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Author

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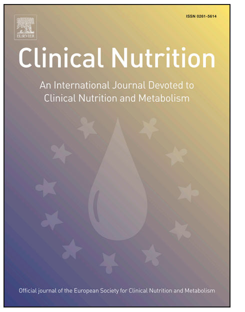

Acute stroke patients not meeting their nutrition requirements: Investigating nutrition within the enriched environment

Samantha T. Robertson, Rohan S. Grimley, Chris Anstey, Ingrid CM. Rosbergen

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Author's name

1. Mrs. Samantha T Robertson[1]: SamanthaT.Robertson@health.qld.gov.au
2. Dr Rohan S Grimley[2,3] MBBS
3. Dr Chris Anstey[3,4] MBBS
4. Dr Ingrid CM Rosbergen[1,5]

Affiliations

1 Allied Health Medical Services, Sunshine Coast Hospital and Health Service, Birtinya, Australia

2 Sunshine Coast Clinical School, The University of Queensland, Birtinya, Australia

3 Department of Medicine, Sunshine Coast Hospital and Health Service, Birtinya, Australia

4 Faculty of Medicine, University of Queensland and School of Medicine, Griffith University

5 Division of Physiotherapy, School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane

Correspondence

Samantha Robertson, Allied Health Medical Services Group, Sunshine Coast University Hospital, 6 Doherty Street, Birtinya, Queensland, Australia 4575

Email: SamanthaT.Robertson@health.qld.gov.au

Tel: +61 752028430

Fax: +61 752020433

Non- standard abbreviations

ASU, Acute Stroke Unit; SGA, Subjective Global Assessment; PM, Protected Mealtimes; NIHSS, National Institute of Health Stroke Scale; mRS, modified Rankin Score

Abstract

Background/Aims: Malnutrition is common after stroke. We investigated the impact of environmental enrichment strategies on dietary intake and rates of malnutrition in an acute stroke unit.

Methods: We performed a before-after study. In standard care, meals were delivered to participants' rooms whilst in the enriched environment, communal meals with assistance were offered and nutritional intake reminders were placed at the patient bedside. Nutrition supplementation was provided to both groups if indicated. Breakfast and lunch meals were directly observed while remaining intake was calculated using food charts. Nutrition requirements were calculated for energy (ratio method), protein (1g/kg) and proportion of requirements met. Malnutrition was assessed using the Subjective Global Assessment and body weight. ANCOVA adjusting for stroke severity was used to determine between group differences. Stepwise multivariable logistic regression was performed to assess predictors of nutritional outcomes, adjusting for intervention group, demographic, clinical and baseline nutritional factors.

Results: Neither standard care (n=30, age 76.0yrs ± SD12.8) or enriched environment (n=30, age 76.7yrs ± SD12.1, p=0.84) met daily requirements for energy (70.7% ± SD16.8 vs. 70.7% ± SD17.3, p= 0.94) or protein intake (73.2% ± SD18.6 vs. 69.8% ± SD17.3, p= 0.70). Mean body weight dropped: standard care 0.92kg ± SD2.47 vs. enriched 0.64kg ± SD3.12 (p=0.53) and malnutrition increased: standard care 3.3% to 26.6% vs. enriched 6.6% to 13.3% (p=0.07). Predictors of malnutrition on discharge in logistic regression models were: length of stay (p<0.01) and protein (p<0.01) or energy intake (p=0.02).

Conclusions: Acute stroke patients were not meeting nutritional requirements and losing body weight. The enriched environment showed no effect on nutritional intake. Malnutrition was associated with lower energy and protein intakes and increased length of stay.

Keywords Stroke; nutrition; nutritional intake; enriched environment, malnutrition, acute stroke unit

Introduction

Stroke is the third leading cause of death in western societies and a leading cause of disability (1, 2). In those who survive a stroke, the physical, cognitive and emotional impacts are considerable and interventions which enhance recovery are required. Poor nutritional status in acute stroke patients is associated with higher post stroke complications and poorer long term outcomes (3-7). Additionally, improvements in nutrition intake after stroke has been correlated with greater functional outcomes in early and rehabilitation phases (8-11).

Malnutrition is associated with increased morbidity and mortality, hospital costs and length of stay (3-5, 7, 12-14) with studies revealing its prevalence in an acute stroke setting ranging from 6 -62% (15). Decline in nutritional status post stroke is multifactorial, with deficits such as hemiplegia, dysphagia, cognitive changes and mood disorders negatively impacting nutritional intake in an acute stroke setting (16-20). The multitude of factors that contribute to poor nutritional intake post stroke suggests that simple approaches may be inadequate and novel interventions may be required to successfully improve malnutrition in the acute phase post stroke.

Interventions to mitigate the impact of malnutrition in the acute stroke setting have primarily focused on nutrition supplementation or enteral feeding (9, 21-27) with insufficient evidence to support routine supplementation to improve nutrition intake or outcomes in acute stroke patients (21, 22). Early enteral feeding is associated with reduction in risk of death, however it is used primarily in dysphagic patients unable to swallow (28). Other strategies to improve oral nutrition intake are required. Interventions such as protected mealtimes and mealtime assistance for acute medical inpatients have been trialled and show mixed results (29, 30).

An enriched environment is a novel intervention that creates a stimulating environment. In animal studies the enriched environment refers to housing conditions that provide physical, cognitive and social stimulation (31). Environmental enrichment in rodents has shown to have a positive impact on physical recovery, learning, mood and cognition (32). We have recently investigated embedding an enriched environment within the acute stroke unit. The enriched environment a) created a stimulating environment using communal areas for dining, socializing and group activities and access to stimulating resources; b) empowered patients and families to drive their own activities; and c) used change management strategies to support staff in changing work routine (33). The effects of an enriched environment that focused on elements of encouragement, stimulation and assistance to stroke survivors to enhance nutritional intake is not yet explored. Hence, the primary aim of this study was to determine if embedding environmental enrichment that altered the way nutrition was offered and encouraged would result in improved nutrition intake in stroke survivors in an acute stroke unit. The secondary aim was to determine if the enriched environment strategies would reduce malnutrition in the acute phase after stroke.

Methods

This is a sub-study of a prospective observational before- after study. The main study showed that an enriched environment in an acute stroke unit increased physical, social and cognitive activity levels in stroke survivors (34). The study was conducted in a regional Australian hospital between June 2014 and June 2015 in accordance with the Declaration of Helsinki. Ethical approval was obtained from Metro North Hospital and Health Service, The Prince Charles Hospital (TPCH) Human Research Ethics Committee (HREC) approval number HREC/14/QPCH/21 and The University of Queensland (UQ) Medical Research and Ethics Committee (MREC) approval number MREC/2014000371. The study was prospectively registered with the Australian New Zealand Clinical Trial Registry (ANZCTR12614000679684).

Participants and Setting

The study was conducted in an acute regional hospital in Queensland, Australia. The Acute Stroke Unit (ASU) is an endorsed stroke unit with 470 stroke admissions per annum and an in-hospital mortality rate of 17%. Acute stroke patients were consecutively enrolled to the study. We first enrolled participants to a control group who received standard care. Following completion of standard care, an enriched environment was embedded in the ward over a six week period. Subsequent enrolment of participants to the enriched group occurred. Participants were advised that the study aimed to determine the effect of an alternative rehabilitation model and were blinded to group allocation. Written informed consent was obtained from the patient or their substitute decision maker.

Eligibility

Eligibility criteria included: (1) admitted to the ASU within 24–72 hours after onset of stroke (ischaemic or haemorrhagic), (2) able to transfer from a bed to chair with the assistance of two persons or less, (3) able to follow single stage commands, (4) require assistance for basic activities of daily living, (5) independent prior to admission (self-report) based on a Functional Ambulation Category score ≤4 and a modified Rankin Score (mRS) of 0-2. Exclusion criteria included rapidly deteriorating conditions or extensive psychiatric history, due to potential impacts on eating behaviours and nutritional intake. To allow for observational data collection, stroke survivors were excluded if discharge from the ASU was likely to occur within two days of admission. There were no specific nutritional factors in the inclusion or exclusion criteria.

Intervention

The standard care cohort received usual ward based dietetic care in line with the Australian Stroke Foundation clinical guidelines for stroke management (35). Every stroke patient was assessed for malnutrition, monitored for adequacy of intake and provided with supplementation or enteral nutrition as required. Main meals were delivered three times a day with a drinks trolley providing tea/coffee and biscuits three times daily between meals. Mealtime assistance was provided individually by nursing staff or assistants in nursing at the bedside where required. This was communicated by a red tray system highlighting patients requiring assistance due to physical or cognitive deficits. A normal texture diet and fluids provided 8305 kilojoules and 87 grams of protein while a texture modified diet provided 9097 kilojoules and 109 grams of protein. The texture modified diet provides higher kilojoule and protein as some food items on this diet code such as the porridge and soup are fortified by the hospital foodservice due to the higher risk of poor oral intake amongst dysphagic patients.

The intervention cohort received usual ward based dietetic intervention as well as stroke care in an enriched environment. The enriched environment altered the approach to delivery of nutrition in the following ways: 1) Communal mealtimes in a ward based dining room which included communal breakfasts on three weekdays and lunch meals on all weekdays. All patients were encouraged to attend communal meals on a voluntary basis, and patients who required nutrition assistance or encouragement were actively scheduled to attend. A trained allied health assistant and assistant in nursing were present during communal mealtimes and assisted participants with meal set-up, encouraged self-feeding and adequate intake. Full feeding assistance was also provided in this setting if required. 2) Activity cards were placed on the patient bedside to highlight nutrition priorities and empower participants and family members to manage their own nutritional intake. The activity cards contained targeted feeding strategy advice such as consuming protein portions of meals first, encouraging intake of supplementation if prescribed, documentation of assistance or supervision required for meals, use of tools such as plate guards to enhance intake and/or swallowing strategies that may assist with fatigue during meals. 3) Volunteer nutrition nurse champions were appointed in order to encourage staff to complete food charts correctly, assist with mid meal supplementation where required and advocate participant attendance to communal dining. Across both groups staffing levels were the same and monitored daily to ensure that staffing levels was not a confounder to result.

Outcomes Measure/ Data Collection

Baseline measures were gathered on admission and included demographics, stroke clinical features and classifications using the Oxford Stroke Classification and National Institute of Health Stroke Scale (NIHSS) (36, 37). Stroke severity was classified by NIHSS on admission: <8 (mild), 8-16 (moderate) and >16 (severe) (or day 1 if thrombolysed).

The primary outcome measure was nutritional intake. Individual nutrition requirements were calculated using the ratio method (100-125kJ/kg body weight/day or 125-145kJ/kg body weight/day if malnourished) (8, 38, 39). Consistent with previous research, protein requirements were based on 1g/kg body weight/day for well nourished stroke patients, 1.2-1.5g/kg body weight/day for malnourished patients and between 0.75-1g/kg body weight/day for renal impairment (Chronic Kidney Disease Stage 3-4) (13). Body weight was adjusted for overweight/obese patients: ((Actual body weight – Ideal body weight) x 0.25) + Ideal body weight. Adequacy of intake was expressed as a percentage (intake/requirements x 100) for both energy and protein.

Nutrition intake was determined via mealtime observations in which visual estimations of proportion of meals consumed (e.g. ¼, ½, ¾, all) was used. The ward dietitian collected data over breakfast and lunch on weekdays and trained nutrition assistants collected data for these meals on the weekend. Food charts completed by trained nursing staff were used to collect the remaining data on dinner and mid-meals snacks and/or supplementation. The ward dietitian and nursing staff utilised the same visual estimation method for quantifying food and fluid intake. The quantity of foods, drinks and supplementation consumed was converted into energy (kJ) and protein (grams) by the ward dietitian. This was calculated based on the hospital ready reckoner according to diet codes, sourced from food supplier nutrient information and foodservice audits. If a participant was nasogastrically fed, fluid balance charts were kept which allowed accurate calculation of energy and protein intake. Data was collected on six days of the week from Monday to Saturday from admission until discharge from the ASU. The day of participant discharge was not included in the analysis as intake was calculated on a daily basis and participants were discharged prior to consumption of all meals for that day. Data collection was ceased if the primary treatment intent for a participant was changed to palliative. Data was classified as missing when food charts were incomplete and participant meal consumption was unable to be determined.

To ensure accuracy in data collection, the dietitian conducted education sessions prior to the control period with supplemental education by nutrition nurse champions throughout both data collection periods. This involved training of nursing staff and nutrition assistants to visually estimate portions of food and drinks (¼, ½, ¾, all) consumed by the participants. In addition, posters were developed and placed in the ward to reinforce this training. Estimated energy and protein intake using visual estimations has previously been validated against weighed food intake records in acute care settings (40, 41).

Malnutrition was assessed via the Subjective Global Assessment (SGA) tool by the ward dietitian on admission and discharge from the ASU. The SGA classifies malnutrition using scores of A (well nourished), B (mild/moderately malnourished) and C (severely malnourished). It includes assessment of body weight, nutritional intake, gastrointestinal symptoms, functional capacity and a physical examination for fat and muscle stores and has proven to have a high degree of inter-observer agreement with a kappa score of 0.78 (42). Participants' body weights were recorded on admission and discharge by a blinded assessor. All patients were reviewed by a speech pathologist to assess swallow function and diagnose the presence of dysphagia. Dietary modifications were classified as: full diet (normal), textured modified, nil by mouth or enteral feeding.

Statistical Analysis

Where appropriate, continuous normally distributed variables are described as mean (SD), non-normal variables are described as median (IQR) and categorical or binary variables as the number of events (%). Depending on the data distribution, either a two-sample two-tailed t-test for normally distributed data or a Wilcoxon ranksum test for non-normal data were performed. For normally distributed paired data, paired t-tests were performed rather than unpaired t-tests. For non-normal paired data, the Wilcoxon signed-rank test was performed rather than the Wilcoxon rank-sum test (=Mann-Whitney U-test). Proportional data were analysed using a Fisher's Exact Test. A one-way analysis of co-variance (ANCOVA) adjusting for NIHSS was performed to determine differences in energy and protein intake between standard care and enriched environment groups. Additionally, ANCOVA was performed between sub groups for mild, moderate and severe participants. Stepwise multivariable logistic regression was used to determine predictors of nutritional outcomes, adjusting for intervention group, age, gender, stroke type and severity, length of stay, admission weight, and dietary modification. Statistics were performed using IBM SPSS statistics for Macintosh version 24.0 (IBM Corp., Armonk, N.Y., USA) and STATA V15.1 (StataCorp., College Station, TX., USA). Significance was set at $p<0.05$.

Results

Participants

From 23rd of June 2014 till the 14th of February 2015 (excluding the 6 weeks period of implementation for the enriched environment) we screened 195 people with suspected stroke. We enrolled a total of

32 participants to the standard care group (2 participants were withdrawn) and 30 to the enriched environment group. See flow of participants in Figure 1.

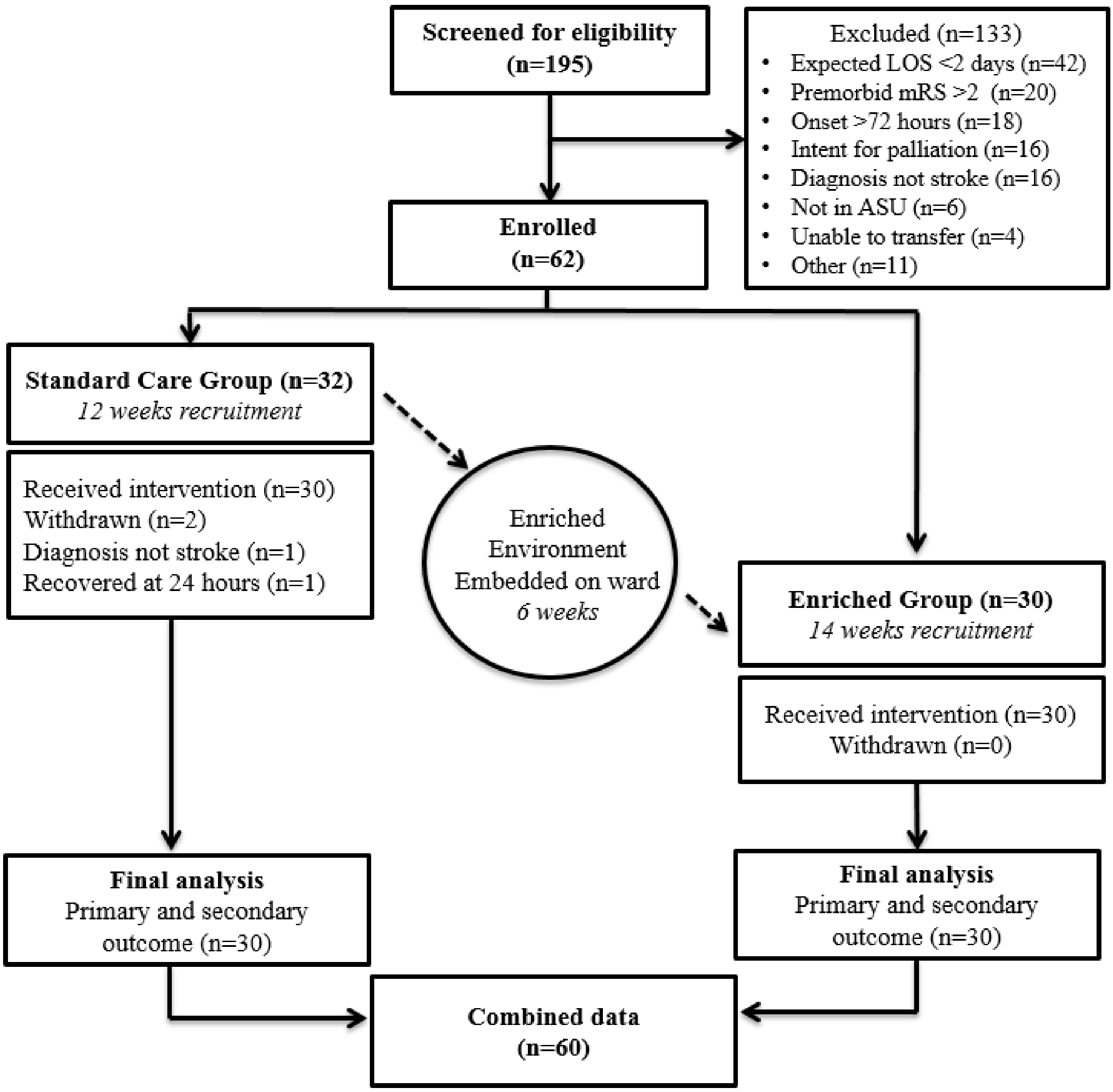

Figure 1. Flowchart describing participant eligibility and recruitment. *LOS* Length of Stay, *mRS* modified Rankin Scale, *ASU* Acute Stroke Unit.

Demographic and clinical characteristics of the participants were similar between the standard care and enriched groups (Table 1). A total of 232 days of data and 510 individual meals were evaluated in the standard care and 152 days and 402 individual meals in the enriched environment group. Missing data was low for both groups: standard care 3.4% and the enriched group 2%. Fidelity monitoring of communal breakfast and lunch meals showed that all meal group sessions occurred during the enriched environment period. There were significantly more days of enteral feeding in the standard care group compared to the intervention group (58 vs 20 days, p=0.01). Length of stay was longer in the standard care group (12.0 days SD ±7.4 vs. 9.7 days SD ±5.7, p=0.02).

Table 1. Baseline Characteristics

Characteristic, n (%) or mean ±SD	Standard Care n=30	Enriched Group n=30	*p* value
Age	76.0±12.8	76.7±12.1	0.84
Gender Male	17 (56.7)	22 (73.3)	0.18
Stroke type Ischemic	27 (50.0)	27 (50.0)	1.00
Stroke side Left	20 (66.7)	18 (60.0)	0.60
NIHSS	8.50±6.5	7.80±5.8	0.66
Stroke severity			
Mild	17 (56.7)	18 (60.0)	0.74
Moderate	9 (30.0)	9 (30.0)	1.00
Severe	4 (13.3)	3 (10.0)	0.66
Initial body weight (kg)	78.4±15.3	82.1±18.2	0.53
Initial SGA (% malnourished)	1 (3.3)	2 (6.6)	0.56
Dysphagia	16 (53.3)	10 (33.3)	0.12

NIHSS: National Institute of Health Stroke Scale; SGA: Subjective Global Assessment

Energy and protein intake

When nutrition was expressed as a percentage of requirements met, neither standard care nor enriched environment group met daily requirements for energy or protein (Table 2).

Table 2. Proportion of energy and protein requirements met (% requirements met ±SD all participants)

% requirements met ±SD	Standard Care n=30	Enriched Group n=30	*p* value
Total energy (%)	70.7 ± 16.8	70.7 ± 17.3	0.94
Total protein (%)	73.2 ± 18.6	69.8 ± 17.3	0.70

When enteral feeding participants were excluded from the dataset similar results were seen (Table 3). No significant differences were found between groups in mean energy intake: standard care 5805kJ ± 1435 vs. enriched environment 6042kJ ±1225: p=0.52, and protein intake standard care 53.8g ±13.5 vs. enriched environment 53.0g ±10.9: p=0.87.

Table 3. Proportion of energy and protein requirements met (% requirements met ±SD enteral feeding participants excluded)

% requirements met ±SD	Standard Care n=26	Enriched Group n=27	*p* value
Total energy (%)	69.3 ± 16.5	70.2 ± 18.3	0.88
Total protein (%)	77.1 ± 18.6	76.9 ± 18.6	0.94

Energy and Protein intake – subgroup analysis

After whole group comparisons, we compared data from each group according to stroke severity. Mild stroke patients (NIHSS <8) in the standard care group (n=17) showed higher, though non-significant, energy and protein intake as compared with the enriched group (n=18) (Energy 76.4% standard care vs 69.8% enriched, p=0.23; Protein 77.9% standard care vs 68.0% enriched, p=0.08). Conversely, in moderate stroke patients (NIHSS 8-16) the enriched environment (n=9) showed higher energy and protein intakes compared with standard care (n=9), which approached significance for energy intake (Energy 63.7% standard care vs 76.8% enriched, p=0.055; Protein 66.2% standard care vs 77.3% enriched, p=0.11) (Table 4). Severe stroke patients (NIHSS >16) showed slightly greater energy and protein intake in the standard care group compared to the enriched environment (see Table 4) however patient numbers were small (n=4 vs. n=3).

Table 4. Proportion of energy and protein requirements by stroke severity

	Stroke severity	Standard Care (%±SD)	Enriched Group (% ±SD)	*p* value
Energy	Mild	76.4 ± 14.4	69.8 ± 15.7	0.23
	Moderate	63.7 ± 13.7	76.8 ± 15.2	0.06
	Severe	62.5 ± 26.5	57.7 ± 29.5	0.83
Protein	Mild	77.9 ± 18.0	68.0 ± 16.6	0.08
	Moderate	66.2 ± 14.5	77.3 ± 16.2	0.11
	Severe	68.6 ± 27.6	57.7 ± 20.8	0.61

Mild: n=17 standard care, n= 18 enriched group; Moderate: n=9 standard group, n=9 enriched group; Severe: n=4 standard care, n=3 enriched group

Malnutrition

Mean body weight dropped in both groups (Table 5). Malnutrition rates increased from admission to discharge from the acute stroke unit: standard care (3.3% to 26.6%) and enriched (6.6% to 13.3%). The absolute difference was 23.3% and 6.7% which was not significantly different between the two groups (p=0.07).

Table 5. Malnutrition as assessed by the SGA and weight changes

Variable N (%) or mean ±SD	Standard Group	Enriched Group	*p* value
Discharge weight (kg)	77.5±15.3	81.5±18.0	0.62
Weight change (kg)	-0.92 (2.47)	-0.64 (3.12)	0.53
Discharge SGA- malnourished (%)	8 (26.6)	4 (13.3)	0.20

SGA: Subjective Global Assessment

Predictors of malnutrition on discharge using logistic regression models showed that length of stay ($p<0.01$), and protein ($p<0.01$) or energy intake ($p=0.02$) were independently associated (Table 6).

Table 6. Predictors of malnutrition on discharge

Predictor variable		Odds Ratio (95% CI)	*p* value
Model #1	Length of stay	1.60 (1.11, 2.31)	0.01
	Protein intake	0.89 (0.81, 0.98)	0.01
Model #2	Length of stay	1.51 (1.09, 2.08)	0.01
	Total energy intake	0.88 (0.79, 0.98)	0.02

Note: Two logistic models were developed. The first (#1) used protein intake as a predictor and the second (#2) used total energy intake. This was done because the two predictors were highly correlated (R = +0.94)

Discussion

The study aimed to investigate the effect of enriched environment strategies that altered the approach to nutrition care on intake and malnutrition rates in the acute stroke unit. We observed that despite adequate food provision, neither standard care nor enriched environment groups met their nutrition intake requirements for total energy or protein. Malnutrition rates increased and body weight decreased for both groups from admission until discharge. Weight loss was secondary to inadequate nutrition intake, with regression models demonstrating the link between protein and energy intake and rates of malnutrition. Although both groups appeared to have lost <1kg overall, standard deviations reflect that some patients lost greater amounts of weight whilst others may have gained weight. Results show non-significantly higher rates of malnutrition were observed on discharge in the standard care group. Regression models showed that in addition to energy and protein intake, length of stay was also an independent predictor of malnutrition.

Our study provides the most comprehensive data reported regarding nutritional intake within the acute stroke setting. Although malnutrition in the stroke population has been widely investigated

(6, 7, 9, 12, 13), there is limited data about nutrition intake amongst this population (10, 11, 20, 43). Perry (20) found that acute stroke patients met 60% of estimated average energy requirements, although this study only included participants with communication impairment and utilised a one day food record only. Nip et al. (11) found that 33% of patients met less than 50% of their requirements and only 10% of patients met ≥100% of their estimated daily requirements, however data was observed on only one day within the first two weeks of acute stroke unit admission. Our study collected daily intake data across the complete admission period in the acute stroke unit (ASU) with a minimum length of stay of 2 days to a maximum of 25 days, therefore allowing comprehensive depiction of patient intake fluctuations.

In a study investigating nutritional intake in acute stroke patients, Foley et al. (43) found that patients consumed 80-91% of their energy and protein requirements, markedly higher than the 71% overall intake in our study. There are a few possible explanations for these differences: firstly, the differences in eligibility criteria. Our study recruited patients from well nourished to malnourished whereas Foley et al. (43) included only well nourished patients who may be expected to have higher nutritional intake than pre-morbidly malnourished patients. Secondly, our study collected data on all meals and snacks on every day (except Sundays) of the patient's acute inpatient stay whereas Foley et al. collected data on days 1, 7, 11, 14, and 21 of admission, which may not represent fluctuations in nutrition intake in the acute phase. Our study used estimated equations to determine nutrition requirements whereas Foley et al. (43) used indirect calorimetry, a gold standard for estimating nutrition requirements which measures resting energy expenditure multiplied by a determined activity factor. Indirect calorimetry produces greater accuracy in determining energy expenditure in comparison to predictive equations, hence, the energy per kilogram ratio method used in our study may have underestimated individual energy requirements.

The intervention of communal mealtimes did not significantly impact nutrition intake overall with results similar between standard care and the enriched environment. Standard care included bedside mealtime assistance by nursing staff although anecdotally, this is sporadic and frequently not timely. When data was analysed for subgroups (mild, moderate and severe stroke patients) the effect of the enriched environment showed most benefit to moderate-severe stroke patients. Mild stroke patients did not show greater nutritional intake within the enriched environment. Total length of stay for this subgroup is shorter when compared with moderate and severe stroke patients (34), providing less opportunity for the enriched environment to have impact. Additionally, mild stroke patients suffer less physical and cognitive deficits that would impact on their nutrition intake (44, 45). In contrast, moderate stroke patients who recovered within the enriched environment showed a trend toward improved energy and protein intake. These patients frequently suffer sensorimotor deficits, neglect (44), dysphagia and altered level of consciousness (16) which all contribute to reduced nutrition intake. Severe stroke participants in our study showed higher energy and protein intakes in the standard care group compared to the enriched group, which may be explained by the higher percentage of enterally fed severe stroke patients in the standard care group.

Provision of communal mealtimes was the main strategy that altered the approach to nutrition care for acute stroke patients within the enriched environment. As research has consistently shown that stroke patients are alone and inactive in an acute stroke unit (46), communal mealtimes provided the opportunity to increase socialization, encourage sitting upright for meals, enhance independence in eating, and provide assistance in nutritional intake if needed. Furthermore, dining in communal areas stimulates physical activity as patients are frequently mobilized to and from meals on the ward (47) which consequently may link to stimulation in appetite.

Protected Mealtimes (PM) is an intervention designed for acute inpatients to reduce unnecessary interruptions during mealtimes and to provide assistance to those patients unable to eat independently (48). A meta-analysis of PM for acute adult inpatients found no effect of PM on energy and protein intake (29), however some aspects of the PM intervention such as mealtime assistance have shown to increase energy and protein intakes in adult inpatients (30, 49, 50). PM was designed to be carried out at the patient bedside however some studies have included designated dining rooms which may better reflect the enriched environment setting. PM studies that included designated dining areas reported that communal dining improved energy intake, had positive effects on wellbeing, socialization and feelings of togetherness and in turn supported the rehabilitation process (51-53). Although our study did not show the effect of improved energy intake for all subgroups of patients, other positive effects explored in prior PM studies such as socialization and improved wellbeing may have resulted. Individual patient preference for eating in a dining room versus eating alone at the bedside was not explored. Further qualitative research is recommended to understand individual preferences with regards to communal mealtimes in acute stroke patients.

Future studies investigating nutrition intake in stroke patients may need to include patients' perception of strategies to increase intake and avoid malnutrition. Lastly, our study used nutritional strategies that were offered across all participants. Future studies may tailor strategies to individuals based on their need for assistance, supervision and support in moderate to severe stroke patients or those with a high risk profile such as decreased cognition and poor appetite.

Limitations

This study is a sub-study from a wider enriched environment trial, which was powered to determine differences in activity levels across both groups. As a result, the study was not designed specifically or powered to detect significant differences between groups for nutrition intake therefore sample size is a limitation of the study. Lack of blinding was also a limitation. Our study was conducted pragmatically on the acute stroke ward with research staff involved in provision of rehabilitation and the first author involved in nutrition data collection. In addition, no formal assessment of inter-rater reliability of meal intake observers was conducted after education of staff. However, meal intake photo posters (e.g. showing ¼ meal consumed and its corresponding food chart information) and nurse champions were used to continuously support staff on a day to day basis and aimed to minimize differences in nutrition intake records.

The use of estimated requirements could be considered another limitation of the study. Indirect calorimetry is considered the most accurate way to measure energy requirements but has limited availability in clinical settings. The guidelines for estimating equations are ambiguous in acute stroke patients. However, they use conservative calculations which suggest stroke as a non-hypermetabolic disease state (38, 39, 54). Our calculations therefore may be considered conservative in terms of energy expenditure, so if the acute phase post stroke did induce catabolism as suggested by Chalela et al. (54), our participants may have met even less of their estimated requirements than suggested in our results. We estimated protein requirement at 1g/kg bodyweight/day which again is a conservative estimate of the amount required to maintain positive protein balance (13, 55).

Our study's strength is the large amount of observational data collected over the acute inpatient episode with few missing data. We included observation of all meals, snacks and supplements from participant admission to discharge providing comprehensive data on nutritional intake in stroke patients in the ASU. Most previous studies that investigated nutritional intake in stroke or general medical patients calculated nutritional intake from data collected over a 24 hour period or extrapolated nutrition intake from consumption of one meal per day (11, 20, 56, 57). Therefore, this study provides more robust findings regarding nutritional intake across the whole acute stroke admission and is the first to investigate the effect of communal dining on nutritional outcomes in the acute stroke population.

Conclusion

It is striking that in both groups stroke survivors only achieved approximately 70% of their nutrition requirements showing that nutrition intake early after stroke is poor. Our study has demonstrated that this is associated with a high risk of developing malnutrition early post stroke indicating a need for effective strategies to ensure sufficient intake to mitigate the effects of malnutrition. An altered nutrition approach using an enriched environment incorporating communal mealtimes and nutritional care support may benefit nutrition intake in acute stroke patients with moderate deficits, but further study is required to confirm this.

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Statement of Authorship

SR conceived and designed the study, implemented interventions, completed data collection, data interpretation and drafted the manuscript. IR contributed to the design concept and protocol, implemented interventions, analysed data and critical review of the manuscript. RG supported the implementation of interventions, contributed to data interpretation and critical review of the manuscript. CA completed statistical data analysis and interpretation and critical review of the manuscript. All authors read and approved the final manuscript.

Conflict of Interest

None

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