JCN Journal of Clinical Nursing

Journal of Clinical Nursing

CLINICAL ISSUES

Population-specific Mini Nutritional Assessment can improve mortality-risk-predicting ability in institutionalised older Taiwanese

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Aim and objectives. The study determined whether a new version of the Mini Nutritional Assessment that adopted population-specific anthropometric cut-points would improve the mortality-predicting ability in institutionalised Taiwanese older people.

Background. Routine screening is the key for detecting emerging malnutrition, but the tool must be simple, reliable and easy-to-use to be well accepted. The Mini Nutritional Assessment can meet these requirements, but for non-Western populations, modifications based on anthropometric considerations are needed.

Design. The study purposively sampled 208 residents, aged >65 years, of a long-term care institution in Central Taiwan. Subjects were free of acute infection/disease and able to communicate. A university human-subject-study ethics committee approved the protocol.

Methods. The study included biochemical measurements and a structured questionnaire for eliciting personal data and answers to questions in the Mini Nutritional Assessment. Follow-up survival/mortality was tracked for two consecutive six-month periods and analysed according to nutritional statuses graded with the original or a modified Mini Nutritional Assessment. The modified version adopted population-specific anthropometric cut-points and was without body mass index.

Results. The modification improved the mortality-predictive ability. Mortality rates for the first six months were 8·7, 3·9 and 0% according to the original Mini Nutritional Assessment and 10·6, 3·4 and 0% according to the modified version for subjects rated malnourished, at risk of malnutrition and normal, respectively. The mortality-predictive ability of both versions weakened after six months.

Conclusion. Both versions can predict follow-up mortality, but the modified version has improved ability. For best results, the tool should be applied every six months or less (shorter for more frail older people) to screen for new cases of at-risk individuals.

Relevance to clinical practice. The Mini Nutritional Assessment that adopts population-specific anthropometric cut-points may have improved nutritional-risk and mortality-risk predictive abilities. The tool can help care-workers detect emerging nutritional problems and enable timely intervention. Routine use of the tool may help improve the quality of care.

Key words: elderly, malnutrition, Mini Nutritional Assessment, nutrition, risk assessment, Taiwan

Accepted for publication: 21 February 2010

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doi: 10.1111/j.1365-2702.2010.03299.x

Introduction

The proportion of the older population is increasing rapidly in most industrialised countries. As people age, the risk of malnutrition and chronic diseases increases (Guigoz *et al.* 2002). Malnutrition is common in institutionalised older people because both ageing-associated conditions and chronic diseases can affect one's eating ability and nutrition. Malnutrition is associated with increased risk of infection, hospitalisation and mortality (Covinsky *et al.* 1999, Persson *et al.* 2002, Allard *et al.* 2004). Early detection of malnutrition and implementation of the needed nutritional intervention may lessen these health risks. The Mini Nutritional Assessment (MNA) is a tool developed for assessing nutritional risk of elders under varying health conditions. It includes 18 non-invasive anthropometric, dietary, global and self-evaluated parameters. The MNA was developed based on health and medical data of Western populations (Guigoz *et al.* 1994). Although the tool has also been used to assess the nutritional status of non-Western older people (Guigoz *et al.*2002, Delacorte *et al.* 2004, Kuzuya *et al.* 2005), there is suggestion that to maintain the content equivalency, the tool should be modified according to specific anthropometric or cultural features when it is applied to non-Western populations (Chumlea 2006). Recently, we have employed the MNA to assess the nutritional risk status of > 65-year-old people in the general population and in long-term care institutions in Taiwan, and we have shown that adoption of population-specific cut-points improved the malnutrition-predicting ability of the tool (Tsai *et al.* 2007, 2008a,b). We also have shown that it was possible to omit the body mass index (BMI) item by reassigning its score to calf circumference (CC) and mid-arm circumference (MAC) items in the scale without compromising the predictive ability of the tool (Tsai *et al.* 2008b). In this study, we further tried to determine whether this modified version of the MNA (MNA-TII) would improve the mortality-predictive ability of older Taiwanese people under a long-term care setting.

Methods

The study investigated the nutritional status and follow-up mortality risk of residents of a relatively large long-term care institution in Central Taiwan. Residents, 65 years or older, with a minimum of three-month residence were recruited to participate after signing an informed consent (by the participants or their legal guardians). Those who had acute infections/diseases, or were hospitalised, unconscious or unable to communicate verbally (because of dementia, stroke, mental disorder, etc.) were excluded. Two hundred and eight residents (86 men and 122 women) met inclusion and exclusion criteria and participated in the study. The Human-Subject Study Ethics Committee of Asia University approved the study protocol. Subjects' confidentiality was preserved throughout the study.

Each participant underwent an on-site face-to-face interview and a series of anthropometric measurements during the same week that subjects underwent their routine biochemical measurements. A questionnaire interview elicited participants' sociodemographic status, healthcare-related information and answers to questions in the MNA (Guigoz *et al.* 1994). All anthropometric measurements were carried out in supine positions (Lee and Nieman 2003), because many residents were frail or physically disabled. To avoid inter-rater variations in anthropometric measurements, one technician performed all measurements. A fasting blood specimen was taken from each subject for measurement of serum albumin and cholesterol concentrations (performed by Sing Chung San Clinical Laboratory, Chang-Hua, Taiwan) for validating the MNA.

In this study, the nutritional risk status of each participant was evaluated with the MNA in two versions, the original version and a modified version (MNA-TII). The modification involved (1) adopting population-specific MAC and CC cut-points and (2) reassigning the score of BMI item in the original MNA scale to CC and MAC items (Table 1) (Tsai

Table 1 Cut-points and assigned scores of anthropometric question in the original and modified versions of the MNA

Question in MNA scale	Original MNA		Modified MNA*	
	Cut-point	Score	Cut point	Score
F. BMI	< 19	0	Omitted	
	19–21	1		
	21–23	2		
	≥23	3		
Q. MAC (cm)	< 21	0	< 22·5/21†	0
	21–22	0·5	22·5–23·5/21–22	1
	≥22	1	≥23·5/22	2
R. CC (cm)	< 31	0	< 28/25†	0
	≥31	1	28–28·9/25–25·9	1
			29–29·9/26–26·9	2
			≥30/27	3

MNA, Mini Nutritional Assessment; BMI, body mass index; MAC, mid-arm circumference; CC, calf circumference.

*The population-specific MAC and CC cut-points (0 score) in the modified scale were the fifth percentile values of the respective population distribution curves of ≥65 year Taiwanese. One of the BMI points was distributed to the MAC and two to the CC questions of the modified scale. All other questions in the MNA scale were unchanged.

†Values for men and women, respectively.

et al. 2008a). Because CC is a better indicator of physical functional status than MAC (except during the very final stage of the decline) (Chumlea 2006, Charlton *et al.* 2005), two points were assigned to CC item and one point to MAC item. The scoring of questions K (intake of marker proteins) and L (intake of fruit and vegetable) was also changed to be based on consumption frequencies instead of servings consumed, because food is generally not prepared or served in 'serving' portions in Taiwan. This change was shown to have a minimal impact of the overall result (Tsai *et al.* 2008a). All other items were not changed. The rationale for adjusting MAC and CC scores to replace BMI scores and the derivation of population-specific MAC and CC cut points from a population representative sample of Taiwanese older people have been given in an earlier report (Tsai *et al.* 2007). The classification of nutritional status was the same as specified in the original MNA: a MNA score ≤16·5 was considered malnourished, 17–23·5 was at risk of malnutrition and ≥24 was normal. Follow-up mortality incidences were observed for a period of 12 months and survival/mortality records during the first and second six-month periods were statistically analysed.

Results were statistically analysed with SPSS Base 12·0 (SPSS Inc. Chicago, IL, USA). Student's *t*-test was employed to determine the significance of differences in biochemical and health parameters between those who survived and those who died. Logistic regression analyses were performed to determine the significance of the association of key demographic, biological and health-related variables with mortality risk. Cox regression was performed to examine the association of nutritional status and assessment method with the time to death from the time of baseline nutritional assessment. Statistical significance for all analyses was accepted at $\alpha = 0{\cdot}05$.

Results

Among 208 older people, nine (4·3%) died during the first six-month follow-up period. Among the nine who died, four were rated malnourished, five at risk of malnutrition and 0 normal according to the original scale, whereas five were rated malnourished, four at risk of malnutrition and 0 normal according to the modified scale (MNA-TII) at baseline. During the second six-month follow-up period, 16 (8·0%) of the remaining 199 residents died and among those died, three were rated malnourished, 12 at risk of malnutrition and one normal according to the original scale; and four were rated malnourished, 10 at risk of malnutrition and two normal according to the MNA-TII. For older people who had very poor MNA score (11 points or less), the mortality rate reached 40% according to the original scale and 33·3% according to the modified scale (Table 2).

Table 3 shows the baseline differences in biochemical and health indicators between those who died and those who

Table 2 First and second six-month follow-up total mortality rates of residents stratified by nutritional status graded with the original or the modified MNA (n = 208)

	Follow-up mortality rate (n of death/ n in group, %)		
Item	Malnourished	At risk of malnutrition	Normal
Original MNA			
First 6 months	4/46 (8·7)	5/127 (3·9)	0/35 (0)
7th–12th months	3/42 (7·1)	12/122 (9·8)	1/35 (2·9)
Modified MNA			
First 6 months	5/47 (10·6)	4/118 (3·4)	0/43 (0)
7th–12th months	4/42 (9·5)	10/114 (8·8)	2/43 (4·7)

MNA, Mini Nutritional Assessment.

Table 3 Comparison of the biochemical and health-related parameters of those who survived vs. those who did not at the end of six months following the assessment (total n = 208)

	Died (n = 9)		Survived (n = 199)	
Parameters	Mean	SD	Mean	SD
MNA score				
Original scale	16·7	6·3	20·5*	4·0
Modified scale	16·4	6·5	20·7*	4·3
Albumin				
Mean (g/dl)	3·63	0·44	3·74	0·29
Cholesterol				
Mean (mg/dl)	164·8	30·5	181·1	38·9
Length of hospital stay† (day)	11·78	14·9	5·53	11·7
Number of disabilities‡	2·44	0·53	1·75**	0·92
Self-rated nutritional status	0·44	0·53	1·07**	0·82
Self-rated health status	0·56	0·53	0·99*	0·76
MAC§ (cm)				
Man	19·9	3·6	25·1*	2·8
Women	22·7	4·7	22·9	3·9
CC§ (cm)				
Man	24·6	4·0	29·8*	3·8
Women	27·1	5·7	26·7	4·4

MNA, Mini Nutritional Assessment; MAC, mid-arm circumference; CC, calf circumference.
†Days of hospitalisation during the first six-month follow-up period.
‡Out of four types of disabilities including immobility, impaired cognitive function, tube-feeding or need assistance and incontinence.
§For MAC and CC, n died = 4 men and 5 men; n survived = 82 men and 117 women survived.
$*p < 0{\cdot}05$, $**p < 0{\cdot}01$ – significantly different from those who died.

Table 4 Logistic regression analysis of the factors associated with 12-month mortality

Variable†	%	Odds ratio (95% CI)
Total ($n = 208$)	100	
MAC (cm)		
≥23·5/22‡	65·6	1
≤23·5/22	34·4	3·48 (1·11–10·88)*

CI, confidence interval; MAC, mid-arm circumference.
†The regression model also included gender, age, serum albumin, days of hospitalisation, number of disabilities and calf circumference.
‡Cut-points for men and women, respectively.
*MAC was statistically significant ($p < 0·05$).

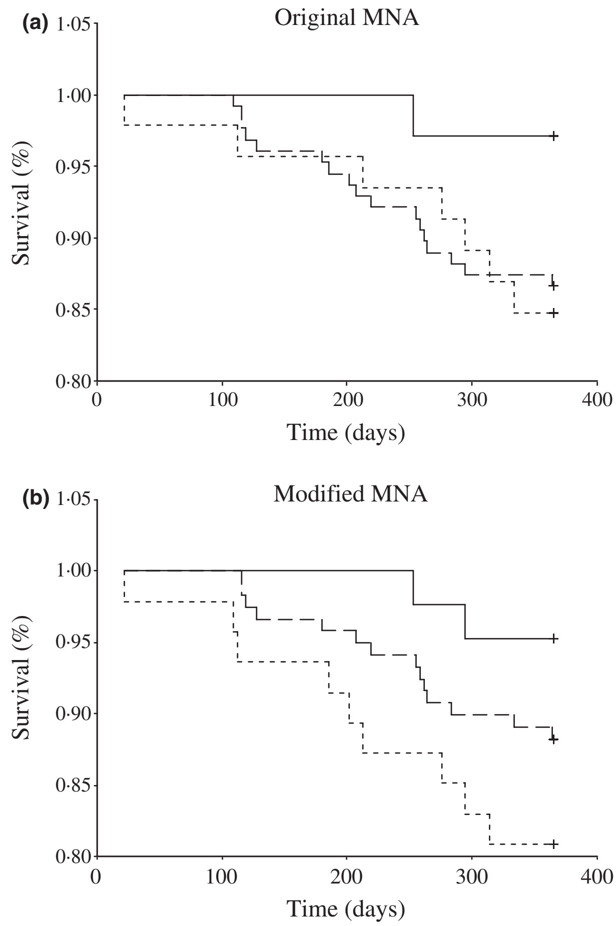

Figure 1 Survival (Kaplan–Meier) curves for subjects according to nutritional status at baseline assessed with either the original MNA (Panel a) or the modified MNA (Panel b), and represent normal, at risk and malnourished status, respectively. Log-rank (Mantel–Cox) tests showed no significant differences ($0·1 > p > 0·05$ between the normal group and at risk or malnourished groups) in 12-month survival when assessed with the original MNA (Panel a) whereas a significant difference was observed between the normal and the malnourished ($p < 0·05$) groups when assessed with the modified MNA (Panel b). MNA, Mini Nutritional Assessment.

survived during the first six-month follow-up period. There were significant ($p < 0·05$) differences in MNA scores, the number of disabilities and self-rated health and nutritional statuses between the two groups. In men but not in women, there were also significant differences in MAC and CC between those who survived and those who died. Logistic regression analysis showed that small MAC was significantly (OR = 3·48; 95% CI = 1·11–10·88; $p < 0·05$) associated with mortality risk of older people, controlled for gender, age, hospitalisation, number of disabilities, serum albumin and CC (Table 4).

Figure 1 shows the survival (Kaplan–Meier) curves and the associations of nutritional status and assessment method with the length of time to death from baseline. Log-rank (Mantel–Cox) tests showed that the differences in 12-month survival between the nutritionally normal and the at-risk older people ($p = 0·08$) and between the normal and malnourished ($p = 0·07$) older people assessed with the original MNA were not significant, whereas a significant difference ($p < 0·05$) was observed in 12-month survival between the normal and the malnourished older people but not between the normal and the at-risk older people rated with the MNA-TII.

Discussion

Mortality-risk predicting ability

Our previous studies have shown that MNA-TII, a Taiwanese-specific MNA without BMI, can be an acceptable alternative to the MNA-TI (a population-specific MNA that adopted Taiwanese-specific anthropometric cut-points) in grading the nutritional status of older Taiwanese (Tsai *et al.* 2007, Tsai & Ku 2008, Tsai *et al.* 2008a). This study has further demonstrated that MNA-TII also has improved ability in predicting the follow-up mortality risk of institutionalised older Taiwanese. According to Cox regression analysis, the 12-month follow-up survival curves for the malnourished older people were significantly different from those nutritionally normal rated with the MNA-TII but not with the original scale. The 12-month survival curve for those older people rated at risk of malnutrition was more distinguishable from those rated malnourished or normal when predicted with the MNA-TII compared with curves predicted with the original MNA. These results suggest that the modified MNA (MNA-TII) has improved mortality-risk predicting ability compared to the original MNA.

During the first six months, mortality risk for those rated malnourished was about two times of those rated at risk of malnutrition based on the original scale and was about three times based on the MNA-TII. However, during the second six-month follow-up period, mortality risk for those rated at risk of malnutrition increased to roughly the same level as those rated malnourished. Mortality even occurred in those who were predicted normal six months ago. These results suggest that the mortality-risk predicting ability of both versions weakens after six months. The health condition of those institutionalised older people can change drastically within a rather short period of time. It is important that nutritional assessment be carried out routinely, within every six months. (Depending on the level of frailty, more frequent monitoring, such as monthly, might be necessary). Most importantly, appropriate interventional actions should be taken to arrest the deteriorating conditions of those older people identified malnourished or at risk of malnutrition. It should be pointed out that for those who scored 11 or less MNA points the mortality risk is very high, > 33% by both scales (about 3–4 times of those predicted malnourished as a whole).

The mortality-risk predicting ability of the MNA has been reported in older people under other healthcare settings. In a group of 70–75 year old subjects of the Danish population, those who scored > 23·5 on MNA had significantly lower mortality risk than those who scored ≤23·5 (Beck *et al.* 1999). Gazzotti *et al.* (2000) also showed that MNA score on hospital admission was predictive of patient's survival. Persson *et al.* (2002) showed that patients classified 'malnourished' had a mortality rate of 40% in one year and 80% in three years compared with a mortality rate of 20% in one year and 50% in three years for patients classified 'well nourished'. Another study by Donini *et al.* (2003) showed a correlation of MNA score with the incidences of adverse clinical events during hospitalisation and mortality in geriatric patients both on admission and on discharge. Beck *et al.* (1999) observed that patients rated ≤23·5 by MNA had increased risk of mortality during the follow-up six-month period. Taken together, low MNA score, in addition to indicating nutritional risk, also suggests increased risk of mortality.

Other health indicators

This study also has shown that the MNA score correlates with several key health indicators. Compared to those who survived the first six-month follow-up period, those who failed have significantly more disabilities and poorer self-rated health and nutritional statuses. However, the differences in serum albumin and cholesterol concentrations between the two groups were not statistically significant. The possible reasons for not reaching a significant difference may be because of relatively few deaths during the follow-up period, and both groups have relatively subnormal albumin concentrations. Low albumin and low cholesterol levels are usually considered the indicators of functional decline (Schalk *et al.* 2004). However, the use of albumin as a marker for malnutrition in physically impaired older people has been questioned (Kuzuya *et al.* 2007). The possible reason is that even in older people with adequate protein intake, hepatic synthesis of albumin can be hampered by elevated level of inflammation, which is common in frail older people (Kuzuya *et al.* 2007). Nutritional risk has also been shown to be associated with the length of hospital stay (Kyle *et al.* 2005). In this study, length of hospital stay for the non-survivors was twice longer compared to that of the survivors, but the differences were not statistically significant because of large individual variations.

Predictors of mortality risk

Both MAC and CC were smaller in the non-survivors compared to the survivors, but the differences were also not statistically significant. However, MAC was the best predictor of an elder's mortality risk according to the regression model. Among the variables examined, MAC was the only parameter observed to be a significant predictor of the mortality risk of the elders, controlled for confounding factors including age, gender, hospitalisation, number of disabilities, serum albumin and CC. The reason that MAC but not CC is a good predictor of one's survival/mortality could be related to the fact that many elders become immobilised (unable to walk) before losing the ability to use their hands. The movement of hand helps maintain arm muscle locally until very late stage of life (Chumlea 2006, Enoki *et al.* 2007). Other studies have also observed that CC is the most sensitive indicator of body protein nutritional status among the anthropometric parameters, whereas MAC is a good predictor of survival for older people under long-term care settings (Bonnefoy *et al.* 2002, Allard *et al.* 2004).

It is of interest to note that self-rated nutritional status and self-rated health status are among the best mortality-risk predictors for frail older people and are highly correlated with the MNA scores (Tsai *et al.* 2007). In several studies, self-rated health status has been shown to be a good predictor of survival and correlated well with the need for and the use of care services (Heikkinen 1989, Segovia *et al.* 1989, Idler *et al.* 1990, McCallum *et al.* 1994).

The MNA was designed to provide the primary-care health professionals a simple and non-invasive tool to efficiently identify older patients at risk of malnutrition (Vellas *et al.* 1999). It was primarily intended for evaluating the nutritional status of the frail older people who might have functional impairments, those who lived in nursing homes and those who were over 85 years old living in the community (Guigoz *et al.* 1996). The instrument has also been shown to be effective in predicting follow-up morbidity and mortality risks among frail older people in free-living populations and in geriatric facilities (Beck *et al.* 1999, Gazzotti *et al.* 2000, Persson *et al.* 2002, Donini *et al.* 2003). Results of this study have further shown that the MNA can predict follow-up mortality risk in institutionalised older people, at least within the first six months of assessment. After the six months, the predicting ability weakens.

The implication of these findings is that low MNA score may serve as a warning signal for heightened care and intervention in geriatric care. Greater attention should be paid to those who are rated malnourished or at risk of malnutrition and necessary interventions be given to them to reduce their mortality risk (Langkamp-Henken 2006). The modified tool should be applicable to all Chinese who share the same anthropometric features and way of living (Woo *et al.* 2005).

However, it should also be mentioned that for frail older people, good nutritional care is more than just routine monitoring of nutritional status and providing nutritious meals. Nutritional status is influenced by many factors and geriatric malnutrition is a multi-factorial problem. In addition to providing nutritious and acceptable meals, we must also pay attention to their physiological state, functional ability, medication and social and psychological well-being because these factors can influence their appetite or ability to consume food (Meydani 2001). Finally, in a wider perspective, the mortality-predictive ability of the MNA may be used by healthcare professionals not only to pay a greater attention to the nutritional well-being but also to help both the resident and the family to prepare for death.

Limitations of the study

Some limitations to this study should be mentioned. The study was carried out in only one large long-term care institution in Taiwan. Long-term facilities vary in the type of patients, considerably in Taiwan. The institution selected for this study is a public-funded one and is considered more representative than others. It covers a wider spectrum of patients. Nevertheless, confirmation of results from other facilities is needed. Mental and cognition impairment is common among older people, but they were excluded from this study. The applicability of the MNA to those patients is unknown and should be examined. Certain other items in the tool such as consumption of specific food items and fluid and weight loss should also be considered for more culturally or ethnically sensitive criteria or standards (Chumlea 2006).

Conclusion

Results of this study have demonstrated the mortality-risk predicting ability of a modified version of the MNA without involving BMI in institutionalised older people in a non-Western population. A tool without BMI has obvious advantages. Measuring weight and height in frail older people can be inaccurate and cumbersome. The weight-measuring equipment is not available in many Taiwanese or Chinese homes or even some long-term care facilities. Nutritional assessment is more likely to be carried out routinely if the process is easier and less time-consuming. The tool, especially the modified version (MNA-TII), can predict the follow-up mortality risk with good degree of accuracy, and it should be a valuable tool for identifying high-risk older Taiwanese for timely intervention.

Relevance to clinical practice

The MNA that adopts population-specific anthropometric cut-points may have improved nutritional-risk and mortality-risk predictive abilities. The tool can help care-workers detect emerging nutritional problems and enable timely intervention. Routine use of the tool may help improve the quality of care.

Acknowledgements

The authors thank the management of the long-term care facility for their co-operation during the course of this study.

Contributions

Study design: ACT, JDT; data collection and analysis: PYK and manuscript preparation: ACT, PYK, JDT.

Financial support

The study received no financial support from any source.

Conflict of interest

Alan Tsai is a member of the International MNA Revision Group and attended a workshop in Switzerland in October 2008 that was fully funded by Nestle, Switzerland. Other authors have no conflict of interest to declare.

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