Comparing the predictive ability of population-specific Mini-Nutritional Assessment with Subjective Global Assessment for patients with hemodialysis: A cross-sectional study.

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Abstract

Background: The Mini-Nutritional Assessment (MNA) and Subjective Global Assessment (SGA) are two frequently used tools in nutritional assessment.

Objectives: This study aimed to evaluate the feasibility of applying the MNA with population-specific anthropometric modifications and to compare the predictive ability of MNA with that of the SGA in patients with hemodialysis.

Design: Purposive sampling.

Methods: This study was conducted in the Hemodialysis Unit of E-Da Hospital in Kaohsiung, Taiwan. A total of 192 patients with hemodialysis were evaluated their nutritional status concomitantly with the SGA and the MNA in two versions-MNA Taiwan version-I adopted population-specific anthropometric cut points, and MNA Taiwan version-II had body mass index (BMI) omitted.

Results: The SGA graded 1% malnourished and 51% at risk of malnutrition for patients with hemodialysis; MNA Taiwan version-I graded 3 and 41%, respectively, whereas MNA Taiwan version-II graded 5 and 36%, respectively. There were significant differences between patterns of nutritional status predicted with the SGA and the MNA versions ($P<0.05$). The scores predicted with both tools correlated positively with appetite, serum albumin and creatinine levels, BMI, and mid-arm and calf circumferences, and negatively with number of emergency visits. However, only MNA versions negatively correlated with length of hospital stay (all $P<0.05$). Linear regression analysis revealed that the MNA Taiwan version-I, -II and SGA scores were positively associated with BMI and serum albumin level, and negatively associated with number of emergency visits after adjusting for confounders (all $P<0.05$). However, only MNA Taiwan version-I and -II were negatively associated with C-reactive protein (CRP) level ($P<0.05$). The associations of MNA Taiwan version-II with albumin and CRP levels were stronger than those obtained using MNA Taiwan

version-I and SGA.

Conclusions: The present study suggests that both the modified MNA versions can evaluate nutritional risk of patients with hemodialysis in Taiwan. The MNA Taiwan version-II which adopted population-specific anthropometric cut values without BMI is better able to assess nutritional status and reflect health status of patients with hemodialysis than MNA Taiwan version-I and SGA.

Keywords: Hemodialysis; Malnutrition; Mini-Nutritional Assessment; Subjective Global Assessment

What is already known about this topic?

- Malnutrition is common for patients with hemodialysis.
- Subjective Global Assessment (SGA) is a frequently used tool to monitor nutritional status of patients with hemodialysis.

What this paper adds?

- Mini-Nutritional Assessment (MNA) and SGA classify patients at risk or malnourished differently.
- The modified MNA Taiwan versions can evaluate nutritional risk and reflect health status of patients with hemodialysis in Taiwan.
- The MNA Taiwan version-II modified with population-specific anthropometric cut values without BMI improves the predictive ability and application of the original MNA and can be administered more efficiently in primary care settings.

1. Introduction

The increasing prevalence of end-stage renal disease in Taiwan is an important public health concern. Between 1990-2001, the incidence of hemodialysis in Taiwan increased 2.6 times, from 126 to 331 per million and the prevalence of hemodialysis increased 3.46 times, from 382 to 1322 per million (United States Renal Data System 2002 and 2005; Yang et al., 2008). The greatest increases in the incidence and prevalence of hemodialysis occurred in those aged 65-74 and ≥75 years (Yang et al., 2008).

Malnutrition occurred in 15-89% of patients with hemodialysis (Mehrotra et al., 2001; Steiber et al., 2007). The worldwide average was around 40% (Mehrotra et al., 2001). Steiber et al. (2007) also observed some degree of malnutrition in 70% of 153 US patients with hemodialysis. Malnutrition contributed to morbidity, mortality and poor prognosis in patients with hemodialysis (Araújo et al., 2006; Segall et al., 2009). Routine monitoring of nutritional status is important for early detection of malnutrition. Subjective Global Assessment (SGA), which was originally developed to identify poor nutritional status in subjects undergoing gastrointestinal surgery (Detsky et al., 1987), has been adopted to use in patients with end-stage renal failure and to quantify the prevalence of malnutrition in patients with hemodialysis (Kidney Dialysis Outcome Quality Initiative, 2000). However, SGA may be a less sensitive tool for elderly population. Previous studies showed that inter-rater agreement of SGA was low when applied to elderly population and discrepancies existed in malnourished reports (Ek et al., 1996; Duerksen et al., 2000). The sensitivity of SGA for serial measurements taken over time in old persons was also questioned (Duerksen et al., 2000).

On the other hand, the Mini-Nutritional Assessment (MNA) was developed and validated for assessing nutritional risk of elderly populations without a specialized

nutritional assessment team or someone with clinical experience (Guigoz et al., 1994). The MNA is composed of simple anthropometric measurements, global and dietary assessments, and subjective self-evaluation. Since variations in anthropometric cut points or food consumption patterns can be race- and ethnicity-related (Vellas et al., 2006), country- or population-specific modifications of this tool were necessary (Chumlea, 1999 and 2006; Kuzuya et al., 2005). This study used two MNA versions modified by Tsai et al. (2008). Version-I adopted Taiwan-specific anthropometric cut points and version-II displaced body mass index (BMI) from the scale and reassigned the score to mid-arm circumference (MAC) and calf circumference (CC) items.

The increase in the prevalence of hemodialysis in Taiwan occurred mostly in the elderly (Yang et al., 2008). However, MNA has not been widely tested for monitoring nutritional status of these patients. This study aimed to evaluate the feasibility of applying MNA with population-specific anthropometric modifications to patients with hemodialysis and to compare the predictive ability of MNA with that of SGA.

2. Method

2.1. Subjects

This study was conducted in patients with hemodialysis at Hemodialysis Unit of E-Da Hospital in Kaohsiung, Taiwan during the summer (July-Aug) of 2008. All patients in the unit who met the inclusion criteria and provided consents were enrolled in the study. Inclusion criteria were being on hemodialysis for at least 6 months, 17 years or older, no acute morbidity, able to answer questions and willing to have height and weight measured. In total, there were 192 enrolled patients. The Institutional Review Board of E-Da Hospital approved the study protocol (EMRP-097-039).

2.2. Nutritional assessment

A trained nurse used SGA and two modified MNA versions concomitantly to

assess nutritional status of each patient with hemodialysis. Both tools were translated into the local language (Mandarin). The trained nurse followed study guidelines and applied SGA and MNA in the same manner. A high inter-rater agreement was achieved prior to formal data collection (agreement percentages = 83.3% and 95.2%; kappa coefficients = 0.66 and 0.83 for SGA and MNA, respectively).

The SGA has the same core components as those described by Detsky et al. (1987) and uses the 7-point scale developed by the Canada-USA Peritoneal Dialysis (CANUSA) study (CANUSA Peritoneal Dialysis Study Group, 1996; Blake et al., 1999). The score of each variable and an overall score varied from 1 to 7. The SGA is a commonly used tool for assessing nutritional status of patients in clinical settings in Taiwan.

2.3. MNA and its modifications

The MNA was developed for assessing nutritional status in old persons (0-30 points) and is composed of simple anthropometric measurements, global and dietary assessments, and subjective self-evaluation (Guigoz et al., 1994 and 1996; Vellas et al., 2001). The cut points of anthropometric parameters-BMI, MAC and CC in the original MNA were designed for older Caucasians. However, Asian populations have different standards for healthy weight and obesity (Ko et al., 2001; Tsai et al., 2007). Gender differences should also be taken into consideration. Therefore, Tsai et al. (2007 and 2008) modified and validated the cut points of BMI, MAC, and CC in the MNA Taiwan version-I to reflect differences in the population-specific and gender-specific anthropometric standards. Further, measurements of height and weight are problematic for many geriatric patients. In version-II, BMI was omitted and its score was re-assigned to the MAC and CC items. We adopted the modifications of cut points and scores for BMI, MAC, and CC from the study by Tsai et al. (2008). MNA Taiwan version-I and -II are identical for all questions as the

original MNA English version except the cut-points and assigned scores of anthropometric parameters.

2.4. Classification of nutritional status

To compare predictive ability of modified MNA versions with that of SGA concomitantly and use conveniently and simply in the present study, subjects were classified as malnourished, at risk of malnutrition, or normal nutrition. With the MNA, individuals scored ≤16.5 were classified as malnourished; 16.5-23.5 were at risk of malnutrition and ≥23.5 were at normal nutrition status, whereas with the SGA, the respective scores were 1-2, 3-5, and 6-7 points. SGA scores 3-5 defined as at risk of malnutrition were equivalent to mild-moderate malnutrition in the present study.

2.5. Anthropometric measurements

A trained nurse measured and recorded the height and dry weight of each participant and measured the MAC and CC with a flexible tape. The MAC measurement was taken on the functional hand after dialysis.

2.6. Serum parameters

All patients underwent biochemical measurements as part of routine care. Blood samples were drawn immediately before dialysis. Serum albumin, total protein, C-reactive protein (CRP), hemoglobin, creatinine, urea, phosphorus and calcium concentrations were determined.

2.7. Health status parameters

Answers to the health-related parameters were from the following questions. (a) "Have you ever been hospitalized due to physical illness in the last 6 months and how long was your hospital stay?" (b) "How many times did you have the emergency visits in the last 6 months?" (c) "How many prescribed long-term medications do you regularly take?"

2.8. Statistical analysis

Distribution differences between nutritional status graded with the SGA, and the MNA Taiwan version-I and -II were assessed using the Wilcoxon Signed-Rank Test. Spearman's correlation analysis was used to determine the strength of relationship between scores of the SGA and the MNA Taiwan version-I & II with serum, anthropometric, and health-related parameters. Since gender differences existed in cut points for waist, MAC and CC, these anthropometric parameters were divided by their respective cut point values for adjusting for gender effects. To avoid the situation in which a score for an independent variable was a component of a dependent variable, we removed the assigned scores for BMI, MAC, CC, use of prescribed medication, and appetite status from the total MNA scores when analyzing the correlation of the total MNA score with the respective parameters. Multivariate linear regression analysis were performed to evaluate the association of the SGA score and the MNA Taiwan version-I & II scores with BMI, serum parameters and health status of subjects after adjusting for potential confounding factors. Since serum albumin and CRP levels were highly correlated, we introduced only one of two serum parameters into the linear regression model each time to avoid collinearities. The SAS statistical software package (SAS Institute, Inc., Cary, NC, USA) was used for all analyses. Statistical significance was set at $P<0.05$. Higher levels of significance, $P<0.01$ and $P<0.001$, were also indicated.

3. Results

Table 1 shows the characteristics of participating subjects. Average age was 61 years in men and 63 years in women. Average duration of hemodialysis was 35 months in men and 42 months in women. Men weighted more, were taller, had larger waists, greater CC and higher serum creatinine level than women (all $P<0.05$).

Table 2 shows the nutritional status of subjects classified by the SGA and the

MNA Taiwan version-I and -II. SGA graded 1% malnourished and 51% at risk of malnutrition for patients with hemodialysis; MNA Taiwan version-I graded 3 and 41%, respectively, whereas MNA Taiwan version-II graded 5 and 36%, respectively. The pattern for nutritional status predicted with the SGA differed significantly from that predicted with both MNA versions ($P<0.001$) while no differences existed between patterns predicted with the two MNA versions by the Wilcoxon Signed-Rank Test.

Table 3 shows Spearman's correlation coefficients of MNA Taiwan version-I, -II and SGA scores with serum and anthropometric and health-related parameters. MNA Taiwan version-I and -II scores correlated positively with albumin and creatinine levels, BMI, MAC, CC, and appetite, and negatively with length of hospital stay and number of emergency visits (all $P<0.05$). The SGA score correlated positively with albumin and creatinine levels, BMI, MAC, CC, and appetite, and negatively with number of emergency visits (all $P<0.05$).

Table 4 shows multivariate linear regression analysis of the SGA and MNA Taiwan version-I and -II scores with BMI, serum parameters, and health status of subjects. In model A, the MNA Taiwan version-I score was only positively associated with albumin level ($P<0.05$). The MNA Taiwan version-II and SGA scores were positively associated with albumin level and BMI (all $P<0.05$). The SGA score was negatively associated with number of emergency visits ($P<0.05$). In model B, the MNA Taiwan version-I and -II scores were positively associated with BMI, and negatively associated with CRP level (all $P<0.05$). The MNA Taiwan version-II score was also negatively associated with number of emergency visits ($P<0.05$). The SGA score was positively associated with BMI, and negatively associated with number of emergency visits (both $P<0.05$).

4. Discussion

4.1. MNA Taiwan version-II and SGA

The present study shows that the MNA Taiwan version-II rated more patients with hemodialysis as malnourished and fewer at risk of malnutrition compared with the SGA (4.69% vs. 1.04% for malnutrition; 36.46% vs. 50.52% at risk of malnutrition, respectively). There were significant differences between patterns of nutritional status predicted with SGA and the MNA versions ($P<0.05$). Persson et al. (2002) and Barone et al. (2003) determined that MNA classified more patients at risk or malnourished than SGA. Persson et al. (2002) found that more geriatric patients were rated protein-energy malnutrition or at risk of protein-energy malnutrition by MNA than by SGA (26% vs. 20% for protein-energy malnutrition; 56% vs. 43% for at risk of protein-energy malnutrition). Barone et al. (2003) who applied MNA and SGA to hospitalized older patients reported that MNA detected a greater number of malnourished subjects than SGA. This observation was consistent across day 0, 30, and 60 and remained statistically significant ($P<0.05$). Afsar et al. (2006) observed that classifications of nutritional status in patients with hemodialysis were inconsistent and MNA identified more malnourished subjects in 137 patients with hemodialysis than SGA did (65.7% vs. 32.8%). In fact, MNA and SGA were different in terms of the classification of patients as at risk or malnourished. Different classification criteria and criteria weights may be the reasons.

Results of the present study shows that the MNA Taiwan version-II and SGA were both positively associated with albumin level and BMI, and negatively associated with number of emergency visits in models A and B, respectively, after adjusting for confounding factors (all $P<0.05$). In model A, the SGA showed slightly better association with BMI and number of emergency visits than the MNA Taiwan version-II. In model B, the associations of SGA and MNA Taiwan version-II with BMI and number of emergency visits did not differ significantly. The SGA and MNA

Taiwan version-II both reflected the effects of BMI and number of emergency visits. However, only the MNA Taiwan version-II was significantly and negatively associated with CRP level. The MNA Taiwan version-II also showed a stronger association with nutritional status marker- albumin level and inflammation marker- CRP level when compared with that by the SGA. Results of the present study support the observations of Vellas et al. (2000), indicating that MNA score correlated well with nutritional intake, anthropometric parameters and albumin level in 155 geriatric subjects ($P<0.05$). Persson et al. (2002) reported that geriatric patients classified as well nourished by MNA had a better 3-year survival rate than well-nourished patients classified by SGA (75% vs. 48%). Bauer et al. (2005) observed significant associations of MNA and SGA with BMI in geriatric hospital patients ($P<0.05$). In terms of serum albumin level and duration of hospital stay, only a significant association was shown for MNA ($P<0.05$), but not for SGA.

A number of studies have demonstrated that SGA is a simple tool and that it correlated significantly with some nutritional parameters (Enia et al., 1993; Steiber et al., 2007; Vannini et al., 2009). On the other hand, SGA for nutritional assessment has discrepancies in detection of malnutrition. SGA showed to discriminate between patients with severe malnutrition and those with normal nutrition, but SGA was not a reliable predictor of mild or moderate malnutrition (Cooper et al., 2002; Persson et al., 2002; Jones et al., 2004; Gurreebun et al., 2007). Gurreebun et al. (2007) reported that SGA failed to detect any additional cases of malnutrition in 141 hemodialysis patients already identified as malnourished by serum albumin level, BMI, and a history of weight loss. With the present results, we suggest that MNA Taiwan version-II is better than SGA at assessing nutritional status of patients with hemodialysis.

4.2. MNA Taiwan version-I and -II

The present results show that the MNA Taiwan version-I and -II were both

positively associated with albumin level in model A and with BMI in model B (all $P<0.05$). Both versions were negatively associated with CRP level in model B, but only version-II was negatively associated with number of emergency visits (all $P<0.05$). The MNA version-II without BMI measurement had stronger associations with serum albumin and CRP levels and number of emergency visits than MNA version-I. The application of population-specific MAC and CC cut points coupled with the modified MAC and CC scores preserved and improved the predictive ability of the MNA for the Taiwanese. The MNA Taiwan version-II has a clear advantage over the original MNA and MNA Taiwan version-I because it can be performed without the need for measuring height and weight.

5. Conclusions

Both the modified MNA Taiwan versions can evaluate nutritional risk for patients with hemodialysis in Taiwan. The MNA Taiwan version-II modified with population-specific anthropometric cut values and without BMI measurement can effectively and functionally assess nutritional status of patients with hemodialysis. Results of the present study suggest that the MNA Taiwan version-II without measuring BMI is better than the MNA Taiwan version-I and SGA in reflecting nutritional and health status of patients with hemodialysis. The MNA Taiwan version-II is an improved version of the original MNA and shortens the assessment time. It improves job efficiency of primary care professionals. Future studies will compare the predictive ability of the modified MNA with that of SGA for elderly populations and discover similarities or discrepancies of nutritional status.

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Conflict of interests: All authors declare that there is no conflict of interest involved in this study.

Ethical approval: The Institutional Review Board of E-Da Hospital approved the study protocol and ethical aspects of the study (EMPR-097-039).

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Table 1

Characteristic of subjects.

	Men (N=106)		Women (N=86)	
Variables	Mean ± SD	N (%)	Mean ± SD	N (%)
Age	60.67 ± 11.95		63.48 ± 11.59	
HD Duration (m)	34.50 ± 37.60		42.13 ± 41.33	
Weight (kg)	62.75 ± 12.11		54.35 ± 9.91***	
Height (cm)	165.27 ± 6.31		154.80 ± 5.89***	
BMI (kg/m^2)	22.74 ± 4.34		22.64 ± 3.68	
Waist (cm)	87.90 ± 10.90		81.54 ± 11.06***	
MAC (cm)	26.26 ± 3.50		26.28 ± 3.26	
CC (cm)	32.10 ± 3.73		29.86 ± 3.52***	
Albumin (g/dl)	3.93 ± 0.33		3.86 ± 0.32	
Creatinine (mg/dl)	11.03 ± 2.83		9.55 ± 2.23***	
CRP (mg/l)	7.39 ± 8.81		9.19 ± 20.31	
Comorbidity (N, %)				
Hypertension		68 (64.15)		48 (55.81)
Heart diseases		36 (33.96)		21 (24.42)
Diabetes		39 (36.79)		28 (32.56)

HD=hemodialysis; MAC=mid-arm circumference; CC=calf circumference;

CRP=C-reactive protein.

***P<0.001

Table 2

Nutritional status (N, %) of subjects classified by SGA and MNA Taiwan version-I and -II[a].

Versions	Malnutrition	At risk of malnutrition	Normal
SGA	2 (1.04)	97 (50.52)	93 (48.44)
MNA Taiwan version-I	6 (3.13)	78 (40.63)	108 (56.25)
MNA Taiwan version-II	9 (4.69)	70 (36.46)	113 (58.85)

SGA=Subjective Global Assessment; MNA=Mini-Nutritional Assessment.

[a]The pattern of nutritional status graded with SGA was significantly different from that graded with MNA Taiwan version-I and -II according to the Wilcoxon-Signed Rank Test (*** $P<0.001$) while no significant differences were observed between the two MNA versions.

Table 3

Spearman correlation coefficients of MNA Taiwan version-I, -II and SGA scores with serum and anthropometric and health-related parameters.

Variables	MNA-Taiwan version-I	MNA-Taiwan version-II	SGA
Albumin	0.40***	0.39***	0.32***
Creatinine	0.45***	0.46***	0.49***
CRP	-0.06	-0.12	0.03
Waist std[a]	0.14	0.10	0.10
BMI	0.20[b,]**	0.31***	0.35***
MAC std[a]	0.33[b,]***	0.29[b,]***	0.33***
CC std[a]	0.38[b,]***	0.29[b,]***	0.38***
No. of prescribed medication	-0.05[b]	-0.06[b]	0.06
Length of hospital stay	-0.20**	-0.20**	-0.10
No. of emergency visits	-0.23**	-0.24**	-0.16*
Appetite status	0.27[b,]***	0.27[b,]***	0.29***

SGA=Subjective Global Assessment; MNA=Mini-Nutritional Assessment; CRP=C-reactive protein; BMI=body mass index; MAC=mid-arm circumference; CC=calf circumference.

[a]Measured values of waist, MAC and CC were divided by respective cut-points values (waist = 90/80 cm, MAC = 22.5/21 cm and CC = 28/25 cm for male/female, respectively) for standardization.

[b]The total MNA score did not contain the score contributed by the respective anthropometric parameters or health status parameters when calculating the correlation of the MNA scores with each of these specific parameters.

*P<0.05, **P<0.01, and ***P<0.001

Table 4

Multivariate linear regression analysis of SGA and MNA Taiwan version-I and -II scores with anthropometric parameters, serum parameters and health status of subjects. (N=189)

Variables	Taiwan version-I[a]		Taiwan version-II[a]		SGA	
	β	t	β	t	β	t
Model A						
Gender	-0.42	-1.04	-0.19	-0.44	-0.26	-2.01*
Albumin	3.45	5.31***	4.50	6.29***	0.85	4.13***
BMI	0.07	1.42	0.15	2.77**	0.05	3.40***
No. of prescribed medication	-0.16	-1.73	-0.19	-1.86	-0.01	-0.25
Length of hospital stay	-0.01	-0.25	-0.003	-0.11	0.01	0.86
No. of emergency visits	-0.18	-0.92	-0.27	-1.29	-0.13	-2.05*
Model B						
Gender	-0.55	-1.36	-0.38	-0.84	-0.32	-2.47*
CRP	-0.06	-4.14***	-0.07	-4.54***	0.002	-0.40
BMI	0.15	3.09**	0.25	4.73***	0.07	4.43***
No. of prescribed medication	-0.08	-0.90	-0.08	-0.85	0.02	0.74
Length of hospital stay	-0.001	-0.05	0.002	0.08	0.004	0.55
No. of emergency visits	-0.36	-1.88	-0.51	-2.39*	-0.15	-2.46*

SGA=Subjective Global Assessment; MNA=Mini-Nutritional Assessment; CRP=C-reactive protein; BMI=body mass index.

[a]The total MNA score did not contain the score contributed by BMI or prescribed medication when analyzing the association of the MNA scores with each of these specific parameters.

*P<0.05, **P<0.01, and ***P<0.001