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Impact of the Controlling Nutritional Status (CONUT) score as a prognostic factor for all-cause mortality in older patients without cancer receiving home medical care: hospital ward-based observational cohort study

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ABSTRACT

Objectives Malnutrition in cancer-free older patients receiving home medical care may affect prognosis, but indicators of long-term nutrition-related prognosis have not been developed. This study investigated the utility of the Controlling Nutritional Status (CONUT) score as a prognostic factor for older patients without cancer receiving home medical care.

Design This was a single-centre, hospital ward-based observational cohort study.

Setting and participants In total, 625 cancer-free older patients (median age, 81.0 years; 47.4% males) receiving continuous home medical care through clinics were enrolled on admission to a hospital ward from March 2011 to September 2018.

Primary outcome measures Continuous cumulative survival curves were obtained using the Kaplan-Meier method after dividing the CONUT score into four groups. The prognostic factors for overall mortality were evaluated using the Cox proportional hazards model. Comparisons with other predictive tools were performed.

Results The Kaplan-Meier curves of CONUT scores revealed a stepwise shortening of the median survival time with increasing scores. The HR of CONUT scores adjusted by age, sex and other confounding variables was 1.422 (95% CI 1.232 to 1.643, p<0.001). The areas under the receiver operating characteristic curve of the CONUT score for 1-year and 5-year survival were 0.684 and 0.707, respectively. The CONUT score displayed greater predictive utility than other nutrition-related predictive tools.

Conclusions The CONUT score on hospital admission could be used to predict overall mortality in older patients without cancer receiving home medical care. It is expected to be a simpler and cheaper screening tool for assessing the nutritional status in the field of home medical care.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This was an observational cohort study on admission to a hospital ward, including 625 cancer-free patients aged >65 years receiving continuous home medical care through clinics.
⇒ Continuous cumulative survival curves after admission were obtained using the Kaplan-Meier method after dividing the Controlling Nutritional Status score into four groups, and compared with other related nutritional tools.
⇒ This study was a single-centre study, and the data did not include those of home-bound patients who have never been admitted to a hospital.

INTRODUCTION

Japan has become a super-ageing society, and the number of older people who are reaching the end of their lives at home or in long-term care facilities while receiving the medical care they desire is gradually increasing.[1] Under these circumstances, the Japanese national government has been promoting home medical care through multidisciplinary collaboration centred on physicians.[1] However, the history of the systematic promotion of home medical care is short, and the evidence about prognostic factors in-home medical care in Japan is scarce.[2–4]

In previous research on home medical care, Ohtsuka *et al*[5] reported that 77.5% of patients (N=993) receiving home medical care exhibited malnutrition or risk of malnutrition in a survey using Mini Nutritional Assessment Short-Form (MNA-SF). Thus, the importance of nutritional assessment in patients receiving home medical care was suggested. In a cross-sectional observation study with no long-term follow-up, Umegaki *et al*[3] also found using MNA-SF that malnutrition was related to unexpected admission and mortality in older patients receiving home medical care. Kaneko *et al*[4] assessed factors associated with overall mortality in patients receiving home

medical care through long-term follow-up and identified several significant factors. However, nutritional assessments, excluding serum albumin, were not examined in this study.

Although nutritional assessment is important, many patients receiving home medical care have low activities of daily living (ADLs) and they are almost bedridden. In Japan, most home visits for such patients are undertaken by physicians at local clinics. For this reason, many patients struggle to measure their body weight on a regular basis, and there has been a demand for simpler nutritional evaluation methods. Contrarily, blood-sampling data can be easily measured even for patients who have difficulty going to the hospital, and they can be tested inexpensively within the Japanese medical system.

The Controlling Nutritional Status (CONUT) score is a nutritional scoring tool that is calculated using serum albumin, the total lymphocyte count (TLC) and total cholesterol (TC).[6] Previous studies reported that the CONUT score is associated with short-term and long-term prognosis, especially in patients with cancers,[7–9] patients with cardiovascular disease[10 11] and older people.[12 13] Most studies examining the CONUT score in patients without cancer assessed short-term outcome.[10–13]

Thus, this study investigated the utility of the CONUT score as prognostic factor for older patients without cancer receiving home medical care in comparison to other nutrition-related tools and examined its usefulness and validity in home medical care.

METHODS

Study design

This was a single-centre, hospital ward-based observational cohort study. This centre had a hospital ward termed 'Home Medical Care Support Ward', which only admitted patients receiving regular physician-led home visits through neighbouring clinics.

Study population

We consecutively enrolled patients without cancer aged ≥65 years admitted to this hospital ward between March 2011 and September 2018. Among the 1269 admitted patients, 488 patients missing data for calculating CONUT scores were excluded. In addition, patients with cancer (N=156) were excluded, and the final study population consisted of 625 patients (figure 1).

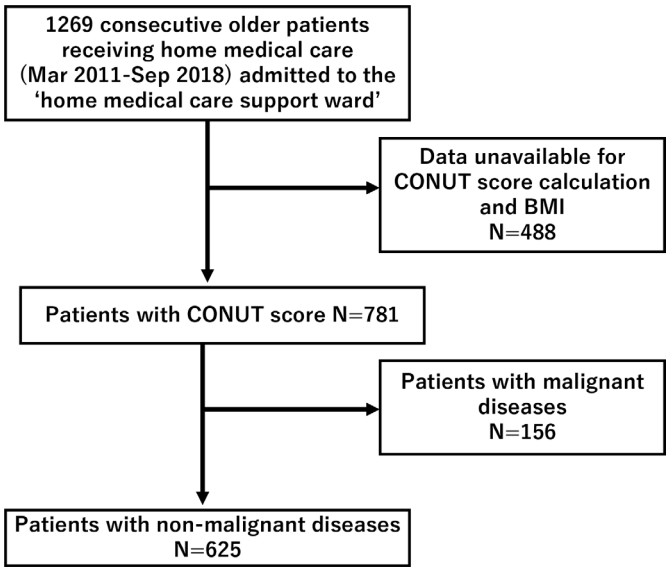

Figure 1 Flow chart of the study. BMI, body mass index; CONUT, Controlling Nutritional Status.

Patients and public involvement

No patient was involved in the development, design and conduct of this study and the data interpretation.

Data collection

We collected data on patient demographics, household structure, the purpose of admission, underlying disorders, comorbidity, ADLs (Barthel index (BI)), body mass index (BMI), Clinical Frailty Scale (CFS) and laboratory tests at hospital admission. The laboratory variables included haemoglobin (Hb), total protein (TP), albumin, serum creatinine (sCr), blood urea nitrogen (BUN), TLC, TC and C reactive protein. Cognitive impairment in patients was defined as a diagnosis of dementia based on medical records or long-term care insurance with a level of 'activities of daily living of people with dementia' greater than III, which is used to assess cognitive impairment in long-term care insurance in Japan as previously reported.[14]

Follow-up

Follow-up on all selected patients was conducted throughout the study period. A prognosis survey was conducted by email once a year for patients and their families. In the case of surviving patients in each survey, the place of residence at that time was confirmed in the questionnaire. For deceased patients, the date and place of death were confirmed by the bereaved family in the questionnaire. Consent by patients and their families was obtained implicitly through receipt of the questionnaires. Observations for each patient were terminated on confirmation of the patient's death or the end of the observation period.

The primary outcome measure was all-cause death after hospital admission.

Nutrition-related tools

The CONUT score was calculated as follows: CONUT score=serum albumin score+TC score+TLC score.[6] The serum albumin score was categorised as follows: 0, ≥3.5 g/dL; 2, 3.0–3.49 g/dL; 4, 2.50–2.99 g/dL; and 6, <2.50 g/dL. The TLC score was classified as follows: 0, ≥1600/μL; 1, 1200–1599/μL; 2, 800–1199/μL; and 3, <800/μL. The TC score was classified as follows: 0, ≥180 mg/dL; 1, 140–179 mg/dL; 2, 100–139 mg/dL; and 3, <100 mg/dL. Patients were categorised as having no (CONUT=0–1), mild (CONUT=2–4), moderate (CONUT=5–8) or high

(CONUT=9–12) nutrition-related risk according to the original study.[6]

The Geriatric Nutritional Risk Index (GNRI) was calculated as follows: GNRI=(14.89×serum albumin (g/dL))+(41.7×actual wt (kg)/ideal weight (kg)).[15] Ideal weight was calculated using the Lorentzian formula.[15] Patients were considered to have no (GNRI≥98), mild (92≤GNRI<98), moderate (82≤GNRI<92) or high (GNRI<82) nutrition-related risk according to the original study.[15]

The Prognostic Nutritional Index (PNI) was calculated as follows: PNI=(10×serum albumin (g/dL))+(0.005×TLC (/µL)).[16] Patients were considered to have no (PNI≥50), mild (45≤PNI<50), moderate (40≤PNI<45) or high (PNI<40) nutrition-related risk according to a previous study.[17]

Statistical analyses

Categorical variables are presented as numbers and percentages, and they were compared using χ^2 test. Continuous variables are presented as the mean±SD or median (IQR). The Shapiro-Wilk test was conducted to determine if the continuous variables were normally distributed. Variables with p≤0.05 showed that the variable was not normally distributed. Data that were not normally distributed were analysed using the Kruskal-Wallis test. We also conducted the Levene test to assess the equality of variances. One-way analysis of variance (ANOVA) was performed if homogeneity of variance was confirmed, while Welch's ANOVA was performed for data with unequal variances. Continuous cumulative survival curves were obtained using the Kaplan-Meier method, and differences between the groups were assessed using the log-rank test with Holm's post-hoc test. We assessed the proportional hazard assumption in Cox regression by graphical approach using log–log survival curves. Univariate and multivariate analyses using the Cox proportional hazards model were performed as the independent tests of significance. Univariate data significant at p<0.1 were included in multivariate analysis along with age and sex. Several variables including albumin and TC exhibited multicollinearity with CONUT scores, and they were excluded from multivariate analysis. HRs with 95% CIs were calculated for all significant variables in univariate and multivariate analyses. In this analysis, the CONUT score was included, on an ordinal scale, as one of the independent variables. The survival receiver operating characteristic (ROC) curve[18] was used to assess the sensitivity and specificity for 1-year and 5-year survival. Two-tailed p<0.05 was considered statistically significant.

We used IBM SPSS Statistics V.29 (IBM, Armonk, NY, USA), R V.4.1.3. (R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/) and EZR V.1.55 (Saitama Medical Center, Jichi Medical University, Saitama, Japan) for analysis.

RESULTS

Baseline characteristics

The baseline characteristics of the study population and nutritional parameters based on CONUT scores are presented in table 1. The median (IQR) of patients' age was 81.00 (13), and 47.4% were men. The median (IQR) of Charlson comorbidity index (CCI) was 2.00 (2). The median (IQR) of BI and CFS were 0.00 (10) and 8.00 (1), respectively, indicating that the study population had lower ADLs and higher frailty.

The CONUT scores of patients and their relationships with other variables are presented in table 2. We confirmed the proportional hazard assumption in Cox regression through log–log survival curves. Age, C reactive protein levels and the frequency of respiratory tract infection at admission were higher in patients with high CONUT scores than in those with low CONUT scores. Conversely, Hb, TP, albumin and TC levels were lower in patients with high CONUT scores.

Survival analysis

Figure 2 presents the Kaplan-Meier curves and the number of patients at risk as classified by CONUT scores. A stepwise shortening of median survival was observed with increasing CONUT scores. The median survival times of patients with no, mild, moderate and high nutritional risk were 1437 (95% CI 854.4 to 2019.6), 943 (95% CI 725.1 to 1160.9), 403 (95% CI 271.6 to 534.4) and 83 days (95% CI 40.6 to 125.4), respectively. The log-rank test revealed significant differences among the four categories (χ^2=89.7, p<0.001). Holm's post-hoc test showed significant differences (p<0.001) when the no nutritional risk group was compared with the moderate and high nutritional risk groups, the mild nutritional risk group to the moderate and high nutritional risk groups and the moderate nutritional risk group to the high nutritional risk group.

Predictors of overall mortality

The factors associated with overall mortality in univariate analyses were age, sex, CCI, underlying diseases, cognitive impairment, household structure, BMI, laboratory findings, respiratory tract infection on admission and the CONUT score (table 2). Among age, sex and variables significant at p<0.1 in univariate analysis, age (HR=1.053, 95% CI 1.038 to 1.069), male sex (HR=1.343, 95% CI 1.071 to 1.685), CCI (HR=1.162, 95% CI 1.059 to 1.276), sCr (HR=1.303, 95% CI 1.171 to 1.450) and CONUT score (HR=1.422, 95% CI 1.232 to 1.643) were found to be significant factors increasing the risk of overall mortality. Conversely, BMI (HR=0.961, 95% CI 0.929 to 0.993) and Hb (HR=0.894, 95% CI 0.839 to 0.952) were significantly associated with a lower risk of overall mortality.

Comparisons of nutrition-related tools

Table 3 (left) presents area under the survival ROC curve (AUC) for 1-year and 5-year survival, the log-rank test, median and 95% CI for the CONUT score, GNRI and

Table 1 Characteristics of patients and nutritional parameters according to the CONUT score

Variables	Total (n=625)	Normal (CONUT score=0–1, n=105)	Mild (CONUT score=2–4, n=283)	Moderate (CONUT score=5–8, n=194)	High (CONUT score=9–12, n=43)	P value
Age (years), median (IQR)	81.00 (13)	77.00 (15)	81.00 (12)	84.00 (11)	84.00 (15)	<0.001
Male, n, (%)	296 (47.4)	55 (52.4)	123 (43.5)	92 (47.4)	26 (60.5)	0.125
Charlson comorbidity index, median (IQR)	2.00 (2)	2.00 (2)	2.00 (2)	2.00 (2)	2.00 (1)	0.466
Barthel index, median (IQR) (missing data=41)	0.00 (10)	0.00 (5)	5.00 (15)	0.00 (8)	0.00 (5)	0.004
Clinical Frailty Scale, median (IQR)	8.00 (1)	8.00 (1)	8.00 (1)	8.00 (1)	8.00 (1)	0.714
Underlying diseases						
Neurological disease, n (%)	182 (29.1)	43 (41.0)	94 (33.2)	40 (20.8)	5 (11.6)	<0.001
Cerebrovascular disease, n (%)	161 (25.8)	23 (21.9)	78 (27.6)	49 (25.3%)	11 (25.6)	0.724
Dementia, n (%)	108 (17.3)	22 (21.0)	34 (12.0)	41 (21.1)	11 (25.6)	0.014
Respiratory disease, n (%)	57 (9.1)	8 (7.6)	32 (11.3)	14 (7.2)	3 (7.0)	0.391
Heart disease, n (%)	34 (5.4)	3 (2.9)	17 (6.0)	13 (6.7)	1 (2.3)	0.4
Bone and joint disease, n (%)	44 (7.0)	3 (2.9)	14 (4.9)	22 (11.3)	5 (11.6)	0.009
Others,* n (%)	39 (6.3)	3 (2.9)	14 (4.9)	15 (7.7)	7 (16.3)	0.012
Cognitive impairment						
Impaired, n (%)	320 (51.2)	51 (48.6)	139 (49.1)	106 (54.6)	24 (55.8)	0.559
Household structure						
Living alone, n (%)	40 (6.4)	4 (3.8)	19 (6.7)	15 (7.7)	2 (4.7)	0.589
Living with one person, n (%)	169 (27.0)	49 (46.7)	70 (24.7)	38 (19.6)	12 (27.9)	<0.001
Living with more than two persons (%)	416 (66.6)	52 (49.5)	194 (68.6)	141 (72.7)	29 (67.4)	<0.001
BMI, kg/m^2, median (IQR)	17.60 (5.0)	18.50 (4.6)	17.70 (5.0)	17.2 (5.0)	16.3 (4.2)	0.001
Laboratory findings, median (IQR)						
Hb, g/dL	12.2 (2.4)	13.2 (1.9)	12.4 (2.1)	11.5 (2.1)	10.3 (2.7)	<0.001
TP, g/dL	6.8 (0.9)	7.10 (0.9)	6.90 (0.9)	6.50 (1.0)	5.80 (1.2)	<0.001
Albumin, g/dL	3.40 (0.7)	3.70 (0.4)	3.60 (0.5)	3.00 (0.5)	2.30 (0.6)	<0.001
sCr, mg/dL	0.60 (0.50)	0.50 (0.45)	0.60 (0.40)	0.60 (0.43)	0.60 (0.80)	0.113
BUN, mg/dL	18.00 (12)	18.00 (11)	17.00 (10)	19.00 (13)	25.00 (18)	0.006
TC, mg/dL	160.0 (52)	198.0 (64)	166.0 (49)	148.0 (45)	108.0 (39)	<0.001
CRP, mg/dL (missing data, n=9)	0.99 (4.37)	0.385 (0.89)	0.66 (0.21)	2.65 (8.38)	10.00 (11.36)	<0.001
RTI at admission, n (%)	93 (14.9)	5 (4.8)	36 (12.7)	37 (19.1)	15 (34.9)	<0.001

*Others include digestive disease, renal disease and skin disease.
BMI, body mass index; BUN, blood urea nitrogen; CONUT, Controlling Nutrition Status; CRP, C reactive protein; Hb, haemoglobin; RTI, respiratory tract infection; sCr, serum creatinine; TC, total cholesterol; TP, total protein.

PNI. The AUCs of the CONUT score for 1-year and 5-year survival were 0.684 and 0.707, respectively. The AUCs were slightly lower for GNRI (0.663 and 0.657, respectively) and slightly higher for PNI (0.721 and 0.743, respectively) relative to those of the CONUT score. The sensitivity and specificity of each tool are presented in table 3. PNI exhibited slightly higher sensitivity than the other tools.

Table 3 (right) shows the results of the log-rank test and median of survival and their 95% CI according to the classes of nutritional risk for all tools. As previously mentioned, survival decreased with increasing CONUT scores. However, there was no stepwise decrease in the median GNRI score by the severity of nutritional risk. For the PNI, only 26 patients had a score indicating no risk, hence, the median could not be calculated. The evaluation of the no risk group for the PNI category was therefore impracticable. Furthermore, the median PNI of the high nutritional risk group was 718 (95% CI 209.83 to 420.17), thus, a shorter-term prognosis could not be estimated. This shows that in terms of the four classes of nutrition-related risk, the CONUT showed a higher predictive ability than the PNI and GNRI.

DISCUSSION

In this study, older patients receiving home medical care, on average, had low ADLs, high frailty and a low

Table 2 Univariate and multivariate Cox proportion analysis

	Univariate analysis		Multivariate analysis	
Variables	HR (95% CI)	P value	HR (95% CI)	P value
Age	1.063 (1.050 to 1.077)	<0.001	1.053 (1.038 to 1.069)	<0.001
Male sex	0.922 (0.745 to 1.141)	0.454	1.343 (1.071 to 1.685)	0.011
CCI	1.167 (1.052 to 1.293)	0.003	1.162 (1.059 to 1.276)	0.002
BI	1.003 (0.997 to 1.009)	0.337		
CFS	1.000 (0.979 to 1.139)	0.997		
Underlying diseases				
Neurological disease	2.168 (1.690 to 2.781)	<0.001		
Cerebrovascular disease	0.834 (0.658 to 1.056)	0.131		
Dementia	0.794 (0.604 to 1.044)	0.099		
Respiratory disease	0.774 (0.529 to 1.134)	0.189		
Heart disease	0.399 (0.262 to 0.607)	<0.001		
Bone and joint disease	0.713 (0.485 to 1.096)	0.121		
Others*	0.709 (0.464 to 1.083)	0.112		
Cognitive impairment				
Impaired	0.830 (0.670 to 1.028)	0.087		
Household structure				
Living alone	0.783 (0.503 to 1.220)	0.28		
Living with one person	1.970 (1.513 to 2565)	<0.001		
Living with more than two persons	0.582 (0.457 to 0.740)	<0.001		
BMI	0.972 (0.941 to 1.003)	0.079	0.961 (0.929 to 0.993)	0.019
Laboratory findings				
Hb	0.781 (0.739 to 0.826)	<0.001	0.894 (0.839 to 0.952)	<0.001
TP	0.689 (0.595 to 0.799)	<0.001		
Albumin	0.368 (0.299 to 0.454)	<0.001		
sCr	1.457 (1.336 to 1.589)	<0.001	1.303 (1.171 to 1.450)	<0.001
BUN	1.019 (1.015 to 1.023)	<0.001		
TC	1.000 (0.997 to 1.002)	0.804		
C reactive protein	1.034 (1.016 to 1.053)	<0.001		
RTI at admission	0.668 (0.501 to 0.891)	0.006		
CONUT score	1.758 (1.535 to 2.014)	<0.001	1.422 (1.232 to 1.643)	<0.001

*Others include digestive disease, renal disease and skin disease.
BI, Barthel index; BMI, body mas index; BUN, blood urea nitrogen; CCI, Charlson comorbidity index; CFS, Clinical Frailty Scale; CONUT, Controlling Nutritional Status; Hb, haemoglobin; RTI, respiratory tract infection; sCr, serum creatinine; TC, total cholesterol; TP, total protein.

nutritional state, as indicated by nutrition-related variables. The CONUT score displayed potential utility as a long-term prognosis predictive factor in these patients. The patients with high CONUT scores had higher mean C reactive protein levels and higher rates of respiratory tract infection on admission. In the CONUT score, the albumin level is weighted twice as heavily as the other indicators. Serum albumin has traditionally been evaluated as a nutritional index, but in recent years, albumin has been evaluated as an index that reflects both pure malnutrition and the presence of inflammation.[13 19] For this reason, the serum albumin level tends to be excluded from the recent definition of malnutrition.[20 21] For the CONUT score including assessments of serum albumin, there are many objective facts about its usefulness as a prognostic factor for survival globally, as previously mentioned.[7–13] The CONUT score reflects malnutrition as well as coexisting inflammation and the immune-related nutrition state based on the TLC,[6] and thus, it may be a more certain predictor of prognosis.

In this study, other factors (age, sex, CCI, BMI, Hb and sCr) affecting the prognosis of patients receiving home medical care were also identified. The HR of the CONUT score adjusted by other factors was also significant. Previous studies on long-term prognosis reported that CCI and serum albumin levels were associated with

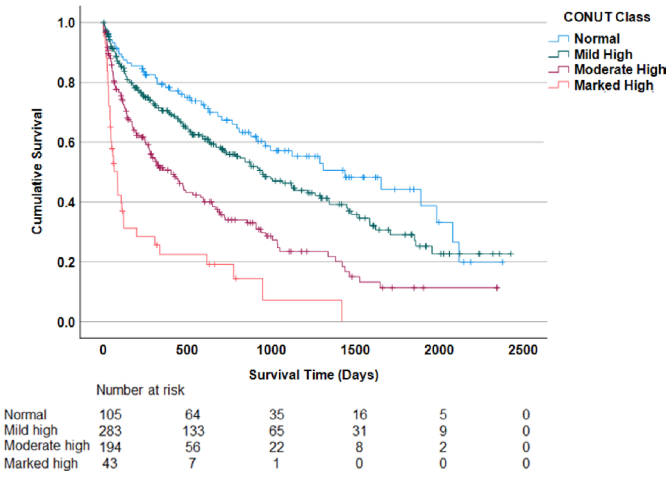

Figure 2 The Kaplan-Meier survival curves and the number of patients at risk according to the controlling nutritional status score. CONUT, Controlling Nutritional Status.

the overall mortality of patients receiving home medical care,[4] but this study did not assess survival using nutritional assessment tools, BMI and laboratory data other than serum albumin. One report found that serum Hb was associated with in-hospital mortality in older adults,[12] but these data only assessed short-term outcomes. Renal dysfunction has been evaluated as a prognostic factor of all-cause mortality in general population.[22]

We also compared the CONUT score with other nutritional prognostic indicators (GNRI[15] and PNI[16 17]), which are candidate indices that can be evaluated in the field of home medical care. The AUC (0.707) of the CONUT score for 5-year survival was higher than that of a standard ROC curve (AUC=0.62; 95% CI 0.580 to 0.665) of the CONUT score for 5-year survival in patients with resected breast cancer. PNI displayed slightly high sensitivity than the other indices. However, after dividing PNI into four classes, few patients had a score indicating no risk, and their median survival could not be calculated. Furthermore, the median survival of the high nutritional risk group for PNI was much longer than that of the corresponding group for the CONUT score. Overall, the use of the four CONUT classes could more practical.

Globally, in both patients with and without cancer, the usefulness of CONUT as a predictor of death and complications during hospitalisation has been examined or from the perspective of risk management for major invasive tests and surgery.[7–13] In other words, the view is settled on the usefulness of hospitals for early response and intervention.

During the social transition in Japan from a hospital-centred medical system to a community/home care-centred medical system, it is important to avoid hospitalisation such as sudden changes during home care and support the patient's home care life. Therefore, it appears useful to use CONUT, which can easily and accurately grasp the physical condition of patients receiving home medical care.

Strengths and limitations

In some home care settings, MNA-SF has been used as a nutrition screening tool. However, it is difficult to repeatedly measure BMI for patients with extremely low ADLs. The CONUT score can be easily calculated from the data of a single blood sampling, and the burden on the site is small. Under the Japanese medical system, medical fees for blood sampling at home are covered,

Table 3 Comparison of the predictive ability of nutrition-related tools

	AUC for 1-year survival	AUC for 5-year survival	Classes of nutrition-related risk	Log-rank test	Median (total dataset)	95% CI (total dataset)
CONUT	0.684	0.707	Normal	χ^2=89.7 (p<0.001)	1437	854.43 to 2019.57
	Threshold=4	Threshold=4	Mild		943	725.06 to 1160.94
	Sensitivity=0.555	Sensitivity=0.457	Moderate		403	271.61 to 534.39
	Specificity=0.725	Specificity=0.857	High		83	40.64 to 125.37
GNRI	0.663	0.657	Normal	χ^2=57.9 (p<0.001)	1437	901.79 to 1972.21
	Threshold=83.5	Threshold=79.5	Mild		943	634.82 to 1251.18
	Sensitivity=0.555	Sensitivity=0.304	Moderate		1006	677.87 to 1334.13
	Specificity=0.758	Specificity=1.000	High		285	170.33 to 399.671
PNI	0.721	0.743	Normal	χ^2=77.1 (p<0.001)	NA	NA
	Threshold=41.4	Threshold=40.76	Mild		1307	754.23 to 1859.77
	Sensitivity=0.764	Sensitivity=0.608	Moderate		1006	605.43 to 1406.58
	Specificity=0.578	Specificity=0.782	High		718	209.83 to 420.17

AUC, area under the receiver operating characteristic curve; CONUT, Controlling Nutritional Status; GNRI, Geriatric Nutritional Risk Index; NA, not applicable; PNI, Prognostic Nutritional Index.

making testing inexpensive. In addition, patients with normal BMI can be checked for the presence of potential nutritional disorders, as previously reported.[13] However, this study had some limitations. First, this was a single-centre, hospital ward-based observational cohort study. There may be regional differences, such as the disease characteristics of patients. Second, this study did not include data on patients receiving home medical care who had never been hospitalised. To obtain more universal results for all patients receiving home medical care, it is necessary to perform a multicentr cohort study of medical institutions that provide home medical care in the future.

CONCLUSIONS

The CONUT score on hospital admission could be used to predict overall mortality in older patients without cancer receiving home medical care. It is expected to be a simpler and cheaper screening tool for nutritional evaluation in the field of home medical care.

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Contributors HM and YG conceived and designed the study. HM collected data. HM and YG also analysed and interpreted data. HM wrote the manuscript. All authors approved the final manuscript. HM is the guarantor.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the Institutional Review Board of National Center for Geriatrics and Gerontology with reference number No. 675. This study complied with the principles outlined in the Declaration of Helsinki. The written informed consent from each patient was waived because of the following reasons, which were accordance with Japanese ethical guideline for medical and health research involving human subjects: (1) we would use clinical information obtained in routine practice on the medical record without any risk to the participants, (2) the waiver of normal consent procedures would not affect adversely the rights and welfare of the participants, (3) the Institutional Review Board of National Centre for Geriatrics and Gerontology approved this study, including the waiver of the written informed consent.[23]

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

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