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Relationship of Geriatric Nutritional Risk Index (GNRI) with length of hospitalization and mortality rate in elderly patients

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ABSTRACT

The proportion of elderly population is growing faster than any other age group. Malnutrition is a widespread problem in elderly and has been recognized as the most common cause of mortality and morbidity. Mini Nutritional Assessment (MNA) is recommended to detect malnutrition risk among geriatrics. However, it is just appropriate for geriatric who stay at home. For hospitalization patients, Nutritional Risk Index (NRI) that using albumin and weight is recommended. However, the weight data is often not possible obtained in geriatrics. Therefore, Geriatric Nutritional Risk Index (GNRI) using ideal body weight is recommended. The aim of this study was to evaluate relationship of GNRI with length of hospitalization and mortality rate in geriatric patients. This was an observational study with a prospective cohort design conducted in Dr. Sardjito General Hospital, Yogyakarta from January to February 2012. Patients who met the inclusion and exclusion criteria were recruited. Laboratoty and clinical examinations as well as GNRI scoring were then performed. Patients were grouped into two groups i.e. patients with GNRI score < 82 and e" 82. The patients were then monitored during hospitalization until they were discharged due to die or recovered. The length of stay and patients died were then recorded. The results showed that the length of stay of patients with GNRI score < 82 (14.32 ± 8.20 days) was significantly longer than those with GNRI score 82 (9.31 ± 6.15 days) (p = 0.006). Moreover, the mortality rate of patients with GNRI score < 82 (42.1%) was significantly higher than those with GNRI score 82 (2.8%) (p = 0.000). Kaplan-Meier survival analysis showed survival rate of patients with GNRI score <82 rapidly decreased when compared with those with GNRI score 82. In conclusion, there is negative correlation between GNRI with length of hospitalization and mortality rate in elderly.

ABSTRAK

Proporsi populasi usia lanjut tumbuh lebih cepat dari kelompok usia lain. Malnutrisi menjadi masalah luas pada usia lanjut dan diketahui sebagai penyebab umum kesakitan dan kematian. *Mini Nutritional Assessment* (MNA) direkomendasikan untuk mendeteksi risiko malnutrisi diantara usia lanjut. Namun demikian, pengukuran ini hanya tepat untuk usia lanjut yang tinggal di rumah. Untuk pasien di rumah sakit, *Nutritional Risk Index* (NRI) yang menggunakan data albumin dan berat badan direkomendasikan. Akan tetapi data berat badan sering tidak bisa diperoleh pada usia lanjut. Sehingga, *Geriatric Nutritional Risk Index* (GNRI) menggunakan berat badan ideal direkomendasikan. Tujuan penelitian ini adalah mengkaji hubungan antara GNRI dengan lama tinggal dan kematian pasien usia lanjut. Penelitian ini merupakan penelitian observasional dengan rancangan kohort prospektif yang dilakukan di RSUP Dr. Sardjito, Yogyakarta pada Januari sampai Februari 2012. Pasien yang memenuhi kriteria inklusi dan eksklusi direkrut. Pemeriksaan laboratorium dan klinik dan perhitungan angka GNRI dilakukan. Pasien dikelompokkan menjadi dua kelompok yaitu kelompok pasien dengan angka GNRI < 82 dan 82. Pasien kemudian dimonitor selama di rawat sampai keluar karena meninggal atau sembuh. Selanjutnya lama tinggal dan kematian pasien dicatat. Hasil penelitian menunjukkan lama tinggal pasien dengan angka

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GNRI < 82 (14,32 ± 8,20 hari) lebih lama dibandingkan dengan pasien dengan angka GNRI e" 82 (9,31 ± 6,15 hari) (p = 0,006). Selain itu, tingkat kematian pasien dengan angka GNRI < 82 (42,1%) lebih tinggi secara nyata dibandingkan pasien dengan angka GNRI 82 (2,8%) (p = 0.000). Hasil analisis survival dengan Kaplan-Meier menunjukkan survival rate pasien dengan GNRI < 82 menurun cepat dibandingkan pasien dengan angka GNRI 82. Dapat disimpulkan, ada hubungan terbalikkan antara GNRI dengan lama tinggal di rumah sakit dan angkat kematian pada usia lanjut.

Keywords : Geriatric Nutritional Risk Index - length of hospitalization - mortality – elderly - malnutrition

INTRODUCTION

The proportion of elderly population is growing faster than any other age group. It is estimated that the elderly population, person 65 years or older, will grow four time faster than the average of world population growth in 2050. This demographic transition occurs due to the decrease mortality and women fertility rates.[1,2]

Malnutrition is a widespread problem in the elderly and has been recognized as the most common cause of secondary immunological dysfunction.[3] Malnutrition has the potential to cause serious problems and is often under-diagnosed among the elderly. The importance of early detection and aggressive intervention is essential to overcome this problem. Correct diagnosis depends on the status of nutrition and the screening tools available. After malnutrition was diagnosed, we can determine intervention to the underlying problem.[4]

Some guidelines recommend the use of the Mini Nutritional Assessment (MNA) to detect risk of malnutrition among elderly subjects aged >70 years. The MNA assessment is based on a questionnaire and does not use a biological indicator.[5] Because of the questionnaire's natural bias, MNA is more suitable for elderly who live at homes or nursing homes than during hospitalization. For adult patients who were hospitalized, it is recommended to use a combination of Body Mass Index (BMI, in kg/m2) and weight loss or Nutritional Risk Index (NRI). Nutritional Risk Index combines two indicators of nutrition (albumin and weight loss), unfortunately it is often not possible to obtain the data of body weight in elderly patients. Therefore, the formula of Geriatric Nutritional Risk Index (GNRI) using ideal body weight (BW) should be prepared. Ideal BW is calculated according to the Lorentz formula that takes the patient's height and gender into account. Height is difficult to measure in patients who are hospitalized because they are often unable to stand. Therefore, it is estimated using the equation based on the high Chumlea knee (Knee height).[6,7]

There is a difference between the risk index related to nutritional status and indices of nutrition and malnutrition. Geriatric Nutritional Risk Index is not an index of malnutrition, but it is risk index that related to nutritional status. Therefore, GNRI score corelates to complications due to nutritional status.[6] The GNRI has been introduced since 2005 as early screening in patients with malnutrition high risk.[8] Therefore early treatment can be conducted and length of stay, cost, morbidity and mortality can be reduced. This study was conducted to evaluate the relationship of GNRI with length of hospitalization and mortality rate in elderly patients in Dr. Sardjito General Hospital, Yogyakarta

MATERIALS AND METHODS

Subjects

This was an observational study with a prospective cohort design to evaluate the mortality rate and length of stay of elderly patients who admitted to the Internal Medicine Ward, Dr. Sardjito General Hospital, Yogyakarta and met the inclusion and exclusion criteria. The study was conducted from January to February 2012. The inclusion criteria were elderly patients (e" 60 years) admitted to the Internal Medicine Ward who were willing to participate in the study, whereas the exclusion criteria were the patients with severe liver disease, severe renal disease, coma patients, patients coming for chemotherapy, and patients who went home at their own or family request. The protocol of this study has approved by Medical and Health Research Ethics Committee, Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta.

Procedure of study

Geriatric patients who admitted to the Internal Medicine Ward were selected. An explanation concerning background, objectives, benefit of the study was given. The patients who fulfilled the inclusion and exclusion citeria were given an informed consent to be signed. Laboratoty and clinical examinations consisting serum albumin and hemoglobin (Hb) level, body weight (BW) and body height (BH), Body Mass Index (BMI), knee height, upper arm circumference, depression status, and GNRI scoring were then performed. The patients were then monitored during hospitalization until they were discharged from the hospital due to died or recovered. The lenght of stay and patients died were recorded.

The measurement of serum albumin (g/dL) and Hb (g/dL) levels were performed in Pathology Laboratory, Dr. Sardjito General Hospital. Body weight (kg) and BH (cm) were measured a portable stadiometer. For non ambulatory patients, estimation of their BW was performed by measurement of their upper arm circumference. For patients who could not be measured their BH, estimation of their BH was performed according to the Chumlea equation based on their knee height. The BMI of patients was measured by the formula of BW divided by BH and calculated as kg/m^2 according to WHO.[9] For non ambulatory patients, BMI was calculated according to the Powell-Truck formula. Depression status of the patients was performed by an independent physician according to the Diagnostic and Statistical Manual IV - Text Revision (DSM IV-TR). Comorbidity Index was calculated based on patient's diagnosis. For each desease, a number of points were allocated according to Charlson Comorbidity Index and the sum of these points gived an overall score. The Comorbidity Index indicating risk relative to mortality was then categorized into two groups i.e. patients with Charlson score of ≤ 3 and > 3.

GNRI was determined by the following formula: GNRI = (1.489 x albumin g/L) + (41.7 x weight/ideal BW).[6] Severe renal impairment was defined if creatinine clearance <15 mL/h according to the Cockcroft and Gault. Severe hepatic impairment was defined if clinical symptoms of liver impairment such as jaundice, hepatomegaly or ascites were observed. Patient was considered to have ascites if Child-Pugh scale was grade C or total score of 10-15.[10]

Statistical analysis

Data were presented as mean ± standard deviation (SD) or median (minimum-maximum) or percent depending on types of data. The relationship of GNRI and length of stay was analyzed using Pearson correlation for normally distributed data or Spearman correlation for abnormally distributed data. Multivariate analysis was performed to evaluate risk factors that influenced mortality and length of stay.

RESULTS

Sixty elderly patients who met the inclusion and exclusion criteria involved in this study. All the patients underwent anthropometric and laboratory examination as well as GNRI measurement. The patients were then monitored their health status during hospitalized until they died or came back home from the hospital. During the monitoring, five patients could not follow the obseravtion and dropped out of the study, therefore only subjects completed this study.

The characteristics of patients are presented in TABLE 1. Thirty (65%) male and 19 (34.5%) female subjects were recruited in this study with the mean age of 67.82 ± 5.91 years, Charlson Cormobidity Index of 3.36 ± 2.35 and length of stay of 11.04 ± 7.27 days. The mean GNRI and Hb level of subjects were 82, 29 ± 16.39 and 11.98 ± 2.59 mg /dL, respectively. Among 55 patients who completed this study, 10 (18.2%) had depression and 45 (81.8%) patients had no depression. In addition, nine (16.4%) patients died and 46 (83.6%) patients came back home.

The characteristics of patients based on the GNRI score is presented in TABLE 2. It was showed that the mean age subjects with GNRI score <82 (68.16 ± 5.6 years) was not significantly different with those with GNRI score ≥ 82 (67.65 ± 6.13 years) (p = 0.677). No significant difference was also observed in gender of subjects (p = 0.126) and in subjects with depression (p = 0.069) between the two groups (GNRI score < 82 vs GNRI score ≥ 82). In contrast, the Hb value of subjects in group with GNRI < 82 was significantly different compared to those with GNRI ≥ 82 (p = 0.030). The group with GNRI < 82 had higher Hb value < 10 mg/dL than the group with GNRI ≥ 82. In contrast, the group with GNRI ≥ 82 had higher Hb value ≥ 10 mg/dL. Furthermore, the Charlson index of the group with GNRI < 82 (4.6 ± 2.7) was signifantly higher than those of the group with GNRI ≥ 82 (2.72 ± 1.8) (p = 0.016). Length of stay of group with GNRI <82 (14.32 ± 8.2 days) was significantly higher than those of group with GNRI ≥ (9.31 ± 6.15 days) (p = 0.006). Likewise, mortality rate of the group with GNRI < 82 (42.1%) was higher than those of group with GNRI ≥ 82 (2.8%) (p = 0.000).

TABLE 1. Characteristics of subjects

Variables	Mean ± SD or Proporsi (N)
Age (year)	67.82 ± 5.91
Charlson index	3.36 ± 2.35
Length of stay (day)	11.04 ± 7.27
GNRI*	82.29 ± 16.39
Hb (mg/dL)	11.98± 2.59
Male	65.5% (36)
Female	34.5% (19)
Depression	18.2% (10)
No Depression	81.8% (45)
Death	16.4% (9)
Live	83.6% (46)

*GNRI: Geriatric Nutritional Risk Index

TABLE 2. Subjects' characteristics based on GNRI value

Variables	GNRI < 82	GNRI = 82	p
Age (year)	68.16 ± 5.6	67.65± 6.13	0.677
Charlson index	4.6 ± 2.7	2.72 ± 1.8	0.016*
Male	78.9 %	58.3%	0.126
Female	21.1%	41.7%	
Hb<10 mg/dL	36.8%	11.1%	0.030*
Hb=10 mg/dL	63.2%	88.9%	
Depresion (DSM IV-TR)	31.6%	11.1%	0.069
Length of stay (day)	14.32 ± 8.20	9.31 ± 6.15	0.006 *
Mortality	42.1%	2.8%	0.000*

*) p< 0.05 : significantly different

Length of stay of subjects in the hospital based on the characteristics of subjects is presented in TABLE 3. Length of stay of subjects was influenced by depression and GNRI value, however it was not influenced by gender and Hb value. Subjects who experienced depression (14.40 ± 4.20 days) had longer length of stay than those who not experienced depression (10.29 ± 8.20 days) (p = 0.003). In addition, subjects of group with GNRI <82 (14.32 ± 8.20 days) had longer length of stay than those in group with GNRI ≥ 82 (9.31 ± 6.15 days) (p = 0.006).

TABLE 3. Length of stay of geriatic patients in the hospital

Variables	Length of Stay (day)	p
Gender		
• Male	10.58 ± 7.00	0.311
• Female	11.89 ±7.87	
Hb value		
• <10 mg/dL	14.00 ± 9.99	0.249
• ≥10 mg/dL	10.00 ± 6.35	
Depression status		
• Depression	14.40 ± 4.20	0.003*
• No depression	10.29 ± 7.60	
GNRI score		
• < 82	14.32 ± 8.20	0.006*
• ≥ 82	9.31 ± 6.15	

*) p < 0.05 : significantly different

The correlation between characteristics of subjects and length of stay in hospital is presented in TABLE 4. No significant correlation was observed between length of stay in hospital with age, Charlson index, gender, depression status as well as Hb value (p>0.05). However, negative significant correlation was observed between the length of stay and GNRI score (p = 0.006; r = -0.352) as presented in TABLE 4 and FIGURE 1. Subjects with higher GNRI score had shorter length of stay in the hospital.

TABLE 4. Correlation between the length of stay in hospital and characteristics of geriatric patients

Variables	r	p
Age (year)	-0.044	0.750
Charlson index	-0.057	0.681
GNRI	-0.352	0.006*
Gender	0.021	0.654
Depression	0.043	0.150
Hb <10 mg/dL	-0.157	0.253

*) p< 0.05 : significantly different

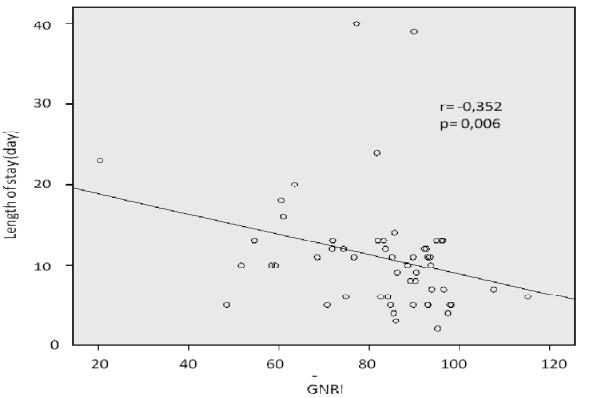

FIGURE 1. Relationship between length of stay and GNRI

The characteristics of geriatric patients accordint to mortality are presented in TABLE 5. The age, gender and depression status were not significantly associated with mortality in geriatric patients ($p > 0.05$). However, the mortality in the geriatic patients significantly associated with their Charlson index, Hb and GNRI values ($p < 0.05$).

TABLE 5. Factors related to mortality rate of subjects

Variables	Death Proportion (%/N)	N total	RR	95% CI	p
Age					
• < 70 year	21.1 (8)	38	3.58	0.485-26.409	0.156
• ≥ 70 year	5.9 (1)	17			
Charlson index					
• >3	36.4 (8)	22	12.00	1.612-89.349	0.002*
• ≤ 3	3 (1)	33			
Gender					
• Male	19.4 (7)	36	1.85	0.425-8.033	0.330
• Female	10.5 (2)	19			
Hb value					
• <10 mg/dL	36.4 (4)	11	3.20	1.027-9.973	0.045*
• >10 mg/dL	11.4 (5)	44			
Depresion status					
• Depression	30 (3)	10	2.25	0.675-7.505	0.200
• No Depression	13.32 (6)	45			
GNRI value					
• < 82	42.1 (8)	19	15.18	2.045-112.360	0.001*
• ≥ 82	5.6 (1)	36			

*) p< 0.05 : significantly different

Survival rate for patients based on GNRI group can be seen on the Kaplan-Meier curves as presented in FIGURE 2. Patients with GNRI score <82 had rapidly decreased survival rate when compared with those with GNRI score ≥ 82.

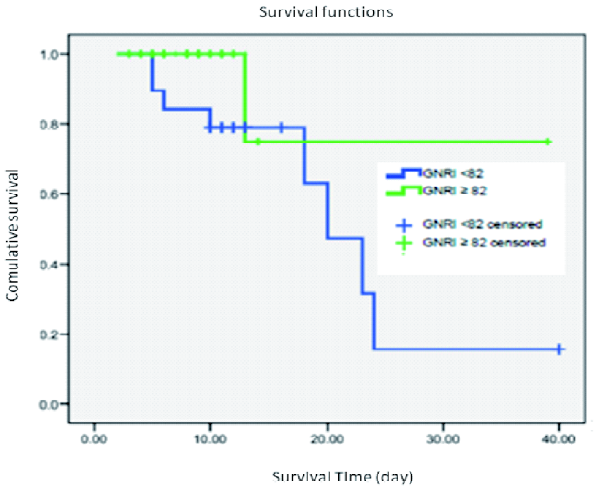

FIGURE 2. Kaplan-Meier survival analysis of patients with GNRI < 82 and ≥ 82.

DISCUSSION

This study showed that the length of stay of subjects was influenced by depression and GNRI value, however it was not influenced by gender and Hb value. Subjects who experienced depression (14.40 ± 4.20 days) had longer length of stay than those who not experienced depression (10.29 ± 8.20 days) (p = 0.003). In addition, subjects of group with GNRI <82 (14.32 ± 8.20 days) had longer length of stay than those in group with GNRI ≥ 82 (9.31 ± 6.15 days) (p = 0.006).

Previous study conducted in Sanglah Hospital, Bali found a negative correlation between GNRI scores and the length of hospitalization.[11] Moreover, a study in geriatric patients hospitalized in France also showed the relationship between the length of hospitalization and GNRI.[12] However, these results is not supported with other study that reported no significant correlation between the length of hospitalization and GNRI.[13]

Consistent with this study, a study conducted in Queen Elisabet Geriatric Center, Victoria reported no significant difference in the length of hospitalization was observed between male and female geriatric patients.[14] In contrast with this study, a significant association between Hb level and the length stay in patients undergoing operations was observed.[15,16] This difference may be caused the difference of patients observed.

This study also showed that the mortality rate was influenced by Charlson index, Hb and GNRI values, however it was not influenced by age, gender and depression status. The mortality rate of patients with GNRI score < 82 (42.1%) was significantly higher than those with GNRI score ≥ 82 (2.8%) (p = 0.001). In addition, the mortality rate of patients with Hb value < 10 mg/dL (36.4%) was significantly higher than those with Hb value > 10 mg/dL (11.4%) (p = 0.045). The mortality rate of patients with Charlson index < 3 (36.4%) was also higher than those with Charlson index ≤ 3 (3.0%) (p = 0.002).

Consistent with this study, a prospective observational study involving 358 elderly newly admitted to a long-term care setting in Italy reported nutritional risk by GNRI, but not nutritional status by MNA, was associated with higher mortality risk.[17] Other studies also showed the relationship between GNRI and mortality in hospitalized elderly patients.[6,12]

As found in this study, the presence of comorbidities has been known to worsen the prognosis of patients. Charlson index has been evaluated in numerous studies as a predictor of mortality in the future.[18,19]

In contrast with this study, a study conducted on heart bypass surgery patients showed that patients with Hb ≤ 10 mg/dL showed postoperative mortality rate in the hospital 10 times higher than those with Hb > 10 mg/dL. In addition, low Hb level, severity as well as comorbidity is a major determinant of patients survival.[20] Another study conducted in anemia patients who underwent percutaneous coronary intervention showed lower post-action survival

rate than those without anemia with a 4-fold relative risk.[21]

Number of male patients who died were higher than female patients in this study, although it was not significantly different. Some studies gave different results regarding the relationship of gender with mortality rate. A study conducted in Japan showed that male patients had a greater risk for death than women.[22] Another study in elderly patients who suffered from a hip fracture showed that female gender was an independent and significant risk factor for mortality. However, other studies found no differences between the sexes.[23]

Geriatric patient with depression had higher mortality rate than those without depression in this study, although it was not significant different. Studies in patients with cardiac symptoms showed that mortality at 2-year folow-up was higher in patients with depression.[24] The difference is probably due to the research subjects or the difference of duration of folow up.

CONCLUSION

In conclusion, there is negative correlation between GNRI with length of hospitalization and mortality rate in elderly who admitted to the Internal Medicine Ward in the hospital. Further study with a larger subjects and a wider range of cases should be encouraged. In addition, elderly patients with GNRI score < 82 should get improved nutrition therapy to reduce the length of stay and mortality rate.

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