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BODY-WEIGHT AND NUTRITIONAL-STATUS CHANGES IN SOUTH AUSTRALIAN NURSING-HOME RESIDENTS

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Abstract: *Objectives:* To characterize body weight and nutritional status of a cohort of elderly nursing home residents in Adelaide, South-Australia, and the factors associated with changes in these measures over 6-12 months. *Design:* Retrospective study. *Setting:* Nursing homes affiliated with a single provider of aged care. *Participants:* Residents aged 87±8years. *Measurements:* Age, gender, body weight and body mass index (BMI), pain, length of stay, and nutritional status assessed by malnutrition universal screening tool (MUST), were obtained from a data base. Changes in these parameters over 6 to 12 months were determined, as were factors associated with weight change. *Results:* 1,020 residents were in the 6-months retrospective analysis, and a subset of 752 residents in the 12-months sub-group. The average weight and BMI for the overall cohort were 66±16kg and 25±6kg/m2. Almost 30% of residents were at medium or high nutritional risk (14% and 16%). Body weight decreased 0.4±4.1kg (0.5±6.4%) over 6-months (P=0.006) and 0.9±5.2kg (1.3±7.8%) over 12-months (P<0.001). 46% of residents had marked weight change (≥ 5% loss or gain) over 12-months. Residents in the lowest BMI tertile (≤23kg/m2) were most likely to experience both marked weight change (52%) and weight reduction (30%). Weight loss was associated with higher pain scores (P=0.012) and greater length of stay in the nursing home (P=0.002). *Conclusion:* On average these older people lost weight, with high rates of both substantial weight loss and gain, particularly among those in the lowest BMI tertile. Almost a third in the lowest BMI tertile lost 5% or more body weight, putting them at increased risk of undernurition-related morbidity, suggesting greatest attention to prevent and treat such morbidity should be focused on that group.

Key words: Older people, body-weight change, nutritional status, nursing home.

Introduction

Ageing is associated with physiological changes in body weight and composition. These changes have impacts on quality of life and life expectancy (1, 2). Weight loss is more common than weight gain in adults aged 65 years or older (2-6), and is associated with increased mortality. For example, in the prospective US Cardiovascular Health Study of community-dwelling older people, weight loss over 3 years of ≥ 5%, was more common than weight gain of ≥ 5% (17% compared with 13%), and associated with a 70% increase in mortality, whereas weight stability and weight gain were not associated with increased mortality (3). There is increasing evidence that large weight fluctuations, either up or down, are associated with poor health outcomes and increased all-cause or cardiovascular-/ cancer-mortality. For example, the Iowa Women's Health study found that both weight loss and weight gain of 5-10% were associated with higher incidence of chronic diseases, and weight gain ≥ 10% was associated with increased rates of myocardial infarction and breast cancer (7). Furthermore, recent evidence from the Systolic Hypertension Study in the Elderly Program (SHEP), in adults aged 60 years or more, indicated that that the extent of weight change over the previous year was a good predictor of all cause and also cardiovascular/cancer-specific mortality, better than baseline weight or body mass index (BMI, kg/m2) (2).

One of the reasons for the association between weight change (particularly weight loss) and adverse outcomes is the development of malnutrition. This is common in older people. We have reported that 45% of 250 older, community dwelling recipients of domiciliary care services in Adelaide, South Australia were malnourished or 'at risk' of malnutrition (~5% and ~40%, respectively) (8). Higher rates of malnutrition have been reported in long-term aged-care facilities (nursing homes), sometimes as high as 85% (9-12).

Knowledge is limited about the mechanisms underlying the associations between weight change, malnutrition and adverse outcomes; one possible common factor is the presence and severity of pain in older people. Eating problems or poor eating behaviour including deficient nutrient intake are not only more prevalent in people that experience oral pain (13) but also in patients with chronic pain (14). For example ~20-30% of patients with chronic pain had caloric under-consumption, with a daily caloric intakes of less than 1200 calories per day according to a food frequency questionnaire (14).

The rates of weight change (particularly weight loss) and associated malnutrition reported elsewhere suggest that such rates will also be high in our community, particularly among the institutionalized elderly. We lack good data, however, on the nutritional status, body weight and weight changes of

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institutionalized older people in South Australia. The purpose of the present study was to characterize these factors, and also pain, and length of stay at nursing home, of adults aged 55 years or more, living in nursing homes affiliated with Southern Cross Care (SA&NT) Inc., South Australia.

Methods

Study Population

Participants were residents of 15 nursing homes in South Australia affiliated with Southern Cross Care (SA&NT) Inc. in March 2015, when "baseline" data from the Southern Cross (SA&NT) Inc. database were obtained and analysed. All residents aged 55 years or more in these 15 homes were included, except those with severe dementia living in the memory support units, those living in their facility for less than 6 months, and those with incomplete baseline body weight, height or Malnutrition Universal Screening Tool (MUST) data. 1,228 residents were screened and 1,020 included in the 6-month cohort (change from 6 months before baseline to baseline), of which 758 were also included in the 12-month cohort (change from 12 months before baseline to baseline). Residents in the 6- but not 12-month cohort had lived in their facility for more than 6 but less than 12 months.

Variables

Variables examined in this study were retrieved, after de-identification, from a computerized database used by Southern Cross Care (SA&NT) Inc. (iCare, iCareHealth, Australia). Age, height, pain score and length of stay at the nursing home were retrieved at baseline; MUST score at baseline and 6 months prior; and body weight and BMI at baseline and 6 and 12 months prior. Body weight was measured using a calibrated digital chair scale (model: HVL-CS, A&D Australasia Pty. Ltd.) and performed by a carer according to a standard weighing procedure during the residents' morning tea-time (10.00-11.30am). Before weighing, residents were asked to remove heavy clothing, such as jacket, shoes or boots. Nutritional status was assessed by one qualified dietician for the whole 15 sites using MUST (score 0 = low risk, 1 = medium risk, 2 or more = high risk of malnutrition) (15). Pain score was measured with the Abbey Pain Scale (score 0 – 2 = No pain, 3 – 7= Mild pain, 8 – 13 = Moderate pain, and 14+ = Severe pain) (16).

Statistical Analysis

Weight change in the past 6 months was calculated by difference between the baseline weight (i.e. most current weight) and weight 6 months prior. While for the 12-months weight change, baseline weight was subtracted by weight 12 months prior. Weight change was then expressed as absolute change in (kg) and percentage of change (%). To determine predictors of weight change, three sets of analysis were performed. We used Pearson Correlation test for continuous variables, i.e. age, BMI, total pain score and length of stay at nursing home, and then ANOVA test for categorical variables, i.e. sites, sex, marital status, BMI tertiles and pain-score category. Clinically relevant variables and those with significant result (P value < 0.05; i.e. age, gender, total pain score, length of stay and BMI) were then entered into linear regression model. To further assess whether body weight changes were associated with BMI, subjects were divided into BMI tertiles (baseline data), using the following cut-off points for BMI: 1st tertile: BMI ≤ 23.0 kg/m2, 2nd tertile: BMI 23.01 - 27.49 kg/m2, and 3rd tertile: BMI ≥ 27.5 kg/m2. Subsequently, cross-tabulation between percentage of weight change (weight loss ≥ 5%, weight stable and weight gain ≥ 5%) and BMI tertiles was conducted to reveal the proportion of weight change according to BMI tertiles over the 6- and 12-months period. All statistical tests were performed by SPSS (v.21.0 for windows, SPSS Inc., USA). All data are expressed as descriptive data (mean ± SD). The study was approved by the Royal Adelaide Hospital Human Research Ethics Committee and registered with the Australian New Zealand Clinical Trial Registry (www.anzctr.org.au, Trial number ACTRN12615000661572).

Results

Baseline

Table 1 shows the characteristics of all subjects (n = 1,020; the 6-month cohort for whom there were baseline and 6-month prior data) and the 12-month cohort (n = 752; for whom there were baseline and 6- and 12-months prior data). The mean age of the 6-month cohort was 87 ± 8 years (range 55 to 105 years), with a BMI of 25 ± 6 kg/m2 (range 12 to 48 kg/m2) with 65% being women. The men were heavier (75 ± 15 kg vs. 63 ± 16 kg, P < 0.001), taller 170 ± 7 cm vs. 158 ± 7 cm, P < 0.001) and had slightly higher BMIs than the women (26 ± 5 kg/m2 vs. 25 ± 6 kg/m2, P = 0.057). Values for these parameters were similar in the 12-month cohort to those in the 6-month cohort. Men in both cohorts were younger (85 ± 8 years vs. 88 ± 7 years, P < 0.001) and had been living in the nursing home for less time than their female counterparts (32 ± 32 months vs. 42 ± 37 months, P < 0.001). Increasing age was associated with a reduction in body weight (r = -0.295, P < 0.001, Figure 1), with the regression line indicating a decrease in body weight of 0.63 kg for each year of increased age.

Based on the MUST score, 30% of residents were classified as being at medium (score of 1) or high (score of 2) nutritional risk (14% and 16%, respectively). Women were twice as likely to be at high nutritional risk as men, with 13% of women at medium nutritional risk and 18% at high risk, compared to 19% of men at medium risk and 9% at high risk (P = 0.001). The average MUST score for women was significantly higher than male residents (0.56 vs. 0.41, P = 0.012). Although most residents had no pain (score < 2), there was a trend of higher pain scores among residents with poorer nutritional

Table 1
Baseline and 6- and 12-month data in men and women of the 6- and 12-month cohort

	6-months cohort				12-months cohort			
	Men (n=259)	**Women (n=761)**	**Total (n=1020)**	**P value ***	**Men (n = 178)**	**Women (n=574)**	**Total (n=752)**	**P value ***
Baseline								
Age (year)	84.8 ± 8.4	87.6 ± 7.3	86.9 ± 7.7	<0.001	85.6 ± 8.1	88.0± 7.1	87.5 ± 7.4	<0.001
Height (cm)	170.4 ± 7.2	158.1 ± 6.7	161.3 ± 8.7	<0.001	170.4 ± 6.9	158.0 ± 6.6	160.9 ± 8.5	<0.001
Pain Score †	1.9 ± 3.2	2.0 ± 3.3	1.98 ± 3.3	0.55	2.1 ± 3.4	2.1 ± 3.3	2.1 ± 3.3	0.91
Length of stay (months)	31.7 ± 31.6	41.6 ± 37.0	39.1 ± 35.9	<0.001	40.1 ± 32.8	48.7 ± 37.2	46.6 ± 36.4	0.01
Body weight (kg)	75.3 ± 14.8	63.2 ± 15.7	66.3 ± 16.4	<0.001	75.3 ± 14.4	63.1 ± 15.7	66.0 ± 16.3	<0.001
BMI (kg/m2) ‡	26.0 ± 4.9	25.2 ± 6.0	25.4 ± 5.7	0.06	26.0 ± 4.9	25.2 ± 6.0	25.4 ± 5.7	0.09
MUST Score §	0.4 ± 0.8	0.6 ± 1.0	0.5 ± 0.9	0.01	0.4 ± 0.8	0.56 ± 0.96	0.5 ± 0.9	0.01
6 months prior								
Body weight (kg)	75.9 ± 14.5	63.5 ± 15.5	66.6 ± 16.2	<0.001	76.2 ± 14.3	63.6 ± 15.5	66.6 ± 16.1	<0.001
BMI (kg/m2)	26.2 ± 4.9	25.4 ± 5.8	25.6 ± 5.6	0.03	26.3 ± 5.0	25.5 ± 5.9	25.66 ± 5.7	0.06
MUST Score	-	-	-	-	0.3 ± 0.7	0.5 ± 0.9	0.4 ± 0.9	0.02
Change in body weight from 6 months prior to baseline								
(kg)	-0.5 ± 4.9	-0.3 ± 3.8	-0.4 ± 4.1	0.47	-0.9 ± 4.2	-0.6 ± 3.8	-0.7 ± 3.9	0.38
(%)	-0.6 ± 6.8	-0.4 ± 6.2	-0.5 ± 6.4		-1.1 ± 5.8	-0.9 ± 6.1	-0.9 ± 6.0	0.69
12 months prior								
Body weight (kg)	-	-	-	-	76.2 ± 13.5	63.9 ± 15.4	66.9 ± 15.8	<0.001
BMI (kg/m2)	-	-	-	-	26.3 ± 4.7	25.6 ± 5.8	25.8 ± 5.6	0.09
Change in body weight from 12 months prior to 6 months prior								
(kg)	-	-	-	-	0.0 ± 4.0	-0.31 ± 3.4	-0.2 ± 3.5	0.29
(%)	-	-	-	-	0 ± 5.53	-0.4 ± 5.4	-0.3 ± 5.5	0.36
Change in body weight from 12 months prior to baseline								
(kg)	-	-	-	-	-0.9 ± 5.6	-0.9 ± 5.0	-0.9 ± 5.2	0.98
(%)	-	-	-	-	-1.1 ± 7.7	-1.3 ± 7.9	-1.3 ± 7.8	0.75

Data represent mean ± SD; * Independent t-test of men compared with women; † Pain score measured with Abbey Pain Scale, 0 – 2 = No pain, 3 – 7= Mild pain, 8 – 13 = Moderate pain, and 14+ = Severe pain; ‡ BMI: body mass index; § MUST: Malnutrition Universal Screening Tool, 0 = low risk, 1 = medium risk, 2 or more = high risk.

status. The mean pain score of residents with medium and high nutritional risk was 2.1 ± 3.5 and 2.6 ± 3.8, compared to 1.8 ± 3.1 for residents with low nutritional risk – although, significant difference was only observed between the high and low nutritional risk group (P = 0.009).

Changes over 6 and 12 months

On average, subjects lost weight during the 6- and 12-month periods before baseline (Table 1). The 6-month cohort of 1,020 residents experienced a 0.4 ± 4.1 kg weight decrease over 6 months, equivalent to 0.5 ± 6% of their starting weight (P = 0.006), and the 12-month cohort of 752 residents had a 0.9 ± 5.2 kg (1.3 ± 7.8%) weight reduction over 12 months (P < 0.001). There were no significant differences in the amount of weight lost between men and women, either in absolute or percentage terms.

A substantial minority of subjects had a reduction or increase in body weight of greater than 5% during the study period; 34% over 6 months among the subjects in the 6-month cohort (Table 2), and 46% over 12 months in the subjects in the 12-month cohort (Table 3).

Factors associated with weight change

Weight change was associated with several variables. Pearson correlation test showed that a higher pain score at baseline (r = -0.082, P = 0.009) and greater length of stay in the nursing home (r = -0.102, P = 0.001) were significantly associated with a reduction in body weight during the 6 months before baseline. These results are supported by multiple linear-regression analysis (total pain score P = 0.012, β = -0.079, 95% Confidence Interval (CI) = -0.176 to -0.022; length of stay P =0.002, β = -0.100, 95% CI = -0.019 to -0.004). There was an association between lower initial BMI 6 months before baseline and greater weight loss over 6 months (r = -0.075, P =

Table 2
Body-weight change over 6 months

BMI-tertiles*			Weight loss ≥ 5%	Weight Stable	Weight gain ≥ 5%
≤ 23.00	n	354	76	211	67
	Percent		21%	60%	19%
23.01 – 27.49	n	329	68	216	45
	Percent		21%	66%	13%
≥ 27.50	n	337	53	250	34
	Percent		16%	74%	10%
Total	n	1020	197	677	146
	Percent		19%	66%	14%

* BMI: body mass index (kg/m2)

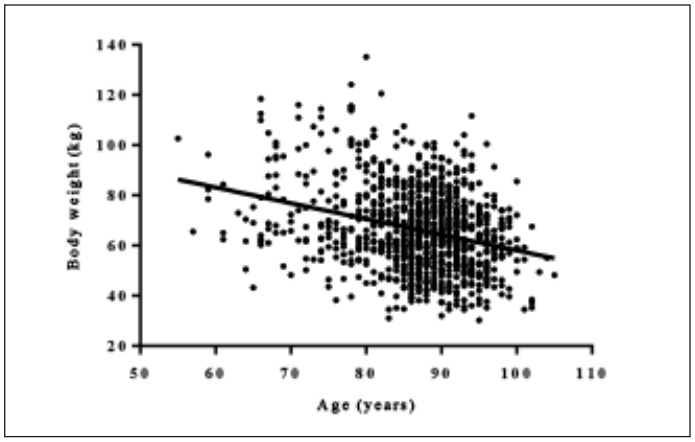
Table 3
Body-weight change over 12 months

BMI-tertiles*			Weight loss ≥ 5%	Weight Stable	Weight gain ≥ 5%
≤ 23.00	n	252	76	121	55
	Percent		30%	48%	22%
23.01 – 27.49	n	248	70	132	46
	Percent		28%	53%	19%
≥ 27.50	n	252	67	151	34
	Percent		26%	60%	14%
Total	n	752	213	404	135
	Percent		28%	54%	18%

* BMI: body mass index (kg/m2)

0.017). Consistent with this, more subjects in the lowest BMI tertile (≤ 23 kg/m2) had a decrease of 5% or more of their body weight than those in the highest tertile over the 6 months before baseline (21.5% compared with 15.7%; Table 2).

Figure 1
Body weight plotted as a function of age



There was an apparent association between initial BMI and the magnitude of weight change, either percentage weight loss or weight gain. Subjects with lower initial BMIs consistently had greater fluctuations in body weight (increases or decreases of ≥ 5% of body weight) than those with higher BMIs over both 6- (Table 2) and 12- (Table 3) month periods. For example, 40% of those in the lowest BMI tertile had weight change (increase or decrease) of ≥ 5% over 6 months, compared to 27% in the highest tertile; while over 12 months 52% of the lowest tertile group had weight change of ≥ 5%, compared to 40% of the highest tertile group ($P < 0.001$).

Discussion

The main findings of this study are that these nursing home residents had a body weight decrease equivalent to approximately 1 to 1.3% per annum (0.8 to 0.9 kg), that underweight residents were the most likely to lose weight, and that there were high rates of substantial body weight changes, both up and down, particularly in residents with initially lower body weights. The prevalence of poor nutritional status in this

study, using the MUST tool, was 30%, in line with rates of 21-38% reported in recent studies of Australian and European nursing home residents using the same tool (17-20).

Various physiological and non-physiological factors have been identified as being associated with, and probably contributing to, weight loss in older people (5, 21, 22). They include dementia, depression, reduced functional status, medical conditions and medications, poor dentition, social isolation and poverty (23-25). This study was unable to investigate the role of most of those variables, but, did identify an association between higher pain scores and weight loss. The association between pain and weight loss in nursing home residents has been reported previously (26) and is likely to be mediated via multiple mechanisms, including the anorectic (27) and cachectic effects of increased cytokine action in painful conditions including malignancies. We do not have an explanation for the significant but weak association identified between greater length of residence in the nursing home and weight loss. It is possible that those admitted to the nursing home earlier started with more disabilities and poorer nutritional status and hence, the longer they live at the nursing homes, the more weight they lose irrespective of intervention provided at the nursing home.

The average decrease in body weight of approximately 1-1.3% per year in this study is consistent with the results of other studies. Longitudinal studies have shown that body weight decreases in community dwelling older people, at approximately 0.5% per year (3, 28, 29). Data on weight change among nursing home residents are more limited, but the rate of weight loss in the present study is consistent with previous findings suggesting higher rates of weight loss in nursing home residents than their community dwelling peers (4, 30, 31). A recent small Italian study reported weight loss of ≥ 5% over one year in 75% of nursing home residents (30), a large multicentre, multi-country study reported weight loss during one year of ≥ 5 kg (~7.5%) in 11% of residents (31), while a US study found substantial weight loss of 5% in 30 days or 10% in 180 days (the Minimum Data Set criteria) in ~10% of nursing home residents (4). The rate of weight decrease identified in this study is of interest, given the association between weight loss and adverse outcomes in older people (29, 31-37). In particular, weight loss > 4-5%, probably irrespective of starting weight (3), is associated with increased mortality in older people, both community dwelling (3, 29, 32, 33) and in nursing homes (31, 34, 36).

Low body weight is also associated with adverse outcomes in older people (29, 31-37). The body weight and BMI associated with maximum life expectancy increases with increasing age (38), as does the BMI value below which there is an increase in associated mortality. Studies in older people indicate that a BMI ≤ ~23 kg/m2, the upper end of the lowest tertile in our study, is associated with increased mortality (22). Furthermore, previous studies have demonstrated an interaction between low body weight and weight loss in their adverse effects on mortality in older people. Newman et al. reported that mortality in older people was approximately doubled by weight loss of ≥ 5% of initial body weight, irrespective of initial weight, but that mortality rates were higher in people of low body weight who lost weight (7.4 per 100 person years) than their normal weight peers who lost weight (4.6 per 100 person years) (3). Similarly, in a study of over 10,000 nursing home residents, Wirth et al. reported a 6-month mortality of 11% in those with a BMI of ≥ 20 kg/m2 who were weight stable, rising to 36% in those with a BMI < 20 kg/m2 who lost more than 5 kg (OR 3.5, P < 0.001) (31). In the present study approximately 6-7% of residents were of low body weight (BMI ≤ 23 kg/m2) and lost more than 5% of their body weight, putting them at particular risk of undernutrition-related adverse events. As recommended by Wirth et al., particular attention should be focused on such people with a view to providing nutritional support (31).

Of interest, those nursing home residents in the present study who lost the most weight were those already at lowest body weight, with almost a third of residents with BMI ≤ 23 kg/m2 experiencing a weight reduction of ≥ 5% over 12 months. Although this rate of weight loss was only marginally higher than that in the highest BMI tertile, this finding is consistent with, and supports, that of Wirth et al. (31). They reported that substantial weight loss (> 5 kg in that study) among nursing home residents was more prevalent in those with initially lower BMIs, with substantially higher rates of weight loss particularly if the initial BMI was < 23 kg/m2 (31). Our finding, and that of Wirth et al., in nursing home residents, are at odds with that of Newman et al., who reported greater weight loss in community dwelling older people with greater baseline weight (3). The reason for this discrepancy is not clear. It may be that underweight nursing home residents, as opposed to community dwelling, are at particular risk of weight loss. In any case, our finding reinforces the need to focus particular nutritional attention on nursing home residents with low body weight.

There was a high rate of substantial weight change among the subjects in this study. Over twelve months 46% of residents had either a weight loss or weight gain ≥ 5%, with weight loss more common than weight gain. While the weighing techniques used were standardized as much as possible, the subjects were resident in multiple homes and not always weighed by the same person, so there would have been some variations in weighing technique that contributed to this high rate. Nevertheless, our findings are consistent with other recent reports of high levels of weight fluctuation among older people in nursing homes. For example, a study of 6,009 nursing home residents in the United States found that 29% of them either lost or gained ≥ 10% body weight over 6 months (39), while in a study from the Netherlands 48% of nursing home residents with dementia lost or gained ≥ 2 kg weight over 24 weeks follow-up (40). These high rates are probably due to the high prevalence of frailty, anorexia and medical conditions such as heart failure, inflammation, and malignancy, together with the treatments

used to combat them, contributing to weight loss on the one hand, with factors such as sudden immobility, glucocorticoid prescription and the identification and active nutritional support of under-nourished older residents contributing to weight gain, on the other. They are of concern, however, as weight fluctuation in either directions have been associated with poor health outcomes in older people (22, 41, 42).

This study has several limitations. Firstly, it relied solely on data recorded by the staff within each facility and it was not possible for the research team to verify the accuracy of the data. Hence, there are possibilities for variation and fluctuations in measurement results of the variables. Secondly, predictive variables for weight change used in this study were limited to only those readily available and feasible to analyse from the iCare database. Other variables that might have a stronger role in weight change such as morbidity, medication, food intake, depression, functional status [(in-) activities of daily living ADL and IADL] and mental status (cognitive performance) were not included. Thus, the role of pain in weight change could be attenuated by the presence of other factors and might become insignificant. Lastly, data for predictive variables were only available for the 6-month time point. This has limited our ability to investigate the role of these variables in a longer time frame.

In summary, the nursing home residents in this study lost weight at an average rate of 1-1.3% (0.8 to 0.9 kg) per annum, approximately double that reported previously for their community-dwelling peers, with substantial numbers losing > 5% of their body weight in one year. Those residents with lower initial body weights were more likely to lose weight, putting them at increased risk of undernutrition associated adverse events. These findings reinforce the need to weigh nursing home residents regularly and address weight loss when detected, particularly in those already underweight.

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Conflicts of interest: The authors have no conflicts of interest to declare.

Ethical standards: The study was approved by the Royal Adelaide Hospital Human Research Ethics Committee, conducted in accordance with the Declaration of Helsinki, and registered with the Australian New Zealand Clinical Trial Registry (www.anzctr.org.au, Trial number ACTRN12615000661572).

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