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1 **An exploratory study to evaluate whether medical nutrition therapy can improve dietary**
2 **intake in hospital patients who eat poorly**

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22

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25 Postgraduate Award. There is no other source of funding to declare. This project was undertaken as
26 part of the PhD study of EA and was supervised by EI, MF and MB. EA, EI, MF and MB
27 conceived, planned and designed the study. EA collected, analysed and interpreted the data. EA
28 wrote the original manuscript. All authors critically reviewed the manuscript and approved the final
29 version submitted for publication.

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35 **Keywords:** acute care, inadequate intake, medical nutrition therapy.

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37 **List of Abbreviations:**

38 ANCDS: Australasian Nutrition Care Day Survey

39 LOS: Length of stay

40 MNT: Medical Nutrition Therapy

41 MST: Malnutrition Screening Tool

42 OR: Odds Ratio

43 SGA: Subjective Global Assessment

44

45 **ABSTRACT:**

46 **Background and aims:** The Australasian Nutrition Care Day Survey (ANCDS) reported two-in-
47 five patients consume $\leq 50\%$ of the offered food in Australian and New Zealand hospitals. After
48 controlling for confounders (nutritional status, age, disease type and severity), the ANCDS also
49 established an independent association between poor food intake and increased in-hospital
50 mortality. This study aimed to evaluate if medical nutrition therapy (MNT) could improve dietary
51 intake in hospital patients eating poorly.

52 **Methods:** An exploratory pilot study was conducted in the respiratory, neurology and orthopaedic
53 wards of an Australian hospital. At baseline, percentage food intake (0%, 25%, 50%, 75%, and
54 100%) was evaluated for each main meal and snack for a 24-hour period in patients hospitalised for
55 ≥ 2 days and not under dietetic review. Patients consuming $\leq 50\%$ of offered meals due to nutrition-
56 impact symptoms were referred to ward dietitians for MNT. Food intake was re-evaluated on the
57 seventh day following recruitment (post-MNT).

58 **Results:** 184 patients were observed over four weeks; 32 patients were referred for MNT. Although
59 baseline and post-MNT data for 20 participants (68 ± 17 years, 65% females) indicated a significant
60 increase in median energy and protein intake post-MNT (3600kJ/day, 40g/day) versus baseline
61 (2250kJ/day, 25g/day) ($p < 0.05$), the increased intake met only 50% of dietary requirements.
62 Persistent nutrition impact symptoms affected intake.

63 **Conclusion:** In this pilot study whilst dietary intake improved, it remained inadequate to meet
64 participants' estimated requirements due to ongoing nutrition-impact symptoms. Appropriate
65 medical management and early enteral feeding could be a possible solution for such patients.

66 (247 words)

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68

69 **INTRODUCTION**

70 The Australasian Nutrition Care Day Survey (ANCDS) is the most comprehensive evaluation of
71 nutritional issues (nutrition care practices, and prevalence of malnutrition and decreased food intake
72 in patients) in Australian and New Zealand hospitals (Agarwal et al., 2012a, Agarwal et al., 2012b).
73 Malnutrition was prevalent in 32% of the cohort (N= 3122) and more than half the malnourished
74 patients (n= 558, 53%) and one-in-three well-nourished patients (n=725, 35%) consumed up to half
75 the offered meals, indicating that decreased food intake was common in hospital patients in this
76 region (Agarwal et al., 2012b). The European NutritionDay is the largest study to evaluate 24-hour
77 food intake in acute care patients admitted across European hospitals (Hiesmayr et al., 2009). The
78 study also reported that only one-third of the participants (N= 16290) consumed all the offered food
79 (Hiesmayr et al., 2009).

80 Participants in the ANCDS and European NutritionDay cited “not hungry” as the most common
81 reason for not consuming all the offered food (Agarwal et al., 2012b, Hiesmayr et al., 2009). Both
82 studies also found a significant association between decreased food intake and increased risk of in-
83 hospital mortality (Agarwal et al., In Press, Hiesmayr et al., 2009). Multiple regression analyses
84 controlling for confounders (age, disease type and severity, nutritional status) indicated that
85 consumption of less than a quarter of the offered food was independently associated with two-three
86 fold increased risk for 30- and 90-day in-hospital mortality (Agarwal et al., In Press).

87

88 Malnutrition management guidelines (Mueller et al., 2011, Watterson et al., 2009, Elia M (chairman
89 and editor), 2003, Kondrup et al., 2003) recommend the routine use of valid and reliable nutrition
90 screening tools (e.g. Malnutrition Screening Tool, Malnutrition Universal Screening Tool)for the
91 identification of malnutrition in hospital patients and facilitate medical nutrition therapy (MNT,
92 defined as diagnostic, therapeutic, and counselling services offered by a dietitian for the
93 management of any disease, condition, illness or disorder). However, no nutrition screening tool
94 identifies patients with inadequate intake during hospitalisation (Young et al., 2013). Therefore, the
95 aims of the present study were to evaluate:

- 96 i. if MNT can improve dietary intake in acute care patients who eat poorly during
97 hospitalisation;
- 98 ii. if MNT can influence the choice and quantity of food items consumed by acute care
99 patients; and
- 100 iii. reasons for decreased food intake in acute care patients.

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103 **METHODS**

104 **Study design, setting and participants:** This was an exploratory pilot study, conducted in the
105 respiratory, orthopaedic and neurology wards of a large tertiary teaching hospital in Brisbane,
106 Australia. Inclusion criteria for recruitment:

- 107 • Age ≥ 18 years;
- 108 • Hospital stay of ≥ 2 days;
- 109 • Observed intake of $\leq 50\%$ of the offered meals for 1 day.

110 Exclusion criteria:

- 111 • Under dietitian's review at the time of recruitment;
- 112 • Terminal/critical illness;
- 113 • Cognitive impairment;
- 114 • Not on solid diet (e.g. nil-by-mouth, fluid diet, receiving artificial nutrition support (e.g.
115 total parenteral nutrition, tube feeds).

116 Ethics approval for the study was obtained from Metro South Human Research Ethics Committee
117 and from the Medical and Research Ethics Committee (University of Queensland).

118 **Data collection:** Data were collected by the first author (EA) over four weeks in 2012. Patients
119 admitted in this hospital are routinely provided with menus to self-select standard sized meals.

120 Dietary intake data were collected at two time points during the study:

- 121 • **Baseline:** Percentage consumption of each food item offered at main meals (breakfast,
122 lunch, dinner) and snacks (morning-tea and afternoon tea) were observed and recorded on a
123 five-point scale (0, 25, 50, 75, and 100%). The software package CBORD, which contains
124 nutrient analysis of all the food items offered in the hospital was used to record energy and
125 protein values of offered food items. Nutritional values in CBORD are derived from the
126 standard national Australian database – Food Standards Australia and New Zealand
127 (FSANZ; <http://www.foodstandards.gov.au>). Energy and protein values corresponding to
128 percentage consumption for each food item were calculated for the entire day. “Decreased
129 food intake” was defined as consumption of $\leq 50\%$ of the offered meals during a 24-hour
130 period. If observed food intake was $\leq 50\%$ of that offered, patients were asked to provide
131 reason/s for not eating everything. If patients indicated nutrition-impact symptoms (e.g. poor
132 appetite, early satiety, disliking taste/smell) they were referred to the ward dietitian for
133 nutrition assessment and MNT. If patients reported other issues (e.g. food-service related, no
134 feeding assistance) EA liaised with nursing staff to address the issues. Patients were
135 excluded from the study if after addressing these issues intake improved to $\geq 75\%$.

136 • **Post-MNT:** Data were collected on the seventh day following recruitment using the same
137 protocol. Medical chart documentation by the dietitian (e.g. nutritional assessment, type of
138 MNT implemented, number of reviews) was recorded.

139 Demographic data (age, gender, anthropometric measurements) were recorded from medical charts.
140 Participants' energy and protein requirements were calculated as 120kJ/kg/day and 1.2g/kg/day
141 respectively (National Collaborating Centre for Acute Care, 2006).

142

143 **Statistical analyses:**

144 Data were analysed using PASW Statistics 18. Categorical variables were reported as frequency and
145 percentage and bivariate analyses were undertaken using chi-square tests. Continuous variables
146 were reported using mean \pm standard deviation if normally distributed (age), or medians (range) if
147 not normally distributed (energy and protein values). Non-parametric Wilcoxin Signed Rank Test
148 was used to determine changes in energy and protein intake between baseline and post-MNT. A *p*-
149 value <0.05 was considered statistically significant.

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152 **RESULTS**

153 Of the 184 patients whose food intake was evaluated, one third (n=62) consumed $\leq 50\%$ of the
154 offered food. Thirty patients indicated dissatisfaction with not self-selecting menu items (n=20),
155 and not receiving feeding assistance at meal times (n=10). Nursing staff were informed and issues
156 were resolved for all 30 patients, who were then excluded from the study.

157

158 At baseline, 32 patients consumed $\leq 50\%$ of the offered food due to nutrition-impact symptoms.
159 Five patients were terminally ill and thus excluded from study Seven participants were lost to
160 follow-up. Complete data were available for 20 participants.

161 **a) Demographic characteristics:** 60% of the cohort was aged ≥ 65 years (Table1). Seven
162 participants (35%) were malnourished (Table1).

163 **b) Energy and Protein consumed:** At baseline, participants' intake was equivalent to
164 approximately 30% of energy (2250kJ/day) and protein (25g/day) requirements (Table2).
165 Post-MNT this improved significantly to 50% of median energy (3600kJ/day, $p=0.005$) and
166 protein (41g/day, $p=0.001$) requirements (Table2).

167 **c) Reason for not eating all the offered food:** "Not hungry" and "feeling full" were the most
168 commonly cited reason for not consuming all the offered food at baseline and post-MNT
169 respectively (Table3).

170 *d) Type of MNT:* Sixteen participants (80%) received an initial assessment, and 4 participants
171 (20%) received an additional review. Interventions included high energy-protein diets ±
172 ONS (n=9, 45%), ONS (n=9, 45%), texture modification (n=2, 10%), and dietary
173 counselling (n=17, 85%).

174

175 **DISCUSSION**

176 The present study aimed to explore the efficacy of MNT in improving dietary intake in patients who
177 ate poorly during hospitalisation. Despite statistical improvements in dietary intake post-MNT, a
178 majority of participants met only half their dietary requirements due to persistent nutrition-impact
179 symptoms. Prolonged inadequate dietary intake can lead to an advanced state of depletion of the
180 body's nutritional reserves(Sullivan et al., 1999). Anorexia and early satiety were most commonly
181 cited for not consuming all the offered food. Both symptoms are common characteristics of acute
182 illness and self-limiting factors (Lennie, 1999), which makes oral replenishment of nutritional
183 deficits challenging (Sullivan et al., 1999). A recent study by Leistra and colleagues (2011)
184 demonstrated that when patients were tube fed during the first four days of hospitalisation, their
185 chances of meeting nutritional requirements more than quadrupled (Leistra et al., 2011). Perhaps
186 future research could evaluate the effectiveness of intensive nutrition support and the medical
187 management of nutrition-impact symptoms.

188 The average LOS of acute care patients in Australian hospitals is approximately six days
189 (Australian Institute of Health and Welfare, 2011), during which time medical needs are likely to
190 supersede nutritional needs. Although nutrition support may commence during hospitalisation, the
191 short average LOS is unlikely to provide sufficient opportunity to replenish nutrient reserves in
192 patients with ongoing sub-optimal dietary intake (Neelemaat et al., 2012). A review of randomised
193 controlled trials found that the use of ONS post-discharge in medical and surgical patients (aged
194 ≥65 years) demonstrated positive effects on nutritional intake and/or weight status (Beck et al.,
195 2013). Neelemaat and colleagues found that a multi-component nutritional intervention (using
196 ONS, food fortification, telephone counselling by a dietitian, and supplementation) was beneficial
197 in improving functional status in elderly patients (aged ≥60 years) at no additional costs (Neelemaat
198 et al., 2012). Previous reports indicate that lower priority is placed on nutrition by nursing staff
199 members (Bell et al., Accepted) and that they are often busy with competing clinical duties that
200 prevent them from always offering support (Kowanko et al., 1999). Plate waste observations
201 highlighted issues that were easily resolved without specialised dietetic intervention. Regular
202 monitoring of patients' food intake must therefore be embedded as routine practice in hospitals
203 alongwith incorporating nutrition support in patients' discharge plans (Holst et al., 2011).

204 **Limitations:** The cross-sectional nature of this study does not allow for a causal relationship to be
205 established between MNT and improved dietary intake. There are ethical issues with demonstrating
206 causality through prospective randomised controlled trials (where a group of patients may not be
207 offered MNT despite best practice of care). Although the small sample size is explained by this
208 being a pilot study, it is noteworthy that at least half the patients with decreased intake were
209 excluded as simple strategies were effective in improving dietary intake.

210 **Strengths & significance:** Much of the published literature focuses on nutritional interventions in
211 undernourished, elderly patients (Neelemaat et al., 2012, Nieuwenhuizen et al., 2010, Milne et al.,
212 2009, Walton et al., 2008, Milne et al., 2006, Jukkola et al., 2005). However this study
213 demonstrates that well-nourished and younger patients are also vulnerable to nutrition-impact
214 symptoms and inadequate dietary intake. . Adequacy of dietary intake in participants was evaluated
215 based on individual assessment of nutritional needs along with detailed recording of intake of each
216 food item at main meals and snacks. Both these provide reliable data and are highly labour intensive
217 methods (Hiesmayr et al., 2009, Patel et al., 2008).

218 **CONCLUSION**

219 The present study found that anorexia and early satiety were the most commonly cited nutrition-
220 impact symptoms inhibiting adequate dietary intake in acute care patients, warranting further
221 research to evaluate the efficacy of early and intensive MNT, and medical management of patients
222 exhibiting ongoing nutrition-impact symptoms. This study also highlights that simple interventions
223 can significantly improve dietary intake of acute care patients eating poorly due to organisational
224 barriers. With two large studies demonstrating an independent association between inadequate
225 dietary intake during hospitalisation and increased risk of in-hospital mortality (Agarwal et al., In
226 Press, Hiesmayr et al., 2009), ensuring dietary adequacy during hospitalisation is a responsibility
227 that should be jointly shared by healthcare team members and patients themselves.

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238 **Table 1: Baseline characteristics of participants consuming $\leq 50\%$ of the offered meals (n= 20)**

Age (years)	Mean \pm SD (range)	68 \pm 17 (33 – 96)
Gender (n, %)	Male	7 (35%)
	Female	13 (65%)
Reason for admission (n, %)	Cerebral Vascular Accident	5 (25%)
	Total hip replacement	3 (15%)
	Haematoma	3 (15%)
	Motor Vehicle Accident	2 (10%)
	Spinal Lesion	2 (10%)
	Pleural Effusion/Pneumothorax	2 (10%)
	Rheumatoid Arthritis	1 (5%)
	Sacral Compression	1 (5%)
	Congestive Cardiac Failure	1 (5%)
LOS (days): Baseline	Median (Range)	5 (3 – 18)
SGA (n, %):	Not performed	3 (15%)
	Incomplete*	2 (10%)
	Well-nourished (SGA-A)	8 (40%)
	Moderately malnourished (SGA-B)	6 (30%)
	Severely malnourished (SGA-C)	1 (5%)

239 (LOS: length of stay in hospital; n: number; SD: Standard Deviation; SGA: Subjective Global
 240 Assessment (Detsky et al., 1987))

241 *Medical chart documentation by the ward dietitians indicated that SGA was incomplete in two
 242 patients as:

- 243 • One patient was not “cooperative” during the assessment;
- 244 • Physical component of the SGA could not be completed in the second patient due to
 245 multiple fractures.

246 **Table 2: Observations related to food and nutritional intake, feeding position and feeding assistance availability (n=20)**

Observations	Baseline (Day 1)	Post-MNT (Day 7)	<i>p</i>-Value
Percentage Food Intake:			
0%	2 (10%)	0	
25%	14 (70%)	6 (30%)	
50%	4 (20%)	11 (55%)	0.041 ^a
75%	0	3 (15%)	
100%	0	0	
Energy Requirement (Median (Range))	7200 (4300 – 10500)kJ/day		
Energy Offered (Median (Range))	9200 (5500 – 11000)kJ/day	8600 (5000 – 12300)kJ/day	0.314 ^{b, c}
Energy Consumed (Median (Range))	2250 (1000 – 7700)kJ/day (meeting 30% of requirements)	3600 (1200 – 7800)kJ/day (meeting 50% of requirements)	0.005 ^c
Protein Requirement (Median (Range))	72 (43 – 106)g/day		
Protein Offered (Median (Range))	99 (65 – 145)g/day	90 (65 – 144)g/day	0.968 ^{b, c}
Protein Consumed (Median (Range))	25 (11 – 54)g/day (meeting 35% of requirements)	40 (8 – 112)g/day (meeting 55% of requirements)	0.001 ^c

247 (g= grams, kJ= kiloJoules; MNT: medical nutrition therapy; n= number; SD: Standard Deviation)

248 ^a Chi-Square Test

249 ^b Non-significant ($p > 0.05$)

250 ^c Wilcoxin Signed Rank Test

251

252 **Table 3: Frequency of reasons cited by participants (n= 20) for not consuming all the offered**
 253 **food at main meals and snacks**

Meal	Reason for not eating	Frequency of cited reasons	
		Baseline n (%)	Post-MNT n (%)
Main meals*	Not hungry	12 (60%)	4 (20%)
	Feeling full	2 (10%)	10 (50%)
	Chewing difficulty	4 (20%)	0
	Nausea/Vomiting	2 (10%)	3 (15%)
	Ate all	0	3 (15%)
	Not offered	15 (75%)	11 (55%)
Snack**	Not hungry	5 (25%)	0
	Dislike Taste	0	4 (20%)
	Ate all	0	2 (10%)
	Feeling full	0	2 (10%)
	Nausea/Vomiting	0	1 (5%)

254 (MNT: medical nutrition therapy)

255 *Main meals: breakfast, lunch, dinner

256 **Snacks: Morning-tea, Afternoon-tea

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