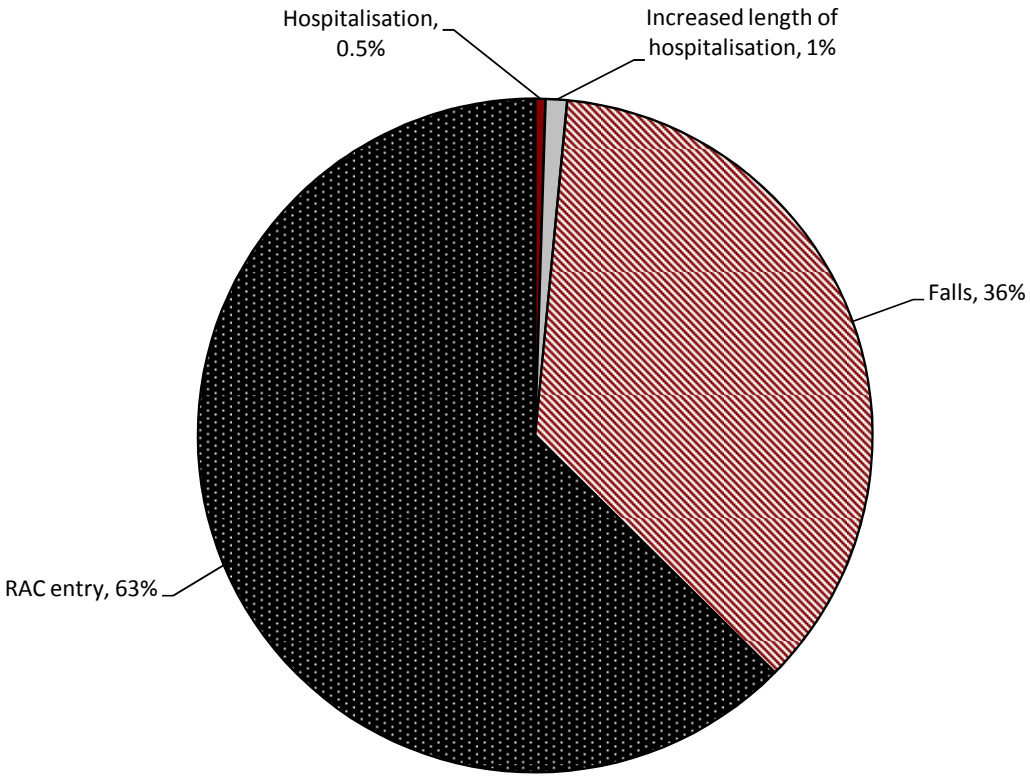
The total financial impact of under-nutrition in the MOW population is of the order $1.7 billion (Table 5.4 and Chart 5.1), noting that the parameters underlying this estimate reflect small sample sizes and there is some uncertainty around the true figure.

Table 5.5: Summary of costs attributed to under-nutrition in MOW clients aged 70 years and over, 2010

Component	Number of events	Cost ($million)
Hospital admission	2,600	12.4
Greater than average length of stay in hospital	4,460	25.8
Falls	9,750	120.4
RAC entry	33,040	1,574.4
Total		**1,733.0**

Source : Access Economics calculations

Chart 5.2: Summary of estimated costs attributed to under-nutrition in MOW clients aged 70 years and over (total $2.5 billion)



Source: Access Economics calculations 2010

6 Cost benefit analysis

A CBA involves the estimation of costs and benefits over a number of years, with future benefits and costs discounted to the present using a discount rate. The net present value (NPV) of the costs and benefits of a particular intervention program are compared. A benefit cost ratio greater than one in this study signals the proposed intervention is associated with cost savings to the health and aged care system, The Office of Best Practice Regulation requires an annual real discount rate of 7% and this rate has been applied here (Department of Finance and Deregulation 2010).

6.1 Scope of costs and benefits

Costs considered include:

- start up costs for the nutritional supplementation program including infrastructure changes, staff training, and printing of new menus and recipes;
- an annual nutritional assessment (MNA-SF) per MOW client; and
- meal supplementation for clients who are malnourished or at risk of malnourishment.

Financial benefits resulting from improved nutritional status have been outlined above and include:

- fewer hospital admissions;
- shorter hospital stays;
- fewer falls; and
- a reduced likelihood of entering RAC.

6.2 Summary of methods

Table 6.1 summarises the derivation of the parameters used to estimate the costs and benefits of the proposed intervention across the entire MOW population.

Table 6.1: Summary of derivation of parameters used to estimate costs and benefits

Component	Method used to derive parameters
Costs	
Start up costs	Estimated at $30,000 by AMOWA following consultations with state branches (personal communication with L Holmes, 07 October 2010). Includes staff training.
MNA-SF assessments	Time to complete the assessment (five minutes per client per year) estimated following discussion with clinical expert N Luscombe-Marsh (personal communication September 2010). Administrative and data entry costs estimated at five minutes per client per year. Hourly staff wage ($25) provided by AMOWA (personal communication with C Pearce, August 2010). Total $4.17 per client per year.
Costs of supplementing meals	Supplement cost of $5.00 per meal (in addition to cost of meal) based on advice from AMOWA
Efficacy	Effectiveness of intervention 14% based on: an average of 28% clients aged 70 years and above consuming their entire delivered meal at lunchtime (Rohan et al 2003); and supplementation is effective in eliminating or avoiding undernourishment in 50% of those eating the full meal (in the absence of available research on efficacy for those living in the community).
Benefits	
Hospital admissions avoided	Hospital admissions prevented were derived by applying (OR-1) (adjusted OR from Luscombe-Marsh et al (unpublished)) to hospitalisation rate (by age group) in WN population (from special request data provided by Luscombe-Marsh, September 2010) and the NWN MOW population. See caveats for OR in section 5. Costs were based on the average cost of hospitalisation from DoHA 2010a factored up for health inflation.
Longer hospital stays avoided	Above average stays prevented derived by applying (OR-1) (adjusted OR from Luscombe-Marsh et al (unpublished)) to rate of hospitalisations lasting more than 14 days in WN population (from special request data provided by Luscombe-Marsh, September 2010) and the NWN MOW population. See caveats for OR in section 2.2.5. Costs were based on the average cost per day of hospitalisation DoHA 2010a) and only the extra days in hospital above the average length of stay were included in the cost.
Falls resulting fracture avoided	Falls prevented were derived by applying (OR-1) (adjusted OR from Luscombe-Marsh et al (unpublished)) to the fall rate in WN population (from special request data provided by Luscombe-Marsh, September 2010) and the NWN MOW population. See caveats for OR in section 2.2.5 Costs were based on the proportion of falls that lead to fractures (Bradley and Harrison, 2007) and the cost of treating fractures (excluding the hospital costs as these are covered by hospital admissions above) (Access Economics 2010a).

Component	Method used to derive parameters
RAC admission avoided	Payette et al (2000) found RAC admission was more likely to occur in individuals who had experienced recent weight loss. The adjusted OR from Luscombe-Marsh et al (unpublished) relating to weight loss was applied to the rate of weight loss experienced in the WN population (from special request data provided by Luscombe-Marsh, September 2010). See caveats for OR in section 2.2.5 The risk of RAC admission from Payette et al (2000) was then applied. This parameter was multiplied by the NWN MOW population to estimate the number of RAC admissions in 2010 associated with undernutrition. Costs were based on the difference between the average annual RAC and HACC cost ($67,116, unpublished Access Economics estimations (from The Report of the Operation of the Aged Care Act, DoHA data), Steering Committee for the Review of Government Service Provision 2010).

6.2.2 Sensitivity analysis

A description of the sensitivity analysis undertaken is provided in Table 6.2.

Table 6.2: Sensitivity analysis

Component	Parameter	Characteristics of sensitivity analysis
Intervention		
Efficacy	50%	Normal distribution, mean = 0.5, SD = 0.19, truncation at 0.1 and 0.9
Compliance	28%	not applicable (NA)
Costs		
Start up costs	$30,000	NA
MNA assessments	$4.17 per client per year	NA
Cost of supplement	$5.00 per meal (in addition to cost of meal)	NA
Benefits		
Hospital admissions	OR=1.40	Normal distribution, mean = 1.27, standard deviation (SD) = 0.07, truncation at 1.00 and 1.40
Longer than average hospital stays	OR=2.10	Normal distribution, mean = 1.72, SD = 0.15, truncation at 1.00 and 2.10
Falls	OR=2.20	Normal distribution, mean = 1.68, SD = 0.15, truncation at 1.00 and 2.20
Weight loss	OR=7.00	Normal distribution, mean = 5.15, SD = 0.40, truncation at 1.00 and 7.00
Premature admission to RAC	Hazard ratio=1.71	Normal distribution, mean = 1.44, SD = 0.15, truncation at 1.00 and 1.71

6.2.3 Results

The mean benefit:cost ratio was 2.07 (95% confidence interval 0.66 to 3.89, standard deviation 0.99) (Table 6.3 and Chart 6.1). A benefit cost ratio of 2.07 implies the net present value of savings to the health system would be more than $463 million over 10 years.

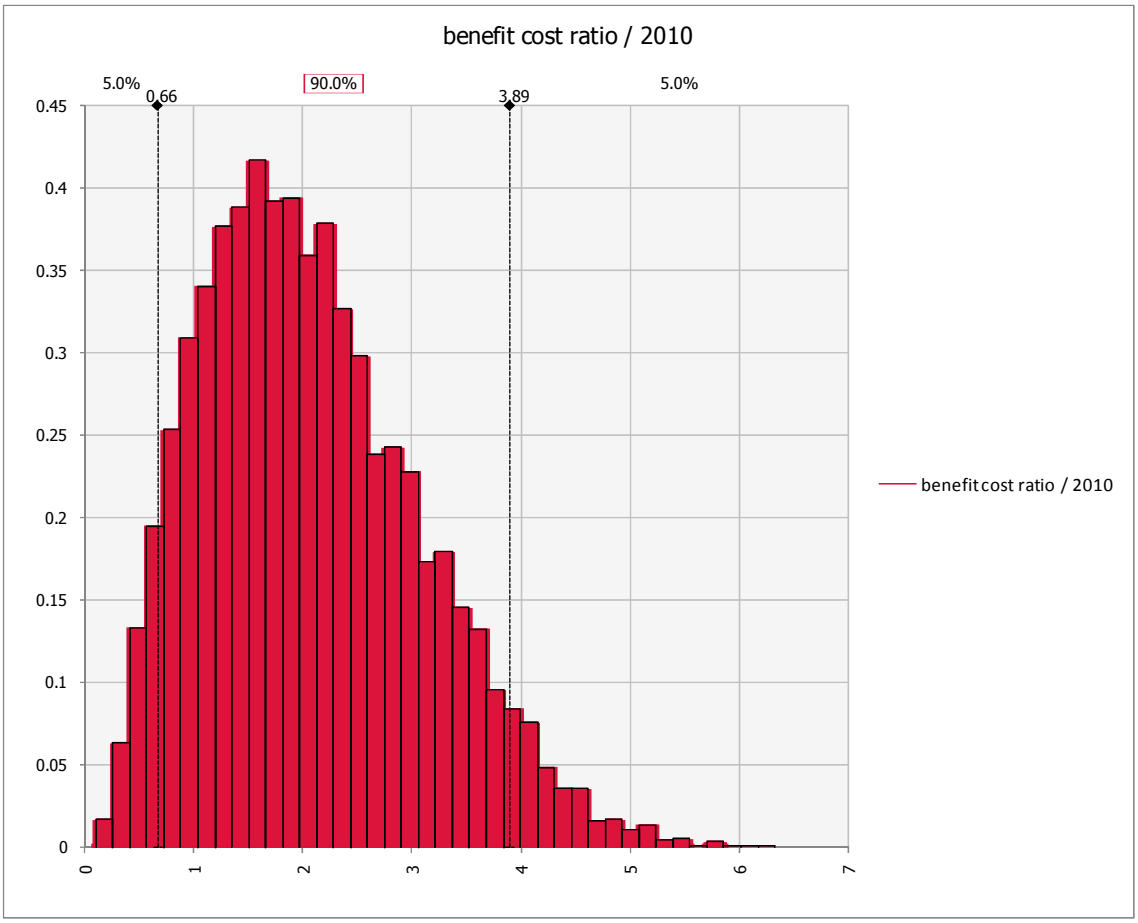
Sensitivity analysis using Monte Carlo simulation found the benefit cost ratio was greater than one 85% of the time, suggesting the intervention is highly likely to be cost saving.

The results are highly dependent on the effectiveness of the intervention. Chart 6.2 shows that a one standard deviation change in the efficacy estimate, would lead to a 0.77 deviation in the benefit:cost ratio.

Table 6.3: Results

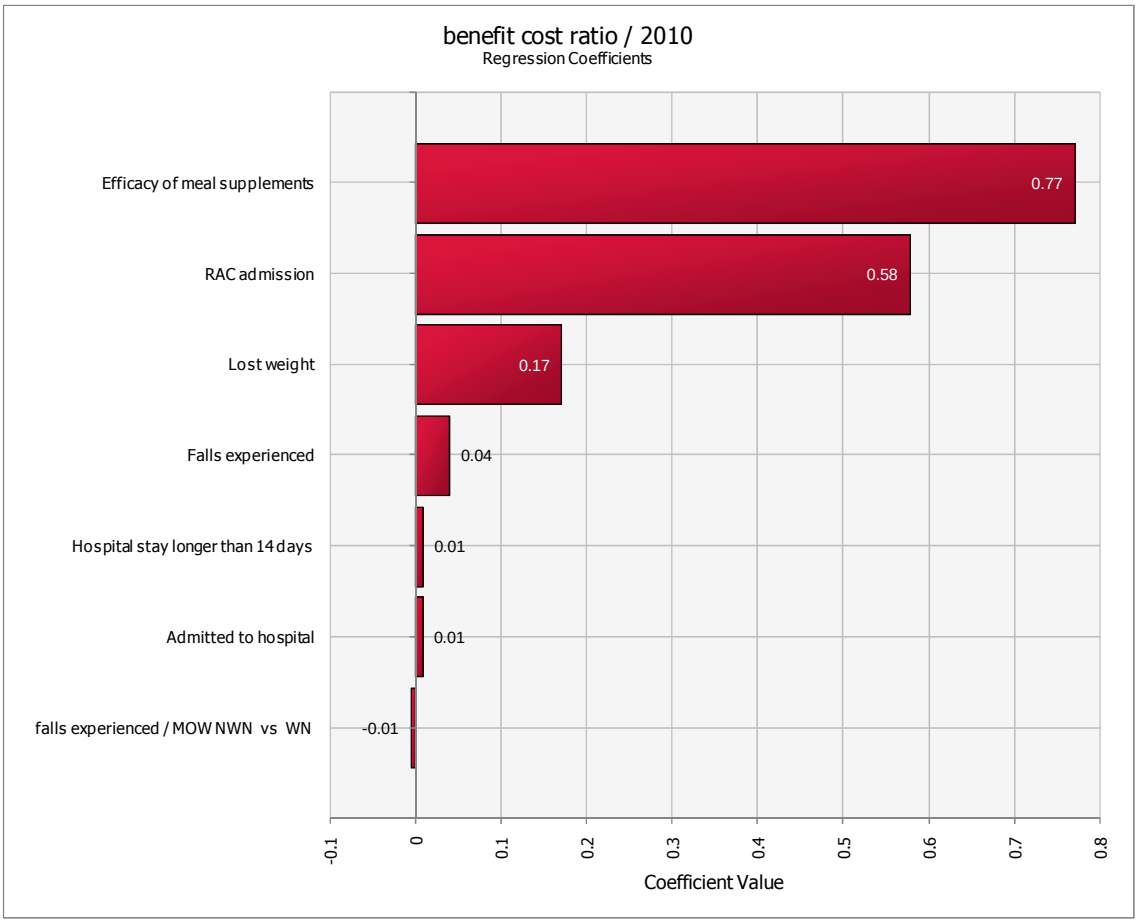
Distribution	Benefit cost ratio
Mean	**2.07**
Standard deviation	**0.99**
Minimum	0.10
Lower bound (95% CI)	0.66
15th percentile	1.03
25th percentile	1.32
75th percentile	2.7
85th percentile	3.16
Upper bound (95% CI)	3.89
Maximum	6.33

Chart 6.1 Probability distribution of benefit:cost ratio, 2010



Source: Access Economics calculations

Chart 6.2: Benefit cost ratio regression



Source: Access Economics calculations

7 Conclusion

Malnutrition among some older HACC clients receiving MOW may lead to poor outcomes such as admission to hospital, lengthy hospital stays (greater than the average), falls and premature admission to RAC. These poor outcomes are associated with high financial costs, for example, the average cost of an admission to hospital is $4,735, of a fall is $92,660 and RAC admission is $67,116 more expensive than average home care costs. Other benefits of improved nutrition include added vitality and increased ability to enjoy life.

Inadequate nutrition is potentially common among older people living in the community — ranging between 30 and 47% (Table 4.4). However, Australian studies of those living in the community are rare and sample sizes are small.

Effective interventions to improve nutrition have significant potential to save costs to the healthcare system. Research on the effectiveness of nutritional interventions is however scarce, and generally focused on older people already in hospital. Findings from the research currently available suggest the effectiveness of maintaining nutrition via MOW is adversely affected by frequent meal splitting by older people and the fact that meal supplements may be associated with a reduction in the usual dietary intake.

The cost benefit analysis in this report shows that — even with seemingly conservative assumptions about the effectiveness of the intervention — meal supplements for under-nourished MOW clients are highly likely to save costs — reducing hospitalisations, falls and premature admission to RAC. Moreover, the results of this study do not take account of the potential additional benefits likely to flow from improved nutrition levels in the elderly — improved quality of life resulting from better health and vitality.

Studies to improve the evidence base would be very valuable given the potential benefits of nutritional interventions and the likely prevalence of undernourishment among older Australians living at home.

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Appendix A

Table A.1: Literature searches performed

Search terms	Number items retrieved	Dates
nutrit and elderly and hospital and reason	52 journal citations, abstracts	2010 to 2005
nutrit and elderly and hospital and fracture	137	
elderly and *nutrit* and community and *economic and admission	3	
elderly and *nutrit* and community and *economic	207	
elderly and malnourished and community and *economic	41	
elderly and malnourished and community	420	
elderly and malnourished and impact and community	33	
MNA	365	
elderly and malnourished and community and cost	23	
elderly and malnourished and community and supplement*	93	
elderly and malnourished and community and supplement* and effect*	45	
nursing home and admission and *nutrit* and elderly	30	
community and *nutrit* and elderly and prevent* and nursing home	30	
elderly and *nutri* and australia and prevent*	151	
community and elderly and malnut* and prevent*	66	