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A modified Mini Nutritional Assessment without BMI can effectively assess the nutritional status of neuropsychiatric patients

Alan C Tsai, Yuan-Ti Chou, Tsui-Lan Chang, Shu-Nu Chang-Lee and Shwu-Feng Tsay

Aim and objectives. To determine whether a modified version of the Mini Nutritional Assessment (MNA) without body mass index (BMI) can effectively identify individuals at risk of malnutrition among patients with neuropsychiatric disorders.
Background. Neuropsychiatric patients have an additional risk of nutritional disorder due to functional impairments and drug effects. However, their nutritional status is generally neglected. It is important to find a tool that is simple, easy to use and non-invasive.
Design. The study involved 105 patients in the acute phase of confirmed neuropsychiatric disorders in an area hospital. All subjects were cognitively able to have effective verbal communication.
Method. The study included serum biochemical and anthropometric measurements and an on-site, in-person interview using a structured questionnaire to elicit personal data, health condition and answers to questions in the MNA. Subjects' nutritional statuses were graded with a MNA that adopted population-specific anthropometric cut-off points or one further with the BMI question removed and its assigned score redistributed to other anthropometric questions.
Results. Both versions of the modified MNA effectively graded the nutritional status of neuropsychiatric patients and showed good correlations with the major nutritional indicators such as BMI, calf circumference and the length of hospital stay.
Conclusions. The MNA can effectively assess the nutritional status of neuropsychiatric patients and enhance timely detection and intervention of their nutritional disorders. A modified MNA without the BMI question can maintain the full functionality of the tool. The version does not require weight and height measurements and thus will enhance the usefulness of the instrument.
Relevance to clinical practice. Neuropsychiatric patients are a high-risk group of nutritional disorders. The MNA, especially the one without BMI, has the potential to improve professional efficiency of the primary care workers.

Key words: assessment, mental health, nurses, nursing, nutrition, older people

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Introduction

Approximately 14% of the global burden of disease has been attributed to neuropsychiatric disorders. Thus, the delivery of mental health care can greatly affect the outcome of health care (Prince *et al.* 2007). People with neuropsychiatric problems have an additional risk of nutritional disorder due to factors such as medication, drug–nutrient interaction, poor self-care, inability to shop or prepare foods, delusions and social isolation (Sullivan *et al.* 1999). Unhealthy lifestyle such as poor diet, lack of exercise, smoking and substance abuse are common among neuropsychiatric patients (Brown

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et al. 1999). Weight changes, behavioural problems and eating disorders are common in neuropsychiatric patients. Patients with schizophrenia are often associated with obesity or overweight, while patients with depression are often associated with depressed appetite and weight loss (Gray & Gray 1989, McCreadie 2003). Asplund *et al.* (1981) observed that 30% of psychogeriatric patients had energy or protein-energy malnutrition and 4% had obesity. Molteno *et al.* (2000) observed that 32% of males and 26% of females with mental handicap were underweight whereas 6% of males and 17% of females were obese. Recent studies have also found that the intakes of micro nutrients such as the B vitamins and omega-3 fatty acids play a role in mental health (Coppen & Bolander-Gouaille 2005, Kerperman *et al.* 2006, Gariballa & Forster 2007). Of course, individuals with neuropsychiatric disorders, like the general population, are also confronted with the common lifestyle-related diseases such as hypertension, diabetes, heart disease and cancer. Despite this, neuropsychiatric patients appear to be a neglected group. Well-planned nutritional assessments rarely take place in psychiatric hospitals. Many psychiatric centres rely on nurses' subjective judgment or simple indicators such as serum protein concentrations for making nutrition-related decisions. However, these judgments are not always reliable or adequate. For example, Abayomi and Hackett (2004) observed that nurses overlooked 29% of nutritionally at risk patients. Thus, a well-planned nutritional assessment should be an integral component of a comprehensive psychiatric assessment (Saxena *et al.* 2006). A well-planned nutritional assessment is crucial, because progressive undernutrition can often go undetected. The prevention of undernutrition requires the identification of the causes to adopt corrective actions for optimal nutritional intervention (Guigoz *et al.* 2002). We have recently modified the Mini Nutritional Assessment (MNA) (Guigoz *et al.* 1994) by adopting the population-specific anthropometric cut-points and found that the modified tool has improved functionality in predicting the nutritional status of Taiwanese older people living in the community or in various care facilities (Tsai *et al.* 2007a, Tsai & Ku 2008, Tsai & Shih 2009). We also have observed that a further modified version that had the body mass index (BMI) question removed from the scale functioned equally well as one that included the BMI (Tsai *et al.* 2009). Although the MNA was developed and validated with older adults, we thought it would be of interest to determine whether this tool, especially the version without BMI, would be useful for identifying individuals at risk of malnutrition among patients with neuropsychiatric disorders who may generally be of younger age. The non-invasive nature and its ease of use coupled with the lack of a more specific and readily available tool make it a worthwhile attempt.

Method

Using patients residing in psychiatric wards at a psychiatric hospital in central Taiwan as a convenient sample, this study evaluated the nutritional status of those patients with two modified versions of the MNA. Patients who had been in the acute phase of confirmed neuropsychiatric disorders for three months or longer and judged cognitively able to have effective verbal communication were recruited to participate in the study. Patients who were diagnosed as having personality, adjustment or developmental disorders according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) (American Psychiatric Association 2000) were excluded from the study. Eligible subjects or their legal guardians were explained of the objective and process of the study. A total of 105 patients (67 men and 38 women) met those conditions and agreed to participate in the study. The protocol and ethical aspect of the study was approved by the Institutional Review Board of the Hospital. Written consents were obtained from the legal guardians and subjects' confidentiality was maintained throughout the study.

The study included three components: (1) measurements of fasting blood biochemical indicators including serum albumin, haemoglobin, haematocrit, glucose, serum creatinine, triglyceride and total cholesterol as a part of hospital's routine laboratory tests, (2) measurements of anthropometric indicators including body weight, height and waist, hip, mid-arm and calf circumferences according to standard methods (Lee & Nieman 2003b), and (3) an on-site, in-person, interview with a structured questionnaire for eliciting socio-demographic and health-related personal data, appetite and mood statuses and answers to questions in the MNA (Guigoz *et al.* 1994, Tsai *et al.* 2009). The caregivers were allowed to assist patients answering the questions or to provide the information on their behalf, if necessary. Anthropometric measurements and the questionnaire interview were carried out within one week of the blood sampling (for biochemical measurements) date. All interviews and physical measurements were carried out by the same (one) interviewer accompanied by the caregivers.

Nutritional status of each subject was assessed with two modified versions of the MNA: the MNA-TI (MNA-Taiwan version I) which adopted Taiwanese-specific anthropometric (BMI, mid-arm circumference, MAC; calf circumference, CC) cut-points and the MNA-TII (MNA-Taiwan version II) which eliminated the BMI question (Question F) from the MNA-TI and reassigned one point of the three BMI points to the MAC

question (Question Q) and two to the CC question (Question R) (Tsai *et al.* 2009). All other questions were the same for both versions and were unchanged from the original MNA (Guigoz *et al.* 1994).

Data were analysed with SPSS/Windows 10.0 software package. Simple statistics was expressed as mean ± SD. Wilcoxon signed-rank test was performed to determine the significance of differences between the patterns of nutritional status predicted by the two modified versions. Pearson's correlation analyses were conducted to determine the level of correlation of the anthropometric, biochemical and health-related parameters with the total MNA scores and also with the concentration of serum albumin.

Results

Table 1 shows the sociodemographic, lifestyle- and health-related statuses of study subjects. Fifty-eight per cent of patients were 45 years or younger. Only five subjects (4·8%, all female) were over 65 years old. Nearly 50% of patients were never married. Approximately 50% of all subjects had less than nine years of formal education and the rest had more. About two-thirds of patients lived with family members and 19% in care institutions. According to DSM-IV, approximately 50% of subjects were classified schizophrenia, 21% major depression, 15% bipolar disorder and 14·3% other types. Twenty-seven percent of subjects had the disorder for less than five years, another 27% 5–10 years and the rest 10 years or more. Forty-five per cent of subjects had other chronic diseases in addition to neuropsychiatric disorders. Thirty-eight per cent of subjects indicated good or very good appetite, 42% neutral and 16% poor or very poor appetite. Thirteen percent of subjects lost more than 3% of body weight during the last three months.

Table 2 shows the anthropometrical and biochemical characteristics of the patients. The average BMI was 24·9 kg/m^2 for male and 24·0 kg/m^2 for female patients. The average MAC was 28·4 and 26·4 cm and the average CC was 34·8 and 33·2 cm for male and female patients, respectively. Average waist circumferences were 87·7 and 80·5 cm and average hip circumferences were 95·7 and 96·7 cm for male and female patients, respectively. Average haemoglobin concentrations were 14·5 and 12·9 g/dl, albumin, 4·1 and 4·1, triglyceride, 152 and 135 mg/dl, cholesterol, 170 and 177 mg/dl, fasting serum glucose, 97 and 102 mg/dl, and serum creatinine, 0·8 and 0·7 mg/dl for male and female patients, respectively.

Subjects' scoring patterns of the MNA questions are shown in Table 3. Subjects scored poorly on several questions. Approximately 27% of patients had reduced food intake during the past three months and a similar proportion (25%) of subjects had reduced weight during the same period. Twenty percent had psychological stress and 24% had dementia or depression. More than half (54%) of patients were on four or more kinds of prescribed medicine while 37% had inadequate vegetable or fruit intake and 57% had inadequate water intake. Approximately 45% of subject

Table 1 Characteristics of subjects (*n*, %)

Item	Men (*n* = 67)	Women (*n* = 38)	All
Age (years)			
< 45	45 (67·2)	16 (42·1)	61 (58·1)
45–64	22 (32·8)	17 (44·8)	39 (37·1)
≥65	0	5 (13·1)	5 (4·8)
Marital status			
Never married	41 (61·2)	11 (28·9)	52 (49·5)
Married	15 (22·4)	14 (36·9)	29 (27·6)
Divorced/widowed	11 (16·4)	13 (34·2)	24 (22·9)
Years of formal education			
≤6	15 (22·4)	13 (34·1)	28 (26·7)
7–9	16 (23·9)	8 (21·1)	24 (22·9)
10–12	29 (43·3)	10 (26·3)	39 (37·1)
> 12	7 (10·4)	7 (18·5)	14 (13·3)
Living status			
Alone	5 (7·5)	3 (7·9)	8 (7·6)
With family	40 (59·7)	28 (73·7)	68 (64·8)
Care institutions	18 (26·8)	2 (5·2)	20 (19·0)
Other	4 (6·0)	5 (13·2)	9 (8·6)
Employment			
No	57 (85·1)	35 (92·1)	92 (87·6)
Yes	10 (14·9)	3 (7·9)	13 (9·5)
Diagnosed mental disorder*			
Schizophrenia	35 (52·2)	17 (44·7)	52 (49·5)
Major depression	16 (23·9)	6 (15·8)	22 (21·0)
Bipolar disorder	10 (14·9)	6 (15·8)	16 (15·2)
Other	6 (9·0)	9 (23·7)	15 (14·3)
Mental disorder history (years)			
< 5	12 (17·9)	16 (42·0)	28 (26·7)
5–10	21 (31·3)	7 (18·5)	28 (26·7)
> 10	34 (50·7)	15 (39·5)	49 (46·7)
Other chronic diseases			
No	36 (53·7)	22 (57·9)	58 (55·2)
Yes	31 (46·3)	16 (42·1)	47 (44·8)
Appetite status			
Very good	9 (13·4)	4 (10·5)	13 (12·3)
Good	22 (32·8)	9 (23·7)	31 (29·5)
Neutral	26 (38·8)	18 (47·4)	44 (41·9)
Poor	10 (14·9)	5 (13·2)	15 (14·3)
Very poor	0 (0)	2 (5·3)	2 (1·9)
% Weight loss during last three months			
> 5	2 (3·0)	2 (5·3)	4 (3·8)
3–5	7 (10·4)	3 (7·9)	10 (9·5)
2–3	5 (7·5)	4 (10·5)	9 (8·6)
≤2	53 (79·1)	29 (76·3)	82 (78·1)

*According to DSM-IV classifications.

Table 2 Anthropometrical and biochemical measurements (Mean ± SD) of subjects

Item	Men (n = 67)	Women (n = 38)
Body height (cm)	167·2 ± 6·9	155·6 ± 5·8
Body weight (kg)	69·8 ± 13·1	58·4 ± 13·8
BMI (kg/m^2)	24·9 ± 4·3	24·0 ± 5·1
MAC (cm)	28·4 ± 3·0	26·4 ± 4·2
CC (cm)	34·8 ± 3·6	33·2 ± 5·0
Waist circumference (cm)	87·7 ± 11·3	80·5 ± 11·4
Hip circumference (cm)	95·7 ± 8·0	96·7 ± 10·7
Haemoglobin (g/dl)	14·5 ± 1·3	12·9 ± 1·4
Haematocrit (%)	41·0 ± 5·9	37·5 ± 4·1
Serum albumin (g/dl)*	4·1 ± 0·4	4·1 ± 0·3
Total serum protein (g/dl)	6·9 ± 0·6	7·0 ± 0·7
Serum triglyceride (mg/dl)	152 ± 99	135 ± 59
Serum cholesterol (mg/dl)	170 ± 45	177 ± 42
Fasting serum glucose (mg/dl)	96·5 ± 27·9	102·4 ± 43·2
Serum urea N (mg/dl)	10·2 ± 4·3	12·2 ± 5·2
Serum creatinine (mg/dl)	0·8 ± 0·3	0·7 ± 0·4
Serum uric acid (mg/dl)	6·6 ± 1·7	5·7 ± 1·5
SGOT (U/l)	51·2 ± 72·0	28·0 ± 22·9
SGPT (U/l)	43·4 ± 45·5	28·6 ± 23·2

BMI, body mass index; MAC, mid-arm circumference; CC, calf circumference; SGOT, serum glutamate-oxaloacetate transaminase; SGPT, serum glutamate-pyruvate transaminase.
*Six men (9·0%) and 2 women's (5·3%) serum albumin concentrations were < 3·5 (g/dl).

thought they were malnourished or were unsure about their nutritional status while 55% thought they had poor health relative to their peers or were unsure about their health status.

The distributions of nutritional statuses assessed according to the two versions of the MNA are shown in Table 4. According to MNA-TI, 7·6, 21·9 and 70·5% of patients were predicted malnourished, at risk of malnutrition and normal, respectively. The respective values were 7·6, 20 and 72·4%, respectively, for MNA-TII. Analysis of these distributions with Wilcoxon signed-rank test showed that no significant differences exist between these two distribution patterns.

Pearson's correlation coefficients (r) of the total MNA scores or serum albumin concentrations with each of the major nutrition- or health-related parameters are shown in Table 5. The total MNA scores of both versions were very highly significantly correlated with subjects' BMI, MAC (in men), CC (in men), number of prescribed drugs, self-assessed appetite status and % weight loss (all $p < 0{\cdot}001$). Total MNA scores were also significantly correlated with serum albumin concentrations ($p < 0{\cdot}05$), CC (in women, $p < 0{\cdot}01$) and MAC (in women, $p < 0{\cdot}05$). Both versions of the MNA had comparable r values. All parameters had weaker correlations with serum albumin than with the MNA scores.

Discussion

Functionality of the modified MNA

Both versions of the modified MNA predicted 8 patients (7·6%) malnourished. The MNA-TI further predicted 23 patients (21·9%) and the MNA-TII further predicted 21 patients (20%) at risk of malnutrition. Analysis of these results with the Wilcoxon signed-rank test suggests that no differences in the patterns predicted by these two versions of the MNA. All 29 patients predicted malnourished or at risk of malnutrition with the MNA-TII were among the 31 predicted with the MNA-TI. Pearson's correlation analyses showed that both versions of the modified MNA predicted nutritional statuses that have comparable degrees of correlations with each of the key nutritional indicators including serum albumin, BMI, MAC, CC, number of prescribed drugs, self-assessed appetite status and % weight loss. These results suggest that both versions of the modified MNA can function equally well and the MNA-TII which has the BMI question (Question F) eliminated from the screen can function as effectively as the MNA-TI in predicting the nutritional risk status of the neuropsychiatric patients.

The observed rates of malnutrition (7·6%) and at risk of malnutrition (20–22%) are in concordance with the expected high prevalence of malnutrition among neuropsychiatric patients. The rates are higher than the 1·5% malnourished and 10·7% at risk of malnutrition observed in the general population of Taiwanese, 65 years or older (Tsai *et al.* 2007a, b), or the 0·7% malnourished and 10–12% at risk of malnutrition in community-living older people (Tsai *et al.* unpublished observation). However, these rates are relatively low compared to the 24% malnourished and 57% at risk of malnutrition of stroke rehabilitation patients (Tsai & Shih 2009), or 14–20% malnourished and 60% at risk of malnutrition of institutionalised older people observed in our recent studies (Tsai & Ku 2008).

There are relatively few studies assessing the nutritional status of neuropsychiatric patients. Asplund *et al.* (1981) assessed nutritional status of patients in psychogeriatric wards based on anthropometric parameters and circulating proteins and found that neuropsychiatric patients had low mean values on these parameters and 30% of patients were undernourished. Molteno *et al.* (2000) examined nutritional status of mental patients in a long-stay hospital and found that 32% of males and 26% of females had BMI < 20. Abayomi and Hackett (2004) compared nurses' judgment vs. a nutrition risk tool on neuropsychiatric patients' nutritional status and found that nurses overlooked 29% at risk patients.

Table 3 Subjects' scoring patterns of each of the MNA questions (n = 105)

Question	Score	%
Food intake declined over the past 3 months		
Severe	0	1·9
Moderate	1	24·8
No decline	2	73·3
Weight loss during last month		
> 3 kg	0	1·9
Does not know	1	8·6
1–3 kg	2	22·9
No loss	3	66·6
Mobility		
Bed- or chair-bound	0	1·0
Able to get out bed but does not go out	1	3·8
Goes out	2	95·2
Psychological stress/acute disease during past 3 months		
Yes	0	20·0
No	2	80·0
Neuropsychological problems		
Severe dementia or depression	0	22·9
Mild dementia	1	1·0
No psychological problems	2	76·2
BMI (kg/m^2)		
(a) MNA-TI		
< 17	0	3·0/5·3*
17–19	1	4·5/2·6
19–21	2	10·7/15·8
> 21	3	81·9/76·3
(b) MNA-TII (This question was omitted)		
Live independently†		
No	0	14·3
Yes	1	85·7
Takes four or more kinds of prescribed drugs per day		
Yes	0	54·3
No	1	45·7
Pressure sores or skin ulcers		
Yes	0	0
No	1	100
Full meals daily		
1	0	4·8
2	1	8·6
3	2	86·6
Daily consumption of protein-rich food		
0 or 1 'yes'	0	0
2 'yes'	0·5	7·6
3 'yes'	1	92·4
Consumes ≥2 servings of fruits or vegetables per day		
No	0	37·1
Yes	1	62·9
Cups of water/fluid consumed		
< 3	0	6·7
3–5	0·5	50·5
> 5	1	42·8
Mode of feeding		
Unable to eat without assistance	0	1·0
Self-fed with difficulty	1	7·6
Self-fed with any problem	2	91·4
Self view of nutritional status		
Views self as being malnourished	0	13·3
Uncertain of nutritional status	1	41·9
No nutritional problem	2	44·8
Self view of health status compared to peers		
Not as good	0	9·5
Does not know	0·5	36·2
As good	1	41·0
Better	2	13·3
MAC (cm)		
(a) MNA-TI		
< 22·5/21*	0	1·5/5·3*
22·5–23·5/21–22	0·5	1·5/0
> 23·5/22	1	97/94·7
(b) MNA-TII		
< 22·5/21	0	1·5/5·3
22·5–23·5/21–22	1	1·5/0
> 23·5/22	2	97/94·7
CC (cm)		
(a) MNA-TI		
< 28/25*	0	1·5/2·6*
> 28/25	1	98·5/97·4
(b) MNA-TII		
< 28/25	0	1·5/2·6
28–29/25–26	1	3·0/0
29–30/26–27	2	0/5·3
≥30/27	3	95·5/92·2

*Values for men and women, respectively.
†Subjects whose conditions were under good control and had rather normal daily life was considered able to live independently.

Compan *et al.* (1999) used the MNA to grade the nutritional status of 918 acute, sub-acute and long-term care older patients and found that malnutrition ranged from 25–33% among 13 subgroups including 88 neuropsychiatric patients whose mean MNA score was 21·1 (ranged from 16·7–21·7 among all subgroups).

Table 4 Distribution of nutritional status of mental patients according to the original and the modified MNA scales (n = 105)

	Nutritional status (n, %)		
Version of MNA	Malnourished	At risk	Normal
MNA-TI	8 (7·6)	23 (21·9)	74 (70·5)
MNA-TII	8 (7·6)	21 (20·0)	76 (72·4)*

*Analysis with Wilcoxon signed-rank test showed that the distributions of nutritional status assessed with the MNA-TI and MNA-TII were not significantly different from each other ($Z = -1{\cdot}414$, $p > 0{\cdot}05$). All subjects identified malnourished or at risk of malnutrition by the MNA-TII were also identified as such by the MNA-TI.

Table 5 Pearson's correlation (r) of the total MNA scores with anthropometric, biochemical and health-related variables[†] (n = 104)

Variable	MNA-TI	MNA-TII	Albumin
Serum albumin (g/dl)	0·216*	0·220*	1
BMI (kg/m^2)	0·520***	0·468***	0·136
MAC (cm)			
Men	0·566***	0·547***	0·266*
Women	0·358*	0·329*	−0·051
CC (cm)			
Men	0·448***	0·465***	0·172
Women	0·436**	0·443**	−0·117
No. of prescribed medicine	−0·348***	−0·370***	−0·330**
Appetite status[‡]	0·656***	0·638***	0·032
% weight change	−0·464***	−0·425***	−0·084

*$p < 0·05$, **$p < 0·01$, ***$p < 0·001$.
[†]No significant correlations were observed with W/H, haematocrit, serum cholesterol and years of mental disorder.
[‡]Self-rated with a five-level Likert type scale ranging from very poor to very good.

Serum albumin

Low serum albumin and unintended body weight loss are the two indicators often used to suggest deteriorating nutritional conditions in neuropsychiatric patients in Taiwan. However, according to results of the present study, the level of serum albumin does not correlate well with the MNA scores. Neither does it correlate well with most of the major general nutrition indicators such as BMI, CC, appetite status and weight loss. The possible explanation for the lack of correlation may be due to the fact that (1) most patients in this study are mature adults younger than 65 years in age, (2) only relatively few (7·6%) of these patients have serum albumin below 3·5 g/dl (the average is 4·1 g/dl), and (3) serum albumin has a relatively long turnover time (half-life 14–20 days) and thus is relatively slow in responding to nutritional changes (Lee & Nieman 2003b). Additionally, some drugs taken by the patients may confound serum albumin concentrations by affecting their appetite or liver function. Thus, although albumin is a valuable indicator of chronic protein-calorie malnutrition in young children and older adults, it does not appear to be a sensitive nutritional indicator for adult neuropsychiatric patients.

Correlation of MNA scores with other parameters

Among the variables examined, appetite status, BMI, MAC and CC (in men), % weight change during the past three months and number of prescribed drugs showed strong correlations with the total MNA scores, CC and MAC (in women) showed moderate correlations whereas serum albumin showed weak but significant correlations. The correlation of each of the above-mentioned variables with serum albumin is much weaker than that with the MNA scores. These results further suggest that the MNA is a valuable and effective tool for identifying individuals at risk of malnutrition among neuropsychiatric patients.

Limitations to the study

Patients with neuropsychiatric disorders have a wide range of potential nutritional abnormalities. Depending on the nature of the disorder, nutritional disorders may include increased weight gain (due to over-eating), delusions, catatonic behaviour, anorexia, drug–nutrient interactions, nutrient imbalance and refusal to eat or drink. The MNA is mainly for identifying individuals with general malnourishment or at risk of malnutrition. It would have limited ability in pinpointing other nutritional problems associated with neuropsychiatric disorders. More elaborate assessments should be performed to determine eating habits and food beliefs, or possible drug–nutrient interactions. Also, results of this study only represent the average condition of the participating subjects in this study. Neuropsychiatric disorders have diverse causes and complex nutritional problems. Without adequate number of subjects in some of the subtypes, the current study is unable to assess the functionality of the MNA in each subtype of the disorder.

It should also be reminded that subjects interviewed in this study were cognitively 'functional' individuals. For those who have impaired cognition, their nutritional status would probably be worse. Further, while MNA might be of value in identifying individual at risk of malnutrition, it would not totally replace well-trained care-givers. Close monitoring and observation of patients' eating behaviour, in addition to periodic nutritional assessment, is essential for early detection of emerging nutritional problems.

Relevance to clinical practice

The MNA-TII, being non-invasive and without the BMI question, does have an advantage over the original MNA which requires weight and height data for the calculation of BMI. Such an advantage does have practical implications in the care practice of neuropsychiatric patients. Measuring weight and height is not always easy or possible, especially for those who are bed-ridden. Some neuropsychiatric patients may also refuse to be weighed. Thus, the MNA-TII has the potential to improve the professional efficiency of the primary care workers by making patients' periodic assessment of nutritional status a less demanding task.

Conclusions

The development of malnutrition is a continuum and often is unnoticeable, especially in mature adults. Malnutrition starts with inadequate or imbalanced food intakes followed by changes in biochemical indicators and possibly also body composition. Neuropsychiatric patients are at extra risk of having malnutrition due to their unusual dietary habits or belief, drug effects or altered lifestyles. Nutritional status and mental status can interact with each other bidirectionally. It is important that the assessment of their nutritional status be conducted routinely so that emerging nutritional problems is detected and intervened before progressing to become a major health problem. The MNA, especially in its modified version (without BMI) appears to serve this purpose well.

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Contributions

Study design: ACT, S-FT; data collection and analysis: YTC, TLC, S-NC and manuscript preparation: ACT, TLC.

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