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Predictors of nutritional status among community-dwelling older adults in Wuhan, China

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Abstract

Objectives: To examine the nutritional and functional status of community older adults in China, to identify the related factors and best predictors of elder nutrition.
Design, setting and subjects: A cross-sectional, descriptive correlation design was utilized. A convenience sample of 162 community older adults (aged ≥65 years) were administered three questionnaires, which were used to obtain demographic characteristics, nutritional status (Mini Nutritional Assessment, MNA) and functional status (Instrumental Activities of Daily Living, IADL).
Results: The mean MNA score was 23·8 (SD 3·92), 36·4% of elders were at risk of malnutrition and 8·0% were malnourished; 61·7% were functionally independent. Spearman's correlation analysis indicated that age, marital status, education level, personal income, number of chronic medical conditions suffered and functional status had significant correlations with nutritional status. Stepwise multiple linear regression analysis identified that the best predictors were the number of chronic conditions suffered, age, functional status and marital status.
Conclusions: The study has suggested that nutritional health remains a problem among older adults in the Chinese community. A large proportion was on the borderline of malnutrition, and deficiency as well as excesses coexisted. Malnutrition is an increasing hazard especially for those suffering from more diseases, at a highly advanced age, functionally dependent and widowed.

Keywords
China
Community older adults
Nutritional status
Functional status

The world is experiencing demographic revolution, with the number of the elderly population increasing dramatically[1]. China has also marched to an ageing society; at the end of 2006, there were about 104·2 million people over 65 years of age, which accounted for 7·9% of the total population[2]. Ageing is accompanied by physiological, psychological, social as well as economic changes, which determine that the elderly population may become vulnerable to inadequate nutrition[3,4]. The terms 'malnutrition' and 'undernutrition' tend to be used interchangeably in the literature. Within the present paper, the term malnutrition refers primarily to undernutrition.

Malnutrition is especially harmful for older adults. Not only does it contribute to many non-specific symptoms commonly observed in older adults, such as chronic fatigue, a feeling of ill health and poor appetite[5], but also it is a major risk factor for illness, hospitalization, poorer recovery, poorer quality of life, longer stay in hospital[6], increased cost of health resources, more complications, increased morbidity and mortality[3].

However, nowadays malnutrition is frequently unrecognized and untreated[7]. Because of different settings, methods and operational indicators, different prevalences of malnutrition and risk of malnutrition have been reported. As assessed by the Mini Nutritional Assessment (MNA), the prevalence of malnutrition in community older adults (*n* 14 149) was 0–8% and the risk of malnutrition was 8–76%[8]. Furthermore, in the UK, McWhirter and Pennington[9] reported that 40% of patients admitted to hospital from the community were malnourished and most were discharged with worse nutritional status than when they entered, establishing a vicious circle and adding a further group of malnourished individuals to the community. Older adults in the Chinese community still have poor nutrition knowledge and attitude as well as behaviour[10]; doctors and nurses also lack awareness of the prognostic significance of undernutrition and knowledge regarding nutrition assessment and management[11].

Functional capacity is recognized as the sixth vital sign and the most universally accepted indicator of health status in older adults[12]. Functional independence determines the ability of elders to be productive, which was also identified by them as their main criterion of well-being and

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quality of life[13]. In China, it is especially important for older adults to preserve functional ability, as they often make significant contributions to family welfare and income via their involvement in tasks such as child care and food preparation, thus freeing younger adults for wage earning. The level of functional ability has a considerable impact on the way elders are treated and respected[14].

Over the past decades, researchers have reported some sociodemographic factors to have direct or indirect impact on elder nutrition[3–5,14–21]. Dependency in activities of daily living was frequently reported to influence the nutrition of geriatric patients or frailer elderly[22]; functional decline also impacted the nutrition of free-living elders although the Instrumental Activities of Daily Living Scale (IADL) was not used as a systematic criterion[18,19,21].

Older adults in the community should be assessed for risk of malnutrition before severe changes in weight and blood biochemistry occur[8]. However, in China where primary health service care has just started, only BMI tends to be used to identify underweight[20] and the risk of malnutrition among community older adults is largely unavailable. A Chinese study[23] investigated the risk of malnutrition among retired Shanghai residents, but did not identify its risk factors. Evidence of functional effect on the nutrition of Chinese community older adults also has not been established.

We are frequently called upon to support people within the community rather than in institutional facilities. Awareness of the possibility of malnutrition in community older adults is important, especially as those at risk of malnutrition – if identified – respond well to intervention, which may reverse its course. Effective manipulation of any problem necessitates identification and analysis of risk factors. Therefore, the aims of the present study were to: (i) examine the levels of nutritional and functional status; (ii) identify the relationships between nutrition and other variables (demographic characteristics, functional status); and (3) explore the predictors contributing to poor nutrition for older adults.

Methodology

Design, setting and subjects

A cross-sectional, descriptive correlation design was utilized. A convenience sample of 162 older adults was recruited from a community of a city in central China. There are about 26 489 resident households and 75 315 permanent residents in the local community. The residents could receive health-related services from large-scale hospitals or a local health service centre or nearby health service stations; of those nine stations, five were authorized for data collection. Selection criteria included older adults who were: (i) living in the community; (ii) 65 years old or over; (iii) able to stand for weight measurement; (iv) able to communicate with the investigator; and (v) had no cognitive impairment. Each eligible older adult was introduced to the investigator by the community health-care providers. Within the area every station serviced, data were gathered in the health station or activity centre or community hall; only a few were collected in the homes of participants who were receiving home care.

Data gathering lasted from July to September, 2007. Based on a power analysis using a moderate effect size ($R^2 = 0{\cdot}13$), a power of 0·80 and a significance level of 0·05, a sample size of 110 participants was needed[24]. One hundred and seventy-five older adults met the criteria, eight refused to participate and five dropped out during the process.

Measurements and instruments

A demographic data questionnaire asked the participants about age, gender, marital status, living status, education level, personal monthly income and chronic medical conditions suffered.

The MNA, created by Guigoz *et al.*[25], was used to assess nutritional status for older adults. The eighteen items can be divided into four parts: (i) anthropometric measurement (BMI, mid upper-arm circumference (MUAC), calf circumference (CC), weight loss); (ii) global assessment; (iii) dietary assessment; and (iv) subjective assessment. It eliminates the need for more invasive tests to measure blood biochemical indices. The total score (maximum, 30) can be used to classify older adults as malnourished (<17), at risk of malnutrition (17–23·5) or nourished (>23·5). Reported internal consistency is 0·83, test–retest reliability is 0·89[26]. In the present study, the reliability α was 0·798. The investigator received permission from the copyright holder, Nestlé Nutrition, to use the MNA.

The IADL, developed by Morris *et al.*[27], was used to assess functional ability. It asks older adults about their performances concerning seven tasks: (i) meal preparation; (ii) ordinary housework; (iii) managing finances; (iv) managing medications; (v) telephone use; (vi) shopping; and (vii) transportation. The possible responses to the specific tasks are: 'independent' (=0), 'some help' (=1), 'full help' (=2) and 'by others or activity did not occur' (=3). Total score ranges from 0 to 21, 0 means completely independent and higher scores indicate more dependency. The average inter-assessor reliability was 0·77[28]. The reliability α for the present study was 0·888. Permission to use the IADL was obtained from the copyright owner, interRAI Corporation.

The two instruments were originally written in English; they were first translated into Chinese, then back-translated into English and the back-translated version was checked against the original English version by a native English speaker prior to use in the study.

Anthropometric measurements consisted of height, weight, CC and MUAC. Measurements were taken by the investigator throughout to minimize intra-interviewer

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variation and strictly adhered to the anthropometric measurement manual. For the twelve older adults with severe spinal curvature, knee heights were measured and equations especially relating to Chinese older adults were utilized to estimate stature[29]:

$$\text{Height (cm)} = [2{\cdot}24 \times \text{knee height (cm)}] + 51{\cdot}16 \quad \text{(men)};$$
$$\text{Height (cm)} = [2{\cdot}46 \times \text{knee height (cm)}] - [0{\cdot}12 \times \text{age (years)}] + 46{\cdot}11 \quad \text{(women)}.$$

BMI was calculated as weight (kg)/[height (m)]^2; BMI classification for adults of the Asia-Pacific Region was used[30].

Procedure and ethical considerations

Permission for data collection was obtained from the administrators of the community and the five health stations. Each potential participant was informed that their involvement was completely voluntary. Once oral informed consent was obtained, the questionnaires were administered. History and information were obtained from participants as well as health providers, supplemented by reviewing health files. Considering the potential existence of illiteracy, weak eyes and inadequate understanding, the researcher only read out the specific items without giving further explanation to avoid introducing bias. Anonymity and confidentiality were respected.

Data analysis

Descriptive statistics were used to address the levels of nutritional and functional status. To analyse the relationships, Spearman's correlation was utilized since some variables were nominal. Stepwise multiple regression analysis was conducted to identify the best predictors. All data were entered into the SPSS statistical software package version 15·0 (SPSS Inc., Chicago, IL, USA) for analysis and a value of $P < 0{\cdot}05$ was considered significant.

Results

Demographic characteristics

The characteristics of the 162 elders are outlined in Table 1. Twenty-eight (17·3 %) had no income and relied totally on adult children or a spouse as their financial source; forty-six (28·4 %) obtained a pension that was lower than the mean pension (812 RMB) in Wuhan centre urban community.

Chronic medical conditions

The number of chronic medical conditions and prevalence of common conditions are presented in Table 2. Only seventeen (10·5 %) participants were free of chronic medical conditions, others suffered one to seven unequally. The most frequent chronic medical conditions were hypertension (51·2 %), bone and joint disease (43·8 %) and digestive system disease (gastritis, peptic ulcer, partial gastrectomy, gallbladder disease, pancreatic insufficiency, chronic hepatitis; 35·1 %).

Table 1 Demographic characteristics of the study subjects: community-dwelling older adults in Wuhan, China (*n* 162)

Variable	*n*	%
Gender		
Male	71	43·8
Female	91	56·2
Age (years), mean 74·14 (SD 5·95), range 65–94		
65–74 (young-old)	97	59·9
75–84 (old-old)	57	35·2
85–94 (very old)	8	4·9
Education level		
Not formally educated	48	29·6
Primary school (1–6 years)	42	25·9
Junior middle school (7–9 years)	29	17·9
Senior middle school (10–12 years)	16	9·9
College or over (≥12 years)	27	16·7
Marital status		
Currently married	113	69·8
Widowed	49	30·2
Personal income per month (RMB)		
<300	28	17·3
300–812	46	28·4
812–1500	46	28·4
≥1500	42	25·9
Living status		
Alone	22	13·6
Only with spouse	76	46·9
With children (with or without spouse)	64	39·5

Table 2 Chronic medical conditions of the study subjects: community-dwelling older adults in Wuhan, China (*n* 162)

Variable	*n*	%
Number of chronic conditions		
0	17	10·5
1	18	11·1
2 or more	127	78·4
Type of chronic condition		
Hypertension	83	51·2
Bone and joint disease	71	43·8
Digestive disease	57	35·1
Heart disease	53	32·7
Ophthalmic problems	50	30·9
Diabetes mellitus	35	21·6
Respiratory disease	33	20·4
Fracture	25	15·4
Cerebrovascular disease	21	13·0
Genitourinary problems	17	10·5
Tumour	13	8·0
Parkinson's disease	4	2·4

Classification

The mean MNA score was 23·8 (SD 3·92), 36·4 % (*n* 59) were at risk of malnutrition, 8·0 % (*n* 13) were malnourished, the remaining 55·6 % (*n* 90) were nourished; and 61·7 % (*n* 100) were functionally independent. The frequencies of points for the individual MNA questions revealed that protein products intake was reduced for 73·5 % (*n* 119) of elders, while 96·3 % (*n* 156) took fruits or vegetables with adequate

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daily amounts; during the past three months, 31·5% (*n* 51) suffered stress or acute disease, and food intake declined due to severe (5·6%, *n* 9) or moderate (27·2%, *n* 44) loss of appetite; 14·8% (*n* 24) took more than three prescription drugs daily; 17·3% (*n* 28) regarded themselves as malnourished and 35·2% (*n* 57) were unable to estimate their nutritional status; 24·7% (*n* 40) perceived their health status were poorer than others and 17·3% (*n* 28) were unable to give such an estimation.

Tables 3 and 4 summarize nutritional and functional status classification according to BMI and IADL.

Correlations

Table 5 displays the correlations between nutritional status and the independent variables (demographic characteristics, functional status). Age, marital status, education level, personal income, number of chronic conditions and IADL function had significant correlations with MNA score.

Predictors

Table 6 shows the combination of demographic characteristics and functional status predicting nutritional status according to the MNA. Number of chronic conditions suffered, age, functional status and marital status all entered the regression equation.

Discussion

Functional status

The current study found that 38·3% of older adults needed help to deal with at least one activity of daily living, which is similar to the prevalence found in a previous study[31]. The order of items in increasing difficulty of performance was: managing medications, telephone use, managing finances, meal preparation, transportation, ordinary housework and shopping. This was a little different from Tang *et al.*[31], who surveyed the IADL function of urban community elders from Anhui province, China, where handling finances resided in the position of the second most difficult with the others being similar. Perhaps this is because the present study excluded those with cognitive problems while the Anhui study did not have such a selection criterion. Cromwell *et al.*[32] illustrated that handling finances needed more cognitive components and memory, and was even called cognitive IADL.

Participants rated shopping as the most difficult task, which might be due to its complex and multiple procedures. First, elders have to access big supermarkets, some have to pass along uneven pavements and crossings; then in the supermarket, elders could encounter many problems, such as searching, bending or stretching for items; finally, carrying shopping is not so easy for them. Managing medication can be dealt with and encountered the least difficulty; this might be because most older adults have taken medication for decades.

Nutritional status

In the present study, the percentage of malnutrition (8·0%) and suspected malnutrition (36·4%) was within the range reported for community-dwelling elders[8].

Table 3 Classification of study subjects according to BMI: community-dwelling older adults in Wuhan, China (*n* 162)

BMI (kg/m^2)	*n*	%
<18·5 (underweight)	24	14·8
18·5–22·99 (normal)	61	37·7
23·0–24·99 (overweight)	36	22·2
25·0–29·99 (level I obesity)	37	22·8
≥30·0 (level II obesity)	4	2·5

Table 5 Spearman's correlation between nutritional status (MNA score) and independent variables: community-dwelling older adults in Wuhan, China (*n* 162)

	Nutritional status (MNA score)	
Variable	*r*	P
Gender	−0·072	0·360
Age	−0·371	0·000
Marital status	−0·246	0·002
Education level	0·155	0·049
Personal income	0·212	0·007
Living status	0·047	0·552
Number of chronic medical conditions	−0·440	0·000
Functional status (IADL score)	−0·450	0·000

MNA, Mini Nutritional Assessment; IADL, Instrumental Activities of Daily Living Scale.

Table 4 Classification of study subjects according to specific item of the Instrumental Activities of Daily Living Scale (IADL): community-dwelling older adults in Wuhan, China (*n* 162)

	Independent		Some help		Full help		By others	
IADL item	*n*	%	*n*	%	*n*	%	*n*	%
(i) Meal preparation	114	70·4	37	22·8	3	1·9	8	4·9
(ii) Ordinary housework	106	65·4	38	23·5	8	4·9	10	6·2
(iii) Managing finances	127	78·3	29	17·9	3	1·9	3	1·9
(iv) Managing medications	156	96·3	6	3·7	0	0·0	0	0·0
(v) Telephone use	148	91·4	11	6·8	0	0·0	3	1·8
(vi) Shopping	105	64·8	38	23·5	14	8·6	5	3·1
(vii) Transportation	113	69·8	43	26·5	6	3·7	0	0·0

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Table 6 Stepwise multiple regression model of demographic characteristics and functional status predicting nutritional status (MNA score): community-dwelling older adults in Wuhan, China (*n* 162)

Step	Variable	R^2	*F*	Final β	Significance
1	Number of chronic medical conditions	0·181	36·574	−0·351	0·000
2	Age	0·276	31·647	−0·183	0·018
3	Functional status (IADL score)	0·301	24·164	−0·206	0·010
4	Marital status	0·321	20·011	−0·156	0·020

MNA, Mini Nutritional Assessment; IADL, Instrumental Activities of Daily Living Scale.

Only one Chinese study, conducted in Shanghai[23], can be used for direct comparison; the corresponding percentage was 1·7% and 19·1%, respectively. There are four possible explanations for the striking difference. The first relates to geographical inequalities; there are significant differences in several aspects between Wuhan and Shanghai, and the former is in poorer position. Elia and Stratton[15] have stated there is geographical inequality in nutrient status among older adults. Second, 17·3% of elders of the present study were financially dependent, while all participants in the Shanghai study were retired residents. Kabir *et al.*[16] have reported that income has a positive correlation with protein and energy intake. Third is the age disparity; age range was 50–89 years (mean 67·5 (SD 9·0) years) for the Shanghai study participants and 65–94 years (mean 74·14 (SD 5·95) years) for the current study. Elia and Stratton[15] also demonstrated that older elders were prone to suffer from poor nutrition. Fourth, Wuhan is one of the three 'stove' cities in China; the data were collected in the hottest season, and some elders said they had lost their appetite and weight just because of the unbearably hot summer weather.

BMI data revealed that underweight and obesity co-existed in the community, which is in accordance with previous results[20,23]. When compared with the national study[20], which surveyed the BMI of Chinese elders aged 60 years or over, the underweight rate (14·8% in present study *v.* >15% nationally) and obesity rate (25·3% *v.* 24%) are comparable. Perhaps the economic development of China has stimulated the alteration of food consumption, which buffers or exceeds the influence of age.

The frequency of points for specific MNA items revealed that inadequate intake of protein products was a serious problem and dairy products were not habitually consumed. Some elders were too restrictive in their choice of diet: for instance, because of a cholesterol-restrictive order, they dared not eat eggs at all; most elders with diabetes mellitus said they never felt full but dared not eat. Just as Zeng *et al.*[10] reported, we also observed that some elders did not acknowledge the significance of diet and a varied understanding of the components of a healthy diet existed. In some developed Western countries, older adults also strived to achieve a healthy diet[33]; nevertheless, for Chinese elders with relatively less knowledge, alternative diets and concrete guidelines must be available.

Because many elders (31·5%) suffered stress or acute disease and so many (14·8%) took more than three prescription drugs daily, community health professionals should be alert to their psychological well-being and ensure optimal prescribing. Worse, some perceived themselves as malnourished or thought their health status was poorer than others; while some others could not give any such estimation. None the less, Griep *et al.*[34] demonstrated that self-rated health had a predictive value for MNA score, so appropriate guidelines on nutrition must be provided for the elderly.

Correlations

Education level was positively associated with MNA score, which is comparable with previous findings[16]. In China, Zeng *et al.*[10] indicated that education was the major factor influencing community elders' nutrition knowledge, attitude and behaviour. A Ugandan study[14] reported that exposure to nutritional knowledge was a predictor of BMI for older adults. Well-educated elders were knowledgeable about disease and elderly-specific daily diet regulations, which played an important role for their nutritional health.

Personal income was found to be positively related with MNA score, which is in accordance with other literature[3,16]. Chen *et al.*[3] reported that low income was related to decreased variety and quantity of food consumed, and financial dilemma could limit purchasing, meal preparation and storage facilities. Low income also influenced consumption of some healthier alternatives which carry a price premium. In China, the disparity between the rich and the poor is increasingly deteriorating[35], so China also presents some conditions that are unobservable in the developed nations. In fact, the pension has increased several times and is enough for daily expenditure. Since many young people are laid-off workers with so much economic stress to raise their children, so the pension always contributed substantially to household budgets. Consequently, in those elders experiencing difficult economic circumstances, where food is not deemed a priority, disease may take precedence.

Age had a significant negative correlation with MNA score, which is similar to a prior study[15]. Brownie[4] demonstrated that ageing was associated with distinct changes in body composition and gastrointestinal function, which might reduce motility rates and disrupt

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digestion or absorption. Chen *et al.*[3] and Brownie[4] also reported the that ability to observe, smell and taste food decreased with ageing. Reduced sensitivity but elevated taste threshold for all taste modalities occurs frequently, with sweet and salty tastes declining first; thus elders can only taste sour or bitter flavour, which may affect their desire for food. Chapman *et al.*[36] showed that ageing was associated with increased satiety factors and a reduced feeding drive.

The widowed were predisposed to suffer from poor nutrition, which is comparable with previous reports[3,18,37]. Spouses act as a social support and provide the long-term partnership associated with food, including meal preparation and companionship at meal times[18]. Hansson *et al.*[37] reported the widowed might have difficulty in forming new attachments, in coping and caring about life, and might tend to suffer the consequences of depression and malnutrition. Wylie *et al.*[18] also showed that the elderly changed their food intake or ate less as a result of the death of their spouses. For a recently widowed elder who has not been responsible for shopping and cooking, the situation could be worse.

As suggested in prior literature[4,19,21], the number of chronic medical conditions that each elder suffered had a significant negative correlation with MNA score. There are two main relevant reasons[38]. First, disease is accompanied with tissue repair and an increased activity of body defence mechanisms, which means increased nutrition requirements; notwithstanding, illness is often associated with a decreased desire for food. Second, elders suffering multiple chronic conditions tend to take various medications, which probably contribute to adverse drug reactions and drug-induced malnutrition. Hanlon *et al.*[39] stated that community-dwelling older Americans took an average of 2·7–4·2 prescriptions and over-the-counter medications. Griep *et al.*[34] even reported that the number of medications that elderly take was the best predictor of MNA score. The mechanisms include hindering of appetite, nutrient absorption, metabolism and excretion.

The current study suggested there was no significant correlation between living status and MNA score. In contrast, Visvanathan *et al.*[6] reported living status was an independent predictor of MNA score. Perhaps this arises because most studies analysed the impact of living alone on elder nutrition, whereas the present study explored the relationship between nutrition and whether they were living with children or not. Those having a house and living separately could prepare meals according to their preference and taste, and the meal time is more flexible.

Functional dependency influences elder nutrition through limiting diet availability and accessibility. Callen and Wells[21] determined that those community elders with higher functional ability had more help to maintain nutritional health, and difficulty with transportation was a significant barrier while the ability to shop was an important aid in maintaining good nutrition. McCormack[40] and Wylie *et al.*[18] reported that incapability of transportation could impinge on social interaction and impede participation in socialization of eating patterns, which could result in deterioration of social networks and indirectly impact on nutrient intake. In the current study, some also complained they could not pursue their interests and pleasures because of transportation limitation. What is worse, according to Chinese tradition, elderly parents should live with the son and daughter-in-law and was supported, whereas daughters are concerned about parents more. If their daughters are living in the same city, independent elders can go to their daughters' frequently and enjoy favourite food that is specially prepared. Reliance on others to shop will result in less availability to fresh food[18], especially among Chinese elders who are always are shy to ask somebody buy what they want to eat, only drop the idea. In Wuhan city, supermarket chains do not offer a free delivery service, which in Western countries functionally limited elderly could enjoy. Some specific diseases may compromise the ability of elderly persons to prepare meals, which also impacted the meal size they took[18]; moreover, especially nowadays that children are the priority, elders' preference and taste were often overlooked, the food was seldom prepared in line with their expectation and their willingness to eat diminished. Schenker[38] even described that budgeting skills could influence the nutrition of community older adults.

Functional independence also has impacts on elders' personal values, interpersonal relationships and emotions, which might indirectly influence nutrition under the special Chinese culture. Wikby and Fagerskiold[19] narrated that independence was a personal value and self-esteem for older adults an important factor stimulating their willingness to eat. Kikafunda and Lukwago[14] stated that elder functional dependency influenced the way they were treated and respected, thus perhaps deteriorating the family relationship. In Chinese culture, it is especially apparent that the harmonious interpersonal relationship which is most difficult to establish is the one between mother-in-law and daughter-in-law, and conflicts always exist. Elder dependency means less contribution and more burden to the family, which is prone to exacerbate conflicts; the daughter-in-law would blame the elder doing nothing, just sitting and eating, argue with them and even be impolite to them, which was the most important and frequent source of elder negative mood in China. On the other hand, Wikby and Fagerskiold[19] reported that rapport relationship with relatives brought elder positive mood, which made them feel satisfied, loved and relaxed, thus they enjoyed food and eating.

Jette *et al.*[41] found that community elders with physical disability had worse oral health relative to those with better functional ability, in that it affected elders' ability to maintain oral hygiene and limited their accessibility to

dental check-up and treatment. Visvanathan and Ahmad[42] proposed that oral health problems could result in dietary intake reduction and alteration of food choices.

Predictors

The number of chronic medical conditions suffered, age, functional status and marital status were found to be the best predictors of elders' nutritional status. That number of chronic conditions could predict nutrition is comparable with previous studies[6,21]. That age predicts nutrition is similar to prior literature[43], which demonstrated that increasing age was a predictor of undernutrition for long-term elderly in care. Functional dependency as a predictor is consistent with a prior study[44] reporting functional dependency on the IADL to be a predictor of low MNA score. That marital status predicts nutrition is in accordance with another study[45] indicating that loss of spouse was a significant predictor of dietary variety decline for community older adults.

Limitations and future research

Several limitations of the present study require acknowledgement. First, the study was conducted only in a single community with relatively small sample size and a non-random sampling was used, which limits the generalization of the results. Second, the cross-sectional nature of the data does not allow examination of causal relationships. Third, the instruments were originally developed in a Western culture, which means that they may not be culturally sensitive to China. Future research is needed to improve data collection through random sampling, utilizing a larger and more diverse sample throughout China, developing locally relevant tools, and using a longitudinal design to infer causal relationships. Continued research is also needed to develop appropriate and concrete nutrition education and intervention programmes.

Conclusions and implications

In conclusion, the current study contributes additional knowledge about the nutritional and functional status of community older adults in China. It showed that a large proportion was at risk of malnutrition, although confirmed malnutrition was not apparent, and some elders could not live independently in the community. Not only did some demographic characteristics appear to be related with nutrition, functional status also was correlated with nutrition among elders. The best predictors were the number of chronic conditions suffered, age, functional status and marital status.

The findings present a challenge and call for the attention of primary health-care professionals, as well as relevant and significant others, to care for nutritional problems in elders. The findings may lead to targeted, cost-effective intervention according to the best predictors for the rapidly growing ageing population in China.

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References

1. World Health Organization (2002) *Active Ageing: A Policy Framework. World Health Report.* Geneva: WHO.
2. National Bureau of Statistics of China (2006) The statistical communique of economical and social development in 2006 in People's Republic of China: Population. http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20070228_402387821.html (accessed May 2007).
3. Chen CC, Schilling LS & Lyder CH (2001) A concept analysis of malnutrition in the elderly. *J Adv Nurs* **36**, 131–142.
4. Brownie S (2006) Why are elderly individuals at risk of nutritional deficiency? *Int J Nurs Pract* **12**, 110–118.
5. Manandhar MC (1995) Functional ability and nutritional status of free living elderly people. *Proc Nutr Soc* **54**, 677–691.
6. Visvanathan R, Macintosh C, Callary M, Penhall R, Horoitz M & Chapman I (2003) The nutritional status of 250 older Australian recipients of domiciliary care services and its association with outcomes at 12 months. *J Am Geriatr Soc* **51**, 1007–1011.
7. Kelly IE, Tessier S, Cahil A, Morris SE, Crumley A, McLaughlin D, Mckee RF & Lean MEJ (2000) Still hungry in hospital: identifying malnutrition in acute hospital admissions. *Q J Med* **93**, 93–98.
8. Guigoz Y (2006) The Mini Nutritional Assessment (MNA) review of the literature – what does it tell us? *J Nutr Health Aging* **10**, 466–485.
9. McWhirter JP & Pennington CR (1994) Incidence and recognition of malnutrition in hospital. *BMJ* **308**, 945–948.
10. Zeng G, Huang CY, Ying WY, Chen J, Luo M & Shuai PQ (1999) Community elderly nutrition knowledge, attitude and behavior investigation. *Chin Chronic Dis Prev Control* **7**, 36–37.
11. Nightingale JM & Reeves J (1999) Knowledge about assessment and management of undernutrition: a pilot questionnaire in a UK teaching hospital. *Clin Nutr* **18**, 23–27.
12. Bierman AS (2001) Functional status, the sixth vital sign. *J Gen Intern Med* **16**, 785–786.
13. Hellstrom Y & Hallberg IR (2004) Determinants and characteristics of help provision for elderly people living in home and in relation to quality of life. *Scand J Caring Sci* **18**, 387–395.
14. Kikafunda JK & Lukwago FB (2005) Nutritional status and functional ability of the elderly aged 60 to 90 years in the Mpigi district of central Uganda. *Nutrition* **21**, 59–66.
15. Elia M & Stratton RJ (2005) Geographical inequalities in nutrient status and risk of malnutrition among English people aged 65y and older. *Nutrition* **21**, 1100–1106.

16. Kabir ZN, Ferdous T, Cederholm T, Khanam MA, Streatfied K & Wahlin A (2006) Mini nutritional assessment of rural elderly people in Bangladesh: the impact of demographic, socio-economic and health factors. *Public Health Nutr* **9**, 968–974.
17. Coelho AK, Rocha FL & Fausto MA (2006) Prevalence of undernutrition in elderly patients hospitalized in a geriatric unit in Belo Horizonte, MG, Brazil. *Nutrition* **22**, 1005–1011.
18. Wylie C, Copeman J & Kirk SFL (1999) Health and social factors affecting the food choice and nutritional intake of elderly people with restricted mobility. *J Hum Nutr Diet* **12**, 375–380.
19. Wikby K & Fagerskiold A (2004) The willingness to eat: an investigation of appetite among elderly people. *Scand J Caring Sci* **18**, 120–127.
20. Stookey JD, Zhai FY, Zohoori N & Popkin BM (2000) Nutrition of elderly people in China. *Asia Pac J Clin Nutr* **9**, 243–251.
21. Callen BL & Wells TJ (2003) Views of community-dwelling, old-old people on barriers and aids to nutritional health. *J Nurs Scholarsh* **35**, 257–262.
22. Castel H, Shahar D & Harman-Boehm I (2006) Gender differences in factors associated with nutritional status of older medical patients. *J Am Coll Nutr* **25**, 128–134.
23. Fei XF, Cheng QM, Shi YM & Cao WX (2003) Nutritional assessment and intervene points for retired residents in a community. *Enteral Parenter Nutr* **10**, 28–31.
24. Polit DF & Beck CT (2004) *Nursing Research: Principles and Methods*, 7th ed. Philadelphia, PA: Lippincott Williams, Wilkins.
25. Guigoz Y, Vellas B & Garry PJ (1994) Mini Nutritional Assessment: a practical assessment tool for grading the nutritional state of elderly patients. *Facts Res Gerontol* **4**, 15–59.
26. Bleda MJ, Bolibar I, Pares R & Salva A (2002) Reliability of the mini nutritional assessment (MNA) in institutionalized elderly people. *J Nutr Health Aging* **6**, 134–137.
27. Morris JN, Carpenter I, Berg K & Jones RN (2000) Outcome measures for use with home care clients. *Can J Aging* **19**, 87–105.
28. Morris JN, Fries BE, Steel K, Ikegami N, Bernabei R, Carpenter I, Gilgen R, Hirdes JP & Topinkova E (1997) Comprehensive clinical assessment in community setting: applicability of the MDS-HC. *J Am Geriatr Soc* **45**, 1017–1024.
29. Li ET, Tang EK, Wong CY, Lui SS, Chan VY & Dai DL (2000) Predicting stature from knee height in Chinese elderly subjects. *Asia Pac J Clin Nutr* **9**, 252–255.
30. World Health Organization, International Association for the Study of Obesity & International Obesity Taskforce (2000) *The Asia-Pacific Perspective: Redefining Obesity and Its Treatment*. Sydney: Health Communications.
31. Tang GF, Wang Y, Zhao YS, Feng Q, Chen FH, Zhang DM & Li GL (2001) Study on activities of daily living and its related factors in the elderly in two cities of Anhui province. *Chin J Gerontol* **20**, 213–215.
32. Cromwell DA, Eagar K & Poulos RG (2003) The performance of instrumental activities of daily living scale in screening for cognitive impairment in elderly community residents. *J Clin Epidemiol* **56**, 131–137.
33. Kearney JM, Gibney MJ, Livingstone BE, Robson PJ, Kiely M & Harrington K (2001) Attitudes towards and beliefs about nutrition and health among a random sample of adults in the Republic of Ireland and Northern Ireland. *Public Health Nutr* **4**, 1117–1126.
34. Griep MI, Mets TF, Collys K, Ponjaert-Kristoffersen I & Massart DL (2000) Risk of malnutrition in retirement homes elderly persons measured by the 'mini-nutritional assessment'. *J Gerontol A Biol Sci Med Sci* **55**, M57–M63.
35. Li P (2007) The present situation analysis and strategy research of the disparity between the rich and the poor in China. *Strategy* **9**, 200–201.
36. Chapman IM, MacIntosh CG, Morley JE & Horowitz M (2002) The anorexia of ageing. *Biogerontology* **3**, 67–71.
37. Hansson RO, Jones WH, Carpenter BN & Remondet JH (1990) Loneliness and adjustment to old age. *Int J Aging Hum Dev* **24**, 41–53.
38. Schenker S (2003) Undernutrition in the UK. *Br Nutr Found Nutr Bull* **28**, 87–120.
39. Hanlon JT, Schmader KE, Rudy CM & Weinberger M (2001) Suboptimal prescribing in older inpatients and outpatients. *J Am Geriatr Soc* **49**, 200–209.
40. McCormack P (1997) Undernutrition in the elderly population living at home in the community: a review of the literature. *J Adv Nurs* **26**, 856–863.
41. Jette AM, Feldman HA & Douglass C (1993) Oral disease and physical disability in community-dwelling older persons. *J Am Geriatr Soc* **41**, 1102–1108.
42. Visvanathan R & Ahmad Z (2006) Good oral health, adequate nutrient consumption and family support are associated with a reduced risk of being underweight amongst older Malaysian residents of publicly funded shelter homes. *Asian Pac J Clinic Nutr* **15**, 400–405.
43. Keller HH (1993) Malnutrition in institutionalized elderly: how and why? *J Am Geriatr Soc* **41**, 1212–1218.
44. Wojszel ZB (2006) Determinants of nutritional status of older people in long-term care settings on the example of the nursing home in Białystok. *Adv Med Sci* **51**, 168–173.
45. Kwon J, Suzuki T, Kumagai S, Shinkai S & Yukowa H (2006) Risk factors for dietary variety decline among Japanese elderly in a rural community: an 8-year follow-up study from TMIG-LISA. *Eur J Clin Nutr* **60**, 305–311.