OLDER PEOPLE

Journal of Clinical Nursing

Trajectory and determinants of nutritional health in older patients during and six-month post-hospitalisation

Cheryl C-H Chen, Siew T Tang, Charlotte Wang and Guan-Hua Huang

Aim. The aim of this study was to characterise the trajectory and to identify determinants of nutritional health over time in a sample of older hospitalised patients, using the Generalized Estimating Equation.

Background. Nutritional health deteriorates and may fluctuate over time during and post-hospitalisation. To develop a target intervention it is essential that we first have a clear picture of how the nutrition changes and examine the determinants of nutritional health during and post-hospitalisation.

Design. A prospective cohort study was conducted on 306 older hospitalised patients aged 65 years and older.

Methods. Subjects were recruited from five surgical and medical wards at a tertiary medical center in northern Taiwan and assessed at four points in time: within 48 hours after admission, before discharge and 3–6 months post-discharge.

Results. Nutritional health fluctuated significantly over time. The curve dropped during hospitalisation, returned at three months and rose slightly at six months post hospitalisation. After controlling for length of stay and surgical treatment, patients showed decreased cognitive capacity, worsening oral health, increased use of medications, increased functional limitations and raised depressive symptoms, all of which affects their nutritional health over time. The extent of functional status impacting on nutrition varies at different points in time while the predictability of other determinants remained stable.

Conclusion. The trajectory of nutritional health is a reflection of the patients' cognitive status, oral health, medication taken, functional status and depressive symptoms. The findings of our study should provide guidance in the development of intervention for the nutritional health of older patients during inpatient as well as transitional care.

Relevance to clinical practice. Multi-faceted packages of interventions targeting a range of determinants for managing undernutrition and subsequent decline during and post-hospitalisation need to be tested.

Key words: acute care, elderly, GEE modeling, geriatrics, nursing, nutritional status

Accepted for publication: 11 February 2009

Introduction

The trajectory of nutritional health, defined as the changes on nutritional health over multiple points in time, represents a dynamic process and frequently signals an underlying impairment. Data from Europe and North America suggested that nutritional health deteriorates with acute hospital stay due to a lack of food intake during admission (Sullivan *et al.* 1999, Corish & Kennedy 2000, Kelly *et al.* 2000, Kubrak & Jensen 2007). Longitudinal data for older hospitalised patients, however, is lacking on the trajectory and magnitude of nutrition changes over time, particularly in the course of post-hospitalisation.

Studies have demonstrated that nutritional health is sub-optimal for older hospitalised patients on admission to hospital and that the prevalence of undernutrition is high

Authors: *Cheryl C-H Chen*, RN, DNSc, Associate Professor, Department of Nursing, National Taiwan University & National Taiwan University Hospital, Taipei, Taiwan; *Siew T Tang*, RN, DNSc, Associate Professor, Chang Gung University, Graduate School of Nursing, Kwei-Shan, Tao-Yuan, Taiwan; *Charlotte Wang*, MS, Research Assistant, Institute of Statistical Science, Academia Sinica, Taiwan; *Guan-Hua Huang*, PhD, Associate Professor, Institute of Statistics, National Chiao Tung University, Hsinchu, Taiwan

Correspondence: Cheryl C-H Chen, Associate Professor, Department of Nursing, National Taiwan University & National Taiwan University Hospital 1, Jen-Ai Rd., Section 1, Taipei, Taiwan. Telephone: +886 2 2312 3456 ext. 88438.

E-mail: cherylchen@ntu.edu.tw

doi: 10.1111/j.1365-2702.2009.02932.x

(Kubrak & Jensen 2007). An Italian study revealed that 19% of 302 older hospitalised patients were severely undernourished while admitted to hospital (Incalzi *et al.* 1996). A prospective American study of 497 older hospitalised male patients indicated that 21% of subjects had an in-hospital intake of less than 50% of their minimal energy requirement (Sullivan *et al.* 1999). Our previous study indicated that 43% of older patients when admitted for cardiac and orthopedic services were at risk for undernutrition (as measured by the mini-nutritional assessment). This number subsequently increased to 60% upon discharge (Chen *et al.* 2007). It is well recognised that undernutrition hits hard during hospitalisation for older patients. However, there have been few studies to examine how long it takes for nutrition to recover, if ever and what determinants impact on nutritional health during this critical period of time.

Determinants associated with nutritional health in older hospitalised patients are multifaceted and include the physiological, psychological and social changes associated with ageing affecting their dietary intake and body weight, which are then exacerbated by the presence of acute illness and comorbidities (Sullivan *et al.* 1999). Commonly cited determinants include age, gender, low income, oral health, functional status, depressive symptoms, cognitive status and social support related parameters (Chen *et al.* 2005, Locher *et al.* 2005, Donini *et al.* 2007). Reliable determinants of nutritional health, from a longitudinal perspective, have yet to be identified. This may at least in part, be attributed to the limited number of published studies designed to directly examine the trajectory and determinants of nutritional health during and post-hospitalisation. The reason this gap in the literature is critical is due to the fact that decline and associations might be transient (Verbrugge *et al.* 1994, Hardy *et al.* 2005, Chen *et al.* 2008). For example, if nutritional decline is long lasting and recovery is difficult then an intervention is urgently needed. To that end and from a longitudinal perspective, determinants of nutritional health during and post a critical event such as hospitalisation need to be established before a focused intervention can be developed.

There is a paucity of prospective longitudinal studies investigating the trajectory and determinants of nutritional health over time, especially around the time of hospitalisation. Additionally, older surgical patients have hardly been included in prior studies, most of which overlook the fact that individuals aged 65 and older now represent more than half of the average general surgical practice (Pofahl & Pories 2003). The present study aimed to characterise the trajectory of nutritional health in a sample of both surgical and medical older patients who were followed prospectively during hospitalisation and six-months post discharge. It was tested whether demographics, medication taken, co-morbidities, visual or hearing impairment, cognitive status, oral health, functional status, social support and depressive symptoms were determinants of their nutritional health during and six-month post-hospitalisation.

Methods

A prospective cohort study with cluster sampling was employed. Five medical and surgical units were selected randomly. Three units were proportionally selected from surgery and two from medicine out of a total of 24 units at a tertiary medical center in northern Taiwan. Every patient aged 65 years and older from these five units who met the inclusion criteria was recruited. Upon obtaining written consent, face-to-face assessments were conducted by standardised measures and protocols at four time points; within 48 hours of admission (T0), before index discharge (T1), three and six months post-index hospitalisation (T2 & T3). Anthropometrics including weight, knee height and mid-arm and calf circumferences were measured and a brief oral health examination involving counting the remaining teeth and inquiring as to the fitness of their dentures was conducted. A preliminary study result with details on the study design has been published elsewhere (Chen *et al.* 2008).

Data were collected by two trained research nurses who used structured instruments to obtain measures on demographics, visual/hearing impairments, oral health, cognitive status, comorbidities, medication taken, functional status, social support, depressive symptoms and nutritional status. The selection of studied determinants was based on a thorough literature review and guided by a theoretical framework developed by Chen *et al.* as shown in Fig. 1 (Chen *et al.* 2007, Kubrak & Jensen 2007). The study protocol was approved by the Research Ethics Review Committee of the National Taiwan University Hospital.

Sample

The sample was composed of 306 consecutive elderly patients who met the inclusion criteria and had been admitted to any of those five medical-surgical units between August 2004–May 2006. Subjects were not recruited if their mini-mental state exam (MMSE) scores was less than 20 (n = 43), their expected length of stay was < 5 (n = 1091), were isolated within the infection control protocol (n = 56), were intubated or were unable to communicate due to profound sensory loss (n = 140). Initially, of the 439 eligible subjects, 351 (79·95%) were enrolled. The reasons for nonparticipation included 'not

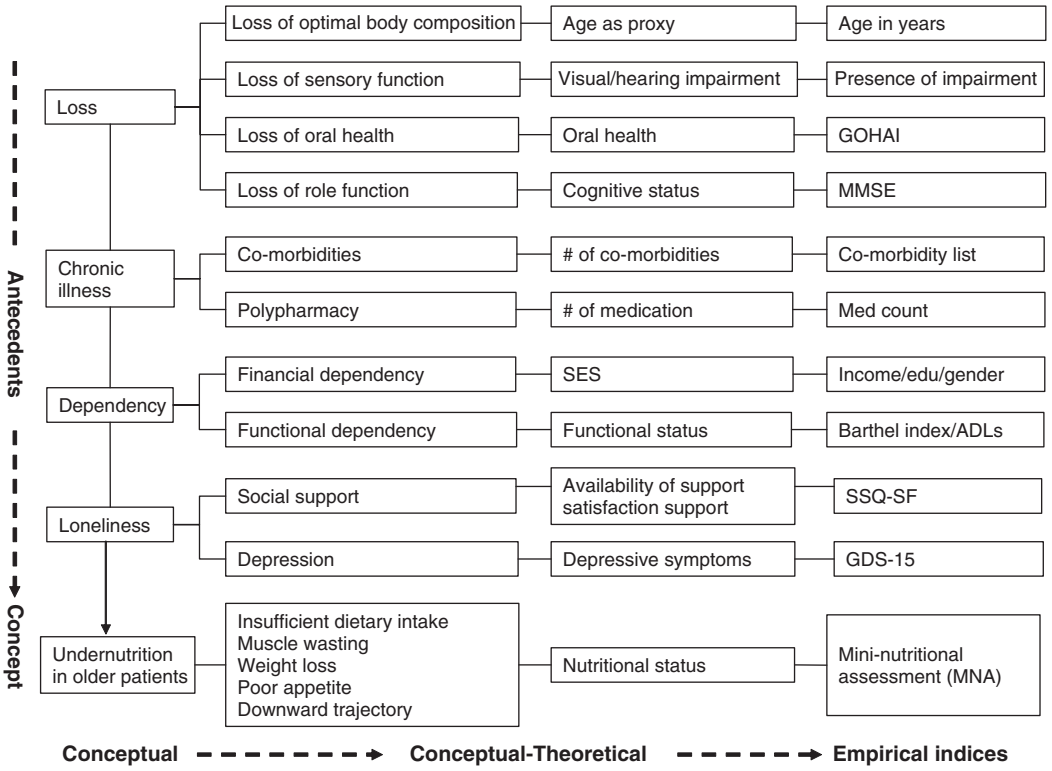

Figure 1 Theoretical framework of studying trajectory and determinants of nutritional health in older hospitalized patients during and six-month post hospitalization. Model was adjusted for LOS and surgical treatment.

interested' (n = 57), 'not feeling well' (n = 20) and for 'privacy protection' (n = 11). For the sake of homogeneity, deaths (n = 44) and individuals who only completed one data collection (n = 1) were excluded from this analysis which reduced the final analysed sample to 306 participants. The analysed participants did not differ significantly from non-participants (n = 88) and excluded subjects (n = 45) in gender (p = 0·235) and years of education (p = 0·595). However, the analysed participants tended to be surgical patients (60·1% vs. 48·9% among non-participating & excluded subjects) and were younger with a mean age of 71·8 years compared to 73·6 years (p = 0·006).

Measures

The psychometric properties of instruments are briefly described as follows:

Demographics and sensory impairment data

A demographic form was designed to collect the data including age, gender, marital status, living status, income, education, occupation and ethnic group. Self-report sensory impairments were also solicited. Subjects with demonstrated hearing or visual difficulties during the interview were automatically coded as having hearing or visual impairments.

Oral health

A 12-item General Oral Health Assessment Index (GOHAI) was used to assess the oral health (Atchison & Dolan 1990). The scores ranged from 12–60 with a higher score indicating a better perceived oral health. Reliability estimates (Cronbach's alpha = 0·83–0·79; inter-rater reliability α = 0·61) and established content, discriminant and construct validity have been reported (Calabrese *et al.* 1999, Wong *et al.* 2002a).

Cognitive status

The 11-item Mini-Mental State Examination (MMSE) was used to measure cognitive status. The sum scores ranged from 0–30 (Folstein *et al.* 1975). Satisfactory test-retest (r = 0·89–0·93), inter-rater reliability (r = 0·83) and content and discriminant validity have been reported (Guo *et al.* 1988).

Co-morbidity and medication taken

Co-morbidity was set equal to the number of chronic illnesses (0–20) the subjects had from the following: myocardial infarction, angina, congestive heart failure, visual impairment, hearing impairment, hypertension, diabetes, hyperlipidemia,

arthritis, stroke, asthma or lung disease, renal disease, gastrointestinal disease, Parkinson's disease, dementia, osteoporosis, hip fracture, pressure sore, cancer and others. The number of prescription and over-the-counter medications taken currently by subjects were coded as a numerical variable.

Functional status

The 10-item Barthel Index (BI) comprising 10 activities of daily living (ADL) was used to measure functional status. Feeding, bathing, grooming, dressing, bowels, bladder, toilet use, transfer, mobility and climbing stairs were assessed. The sum scores range from 0–100 with a higher score indicating a better functional status (Mahoney & Barthel 1965). Satisfactory reliability (Cronbach's α = 0·87–0·91; Kappa = 0·70–0·88) and validity have been reported (Sainsbury *et al.* 2005).

Social support

The six-item Social Support Questionnaire-Short Form (SSQ-SF) was used to measure social support. The coefficient α ranged from 0·90–0·93 and established construct and content validity have been reported (Sarason *et al.* 1987).

Depressive symptoms

The 15-item Geriatric Depression Scale Short-Form (GDS-15) was used to measure the presence of depressive symptoms. High sensitivity and specificity have been reported (Yesavage *et al.* 1983, Wong *et al.* 2002b). The sum score of GDS-15 was used as a continuous variable.

Nutritional health

The 18-item Mini-Nutritional Assessment was used to measure outcome-nutrition health. The sum score can categorise older patients as: (1) 24, well-nourished; (2) 23·5–17, at risk; and (3) < 17, malnourished. Interval MNA scores were used in the GEE analysis. The 96% sensitivity, 98% specificity and satisfactory inter-rater reliability (Kappa coefficient = 0·65–0·42) have been reported (Guigoz *et al.* 1996). Weight was measured by the trained research nurses using a portable digital scale (Tanita Corp., Tokyo, Japan) and body mass index was calculated using the measured height and weight within 0·5 cm and 0·5 kg, respectively.

Length of stay and surgical treatment

The length of hospital stay was obtained from the computer system by a research nurse trained specifically for this project. To account for the potential difference in the trajectory of nutrition health between surgical and medical patients, a code named surgical treatment was created to document whether patients underwent any surgical procedures during the index hospitalisation. Coding was done by the same research nurse who was blinded to the hypothesis tested.

Data analysis

Data were analysed using SAS version 9 (SAS Institute, Inc., Cary, NC). Data were reviewed and double entered to assure accuracy. The univariate analysis was conducted to describe the characteristics of the sample. Given the nature of the longitudinal study, a marginal model, population-based approach was used to analyse the data. The Generalized Estimating Equation (GEE) was used to adjust for within-person correlations and to obtain variance-covariance estimates. The GEE was also used to individually assess the significance of the crude association of MNA scores with the selected determinants. Demographics, co-morbidities, visual or hearing impairment, medication taken, oral health, cognitive status, functional status and presence of social support and depressive symptoms over four time points were examined as determinants of MNA scores. Those significantly associated with MNA scores in the bivariate analyses were further included in a multivariate GEE. Data were assessed for congruence with regression assumption prior to multivariate analyses. For each significant determinant of MNA, an interaction term of time (T0, T1, T2, T3) with that determinant was further fitted in the GEE to assess whether the magnitude of that association remained constant over time during the observational period. Length of stay (LOS) and surgical treatment were explored as confounders for nutritional health and the final model was therefore adjusted for these two confounders. Given the exploratory nature of this approach, a trade-off decision was made not to include other medical treatments such as receiving oxygen therapy or hemodialysis in the present study. After obtaining primary coefficient estimations, log-likelihood ratio statistics (deviance) was used to evaluate the model fitness. Significance was set at $p < 0{\cdot}05$.

Results

The sample was relative diverse in gender, education and income levels. A large majority of the sample were married, living with others and retired. Ages ranged from 65–89 years with a mean of 71·8 years. The detailed sample demographics and baseline measures are shown in Table 1.

Prevalence of undernutrition

When admitted to the hospital, only 8·5% (n = 26) of the participants were classified as undernourished by scoring less than 17 in MNA and 28·0% (n = 86) were well-nourished.

Table 1 Sample demographic characteristics at admission baseline (N = 306)

Variable	
Female, %	53·27
Marital status	
Married, %	69·61
Widowed, %	27·45
Living with others, %	95·42
Retired, %	91·18
Monthly income > NTD$10K*, %	40·85
Visual impairment, %	65·03
Hearing impairment, %	10·46
Age in years, mean (SD)	71·75 (5·62)
Years of education, mean (SD)	6·88 (5·55)
Number of co-morbidities, mean (SD)	4·10 (1·80)
Number of medications taken, mean (SD)	3·39 (2·47)
BI score, mean (SD)	94·06 (11·28)
MMSE score, mean (SD)	25·41 (3·11)
GDS-15 score, mean (SD)	4·42 (3·36)
MNA score, mean (SD)	21·39 (3·37)
GOHAI score, mean (SD)	50·47 (6·36)
SSQ-SF score, mean (SD)	53·86 (10·52)
Surgical treatment received, %	60·13
Length of hospital stay, mean (SD)	15·67 (9·70)
NPO days, mean (SD)	2·63 (3·41)

BI, barthel index; MMSE, mini-mental state examination; MNA, mini-nutritional assessment; GOHAI, general oral health assessment index; GDS-15, geriatric depression scale-short form; SSQ-SF, social support questionnaire-short form; NPO, nil-by-mouth.
*New Taiwan Dollar, 33 NTD = 1USD = 0·56GRP.

After an average of 15·7 days hospitalisation, prevalence of undernutrition was much higher with 37·3% (n = 114) of the sample classified as undernourished (MNA < 17) and 54·2% (n = 166) at risk for undernutrition (MNA = 17–23·5) at discharge. At three and six months post-hospital discharge, 46 (15·0%) and 44 subjects (14·4%) remained undernourished, respectively.

Trajectory and decline of nutritional health

Overall, nutrition dropped sharply at the event of hospitalisation, showed some recovery at three months post-discharge and steadily improved at six months post-discharge. The box plot for MNA scores among four time points is shown in Fig. 2. Using 10% of MNA change as a cutoff, nutritional decline was common with 178 subjects (59·7%) experiencing a 10% decline in MNA points at discharge compared to the admission baseline. At three months post discharge, 27·0% (n = 81) remained 10% below their admission baseline. At six months post discharge, 21·3% (n = 64) had persistent nutrition decline defined by scoring 10% lower MNA points compared to the admission baseline.

Determinants of nutritional health

The bivariate analyses revealed that gender, widowhood, age, years of education, number of comorbidities and medication taken, oral health, cognitive status, functional status, presence of depressive symptoms and social support were all associated with nutritional health (Table 2). The multivariate GEE was used to identify factors associated with nutritional health over time, adjusting for the time effect. Variables that were retained in the final best fitting model are presented in Table 3. The overall model was significant (p < 0·001) and survived the goodness-of-fit test by the deviance statistics. The results showed that nutritional status fluctuated in the course of acute hospitalisation and differed significantly over time. Oral health (beta = 0·11), cognitive status (beta = 0·09), number of medications (beta = −0·08), functional status (beta = 0·17) and depressive symptoms (beta = −0·35) were significantly associated with nutritional health, adjusting for time, LOS and surgical treatment.

There were no significant interactions between most predictors and time except for functional status (result not shown). The scatter plot and GEE results suggested that the associations between nutritional health and functional status measured by the Barthel index differed over time. The association at discharge was minimal with every one Barthel point increased resulting in a 0·04 MNA points raise. However, at six months post-discharge, the association between the Barthel and the MNA scores increased substantially with Beta = 0·22. In other words, the association of functional status and nutrition is stronger at the post-discharge phase compared with the hospitalisation phase.

Discussion

Nutritional status dropped sharply at the event of hospitalisation, showed some recovery at three months post discharge and improved steadily at six months post-discharge. The determinants of nutritional health over time included oral health, cognitive status, number of medication taken, functional status and depressive symptoms after adjusting for LOS and surgical treatment. Among those, the relationship of functional status and nutritional health differed in intensity over time with the weakest association being observed at discharge and the strongest at six months post-hospitalisation. This finding is new to the literature and requires replication. If verified, this finding will have implication in planning target intervention packages. For example, different weights and priorities must be set for mobilisation and functional related protocol in acute vs. sub-acute care settings.

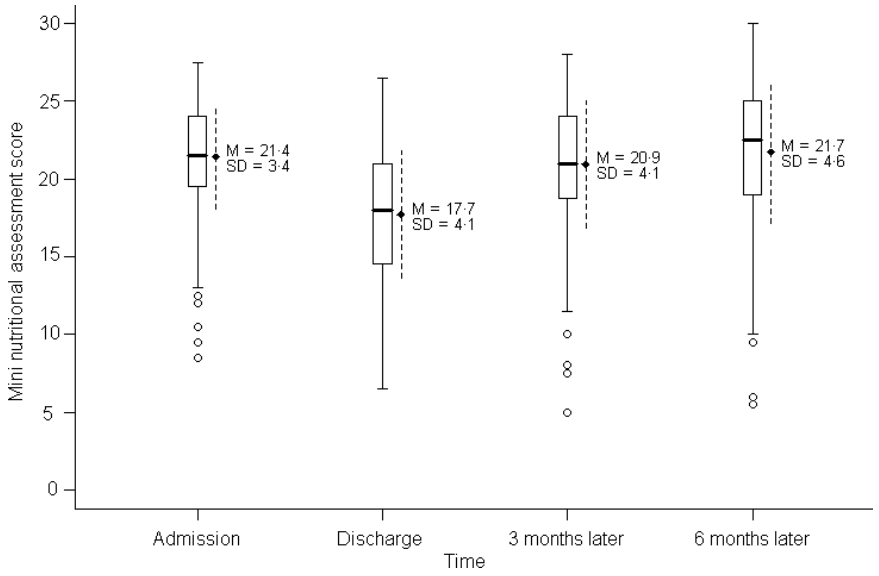

Figure 2 The trajectory of MNA scores over four points in time (n = 306). The dots and dashed lines denote means and standard deviations at each observed time, respectively.

Table 2 Bivariate GEE results (N = 306)

Variable	Beta	Standard error	95% CI	p-value
Gender (female vs. male)	0·73	0·36	(0·02, 1·45)	0·04
Marital status				
Married	Ref.			
Widowed	−0·88	0·44	(−1·75, −0·01)	0·05
Others	−0·68	0·99	(−2·62, 1·25)	0·49
Living status (alone vs. with others)	0·08	0·52	(−0·94, 1·10)	0·88
Occupation (non-retired vs. retired)	0·33	0·52	(−0·40, 1·36)	0·53
Monthly income (≤ 10K vs. > 10K in NTD*)	−0·16	0·28	(−0·70, 0·39)	0·57
Visual impairment (yes vs. no)	−0·15	0·33	(−0·80, 0·51)	0·66
Hearing impairment (yes vs. no)	−0·68	0·59	(−1·83, 0·47)	0·25
Age in years	−0·12	0·04	(−0·19, −0·05)	0·0005
Years of education	0·11	0·03	(0·05, 0·18)	0·0008
Number of co-morbidities	−0·50	0·11	(−0·71, −0·30)	< 0·0001
Number of medications taken	−0·47	0·07	(−0·60, −0·34)	< 0·0001
BI score	0·17	0·01	(0·15, 0·19)	< 0·0001
MMSE score	0·51	0·04	(0·43, 0·60)	< 0·0001
GDS-15 score	−0·70	0·03	(−0·75, −0·64)	< 0·0001
GOHAI score	0·19	0·02	(0·14, 0·23)	< 0·0001
SSQ-SF score	0·05	0·01	(0·03, 0·08)	0·0001
Surgical treatment (yes vs. no)	0·19	0·37	(−0·53, 0·92)	0·60
Length of hospital stay	−0·10	0·02	(−0·14, −0·06)	< 0·0001
NPO days	−0·18	0·08	(−0·33, −0·03)	0·02

BI, barthel index; MMSE, mini-mental state examination; MNA, mini-nutritional assessment; GOHAI, general oral health assessment index; GDS-15, geriatric depression scale-short form; SSQ-SF, social support questionnaire-short form; NPO, nil-by-mouth.
*New Taiwan Dollar, 33 NTD = 1USD = 0·56GRP.

Consistent with the existing literature and prior cross-sectional findings, the antecedents of loss, chronic illness, dependency, loneliness and their sub-concepts affect nutritional health over time, which support the validity of this framework. Given that undernitrition is common and the deficit is long lasting, a framework like this will have implications for guiding nurses in designing and implementing intervention packages in acute hospitals, sub-acute care units as well as in a community setting. The finding of this study mandates heightened attention to the prevalent

Table 3 GEE analysis with standardized betas (*p*-values) shown at each step (*N* = 306)

Step determinants	Beta	Standard error	95% CI	*p*-value
Intercept	−0·10	0·03	(−0·20, 0·00)	0·06
Time				
Admission	Ref.			
Discharge	−0·28	0·06	(−0·34, −0·17)	< 0·0001
Three months later	0·15	0·06	(0·05, 0·26)	0·0056
Six months later	0·43	0·06	(0·32, 0·55)	< 0·0001
Loss				
GOHAI score	0·11	0·03	(0·05, 0·17)	0·0002
MMSE score	0·09	0·02	(0·04, 0·13)	0·0002
Chronic illness				
Number of medication taken	−0·08	0·02	(−0·13, −0·04)	0·0002
Dependency				
BI score	0·17	0·06	(0·05, 0·28)	0·0045
BI score × discharge	0·04	0·07	(−0·09, 0·17)	0·55
BI score × three months later	0·12	0·07	(−0·02, 0·26)	0·09
BI score × three months later	0·22	0·08	(0·05, 0·38)	0·0094
Loneliness				
GDS-15 score	−0·35	0·03	(−0·41, −0·29)	< 0·0001
Adjusted				
LOS	−0·08	0·04	(−0·15, −0·01)	0·03
Surgical treatment (yes vs. no)	0·07	0·06	(−0·05, 0·20)	0·25

p-value is based on Wald's test.
BI, barthel index; MMSE, mini-mental state examination; MNA, mini-nutritional assessment; GOHAI, general oral health assessment index; GDS-15, geriatric depression scale-short form; LOS, length of stay.

geriatric concepts, such as reduced cognitive capacity, oral health problems, polypharmacy, compromised functional status especially in the post discharge phase, depressive symptoms and their impact on nutritional health and the resulting frailty.

Relevance to clinical practice

Two points need to be emphasised in light of the finding. First, the impact of acute treatment and hospitalisation is significant. The majority of older patients that were discharged to their home were recorded as having a record low nutritional status and many of them took at least three months to return to their admission baseline. However, over one-fifth of the older subjects (21·3%) remained 10% below their admission MNA scores at six months post-discharge and need specific and effective interventions to avoid further decline and hopefully return to their admission baseline.

Second, given the fact that the risk profile is multifactorial, targeting a range of determinants may be more effective than using strategies relying on a single aspect such as giving oral supplements. The intervention should be tailored to include components on oral health, cognitive status, polypharmacy, ADL function and depressive symptoms. Specifically, it should include oral care to enhance swallowing chewing functions and taste sensitivity (Ohno *et al.* 2003, Kikutani *et al.* 2006), as well as medication review to reduce medication taken (Frazier 2005), orientation cues to avoid acute confusion and cognitive decline (Inouye *et al.* 2000), early mobilisation to improve bowel movement and avoid ileus (Henriksen *et al.* 2002, Junger & Schoenberg 2007), feeding assistance in terms of logistics and food texture adjustment (Boylston *et al.* 1996, Kayser-Jones & Schell 1997, Keller *et al.* 2003, Manthorpe & Watson 2003) and supportive measures such as presence of others during meals (Locher *et al.* 2005) might generate positive effects. These above recommendations are essentially basic elements of good care, yet they might be able to reduce incidences of undernutrition and resulting frailty.

Study limitation

This study is subject to several limitations. First, the interrelations among nutrition, cognitive status, oral health, functional status and depressive symptoms are complex and reciprocal, therefore the causality dilemma can not be confirmed. In fact, our study is correlational in nature and so does not allow for causal interpretation. Second, the predictive ability is conditional on survival considering the fact that deaths were excluded from the analysis. Third, although the model was adjusted for surgical treatment and length of stay, the possibility of undetected confounders cannot be excluded. Finally, subjects were recruited from only one medical center and thus the generalisibility of our findings might be limited. Nevertheless, this study has strengths beyond past studies in its prospective design, inclusion of the most cited determinants and use of a strong analytical approach controlling the time effects.

Conclusion

Undernourished older patients often receive little attention as to their nutritional health during and post-hospitalisation (Elia *et al.* 2005). Many older patients subsequently develop a cycle of progressive decline and this cycle appears to be a rapid and hard-to-reverse process (Abbasi *et al.* 1992). Unfortunately, studies have shown that simple oral supplementation is not effective to improve patient outcomes once

undernutrition is established. Milne *et al.* (2005) conducted a meta-analysis which included 49 nutritional trials with 4790 randomised patients studied, of which almost all used an oral liquid supplement. They concluded that supplementation produces a small but consistent weight gain in older patients. However, no evidence of improvement in clinical outcome or functional benefit was found (Milne *et al.* 2005). It is evident that it is not enough to provide supplementations and hope for the best. Without sophisticated targeting of a range determinant at the right time, clinical outcomes of relevance to patients such as function and quality of life can not be expected.

Given that undernutrition is a major cause of functional decline and increased morbidity and mortality in older patients (Olde & Rigaud 2003), there remains a need to understand how nutritional care should be structured to improve the quality and outcomes of hospital care. For example, if a single factor intervention of oral supplements is proven not sufficient, should protocols targeting cognitive, oral health, medication, function and depressive symptoms *all* be included in the intervention package? What combination could generate maximal effects? What is preferred by older patients? When is the best time to intervene? What would be feasible within the current context of our health system? Given its diverse predisposing and precipitating factors and how common undernutrition is, future studies should focus on evaluating multi-faceted packages of intervention in various hospital settings.

Acknowledgement

This study was supported by National Science Council Grants # 93-2314B002-293 & # 94-2314B002-226 awarded to CCH Chen and GH Huang.

Contributions

Study design: CC, ST, GH; data collection and analysis: CC, ST, CW, GH; manuscript preparation: CC, ST, CW, GH.

References

Abbasi AA, Basu S & Rudman D (1992) Caloric requirements for weight gain in malnourished nursing home patients. *Journal of American Geriatric Society* **40**, 24–30.

Atchison KA & Dolan TA (1990) Development of the geriatric oral health assessment index. *Journal of Dental Education* **54**, 680–687.

Boylston E, Ryan C, Brown C & Westfall B (1996) Preventing precipitous weight loss in demented patients by altering food texture. *Journal of Nutrition for the Elderly* **15**, 43–48.

Calabrese JM, Friedam PK, Ross LM & Jones JA (1999) Using the GOHAI to assess oral health status of frail homebound elders: reliability, sensibility and specificity. *Special Care in Dentistry* **19**, 214–219.

Chen CC-H, Chang CK, Chyun DA & McCorkle R (2005) Dynamics of nutritional health in a community sample of American elders. *Advances in Nursing Science* **28**, 376–389.

Chen CC-H, Bai YI, Huang GH & Tang ST (2007) Revisiting the concept of malnutrition in older people. *Journal of Clinical Nursing* **16**, 2015–2026.

Chen CC-H, Wang C & Huang GH (2008) Functional trajectory 6 months posthospitalization: a cohort study of older hospitalized patients in Taiwan. *Nursing Research* **57**, 93–100.

Corish CA & Kennedy NP (2000) Protein-energy undernutrition in hospital in patients. *British Journal of Nutrition* **83**, 579–591.

Donini LM, De Felice MR & Cannella C (2007) Nutritional status determinants and cognition in the elderly. *Archives of Gerontology and Geriatrics* **44**, 143–153.

Elia M, Zellipour L & Stratton RJ (2005) To screen or not to screen for adult malnutrition? *Clinical Nutrition* **24**, 867–884.

Folstein MF, Folstein SE & McHugh PR (1975) 'Mini-mental state' A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research* **12**, 189–198.

Frazier SC (2005) Health outcomes and polypharmacy in elderly individuals: an integrated literature review. *Journal of Gerontological Nursing* **31**, 4–11.

Guigoz Y, Vellas B & Garry PJ (1996) Assessing the nutritional status of the elderly: the mini nutritional assessment as part of the geriatric evaluation. *Nutrition Review* **54**, S59–S65.

Guo N-W, Liu H-C, Wong P-F, Liao K-K, Yan S-H, Lin K-O, Chang C-Y & Hsu T-C (1988) Chinese version and norms of the Mini-Mental State Examination [Chinese]. *Journal of Rehabilitation Medicine Association* **16**, 52–59.

Hardy SE, Dubin JA, Holford TR & Gill TM (2005) Transitions between states of disability and independence among older persons. *American Journal of Epidemiology* **161**, 575–584.

Henriksen MG, Jensen MB, Hansen HV, Jespersen TW & Hessov I (2002) Enforced mobilization, early oral feeding and balanced analgesia improve convalescence after colorectal surgery. *Nutrition* **18**, 147–152.

Incalzi RA, Gemma A, Capparella O, Cipriani L, Landi F & Carbonin P (1996) Energy intake and in-hospital starvation. *Archives of Internal Medicine* **156**, 425–429.

Inouye SK, Bogardus ST, Baker DI, Leo-Summers LM & Cooney LM (2000) The hospital elder life program: a model of care to prevent cognitive and functional decline in older hospitalized patients. *Journal of American Geriatrics Society* **48**, 1697–1706.

Junger M & Schoenberg MH (2007) Postoperative care in fast-tract rehabilitation for elective colonic surgery. *Transfusion Alterations in Transfusion Medicine* **9**, 66–77.

Kayser-Jones J & Schell ES (1997) The effect of staffing quality of care at mealtime. *Nursing Outlook* **45**, 67–72.

Keller HH, Gibbs AJ, Boudreau LD, Goy RE, Pattillo MS & Brown HM (2003) Prevention of weight loss in dementia with comprehensive nutritional treatment. *Journal of the American Geriatrics Society* **51**, 945–952.

Kelly IE, Tessier S, Cahill A, Morris SE, Crumley A, McLaughlin D, McKee RF & Lean ME (2000) Still hungry in hospital: identifying

malnutrition in acute hospital admissions. *Quarterly Journal of Medicine* **93**, 93–98.

Kikutani T, Enomoto R, Tamura F, Oyaizu K, Suzuki A & Inaba S (2006) Effects of oral functional training for nutritional improvement in Japanese older people requiring long-term care. *Gerodontology* **23**, 93–98.

Kubrak C & Jensen L (2007) Malnutrition in acute care patients: a narrative review. *International Journal of Nursing Studies* **44**, 1036–1054.

Locher JL, Robinson CO, Roth DL, Ritchie CR & Burgio KL (2005) The effect of the presence of others on caloric intake in homebound older adults. *Journal of Gerontology: Medical Sciences* **60A**, M1457–M1478.

Mahoney FI & Barthel DW (1965) Functional evaluation: the Barthel Index. *Maryland State Medical Journal* **14**, 61–65.

Manthorpe J & Watson R (2003) Poorly served? Eating and dementia *Journal of Advanced Nursing* **41**, 162–169.

Milne AC, Potter J & Avenell A (2005) Protein and energy supplementation in elderly people at risk from malnutrition. *Cochrane Database Systematic Reviews* **2**. CD003288

Ohno T, Uematsu H, Nozaki S & Sugimoto K (2003) Improvement of taste sensitivity of the nursed elderly by oral care. *Journal of Medical & Dental Sciences* **50**, 101–107.

Olde Rikkert MGM & Rigaud AS (2003) Malnutrition research: high time to change the menu. *Age and Ageing* **32**, 241–243.

Pofahl WE & Pories WJ (2003) Current status and future direction of geriatric general surgery. *Journal of the American Geriatrics Society* **51**, S351–S354.

Sainsbury A, Seebass G, Bansal A & Young JB (2005) Reliability of the Barthel Index when used with older people. *Age and Ageing* **34**, 228–232.

Sarason I, Sarason B, Shearin E & Pierce GR (1987) A brief measure of social support: practical and theoretical implications. *Journal of Social and Personal Relationships* **4**, 497–510.

Sullivan DH, Sun S & Walls RC (1999) Protein-energy undernutrition among elderly hospitalized patients: a prospective study. *Journal of American Medical Association* **281**, 2013–2019.

Verbrugge LM, Reoma JM & Gruber-Baldini AL (1994) Short-term dynamics of disability and well-being. *Journal of Health and Social Behavior* **35**, 97–117.

Wong MC, Liu JK & Lo EC (2002a) Translation and validation of the Chinese version of GOHAI. *Journal of Public Health Dentistry* **62**, 78–83.

Wong MTP, Ho TP, Ho MY, Yu CS, Wong YH & Lee SY (2002b) Development and inter-rater reliability of a standardized verbal instruction manual for the Chinese Geriatric Depression Scale-Short Form. *International Journal of Geriatric Psychiatry* **17**, 459–463.

Yesavage JA, Brink TL & Rose TL (1983) Development and validation of a geriatric depression scale. *Journal of Psychiatric Research* **17**, 31–49.