Mini Nutritional Assessment Short-Form (MNA-SF) Predicts Clinical Outcomes: Cohort Study of Small-Sized Hospital in Japan

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**Background:** Among the elderly, the rate of complications resulting from malnutrition is high. A mini nutritional assessment short-form (MNA-SF) was confirmed overseas to identify malnutrition and predict clinical outcomes. This study aimed to evaluate the MNA-SF usefulness in Japanese small-sized hospital.

**Methods:** This was a prospective cohort study conducted on hospitalized patients at small-sized hospital, Department of General Internal Medicine which has 30 beds. All consecutive hospitalized patients for 4 months were included. A MNA-SF assessment on admission was implemented as exposure factor. Primary outcomes included death and complications such as infectious disease, organ failure, delirium, falls, diagnosis of malignancy and poor oral intake. Secondary outcomes including days of hospitalization and discharge rate back to home were also measured.

**Results:** 177 patients were analyzed with the MNA-SF assessment. Twenty-three (13%) patients were “normal nutritional status”, 64 (36%) were “at risk” and 90 (51%) were “malnourished”. The mortality rate was 0, 1.4 and 6.9 cases/1000 person-day (incidence ratio 4.9 times), respectively. The complications incidence rate was 0, 18 and 30.1 cases/1000 person-day (incidence ratio 1.7 times), respectively. The number of days in hospital were 11.1, 14.0 and 21.6 days (p < 0.01), respectively. The discharge to home rate was 90.4, 84.4 and 53.3% (p < 0.01), respectively.

**Conclusions:** Among all patients on a Japanese general medicine ward, those with poor nourishment assessed by the MNA-SF showed a high death rate and complication incidence rate. And they are also proved to be difficult to early discharge from the hospital back to the patient’s homes.

**Keywords:** super-aged society, general practice, mini nutritional assessment short-form, comprehensive geriatric assessment, Type 2 translational research

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Introduction

Background

As the elderly population increases in Japan, there is also a concomitant increase of hospitalized patients who may also have various disease and disabilities. This combination of age and comorbidity may cause difficulty in coordinating the timely discharge from the hospital back to the patient’s home. Among the aged, the rate of nutritional deficiency is increasingly common, and the relationship with malnutrition and the clinical outcomes is important to identify.¹

There are various ways of assessing nutritional status, the Mini Nutritional Assessment (MNA) is a nutritional assessment tool that was developed for the elderly and which is an 18-item interview. The assessment has identified independent predictors such as mortality rate, the number of days being hospitalized, and the period of stay in a facility.²³ This assessment requires 10–15 minutes, so it is difficult to do this on a daily basis in a busy hospital facility. Instead, a Mini Nutritional Assessment Short-Form (MNA-SF) was developed as a simplified assessment without the sensitivity deterioration of discovering nutritional deficiency, and with no special measurement device being required. It is possible to implement this test in three minutes and with the correlation to the standard MNA being strong (correlation coefficient; r = 0.945).⁴ When the MNA-SF is conducted, patients checked with declined food intake, weight loss, nutritional status (Body Mass Index or Calf Circumference, if body weight is not available), mobility, neuropsychological problems (dementia or depression), acute disease or mental stress on a scale of zero to three, the total score can be categorized into one of three groups namely: “normal nutritional status”, “at risk” of malnutrition, and “malnourished.” The clinical outcome predictability of the MNA-SF itself is currently being verified in the world, whereas domestically, the MNA-SF had been studied the relationship with the number of days of hospitalization and the activities of daily living improvement in a university hospital,⁵ the relationship with rehabilitation outcome at a convalescent rehabilitation ward,⁶ the relationship with mortality rate and the number of days in hospital and the hospital discharge rate among very elderly aged more than 85 years old at department of general emergencies in mid-sized general hospital.⁷ However, no study has directly reviewed the clinical outcome and nutritional status among all hospitalized patients, which does not differentiate by age and disease at general internal ward in small scale hospitals, which assume 70% of our nation’s hospital.⁸

Objective

This study was focused on small-sized hospitals with general internal medicine wards which were not sub-specialized, with the target being the patients’ nutritional assessment at time of hospitalization using the MNA-SF and clarifying the clinical outcome of the relationship to mortality rate during hospitalization and number of days in hospital. Simultaneously, the ability to carry out the nutritional assessment of the MNA-SF at Japanese busy clinical sites on a daily basis was also evaluated.

Methods

Study design

We investigated prospective cohort study, which included inpatients of general internal medicine at our hospital. We measured their nutritional status on admission as exposure factors, and then conducted a follow-up survey to observe outcomes such as mortality and complications during hospitalization.

We also investigated whether it was possible to apply the usefulness and convenience of this measurement system to small-sized Japanese hospitals which have differences in both system and patient type from foreign hospitals.

Setting

Study location: The study was carried out in the Kin-ikyo Sapporo Hospital, on the general internal medicine ward. This hospital is located in Sapporo City in Hokkaido, Japan and the ward has 30 medical beds out of a total of 150, which cares for acute internal medical conditions; one nurse oversees 10 patients with there being no specialized internal medicine wards and with the doctors being general internists from staff.
grade to senior resident. The patient demographics include those with mild to moderate severity acute disease, diabetic education, for close inspection of varied symptoms, disuse syndrome, and there are many who possess sociopsychological difficulties.

**Data source and Acquisition:** Data was acquired from the electronic charts of the hospital patients at the above institution. Patients were entered into the study from 1st July 2013 to 31st October 2013, inclusive. The follow-up survey was carried out when the patient left the hospital either when relocated at another institution or at their home or upon their death. Follow-up after discharge was not conducted.

**Participants**

**Inclusion criteria:** All consecutive patients who were admitted to the general internal medicine ward were included in the study within the above mentioned date interval.

**Exclusion criteria:** Patients who were considered to be admitted for short-term medical examinations were excluded. This study is designed to detect high risk patient, but these patients didn’t have death or complication between previous one year, therefore this exclusion criteria is not have much influence on study interpretation.

**Sampling methods:** Patient’s were entered into the study weekly via a patient electronic chart. In order to avoid missing the registration of cases who were discharged from the ward within one week of admission, a reference was made about the patient’s admission on a dedicated ledger.

**Variables**

**Exposure Factor:** MNA-SF

At the time of patient registration, the patients were entered on to the electronic chart and the “MNA-SF template” was completed. With respect to the information required for the MNA-SF calculation, the amount of oral consumption was defined by the routine assessment by a nurse and a registered dietitian at the time of hospitalization. Nutritional status was defined with Body Mass Index (BMI) by a clinical clerk for patients when such patients could ambulate. For those patients who couldn’t ambulate, if the patient used a wheelchair, then their weight was measured while sitting in it. For those patients who were bed bound, weight measurements were not conducted but measured the Calf Circumference (CC) by a rehabilitation technician. When multiple measurement values existed, the most recent after hospitalization was adopted.

For statistical analysis, the result of three categories including “normal nutritional status”, “at risk”, and “malnourished,” was based on the total score. The scores of each item were not assessed because the purpose was to determine if the simple assessment of three groups was effective or not.

A “MNA-SF template” was created on the electronic chart including assessment of each item with judgment criteria. When information was entered into the template, a total score was automatically calculated and displayed. Baseline cut-off values for the MNA-SF were 12–14 for “normal nutritional status”, 8–11 for “at risk”, and 0–7 for “malnourished,” respectively.

**Major Outcomes:** Death and complications Complications included infectious disease, organ failure, delirium, fall, diagnosis of malignancy, and an inability to have oral intake.

Outcome assessment was conducted after all patients were released from hospital and in the period from 1st December 2013 to 31st January 2014, inclusive. With respect to all registered patients, a researcher referred to the electronic chart for the patients’ progress records and their discharge summaries. From this information it was possible to determine the outcome type and day of the adverse event. Simultaneously, the attending physician of the patient was consulted with regard to the type of outcome and on the day it occurred; if any deviations in judgment between the researcher and attending physician existed, the final decision was made according to the electronic chart information re-evaluation and finally confirmed by discussion. In cases for which multiple events existed during hospitalization, only the initial event was registered regardless of type. Infectious diseases included pneumonia, urinary tract infection, hepatobiliary infection, decubitus infection, *Clostridium difficile* infection, catheter-related blood stream infection, and it was determined...
when they occurred during the hospitalization. Organ failure, included acute heart failure, acute exacerbations of chronic heart failure, acute exacerbation of chronic obstructive pulmonary disease, asthmatic attack, acute kidney injury, acute exacerbation of chronic kidney disease, and liver failure. With regard to infectious disease and organ failure, if it did not satisfy the diagnostic criteria for each disease, the reason for the diagnosis and the differential diagnosis from the discharge summary was taken into consideration, and finally the attending physician’s clinical judgment was adopted. Delirium was diagnosed with the Confusion Assessment Method (CAM), but finally, the clinical judgment of the attending physician was adopted. All falls were recorded on an incident report by the nurse. Diagnosis of malignancy had exclusions including when there was an admission for examination when the cancer was diagnosed in the outpatient clinic; only cases for which examinations were undertaken for causes of symptoms leading to a diagnosis of cancer or when a cancer was identified upon examination for other reasons were registered. Cancer was confirmed either histopathologically, or when in cases that the patient was too unwell to have a biopsy, via imaging modalities e.g. computed tomography scans. When oral intake was not possible after admission, the outcome occurrence date was determined at that date when the fasting state began or when the patient had to be maintained by naso-gastric tube insertion, percutaneous endoscopic gastrostomy tube insertion, or when total parenteral nutrition was began.

**Secondary Outcomes:** Number of days in hospital and rate of discharge to home

Days in hospital were extracted from the electronic chart. With regard to the rate of discharge to home or elsewhere, the destination to where the patient was discharged to was confirmed from the summary and the patient referral document. This information was verified by the attending physician.

**Confounding factor:** Background of the patients, index of nutritional status at time of admission for other than MNA-SF, purpose of hospitalization

The patients’ backgrounds such as age and gender were extracted from electronic chart. Height, weight, BMI, serum albumin, total lymphocyte count, and C-reactive protein, which are indexes of nutritional status on admission other than MNA-SF were also extracted from electronic chart, if measured within one week after hospitalization. As for infectious disease, organ disorder, metabolic disease, admission for detailed examination, rehabilitation, others, as soon as the time of hospitalization was determined, referring to information before admission such as outpatient chart and referral form.

**Others:** Consideration of practicality

The executing rate of nutritional information gathering and the approximate time spent for fulfilling the MNA-SF template was also recorded.

**Countermeasure of bias**

Selection bias was not considered to be an issue because our hospitalized patients were studied to see if they matched previous larger cohort study outcomes.

With respect to information bias, there were no issues regarding disclosure, since all cases were measured exposure factors within one week of admission. As this study was not able to be blinded, it is possible that more complications were reported in malnourished patients. The impact of this was minimal due to the fact that information was extracted from the electronic chart and deviations in diagnosis were confirmed through independent researcher and discussion with the attending physician.

Confounding factors were considered to be due to age, gender, the patient’s nutritional status at the time of hospitalization, reason for hospitalization, extent of activities of daily living (ADL) and rehabilitation, nutritional intake. Multivariate analyses were used to assess age, gender and reason for hospitalization during the final analysis. The nutritional status other than MNA-SF was reported previously having correlation with MNA-SF, so these were not built in analysis. ADL, rehabilitation and nutritional intake at hospitalization were considered to have significant influence, but these information was got little, so we couldn’t use in multivariate analyses.
Method of Statistical Analysis
The results of the participants’ characteristics and nutritional status for continuous variables were expressed by averages and standard deviations; if deviation outlier and distribution issues existed, such results were expressed as medians and quartiles. Categorical variables were expressed in actual numbers and percentages. For verification of the difference between participants’ characteristics in the MNA-SF-determined three groups, for category variables, if there was less than five items of expectation value, Fisher’s exact test was applied, and failing that, the chi-square test was implemented. Continuous variable parametric verification was calculated using the Welch verification and for nonparametric verification the Kruskal-Wallis verification was used. Statistical significance was taken as a P value of less than 0.05. When multiple comparisons were conducted in the three groups, Bonferroni Law was implemented and statistical significance was taken as a P value of less than 0.01.

For major outcome analysis, the cumulative incidence of each group was calculated by dividing the new outcome occurrence number within the observation period by the total number in the observation group. For patients for which multiple events occurred, this was counted as one event. For incidence rate was calculated by dividing the new outcome occurrence number within the observation period by the total person-years. The unit of person-year method, it was determined so that the occurrence number for one month for our hospital ward could be understood sensuously and was set to be not person-year but 1000 person-day (= 30 beds × 30 days). Kaplan-Meier Law survival curves were generated in addition to the Log rank verification, and the survival periods were compared. Occurrences of complications were also conducted multivariate analysis with the Cox proportional hazards regression analysis with respect to age, gender, and purpose of admission.

Statistical analysis, was undertaken using Easy R (EZR version 1.22). Ethical Approval
This study was conducted in accordance with the Helsinki declaration and epidemiological study ethical guidelines and was given approval from the Kin-ikyo Sapporo Hospital Ethical Review Committee. No informed consent was sought from the individual patients or families because the collection of data was from usual information acquired during usual clinical practice. However, the study was advertised on the hospital’s internet website giving an explanation of the study and allowing for patients to be withdrawn if necessary.

Patient data was protected by linkable anonymous access, and when data had defects, the information was referenced to the electronic chart and the attending physician. After the end of the study, certain information was destroyed to ensure protection of the patients’ data.

Results
There were 200 patients admitted to the general medical ward during the study acquisition period. 177 patients were finally chosen to remain in the study after exclusions. There were no dropouts from the study.
Participants’ characteristics are shown in Table 1. The patients’ average age was 75.7 years and 58.2% were females. The average BMI was 21.9, and the average serum albumin value was 3.4 g/dl. The average period of stay in hospital was 17.5 days (median 13.0 days, minimum value 1.0 day, maximum value 71.0 days), and the rate of discharge from the hospital was 68.9%, and the mortality rate was 5.6%. The MNA-SF three-group patients number was 23 (13%) in the “normal nutritional state” group, 64 (36%) in the “at risk” group, and 90 (51%) in the “malnourished” group, respectively. There was no difference among the three groups with sex and the purpose of hospitalization which included organ failure and others. There were significant differences with respect to age, BMI, and all laboratory data, and the purpose of admission which included infectious diseases, metabolic disease, for close inspection, rehabilitation.

The major outcomes including mortality and complications are shown in Table 2. There were no deaths or complications in the “normal nutritional status” group. Whereas there were 1 and 9 deaths in the “at risk” group and “malnourished” group, respectively ($P = 0.045$). The cumulative mortality rate was 0.02 and 0.1, respectively (relative risk 9.4, 95% confidence interval 0.8–49.2), and the mortality rate was 1.4 and 6.9 cases/1000 person-day (mortality rate difference 5.5 cases/1000 person-day, mortality rate ratio 4.9 times). There were 13 complications in the “at risk” group and 39 in the “malnourished” group, respectively ($P < 0.001$). The cumulative complications occurrence rate was 0.2 and 0.43, respectively (relative risk 2.1, 95% confidence interval 1.2–3.6), and the complications occurrence rate was 18.0 and 30.1 cases/1000 person-day (incidence rate difference 12.1 cases/1000 person-day, incidence rate ratio 1.7 times). The survival

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**Table 1. Participants’ Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>All participants (N = 177)</th>
<th>MNA-SF result</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Normal nutritional status group (N = 23)</td>
<td>At risk group (N = 64)</td>
<td>Malnutrition group (N = 90)</td>
<td></td>
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<tr>
<td><strong>Background</strong></td>
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<tr>
<td>Age, mean (SD)</td>
<td>75.7 (14.9)</td>
<td>69.0 (14.4)</td>
<td>72.4 (16.1)</td>
<td>79.8 (12.7)</td>
<td>0.001**</td>
<td></td>
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</tr>
<tr>
<td>Female, n (%)</td>
<td>103 (58.2)</td>
<td>16 (69.6)</td>
<td>38 (59.4)</td>
<td>49 (54.4)</td>
<td>0.411*</td>
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<td><strong>Physical Features</strong></td>
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<tr>
<td>BMI, mean (SD)</td>
<td>21.9 (5.4)</td>
<td>26.1 (4.6)</td>
<td>23.1 (6.3)</td>
<td>19.5 (3.5)</td>
<td>&lt;0.001**</td>
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<tr>
<td><strong>Blood test</strong></td>
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<tr>
<td>Serum albumin value (g/dl), mean (SD)</td>
<td>3.4 (0.5)</td>
<td>3.72 (0.55)</td>
<td>3.55 (0.38)</td>
<td>3.14 (0.46)</td>
<td>&lt;0.001**</td>
<td></td>
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<tr>
<td>Total lymphocyte number (cells/mm3), median (25%, 75%)</td>
<td>1084</td>
<td>1833</td>
<td>1047</td>
<td>975</td>
<td>&lt;0.001***</td>
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<tr>
<td>CRP (mg/dl), median (25%, 75%)</td>
<td>0.9 (0.2, 5.1)</td>
<td>0.2 (0.0, 0.3)</td>
<td>0.4 (0.1, 2.6)</td>
<td>2.1 (0.5, 6.9)</td>
<td>&lt;0.001***</td>
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<tr>
<td><strong>Purpose of hospitalization</strong></td>
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<tr>
<td>Infectious disease, n (%)</td>
<td>61 (34.5)</td>
<td>1 (4.3)</td>
<td>17 (26.6)</td>
<td>43 (47.8)</td>
<td>&lt;0.001*</td>
<td></td>
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</tr>
<tr>
<td>Metabolic or endocrine disease, n (%)</td>
<td>35 (19.8)</td>
<td>12 (52.2)</td>
<td>16 (25.0)</td>
<td>7 (7.8)</td>
<td>&lt;0.001*</td>
<td></td>
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</tr>
<tr>
<td>Detailed symptom checking, n (%)</td>
<td>28 (15.8)</td>
<td>4 (17.4)</td>
<td>17 (26.6)</td>
<td>7 (7.8)</td>
<td>0.007*</td>
<td></td>
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<tr>
<td>Organ failure, n (%)</td>
<td>25 (14.1)</td>
<td>4 (17.4)</td>
<td>8 (12.5)</td>
<td>13 (14.4)</td>
<td>0.84*</td>
<td></td>
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</tr>
<tr>
<td>Rehabilitation, n (%)</td>
<td>16 (9.0)</td>
<td>0 (0.0)</td>
<td>2 (3.1)</td>
<td>14 (15.6)</td>
<td>0.008*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others, n (%)</td>
<td>12 (6.8)</td>
<td>2 (8.7)</td>
<td>4 (6.3)</td>
<td>6 (6.7)</td>
<td>0.921*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Purpose of hospitalization “others” include psychiatric disease, hematologic disease, trauma, drug side effect and others

1) chi-square test*, 2) Welch’s test**, 3) Kruskal-Wallis test***
curves of the deaths and complications are shown each in Figure 1 and Figure 2, respectively. There were no significant differences in death. There were significant differences seen for complications in univariate analysis ($P = 0.003$), but no significant differences seen in multivariate analysis.

Table 2. Death and Complications

<table>
<thead>
<tr>
<th>MNA-SF result</th>
<th>Normal nutritional status group (N = 23)</th>
<th>At risk group (N = 64)</th>
<th>Malnutrition group (N = 90)</th>
<th>Screening result ※</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of deaths (cases)</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>$P = 0.045^*$</td>
</tr>
<tr>
<td>Cumulative mortality rate (%)</td>
<td>0</td>
<td>0.02</td>
<td>0.1</td>
<td>Relative risk 9.4 (95%CI: 0.8–49.2)</td>
</tr>
<tr>
<td>Mortality rate (cases/1000 person-day)</td>
<td>0</td>
<td>1.4</td>
<td>6.9</td>
<td>Mortality rate difference 5.5, mortality rate ratio 4.9</td>
</tr>
<tr>
<td>Number of complications (cases)</td>
<td>0</td>
<td>13</td>
<td>39</td>
<td>$P &lt; 0.001^*$</td>
</tr>
<tr>
<td>Cumulative complications incidence rate (%)</td>
<td>0</td>
<td>0.2</td>
<td>0.43</td>
<td>Relative risk 2.1 (95%CI: 1.2–3.6)</td>
</tr>
<tr>
<td>Complications incidence rate (case/1000 person-day)</td>
<td>0</td>
<td>18.0</td>
<td>30.1</td>
<td>Incidence rate difference 12.1, incidence rate ratio 1.7</td>
</tr>
</tbody>
</table>

Complications: Total number of infectious disease, organ failure, delirium, falls, malignancies, oral intake decreased or absent
※ Comparison of “at risk” group and “malnutrition” group
*Fisher exact probability screening
Case/1000 person-day = case/30 beds × 30 days = case/hospital ward × month

Figure 1. Survival curve related to deaths

Figure 3 shows the outcome number of days of hospitalization and the rate of discharge to home. The average number of days in hospital for the “normal nutritional status” group, the “at risk” group, and the “malnourished” group was 11.1, 14.0, and 21.6 days ($p < 0.001$) respectively, and the discharge to home rate for each was 90.4, 84.4, and 53.3% ($p < 0.001$), respectively.

As for consideration of practicability, the rate of nutritional assessment implementation with weight measurement rate for other occupations was 96.9%, height and BMI measurement rate was 84.2%, and the MNA-SF assessment implementation rate by researcher was 100%. The time spent for the MNA-SF assessment was approximately 6 minutes (Approximately 60 min/week × 18 weeks (study period) = 1080 minutes/177 cases = 6.1 mins/case).

Discussion

In general internal medicine ward of our small-sized hospital, there were numerous patients with an ‘at risk’ group and ‘malnourished’ group. Among the groups with malnutrition, there was a tendency of increased
mortality and complications during hospitalization, prolonged days in hospital and difficulty in discharging such patients back to their homes. It was determined that assessment could be done easily in short time. This result was consistent with previous similar studies. In addition, compared with previous researches performed in Japan, this study shows usefulness of the MNA-SF in a small hospital, and among not high-aged patients.

Interpretation
In Japan’s super-aged society in which the numbers of fragile and disabled elderly persons are increasing, it is important to be able to pick up high risk patients for complication and having potential problems for discharge. The MNA-SF was able to conduct in a short time, and it utilized information within the current scope of every day work, and it could be applied to all hospitalized patients despite their background, hospital, or disease.

The MNA-SF could potentially be incorporated into a Comprehensive Geriatric Assessment (CGA) for assessment of all hospitalized patients in small-sized hospitals to determine prognostic information. In our hospital, based on these study results, all cases are assessed using the CGA and the MNA-SF to identify high risk groups, leading to targeted interventions. However, whether prognostic improvement in malnourished patients can be achieved is currently uncertain and is this needs to be studied further.

Limitations
We couldn’t indicated significant difference in Figure 1 and 2, but we confirm similar trends consistent with other larger studies. With regards to confounding factors, significant information was missing on the electronic charts for other variables such as the participants’ socioeconomic status, the intervention of nutrition or rehabilitation, and therefore could not be analyzed.
The required time for the MNA-SF calculation in our study is 6 minutes, that is longer than previous study, this is because the lack of dedicated staff for performing the assessment. The use of an automated calculation via routine assessment on admission by occupational staff other than physicians, led to a decreased burden of work.

Conclusion
In general internal medicine ward of small-sized hospital in the super-aged society of Japan, the application of the MNA-SF for the assessment of the nourishment states to evaluate clinical outcome is useful, and that such a test can be carried out in a quick and simple manner.

Disclosure of conflicts of interest - None disclosed.

Acknowledgement
I would like to extend my heartfelt appreciation to Professor Masato Matsushima of the Division of Clinical Epidemiology, Jikei University School of Medicine, and all the guiding physicians of the Jikei Clinical Research Program for Primary Care for their assistance and in cooperating in this study. Moreover, I would like to express my deepest thanks to the General Practice and Medical Education Center, Hokkaido Kin-ikyo staffs, especially to Kenji Kanto, Kotoe Katsuta, Toru Higuchi, and to the hospital ward nurses, rehabilitation technicians, management nutritionist, and hospital ward clerks who gave their assistance enthusiastically.

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