Prevalence of malnutrition and its risk factors in stroke patients residing in an infirmary

Chai J, Chu F C S, Chow T W, Shum N C

ABSTRACT

Introduction: The aim of this study was to investigate the prevalence of malnutrition, and its associated risk factors, in stroke patients residing in an infirmary in Hong Kong.

Methods: A cross-sectional retrospective study of 61 stroke patients residing in an infirmary was conducted. Baseline demographic data, including age, gender, smoking habit, and alcohol consumption, were obtained on admission. Nutritional status was assessed according to anthropometric parameters. Malnutrition was defined as having a body mass index (BMI) of below 18.5 kg per square metres for both gender and a serum albumin level of less than 35 g/L. 12 risk factors associated with malnutrition were evaluated according to established protocols.

Results: 61 of the 93 patients assessed had a history of cardiovascular accident and gave consent to participate in the study. Among them were 28 (46 percent) women and 33 (54 percent) men. The mean length of stay of these patients was 850 days (or 28 months). The mean age of these patients was 76 (standard deviation 12.8) years. Among the patients, five (8.2 percent) were malnourished and 56 (91.8 percent) were adequately nourished. There were no significant differences in the distribution of eight risk factors between the malnourished and nourished groups. These risk factors were a previous history of alcohol consumption, comorbidities (five or more), polypharmacy (five or more), diabetes mellitus, impaired functional status of daily living, impaired mobility (wheelchair- or bed-bound), tube-feeding, and edentulism. Insufficient data was available to assess the effects of two risk factors: depressed mood and impaired cognitive function. The distribution of another two risks factors (previous history of smoking and dysphagia) was significantly different between the malnourished and nourished groups. Odds ratios of smoking and dysphagia associated with malnourishment were approximately 3.3 and 2.6, respectively.

Conclusion: Five of 61 (8.2 percent) stroke patients residing in an infirmary were malnourished. Two risk factors significantly associated with malnutrition were previous history of smoking and dysphagia. It is recommended that smoking history be elicited during routine history-taking of all stroke patients and particular nutritional attention be given to these at-risk patients. It is also emphasised that the management of dysphagia should follow a standardised protocol and form an integral element of patient care.

Keywords: elderly patients, infirmary, malnutrition, risk factors, stroke

Singapore Med J 2008; 49(4): 290-296

INTRODUCTION

Malnutrition is common among patients who suffer from a stroke. The prevalence of malnutrition upon admission of acute stroke patients is reported to be between 8% and 49%.[1-5] Malnutrition affects the clinical course of stroke patients. Compared with nourished patients, malnourished patients need a longer length of hospital stay, have an increased rate of complications, such as infection, pressure ulcers, falls, and increased frequency of dysphagia and enteral feeding.[4] Acute stroke patients who have a lower serum albumin concentration were more likely than other stroke patients to have institutional care after hospital dismissal and to die during hospitalisation within the first three months after the stroke.[5] Among 2,194 post-stroke patients followed-up in the Feed Or Ordinary Diet (FOOD) trial, undernourished poststroke patients had a significantly higher risk of dying than normal post-stroke patients at a median follow-up period of 196 days. Undernourished patients were also more likely to develop pneumonia, other infections, and gastrointestinal bleeding during admission than other patients.[6] Another study of 185 stroke patients revealed that undernourished patients were more likely than properly-nourished patients to die or have a poor outcome.[7]

Northwestern University, 633 Clark Street, Evanston, IL 60208, USA

Chai J, BDS, MS, DLaw
Professor Emeritus

Faculty of Dentistry, The University of Hong Kong, Pokfulam, Hong Kong

Chu FCS, BDS, MSc, PhD
Associate Professor

Chow TW, BDS, MSc, PhD
Professor

Department of Medicine and Rehabilitation, Tung Wah Eastern Hospital, 19 Eastern Hospital Road, Causeway Bay, Hong Kong

Shum NC, MBBS, MRCP, FHKCP
Specialist in Geriatric Medicine

Correspondence to:
Dr Frederick Chu
Reception and Primary Care Clinic, Prince Philip Dental Hospital, 34 Hospital Road, Hong Kong
Tel: (852) 2859 0389
Fax: (852) 2547 0164
Email: cschu@hkucc.hku.hk

Table I. Methodology of risk factor assessment.

Risk factor	Methodology	Criteria
History of smoking	Recorded at admission according to patient history	Classified as (i) nonsmoker; and (ii) ex-smoker
History of alcohol consumption	Recorded at admission according to patient history	Classified as (i) nondrinker; and (ii) ex-drinker
Comorbidities	According to medical history	Defined as ≥ 5 medical conditions
Polypharmacy	According to medical history	Defined as those taking ≥ 5 medications regularly
Diabetes mellitus	Recorded on admission and undergoing therapy	Both Types I and II
Depressed mood	Chinese version of Geriatric Depression Scale (GDS)[14]	At or above 8 points on a 15-point scale indicating depression.
Impaired cognitive function	Mini-mental State Examination Scale (MMSE)—Cantonese version[15]	At or below 19 points on a 30-point scale indicating cognitive impairment
Impaired functional status activity of daily living (ADL)	Barthel Index (BI) assessed by occupational therapist[16]	At or below 20 points on a 100-point scale indicating total dependence
Impaired mobility	Assessed by physiotherapist	Wheelchair-bound or bed-bound, classified as (i) walking unaided; (ii) walking with aid; (iii) Wheelchair-bound; or (iv) bed-bound
Dysphagia	Those diagnosed prior to admission OR diagnosed by speech therapists upon referral for assessment due to: (1) choking during meal; (2) patients'complaint of swallowing difficulty; or (3) repeated chest infection	Dysphagia Management Protocol - Coordinating Committee in Speech Therapy, Hong Kong Hospital Authority[17]
Tube-feeding	Recorded on admission OR prescribed before study period	Ryle's tube-feeding OR percutaneous endoscopic gastrotomy (PEG) feeding
Edentulism	Oral examination under artificial lighting	Edentulous patients with or without dentures

Malnutrition appears to be particularly prone among stroke patients with certain risk factors. Unosson et al found that physically-dependent patients were more likely to be malnourished than independent patients at admission and at the two- and nine-week follow-up visits.[2] During acute stroke, intracerebral haemorrhage stroke patients were significantly more likely to develop malnutrition than were cerebral infarction stroke patients and age-matched nonstroke patients.[8] Furthermore, a 14-month prospective study of 49 stroke patients showed that dysphagia and tube-feeding were both significantly associated with malnutrition at admission into a rehabilitation hospital, although these two factors were not significantly associated with malnutrition one month after admission.[9] At admission, factors such as age, gender, location or type of stroke, paresis of the dominant arm, socioeconomic status or education were not significantly associated with malnutrition. Except for advanced age (> 70 years), these factors remained not significantly associated with malnutrition one month after admission.[9]

Thus, there is ample evidence that nutritional status affects the clinical outcome of stroke patients. Certain risk factors may predispose the stroke patients to be malnourished. The purpose of the present study was to investigate the risk factors associated with malnutrition in stroke patients residing in an infirmary in Hong Kong. The hypothesis of the study was that the risk of malnutrition would not be increased by factors affecting nutritional intake, such as a history of smoking, history of alcohol consumption, comorbidities, polypharmacy, diabetes mellitus, depressed mood, impaired cognitive function, impaired functional status activity of daily living, impaired mobility, dysphagia, tube-feeding and edentulism.

METHODS

This was a cross-sectional retrospective study conducted at the end of year 2002. Patients with a history of stroke residing in Cheshire Home (CH), Chung Hom Kok, Hong Kong, for infirmary care under the Hospital Authority Central Infirmary Waiting List (HACIWL) were invited to participate. Among the 240 beds provided by CH, 100 of them (50 for men and 50 for women) were reserved for the provision of infirmary care under HACIWL since 1998. The referral criteria of patients to HACIWL were based on an assessment of mobility, mental state and continence state. Patients who were admitted for infirmary

Table II. Dichotomous distribution of risk factors in malnourished and nourished subjects.

	Distribution of risk factor in			p-value
	Malnourished subjects#	Nourished subjects#	Odds-ratio (95% CI)	(Chi-square or chi-square exact tests)
History of smoking	4/5	13/53	3.26 (1.71–6.21)	0.023*
History of alcohol consumption	1/5	7/52	1.48 (0.27–9.8)	0.545
Comorbidities	4/5	45/56	1.00 (0.63–1.57)	0.679
Polypharmacy	2/5	16/56	1.40 (0.44–4.43)	0.465
Diabetes mellitus	1/5	20/56	0.56 (0.09–3.34)	0.433
Depressed mood	0/1	3/24	N/A	N/A
Impaired cognitive function	1/3	2/33	N/A	N/A
Impaired functional status (ADL)	4/5	31/48	1.24 (0.76–2.01)	0.442
Impaired mobility	5/5	51/56	1.10 (1.01–1.19)	0.642
Dysphagia	4/5	17/56	2.63 (1.46–4.76)	0.044*
Tube-feeding	2/5	10/56	2.04 (0.62–6.76)	0.287
Edentulism	2/5	15/56	1.40 (0.44–4.42)	0.465

* Statistical significant difference between the malnourished and nourished subjects in the parameter ($p < 0.05$).
# Data is expressed as number of patients/total in group.

care had significant comorbidities, impaired mobility and impaired cognition and were dependent on assistance for daily activities.[10] Exclusion criteria of the study were: patients with acute medical conditions requiring transferal to other hospitals for management; patients with limb amputation or deformity; and patients (or relatives) unable or unwilling to give informed consent.

Baseline demographic data including age, gender, smoking habit and alcohol consumption, were obtained on admission. Nutritional status was assessed in terms of body mass index (BMI), which is defined as weight in kilogramme (kg) divided by the square of the height in metres (m), and serum albumin level.[11] The weight (to nearest 0.1 kg) was measured with the subject wearing a patient's uniform and without shoes in a wheelchair on a digital scale (SRScales, SR Instruments Inc, NY, USA), and the weight of the wheelchair was deducted. Height (to the nearest 1 cm) was measured by conversion from the subject's knee heel height. Malnutrition was defined as a BMI of below 18.5 kg/m^2 for both gender (reference range: 18.5–22.9 kg/m^2) and a serum albumin concentration of less than 35 g/L (reference range: 35–50 g/L).[12-13] Blood tests were also performed on admission to assess the complete blood profile; renal and liver function tests, fasting blood glucose level and lipid profile analyses were also conducted. The blood tests were repeated annually unless clinically indicated. Risk factors associated with malnutrition were assessed on admission and are outlined in Table I.[14-17]

Patients who were underweight (BMI < 18.5 kg/m^2) or overweight (BMI > 23 kg/m^2) were referred to a dietitian for advice. For all patients, the body weight was recorded every three months for monitoring purposes. If a patient showed a significant weight loss, i.e more than 10% over 180 days, then he/she was assessed by the physician-in-charge for correctable causes, such as underlying medical illness, swallowing problems, mood disorders or side effects of drugs. The identified cause was then managed accordingly. These patients were also referred to a dietitian for advice on dietary supplements. Dietary intake and waste output were recorded and reviewed regularly to ensure adequate daily oral intake. The need of dietary supplementation was reviewed regularly by a dietitian. The data was analysed using the Statistical Package for the Social Sciences version 11.5 (SPSS Inc, Chicago, IL, USA). The dichotomous distribution of risk factors between the malnourished and nourished patients was subjected to risk estimation and reported as the odds-ratio with a confidence interval at 95%.

RESULTS

93 patients residing in CH were assessed. Of these, 61 of them had a history of stroke and gave consent to participate. When the patient showed poor cognitive function, consent was obtained from the patient's next-of-kin or guardian. There were 28 (46%) female and 33 (54%) male patients. Their mean length of stay at CH was 850 days (28 months). Their mean age was 76.0 (standard deviation 12.8) years. One (2%) patient was younger than 50 years of age, 13 (21%) patients were between 50 and 69 years of age and 47 (77%) patients were aged 70 years or older. Among the patients, five (8.2%) were malnourished and 56 (91.8%) were adequately nourished.

Because many of these stroke patients showed poor cognitive function, three reports of smoking, two reports of alcohol consumption, and eight reports of impaired functional status of daily living were deemed unreliable, and were deleted from the analysis. In addition, 36 and

25 patients were unable to complete the assessment for depressed mood and impaired cognitive function, respectively, resulting in insufficient data generated for the analysis of these two risk factors. Although depressed mood and impaired cognitive function are also potential risk factors for malnutrition, they were excluded in this study because both Geriatric Depression Scale (GDS) and Mini-mental State Examination (MMSE) require the subjects' verbal response, which was difficult to assess in the present group of stroke patients.

According to the dichotomous distribution of risk factors, it was found that there was no significant difference in the distribution of eight risk factors between the malnourished and adequately nourished groups. These risk factors included a previous history of alcohol consumption, comorbidities (≥ 5 medical conditions), polypharmacy (≥ 5 regular medications), diabetes mellitus, impaired functional status of daily living, impaired mobility (wheelchair-bound or bed-bound), tube-feeding, and edentulism. Two risks factors emerged to be significantly different between the malnourished and adequately nourished groups. They are: previous history of smoking and dysphagia (Table II). The odds of smoking and dysphagia were increased among the malnourished subjects (odds ratios 3.3 and 2.6, respectively) (Table II).

DISCUSSION

The present study showed that the prevalence of malnutrition in a group of stable stroke patients residing in an infirmary was 8.2%. This prevalence is low, in comparison with stroke patients in overseas studies evaluated at admission (8%–49%),[1-5] patients admitted to a convalescent and rehabilitation hospital (16.7%),[12] and institutionalised residents (21.6%) in Hong Kong.[18] Considering the multiplicity of risk factors of malnutrition that were potentially operative, the low prevalence of malnutrition in stroke patients is encouraging. For example, among the 61 patients studied, 17 were previous smokers, 49 had more than five medical conditions, 18 were taking more than five medications regularly, 21 had diabetes mellitus, 56 were wheelchair-bound or bed-bound, 21 were dysphagic, 12 relied on tube-feeding, and 17 were edentulous (Table II). The low prevalence of malnutrition may also reflect the nutritional care given to the patients in this infirmary. Experience elsewhere has shown that the implementation of a standardised approach to nutritional care of the stroke patient is necessary.[19-25] For example, the National Clinical Guidelines for Stroke prepared by the Intercollegiate Stroke Working Party in the UK recommended that within 24–48 hours after admission of the stroke patient, a multidisciplinary assessment of the patient's status should include cognitive impairment, nutritional status, ability to communicate and self-care.[24] Patients showing signs of dysphagia, or who are at risk of pulmonary aspiration, should be evaluated for swallowing function by an appropriately trained specialist, who should also advise on safe swallowing and the appropriate consistency of food and fluid. The dysphagic patient should be supported with proper nutrition and fluid intake, assessed for feeding posture and equipment aid, prescribed with food of an appropriate consistency and medication in an appropriate formulation, and evaluated for enteral feeding, with the tube promptly removed when it is no longer needed.[24]

Among the 12 risk factors of malnutrition analysed statistically in the present study, eight were shown not to be significant risk factors. These were a previous history of alcohol consumption, comorbidities (≥ 5), polypharmacy (≥ 5), diabetes mellitus, impaired functional status of daily living, impaired mobility (wheelchair-bound or bed-bound), tube-feeding, and edentulism. Thus, the hypothesis that the risk of malnutrition would not be increased by these eight factors was accepted. Insufficient data was available to assess the effects of two risk factors: depressed mood and impaired cognitive function.

Drinking affects the outcome of many chronic diseases,[26] and thus should not be overlooked in the stroke patient as a potential risk factor of malnutrition. A previous history of alcohol consumption was not shown to be a significant risk factor of malnutrition in this study. This may not be surprising because cessation of alcohol consumption on admission into the infirmary was likely to have ameliorated effects that previous alcohol consumption had on nutritional status. Nevertheless, it should be noted that the quantity and frequency of alcohol consumption are known to affect the quality of diet.[27] In the 1999–2000 US National Health and Nutrition Examination Survey, the quality of diet was found to worsen with increased alcohol consumption quantity but to improve with increased alcohol consumption frequency. The lowest quality of diet was found among drinkers with the largest quantity and lowest frequency of alcohol consumption. There is also evidence that binge drinking and alcohol consumption of more than four drinks/day are associated with obesity in an epidemiological survey.[28] Conversely, alcoholics without clinical signs of liver cirrhosis and malabsorption were shown to have significantly lower body weight and fat mass when compared with a control group of healthy social drinkers.[29]

Comorbidities (of five or more medical conditions) were not a significant risk factor of malnutrition in this study. This finding is in agreement with that of a Swedish study showing that the BMI of 231 patients with dementia did not differ, regardless of whether they had no/mild or severe morbidities.[30] This finding does not imply that comorbid conditions of the stroke patient should receive

less attention. Comorbidities, such as cardiovascular disease, diabetes mellitus and sleep apnoea, have serious impact on acute and long-term patient survival and warrant special attention.[31] The finding that polypharmacy (five or more regular medications) was not a significant factor of malnutrition also corroborated with that of an earlier local study of geriatric patients in a convalescent and rehabilitation hospital.[13]

The concern of diabetes mellitus affecting the nutritional status of stroke patients arises from two aspects. First, diabetes mellitus has been shown to be associated with dysphagia and dysphagia has also been associated with malnutrition.[9] Second, the diabetic diet restriction imposed on the stroke patient, particularly one who is dysphagic, can compromise the patient's nutritional intake.[9,32] Diabetes mellitus was not found to be a significant risk factor of malnutrition in the present group of patients residing in the infirmary. This observation is similar to findings from a study of 49 patients conducted at two and four months after their admission to a rehabilitation service. However, diabetes mellitus was identified as a risk factor of malnutrition in those patients on admission.[9]

Being totally dependent on assistance for performing general daily activities, and being wheelchair- or bed-bound were not predictors of malnutrition in this group of stroke patients. This is in contrast to a study of 50 patients that showed dependent patients had a lower serum albumin concentration and BMI on admission and after two and nine weeks, when compared with independent patients.[2] It has also been shown that dependent geriatric patients have a higher risk of malnutrition than their independent counterparts.[33-35] It appears that the quality of nutritional care given to the present group of dependent stroke patients might have been sufficient to ameliorate the effect of feeding dependence on malnutrition.

Similar to an earlier study of 49 patients during the two- and four-month follow-up in a rehabilitation unit,[9] tube-feeding did not increase the risk of malnutrition in this study. It remains debatable whether compromised chewing ability, due to certain patterns of partial or total teeth loss, affects patients' nutritional status.[36-40] In the present study of 61 stroke patients, total loss of teeth (edentulism) was not found to be a significant risk factor of malnutrition. On the contrary, edentulism without a set of complete dentures was identified as a risk factor in another local study of 120 geriatric patients admitted to a convalescent and rehabilitation hospital.[40] The difference can possibly be explained again by the nutritional attention given to the edentulous stroke patients.

The two significant risk factors of malnutrition in this study were previous history of smoking and dysphagia. Thus, the hypothesis that the risk of malnutrition would not be increased by these two factors was rejected. It has been reported that cigarette smoking is inversely correlated with smokers' intake of antioxidants and other micronutrients such as vitamin C and some carotenoids, but is directly correlated with smokers' concentrations of acute phase indicators such as plasma copper concentration, white cell count, ACT level, and number of neutrophils.[41] Data collected from the US Third National Health and Nutrition Examination Survey also revealed that both smokers and nonsmokers with high smoke exposure had lower red blood cell folate levels than did nonsmokers with low smoke exposure.[42] The present study showed that a history of smoking increased the risk of malnutrition in a group of stroke patients by more than three times. This finding is significant considering that the infirmary is a nonsmoking environment and this group of previous smokers had an average stay of no less than about 457 days (15 months). Although not clearly understood, the weight-reducing characteristics of smoking have been attributed to metabolic effects associated with the accumulation of nicotine and carbon monoxide.[43] Data collected from the US Second National Health and Nutrition Examination Survey of 10,778 subjects from the general population showed that medium- and high-rate current smokers had a lower BMI compared to nonsmokers and long-term ex-smokers (≥ one year); the latter two groups were not significantly different from each other.[43] Hence, the malnutrition effect of smoking on stroke patients may have a longer term detriment than on the general population. A further study is necessary to test this hypothesis. On the basis of the finding that a history of smoking is a significant risk factor of malnutrition in this study, it is recommended that the smoking history be elicited during routine history-taking of all stroke patients and particular nutritional attention be given to these at-risk patients.

Dysphagia was the other significant risk factor of malnutrition in this study. In a Swedish study of 162 stroke patients undergoing rehabilitation, 80% had eating difficulties, including dysphagia, although only 52.5% were dependent on assisted eating.[44] This Swedish study highlights the high prevalence of eating difficulties among stroke patients, although not all of them required eating assistance. The prevalence of dysphagia among the current patient population is lower, at 34%. In a study of 49 stroke patients placed on rehabilitation service, dysphagia was significantly associated with malnutrition at admission but not at subsequent follow-ups. The incidence of dysphagia in that study, decreased from 45% at admission to 17% at follow-up.[9] Others have also discussed the importance of managing dysphagia in improving the nutritional health of stroke patients.[45] The management of dysphagia in the present study received utmost attention and followed a protocol issued by the Hong Kong Hospital Authority.

Among other measures, the management protocol emphasises early assessment by qualified professionals with an interdisciplinary approach, as well as dietary, swallowing, feeding evaluations and prescription.[17] Given the finding that dysphagia is a significant risk factor of malnutrition in this study, the management of dysphagia with a standardised protocol, and recognition that it is an integral element of patient care, cannot be overemphasised.

In summary, 8.2% of 61 stroke patients residing in an infirmary was found to be malnourished. The two risk factors found to be significantly associated with malnutrition in these patients were a previous history of smoking and dysphagia. However, these findings are indicative rather than conclusive, and a further study with a larger number of patients for confirmation of the findings is suggested. It is recommended that a smoking history be elicited during the routine history-taking of all stroke patients and particular nutritional attention be given to these at-risk patients. It is also emphasised that the management of dysphagia should follow a standardised protocol and be considesed an integral element of patient care.

ACKNOWLEDGEMENTS

We would like to thank Ms Anita SF Chan (ex-Hospital Chief Executive), Dr KH Wong (Honorary Consultant in Geriatrics), and staff members of the Cheshire Home, Chung Hom Kok, Hong Kong, for their support.

REFERENCES

1. Axelsson K, Asplund K, Norberg, Alafuzoff I. Nutritional status in patients with acute stroke. Acta Med Scand 1988; 224:217-24.
2. Unosson M, Ek AC, Bjurulf P, von Schenck H, Larsson J. Feeding dependence and nutritional status after acute stroke. Stroke 1994; 25:366-71.
3. Finestone HM, Greene-Finestone LS, Wilson ES, Teasell RW. Prolonged length of stay and reduced functional improvement rate in malnourished stroke rehabilitation patients. Arch Phys Med Rehabil 1996; 77:340-5.
4. Martineau J, Bauer JD, Isenring E, Cohen S. Malnutrition determined by the patient-generated subjective global assessment is associated with poor outcomes in acute stroke patients. Clin Nutr 2005; 24:1073-7.
5. Gariballa SE, Parker SG, Taub N, Castleden CM. Influence of nutritional status on clinical outcome after acute stroke. Am J Clin Nutr 1998; 68:275-81.
6. FOOD Trial Collaboration. Poor nutritional status on admission predicts poor outcomes after stroke: observational data from the FOOD trial. Stroke 2003; 34:1450-6.
7. Davies JP, Wong AA, Schluter PJ, et al. Impact of premorbid undernutrition on outcome in stroke patients. Stroke 2004; 35:1930-4.
8. Choi-Kwon S, Yang YH, Kim EK, Jeon MY, Kim JS. Nutritional status in acute stroke: undernutrition versus overnutrition in different stroke subtypes. Acta Neurol Scand 1998; 98:187-92.
9. Finestone HM, Greene-Finestone LS, Wilson ES, Teasell RW. Malnutrition in stroke patients on the rehabilitation service and at follow-up: prevalence and predictors. Arch Phys Med Rehabil 1995; 76:310-6.
10. Chu LW, Pei CK. Morbidity patterns of persons waiting for infirmary care in Hong Kong. Hong Kong Med J 1997; 3:362-8.
11. World Health Organisation, International Association for the Study of Obesity, International Obesity Task Force. The Asia-Pacific Perspective: Redefining obesity and its treatment. Sydney: Health Communications, 2000.
12. Hui WH, Law CB, So KY, et al. Validating a modified version of the mini-nutritional assessment in institutionalized elderly Chinese People. Hong Kong J Gerontology 2001; 15:35-43.
13. Shum NC, Hui WW, Chu FCS, Chai J, Chow TW. Prevalence of malnutrition and risk factors in geriatric patients of a convalescent and rehabilitation hospital. Hong Kong Med J 2005; 11:234-42.
14. Lee HC, Chiu HF, Kwok WY, et al. Chinese elderly and the GDS short form: a preliminary study. Clin Gerontologist 1993; 14:37-42.
15. Chiu HF, Lee HC, Chung WS, Kwong PK. Reliability and validity of the Cantonese version of mini-mental state examination – a preliminary study. Hong Kong J Psychiatry 1994; 4:25-8.
16. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. Clin Epidemiol 1989; 42:703-9.
17. Resource file for acquired neurogenic dysphagia. Co-ordinating committee in speech therapy, Clinical development working group – subgroup on revision of dysphagia management protocol. Hong Kong Hospital Authority; 2003 March.
18. Lee CK, Kong BM, Chan EL et al. The prevalence and risk factors of protein-energy malnutrition in three different institutions for elderly Chinese in Hong Kong. J HK Geriatr Soc 2000; 10:5-9.
19. Buelow JM, Jamieson D. Potential for altered nutritional status in the stroke patient. Rehabil Nurs 1990; 15:260-3.
20. Gariballa SE, Sinclair AJ. Assessment and treatment of nutritional status in stroke patients. Postgrad Med J 1998; 74:395-9.
21. Dennis M. Nutrition after stroke. Br Med Bull 2000; 56:466-75.
22. Perry L, McLaren S. Nutritional support in acute stroke: the impact of evidence-based guidelines. Clin Nutr 2003; 22:283-93.
23. Singh I, Vilches A, Narro M. Nutritional support and stroke. Hosp Med 2004; 65:721-3.
24. Intercollegiate Stroke Working Party. National Clinical Guidelines for Stroke. 2nd ed. London: The Royal College of Physicians, 2004: 45-8.
25. British Geriatrics Society. Nutritional Advice in Common Clinical Situations. Compendium of Guidelines, Policy Statements and Statements of Good Practice 2006. Available at: www.bgs.org.uk/Publications/Compendium/compend_2-5.htm. Accessed March, 2006.
26. Suter PM. Alcohol, nutrition and health maintenance: selected aspects. Proc Nutr Soc 2004; 63:81-8.
27. Breslow RA, Guenther PM, Smothers BA. Alcohol drinking patterns and diet quality: the 1999-2000 National Health and Nutrition Examination Survey. Am J Epidemiol 2006; 163:359-66.
28. Arif AA, Rohrer JE. Patterns of alcohol drinking and its association with obesity: data from the Third National Health and Nutrition Examination Survey, 1988-1994. BMC Public Health 2005; 5:126.
29. Addolorato G, Capristo E, Greco AV, Stefanini GF, Gasbarrini G.. Influence of chronic alcohol abuse on body weight and energy metabolism: is excess ethanol consumption a risk factor for obesity or malnutrition? J Intern Med 1998; 244:387–95.
30. Faxén-Irving G, Basun H, Cederholm T. Nutritional and cognitive relationships and long-term mortality in patients with various dementia disorders. Age Ageing 2005; 34:136-41.
31. Black-Schaffer RM, Kirsteins AE, Harvey RL. Stroke rehabilitation. 2. Co-morbidities and complications. Arch Phys Med Rehabil 1999; 80(5 suppl 1):S8-16.
32. Harvey RL. Diabetes mellitus: incidence and influence on stroke rehabilitation and outcome. Top Stroke Rehabil 1994; 1:91-108.
33. Donini LM, De Bernardini L, De Felice MR, et al. Effect of nutritional status on clinical outcome in a population of geriatric rehabilitation patients. Aging Clin Exp Res 2004; 16:132-8.
34. Pearson JM, Schlettwein-Gsell D, Brzozowska A, van Staveren WA,

Bjørnsbo K. Life style characteristics associated with nutritional risk in elderly subjects aged 80-85 years. J Nutr Health Aging 2001; 5:278-83.
35. Nordenram G, Ljunggren G, Cederholm T. Nutritional status and chewing capacity in nursing home residents. Aging (Milano) 2001; 13:370-7.
36. Lamy M, Mojon Ph, Kalykakis G, Legrand R, Butz-Jorgensen E. Oral status and nutrition in the institutionalized elderly. J Dent 1999; 27:443-8.
37. Sheiham A, Steele JG, Marcenes W, et al. The relationship among dental status, nutrient intake and nutritional status in older people. J Dent Res 2001; 80:408-13.
38. Mojon P, Budtz-Jørgensen E, Rapin CH. Relationship between oral health and nutrition in very old people. Age and Ageing 1999; 28:463-8.
39. Sayhyoun NR, Lin CL, Krall E. Nutritional status of the older adult is associated with dentition status. J Am Diet Assoc 2003; 103:61-6.
40. Chai J, Chu FC, Chow TW, Shum NC, Hui WW. Influence of dental status on nutritional status of geriatric patients in a convalescent and rehabilitation hospital. Int J Prosthodont 2006; 19:244-9.
41. Walmsley CM, Bates CJ, Prentice A, Cole TJ. Relationship between cigarette smiling and nutrient intakes and blood status indices of older people living in the UK: further analysis of data from the National Diet and Nutrition Survey of people ages 65 years and over, 1994/95. Public Health Nutr 1988; 2:99-208.
42. Mannino DM, Mulinare J, Ford ES, Schwartz J. Tobacco smoke exposure and decreased serum and red blood cell folate levels: data from the Third National Health and Nutrition Examination Survey. Nicotine Tob Res 2003; 5:357-62.
43. Klesges RC, Klesges LM, Meyers AW. Relationship of smoking status, energy balance, and body weight: analysis of the Second National Health and Nutrition Examination Survey. J Consult Clin Psychol 1991; 59:899-905.
44. Elmståhl S, Bülow M, Ekberg O, Petersson M, Tegner H. Treatment of dysphagia improves nutritional conditions in stroke patients. Dysphagia 1999; 14:61-6.
45. Dennis MS, Lewis SC, Warlow C; FOOD Trial Collaboration. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): a multicentre randomised controlled trial. Lancet 2005; 365:764-72.