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Long-form but not short-form Mini-Nutritional Assessment is appropriate for grading nutritional risk of patients on hemodialysis—A cross-sectional study

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ABSTRACT

Background: Routine screening/assessment of protein-energy status is essential for preventing uremic malnutrition in patients on hemodialysis (HD). A simple, low cost, reliable and non-invasive tool is greatly desired.
Objective: This study aimed to evaluate the appropriateness of using the long-form (LF) and the short-form (SF) Mini Nutritional Assessment (MNA) for grading the risk of protein-energy malnutrition in patients on HD.
Design and sampling: A cross-sectional study with purposive sampling.
Setting: A hospital-managed hemodialysis center.
Participants: 152 adult ambulatory patients on hemodialysis.
Methods: The nutritional status of each patient was graded with MNA-LF and MNA-SF, each in two versions—a normalized-original (content-equivalent) version (by adopting population-specific anthropometric cut-off points) and an alternative version that replaced calf circumference for BMI in the scale. The SGA, serum albumin and serum creatinine served as references. Cross-tabulation test was used to evaluate the consistency of the versions.
Results: MNA-SF versions rated fewer HD subjects malnourished or at risk of malnutrition (32.2% and 24.3% for T1 and T2, respectively) compared to MNA-LF versions (40.8% and 36.2%) or the SGA (47.4%). MNA-SF versions (kappa = 0.450 and 0.446) also did not perform as well as MNA-LF versions (kappa = 0.734 and 0.666) in predicting the risk of malnutrition in HD patients using the SGA as the reference. MNA-SF also did not perform as well as the MNA-LF using serum albumin or serum creatinine as the reference.
Conclusions: The MNA-LF is appropriate for predicting protein-energy malnutrition in HD patients but MNA-SF may under-rate these patients. Effort should be made to improve the MNA-SF for HD patients since the short-form is more time-efficient and thus, greatly desired in clinical practice.

What is already known about the topic?

- Patients on hemodialysis are at high risk of malnutrition. Routine monitoring of their nutritional status is important in preventing protein-calorie malnutrition in these patients.
- Subjective Global Assessment is the recommended tool for monitoring their nutritional status. But extensive training and experience is needed to use this tool properly. Thus, a simple, reliable, non-invasive and time-saving tool is greatly desired.
- Long-form Mini-Nutritional Assessment (MNA-LF), a relatively simple and non-invasive tool, is appropriate

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for grading the risk of protein-calorie malnutrition in patients on hemodialysis (HD). But the validity of the short-form (SF) has not been examined.

What this paper adds

- The MNA-LF and MNA-SF do not agree well to each other in grading nutritional risk of patients on HD.
- The MNA-SF rates a smaller proportion of patients on HD malnourished or at risk of malnutrition compared to that rated with the MNA-LF.
- Until it is further revised and validated, the MNA-SF should be used with caution for grading the risk of malnutrition in patients on HD.

1. Introduction

The total number of patients being treated for end-stage renal disease (ESRD) has been on the rise globally in recent years (Schober-Halstenberg, 2009) and protein-energy malnutrition is common in these patients (Qureshi et al., 1998; National Kidney Foundation, 2000). Persons on hemodialysis (HD) are at high risk of protein-energy malnutrition because these patients often have depressed appetite, restricted diet, drug–nutrient interactions and dialysis-related loss of nutrients. They also often have non-protein-energy-malnutrition-associated metabolic abnormalities such as hyperphosphatemia, hyperkalamia and acidosis. To avoid severe nutritional deficiency it is imperative to monitor/screen their nutritional status routinely.

The Subjective Global Assessment (SGA) has been recommended by the U.S. National Kidney Foundation Kidney Disease/Dialysis Outcomes and Quality Initiative (K/DOQI) clinical practice guidelines as a regular tool for assessing protein-energy malnutrition in large populations of ESRD patients (National Kidney Foundation, 2000). It is also the tool recommended for assessing the nutritional status of HD patients in Taiwan (Taiwan Society of Nephrology, 2010). Several studies have shown that the SGA is reliable for assessing protein-energy malnutrition in HD patients (Steiber et al., 2007; Yang et al., 2007). A recent study has also shown that the SGA is effective in identifying malnutrition and is appropriate for cross-sectional assessment of nutritional status in predialysis patients (Campbell et al., 2007). Longitudinal studies have shown that baseline nutritional status assessed with the SGA is also associated with future mortality risk in chronic dialysis patients (Dwyer et al., 2005; de Mutsert et al., 2009). However, there are also studies that questioned the validity and reliability of SGA in identifying ESRD patients at risk of malnutrition (Cooper et al., 2002; Jones et al., 2004; Steiber et al., 2004).

The Mini Nutritional Assessment (MNA) is an appropriate tool for grading/assessing the risk of protein-energy malnutrition in persons with various health conditions (Guigoz et al., 2002; Vellas et al., 1999). The MNA is easy-to-use, low cost, reliable and non-invasive and does not require extensive professional background or training to use. So, the tool, especially the short-form, is highly desired. However, few studies have attempted to examine the suitability of this tool for grading the risk of malnutrition in patients on HD. Afsar et al. (2006) found that the full-MNA overestimated the risk of malnutrition of patients on HD compared to the SGA (65.7% vs. 32.8%). Nevertheless, one recent study found the full-MNA appropriate for rating nutritional risk of patients on HD (Tsai et al., 2009). The MNA also has a short-form (SF) for screening the risk of undernutrition. Because of its time-saving feature, the SF is much preferred by clinical practitioners. Results rated with the two forms generally agree with each other well in patients from most settings (Tsai et al., 2010a), but their agreement in patients on HD patients has not been evaluated. Hence, the present study was aimed to examine whether the MNA-SF agreed well with the MNA-LF in grading patients on HD.

2. Methods

2.1. Nutritional assessment/screening tools

This study involved three nutrition assessment/screening scales: the SGA, MNA-LF and MNA-SF. The SGA grades nutritional risk by subjectively assessing a patient's historical data on weight change, altered dietary intake, and gastrointestinal symptoms influencing nutrient intake or absorption, and effects of under-nutrition. The process also involves a physical examination to detect clinical characteristics of under-nutrition (Detsky et al., 1987; Enia et al., 1993). However, professional knowledge, clinical experience and special training are essential in applying the tool properly. The SGA is based on a 7-point scale. Those who scored 1–2 points are considered at high risk of malnutrition; 3–5 points at moderate risk; and 6–7 points at low risk (National Kidney Foundation, 2000).

The MNA was developed based mainly on clinical data of older adults in Europe and US. The tool has two forms: MNA-LF consists of 18 items covering four dimensions (dietary, anthropometric, global and self-evaluated parameters) for assessing nutritional risk status and the MNA-SF consists of 6 items (the first 6 items of the MNA-LF), for screening the risk of malnutrition (Rubenstein et al., 2001). The two forms can identify persons with protein-energy malnutrition in a two-step screening process. Persons who are identified as "at risk" with the SF are further evaluated with the rest of the LF to confirm the diagnosis and plan interventions. It normally takes about 3–5 min to complete the SF and about 10–20 min to complete the LF. The MNA-LF has a maximum score of 30. A score of 16.5 or less was considered malnourished; 17–23.5, at risk of malnutrition; and 24 or more, normal (Vellas et al., 1999). The MNA-SF has a maximum score of 14. A score of 0–7 was considered at high risk of malnutrition; 8–11, moderate risk and 12–14, low risk (Kaiser et al., 2009).

2.2. Subjects

In this study we purposively recruited outpatients who were undergoing maintenance HD treatment at a regional hospital in Central Taiwan. Of 159 HD patients, 152 (78 men and 74 women) agreed to participate in the study. Patients were eligible to participate if they were $\geq$18 years

of age, non-pregnant, without acute disease or infection, patients of the center for ≥1 month and willing to sign an informed consent. The study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the ethics review board of the hospital.

2.3. Procedure

A researcher (clinical nurse) who had prior experience in using the SGA was trained by a clinical dietitian to rate the risk of malnutrition of HD patients with both the SGA and the MNA. After good consistency was established between the dietician and the researcher (kappa > 0.80), the researcher rated the patients independently. The researcher interviewed each qualified participant with a structured questionnaire to elicit personal data and to rate his/her nutritional status with the MNA during a routine dialysis session. The same clinical nurse also evaluated each patient's nutritional status with the SGA during another dialysis session. The two interviews were approximately two weeks apart (roughly before and after the blood sampling date) and took place in random order. To avoid bias, the researcher did not access the rated results until both ratings were completed. Biochemical data were obtained from patients' routine laboratory tests performed by the clinical laboratory of the hospital. Data collection took place during August through December 2009.

The risk of malnutrition in these HD patients was rated with the LF and SF of two Taiwanese-specific MNA versions (MNA-T1 and MNA-T2). MNA-T1was the same as the original MNA, except it adopted the Taiwanese-specific anthropometric cut-off points to maintain content-equivalency of the scale. MNA-T2 further substituted calf-circumference (CC, item R) for BMI (item F) and doubled the weighting of item Q (MAC) (Tsai et al., 2007, 2008). The validity of the Taiwanese-specific long-form versions has been shown previously (Tsai et al., 2008). Adoption of Taiwanese-specific anthropometric (BMI, MAC and CC) cut-off points (MNA-T1) improved the predictive ability of the scale whereas replacement of CC for BMI with an increase of MAC to 2 points (MNA-T2) further improved the predictive ability of the MNA. Similar results were observed in the short-form versions. Adoption of population-specific anthropometric BMI cut-off points improved the predictive ability of the MNA-T1-SF, whereas replacement of CC for BMI further improved the predictive ability of the scale (kappa values were 0.596, 0.742, and 0.843 for community-living; 0.560, 0.683, and 0.839 for care center-living; and 0.346, 0.454, and 0.522 for nursing home-living elderly for the original, MNA-T1-SF, and MNA-T2-SF, respectively, using MNA-T1-LF as reference) (Tsai et al., 2010a). MNA-T2 had 17 instead of 18 items (without BMI) but maintained the same maximum score (30 points). MNA-T2 was shown to function at least as well as MNA-T1 in Taiwanese (Tsai et al., 2010a,b). Weight, height, mid-arm circumference and calf circumference were measured according to standard procedures (Lee and Nieman, 2003) and as described previously (Tsai et al., 2010a).

It is generally recognized that in ESRD patients, no single measure can provide a comprehensive indication of protein-energy nutritional status and malnutrition may be identified with greater sensitivity and specificity using a combination of factors (K/DOQI, 2000). Thus, in the present study nutritional scores/status graded with the MNA and the SGA were compared to the predialysis serum albumin and creatinine, in addition to the SGA. These biochemical indicators are considered valid and clinically useful measures of protein-energy nutritional status in maintenance dialysis patients and are future indicators of mortality risk (National Kidney Foundation, 2000; Pifer et al., 2002; Honda et al., 2006; Phelan et al., 2008; Herselman et al., 2010). We arbitrarily chose 3.8 g/dL as the cut-off point for serum albumin and 10 mg/dL for serum creatinine. These values are the same as (or close to) the outcome guideline values recommended by the K/DOQI (National Kidney Foundation, 2000). It should also be mentioned that although both serum markers are considered valid and clinically useful measures of protein-energy nutritional status in maintenance dialysis patients, the presence of acute or chronic inflammation can limit the specificity of serum albumin whereas diminished skeletal muscle mass can also impact serum creatinine concentration (National Kidney Foundation, 2000).

2.4. Statistical analysis

Results were analyzed with SPSS 15.0 (Statistical Package for the Social Science, SPSS Inc., Chicago, IL). Simple statistics (*n*, %) were used to show the distribution of subjects' basic characteristics. Biochemical data were shown in means and standard deviations (SD). Wilcoxon's Signed-Rank test was used to evaluate the significance of differences among the distributions of nutritional status graded with various scales. Cross-tabulation test was performed to determine the agreement (sensitivity, specificity and kappa) of nutritional status predicted with the MNA with that predicted with serum albumin, creatinine or the SGA. Statistical significance was accepted at alpha = 0.05.

3. Results

Table 1 shows the sociodemographic, anthropometric and biochemical characteristics of subjects. Most patients (83% of male and 90% of female) had at least one comorbidity. Average serum albumin concentrations were 3.9 and 3.7 g/dL; and creatinine, 10.9 and 8.9 mg/dL for men and women, respectively. Table 2 shows the distributions of nutritional status (or risk levels) rated with the SGA and the MNA. Results rated with the SGA and MNA-T1-LF and MNA-T2-LF were not significantly different from each other. The two short-form versions did not agree well with the SGA or the respective long-form versions. Table 3 shows results of cross-tabulation tests. Using the SGA as a reference, the consistency with the MNA-T1-LF and MNA-T2-LF was moderate (kappa = 0.734 and 0.666, respectively); the consistency with the two short-form versions was lower (kappa = 0.450 and 0.446, respectively). The consistency with serum albumin and creatinine was generally relatively low. Subjects' MNA and

Table 1
Sociodemographic, anthropometric and biochemical characteristics of subjects.

Item	Men ($N = 78$)		Women ($N = 74$)	
	N (%)	Mean ± SD	N (%)	Mean ± SD
Age (years)		58.8 ± 13.0		64.9 ± 12.2
18–39	6 (7.7)		3 (4.1)	
40–64	49 (62.8)		31 (41.8)	
65–85	23 (29.5)		40 (54.1)	
Formal education (years)				
≤6	30 (38.4)		49 (66.2)	
7–9	10 (12.8)		12 (16.2)	
10–12	19 (24.4)		11 (14.9)	
>12	19 (24.4)		2 (2.7)	
Smoking status				
No	39 (50)		74 (100)	
Yes	18 (23.1)		0 (0.0)	
Past smokers	21 (26.9)		0 (0.0)	
Alcohol drinking[a]				
No	74 (94.9)		73 (98.6)	
Yes	4 (5.1)		1 (1.4)	
Routine exercise[b]				
No	37 (47.4)		47 (63.5)	
Yes	41 (52.6)		27 (36.5)	
No. of co-morbidity[c]				
0	13 (16.7)		7 (9.5)	
1	24 (30.8)		16 (21.6)	
2	23 (29.5)		27 (36.5)	
≥3	18 (23.1)		24 (30.5)	
Functional status				
Totally independent	49 (62.8)		28 (37.8)	
Need help by others	27 (34.6)		45 (60.8)	
Totally dependent on others	2 (2.6)		1 (1.4)	
BMI (kg/m^2)		22.7 ± 3.1		22.5 ± 3.8
Mid-arm circumference (cm)		27.6 ± 3.1		27.2 ± 3.7
Calf circumference (cm)		32.9 ± 3.4		29.7 ± 3.3
Biomarkers[d]				
Hemoglobin (g/dL)		11.2 ± 1.4		10.3 ± 1.2
Serum albumin (g/dL)		3.9 ± 0.3		3.7 ± 0.2
Serum TG (mg/dL)		140.0 ± 98.5		166.0 ± 104
Serum cholesterol (mg/dL)		144.0 ± 34.2		166.0 ± 37.6
Fasting blood glucose (mg/dL)		105.0 ± 46.3		118.0 ± 54.6
Serum creatinine (mg/dL)		10.9 ± 2.4		8.9 ± 1.3
Serum uric acid (mg/dL)		7.1 ± 1.2		7.1 ± 1.4
Urea clearance rate (Kt/v)		1.32 ± 0.1		1.4 ± 0.1
Serum calcium (mg/dL)		9.5 ± 0.7		9.7 ± 0.7
Serum P (mg/dL)		4.6 ± 1.3		4.6 ± 1.1

[a] Drink at least one time/week.
[b] Exercised 3 days or more/week.
[c] Including hypertension, diabetes, heart disease, psychiatric disease, respiratory disease, stroke and cancer.
[d] All biochemical values are predialysis.

SGA scoring patterns are shown in Appendices 1 and 2, respectively.

4. Discussion

4.1. Predictive ability of the MNA

Results of the present study suggest that two MNA-LF versions are appropriate for grading the nutritional risk of malnutrition in patients on HD. The two LF versions have moderately high consistency with the SGA, the tool recommended by K/DOQI for monitoring the nutritional status of patients on HD (National Kidney Foundation, 2000). The two MNA-LF versions are also comparable to the SGA in grading the nutritional risk of patients on HD using biochemical parameters (albumin and creatinine) as references. However, the two MNA-SF versions performed less favorably compared to the two MNA-LF versions or the SGA. Both MNA-T1-SF and MNA-T2-SF rated fewer subjects "malnourished + at risk of malnutrition" than their respective long-form versions or the SGA. These results suggest that MNA-SF may under-rate the risk of malnutrition and cause a delay in the revelation of emerging protein-energy malnutrition in patients on HD.

In addition to the SGA, two scales developed from the SGA (Dialysis Malnutrition Score, DMS and Malnutrition Inflammation Score, MIS), have also been used for assessing nutritional status of patients on HD (Kalantar-Zadeh et al., 1999). DMS was developed using the components of the conventional SGA but with a quantitative scoring system. Each component has a score ranging from 1 (normal) to 5 (severely abnormal). The sum of all seven items ranges from 7 (normal) to 35 (severely malnourished). MIS was developed to make the scoring

Table 2
Distribution of nutritional status rated with the MNA-LF, MNA-SF or SGA ($N = 152$).

Scale and version	Distribution of rated status (N, %)			
	Malnourished	At risk	Normal	Test
SGA (score range)	(1–2)	(3–5)	(6–7)	
Distribution	1 (0.7)	71 (46.7)	80 (52.6)	a[a]
Long-form (score range)	(0–16.5)	(17–23.5)	(24–30)	
MNA-T1	10 (6.6)	52 (34.2)	90 (59.2)	a
MNA-T2	10 (6.6)	45 (29.6)	97 (63.8)	a, b
Short-form (score range)	(0–7)	(8–11)	(12–14)	
MNA-T1	4 (2.6)	45 (29.6)	103 (67.8)	b
MNA-T2	4 (2.6)	33 (21.7)	115 (75.7)	c

SGA = Subjective Global Assessment; MNA = Mini Nutritional Assessment; LF = long-form; SF = short-form; T1 = Taiwan version-1; T2 = Taiwan version-2.
[a] a–c indicate whether the distributions rated with the scales are different from each other. Sets of distribution not indicated by the same alphabets are significantly different from each other on the basis of Wilcoxon's Signed-Rank test ($p < 0.05$).

Table 3
Binary classification tests of nutritional assessment/screening scales with reference standards ($N = 152$).

Scale	Serum albumin		Creatinine		SGA	
	At risk	Normal	At risk	Normal	At risk	Normal
SGA						
At risk	43 (59.3)[a]	15 (18.8)[b]	56 (77.8)	25 (31.2)	–	–
Normal	29 (40.7)[c]	65 (81.2)[d]	6 (22.2)	55 (68.8)		
Kappa		0.414[***]			0.462[***]	
MNA-T1-LF						
At risk	40 (64.5)	18 (20.0)	48 (77.4)	33 (36.7)	57 (91.9)	15 (16.7)
Normal	22 (35.5)	72 (80.0)	14 (23.6)	57 (63.3)	5 (8.1)	75 (83.3)
Kappa		0.450[***]		0.389[***]		0.734[***]
MNA-T2-LF						
At risk	38 (69.1)	20 (20.6)	44 (80.0)	37 (38.1)	51 (92.7)	21 (21.6)
Normal	17 (30.9)	77 (79.4)	11 (20.0)	60 (61.9)	4 (7.3)	76 (78.4)
Kappa		0.479[***]		0.380[***]		0.666[***]
MNA-T1-SF						
At risk	28(57.1)	30 (29.1)	38 (77.6)	43 (41.7)	40 (81.2)	32 (31.1)
Normal	21(42.9)	73 (70.9)	11 (22.4)	60 (58.3)	9 (18.8)	71 (68.9)
Kappa		0.267[***]		0.306[***]		0.450[***]
MNA-T2-SF						
At risk	26 (17.1)	32 (21.1)	30 (19.7)	51 (33.6)	34 (91.9)	38 (26.7)
Normal	11 (7.2)	83 (54.6)	7 (4.6)	64 (42.1)	3 (8.1)	77 (73.3)
Kappa		0.356[***]		0.262[***]		0.446[***]

At risk of malnutrition was defined as <3.8 g/dL of serum albumin or <10 mg/dL of creatinine.
[a] n (sensitivity).
[b] n (1 − specificity).
[c] n (1 − sensitivity).
[d] n (specificity).
[***] $p < 0.001$.

system more comprehensive and quantitative. It included the seven DMS items (with revisions) and three new items: BMI, serum albumin level and total iron-binding capacity (TIBC). Each item can score from 0 (normal) to 3 (severely abnormal) and the total score ranges from 0 (normal) to 30 (severely malnourished).

All three scales (SGA, DMS, and MIS) and MNA evaluate items covering weight loss, appetite, GI function, functional capacity (or mobility), comorbidity (years of dialysis or comorbidity of dialysis for SGA, DMS and MIS; and psychological stress, acute disease, depression and dementia for MNA), loss of subcutaneous fat and muscle wasting (MAC and CC for MNA). MIS and MNA also rate BMI. However, only MIS includes biochemical indicators (serum and TIBC) and only the MNA includes self-view of health and nutritional status and intake of water, protein-rich foods and fruits and vegetables. The MNA has a weighted scoring system while the other three scales have an equal-score system for all items. MNA-SF is the first section of the MNA-LF and does not cover dietary intakes or self-evaluated items. It is a prescreening tool rather than an assessment tool. The MIS has been suggested to be superior to the conventional SGA and DMS because it includes biochemical indicators (Kalantar-Zadeh et al., 2001). However, it also makes the process invasive, more costly and more time-consuming. According to the results of the present study, the MNA-LF is at least comparable to the SGA in assessing the risk of malnutrition in patients on HD.

It should also be mentioned that compared to the SGA, the two long-form MNA versions rated slightly lower (not statistically significant) proportions (47.4% vs. 40.8% and 36.2%) of subjects at risk of malnutrition. On the other

hand, Afsar et al. (2006) suggested that the MNA overrated the proportion of HD patients at risk of malnutrition compared to the SGA. The reason(s) for these discrepancies is not apparent at the present time, but could be user-related. The SGA has been observed to be associated with relatively large inter-rater variations (Ek et al., 1996; Vellas et al., 2001) presumably due to the subjective and non-quantitative nature of the tool. Further studies are needed to clarify the discrepancy.

4.2. Comparison among scales

These results suggest that the MNA-LF versions are at least as good as the SGA in grading the nutritional risk of HD patients. This result is in line with the observation made in a prospective single-blind study which showed that the MNA was better in identifying malnutrition in hospitalized (non-ESRD) patients (Barone et al., 2003). However, results of the present study show that the MNA-SF versions are not as good as the SGA or the MNA-LF in predicting under-nutrition in HD patients. The reasons for the MNA-SF to underpredict risk of malnutrition in HD patients can essentially be explained by the composition of the scales. The MNA-LF versions contain 18 items (Vellas et al., 1999) (17 items for MNA-T2) whereas the MNA-SF versions contain only the first 6 of the 18 items in the MNA (Kaiser et al., 2009). Although the 6 items are the key items, some aspects important to HD patients are not adequately represented in the 6 items. HD patients have rather unique appetite, medication and fluid intake problems and they are less satisfied with their health and nutritional status. These items are not adequately reflected in the MNA-SF versions.

4.3. Alternative MNA versions

Results of the present study also confirm again that CC is an acceptable alternative to BMI in the MNA. Overall, the T2 version performed relatively well compared to the T1 versions. Replacing CC for BMI in these scales has certain advantages. It enables easy completion of these scales without the need for measuring weight and height which can be quite cumbersome in frail elderly or persons with disability.

4.4. Study limitations

The study has some limitations. (a) Subjects were purposively recruited from only one hospital so the sample may not totally represent the entire HD population in Taiwan. (b) Although we have done our best to minimize it, there is still a potential of bias given that the same investigator evaluated participants with the MNA and the SGA. (c) Although we have attempted to use the most appropriate reference scales and biochemical indicators, no-one is certain that they are indeed the most ideal ones. (d) Some serum parameters such as C-reactive protein (CRP), a tissue inflammation biomarker, could have been determined and its impact on appetite and nutritional status been evaluated. However, CRP is not a routinely measured item.

5. Conclusion

Both versions of the long-form MNA are effective in grading the risk of malnutrition in patients on HD. However, the MNA-SF versions are not as good as the MNA-LF or the SGA in screening under-nutrition in these patients. It is advised that the MNA-SF not be used for rating the risk of malnutrition in patients on HD under the present form. Efforts should be made to adjust or revise the MNA-SF for HD patients because the short-form version is much more time-saving and greatly desired in clinical practice.

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Conflict of interest. None declared.

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Ethical approval. Chung Shan Medical University Hospital Institutional Review Board (#CS09-031).

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ijnurstu.2011.05.004.

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