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Original Article

Worse pre-admission quality of life is a strong predictor of mortality in critically ill patients

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ABSTRACT

Objectives: In this study, we aimed to investigate whether quality of life (QoL) before intensive care unit (ICU) admission could predict ICU mortality in critically ill patients.

Patients and methods: Between January 2019 and April 2019, a total of 105 ICU patients (54 males, 51 females; mean age: 58 years; range, 18 to 91 years) from two ICUs of a tertiary care hospital were included in this cross-sectional, prospective study. Pre-admission QoL was measured by the Short Form (SF)-12- Physical Component Scores (PCS) and Mental Component Scores (MCS) and EuroQoL five-dimension, five-level scale (EQ-5D-5L) within 24 h of ICU admission and mortality rates were estimated.

Results: The overall mortality rate was 28.5%. Pre-admission QoL was worse in the non-survivors independent from age, sex, socioeconomic and education status, and comorbidities. During the hospitalization, the rate of sepsis and ventilator/hospital-acquired pneumonia were similar among the two groups (p>0.05). Logistic regression analysis adjusted for sex, age, education status, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scores showed that pre-admission functional status as assessed by the SF-12 MCS (odds ratio [OR]: 14,2; 95% confidence interval [CI]: 2.5-79.0), SF-12 PCS (OR: 10.6; 95% CI: 1.8-62.7), and EQ-5D-5L (OR: 8.0; 95% CI: 1.5-44.5) were found to be independently associated with mortality.

Conclusion: Worse pre-admission QoL is a strong predictor of mortality in critically ill patients. The SF-12 and EQ-5D-5L scores are both valuable tools for this assessment. Not only the physical status, but also the mental status before ICU admission should be evaluated in terms of QoL to better utilize ICU resources.

Keywords: EQ5D5L scores, intensive care unit, preadmission, prognosis, quality of life analysis, short form-12.

Severity scales are widely used in intensive care unit (ICU) practice to characterize disease severity, evaluate the effectiveness of treatment practices, predict outcome, and assess resource use. Both the generic and organ-specific scores estimate alliance of three key factors: demographics, medical comorbidities, and the worst acute physiological parameters including vital signs and laboratory examination results obtained within the first 24 h on ICU admission.[1,2] However, none of the determinants used in these scores evaluate pre-hospital health condition or quality of life (QoL).

Although three is no certain description widely used in the literature, pre-admission QoL can be designated by the capability to achieve the vital activities of daily living including mobility, self-care, usual actions, and healthy psychological status.[3] Despite less attention than the analysis of mortality rate in the routine

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practice of ICU, recent reports have shown that it is closely related to mortality.[4-6] According to a systematic analysis including 7,320 patients, ICU survivors had a lower baseline QoL which changed over time in most components and it remained lower, compared to the healthy population during long-term follow-up.[7] Estimating prognosis with the light of the pre-admission QoL has critical effects on not only predicting the outcomes and characterizing patients' requirements, but also on decision making regarding ICU admission to better use the ICU sources.[8] Assessing the QoL before ICU admission may give a more detailed mapping of the patient's condition, thus, would ease the use of World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF) framework to reveal deficiencies in body functions and structures, together with activity limitations and participation restrictions associated with deteriorating disease necessitating ICU stay and may lead to a better guided rehabilitation plan. It was shown that individuals with post-intensive care syndrome had impairments in all domains of the ICF.[9] With advances in the intensive care services, the number of critical illness survivors has been increasing and it is unquestionable that patients should receive the best care from a multidisciplinary team, including the physicians, physical and occupational therapists, and nurses. It is of utmost importance that every member of the team has knowledge and awareness about the utility of rehabilitation, and they should have the skills to foster rehabilitation in the ICU. Unfortunately, there is still inadequate evidence about the effects of early mobilization on muscle strength, physical performance, and QoL in this patient population.

Recent researches have focused on several approaches for screening or identifying the patient's QoL before the ICU admission.[4,5,10] However, none of the indices are accepted as the gold standard and currently used in routine clinical practice. The Short Form-12 (SF-12) is a multi-item generic health assessment which measures general health concepts not specific to any disease or treatment group.[11] The EuroQoL five-dimension, five-level scale (EQ-5D-5L) is a self-report instrument which assesses five dimensions including mobility, self-care, standard activities, pain/discomfort and anxiety/depression. The EQ-5D™ is a trademark of the EuroQoL Research Foundation. The EuroQoL Visual Analog Scale (EQ-VAS) is used to evaluate the general health status of the individual.[12] The EQ-5D-5L has also been used in several populations including ICU survivors to date.[13-16] However, pre-admission QoL has not been widely investigated using both SF-12 and EQ-5D-5L scores in critically ill patients. In the present study, therefore, we aimed to evaluate whether QoL before ICU admission could predict ICU mortality in these patients.

PATIENTS AND METHODS

This cross-sectional, prospective study was conducted at two ICUs of Cukurova University, Faculty of Medicine between January 2019 and April 2019. A total of 105 consecutive ICU patients (54 males, 51 females; mean age: 58 years; range, 18 to 91 years) with a length of ICU stay over 24 h were included. *Exclusion criteria were as follows:* <18 years old, being hospitalized for <24 h, questionnaires not completed within 48 h, and giving no consent for the study. Patients with readmission during their same hospitalization period were also excluded from the study population. During hospitalization of 24 to 48 h in the ICU, the patients were requested to fill the SF-12 and EQ-5D-5L questionnaires based on their memories of health status within the past four weeks before the ICU admission. All patients were followed until discharge. A written informed consent was obtained from each patient. If the patient was unconscious or otherwise cognitively impaired, no written informed consent was obtained and the questionnaires were filled by his/her first-degree relative living with the patient. The study protocol was approved by the Çukurova University Faculty of Medicine Ethics Committee (No. 72, Date: 28/12/2017). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data including demographic and clinical characteristics of the patients (age, sex, body mass index, smoking history, chronic systemic diseases, marital status, education status, alcohol consumption, monthly income, and social insurance); main reason for ICU admission; sepsis, hospital- and ventilator-acquired pneumonia (HAP/VAP) development and the need of non-invasive and/or invasive mechanical ventilation during hospitalization; and severity of illness as assessed by the following scoring systems were recorded.

The Acute Physiology and Chronic Health Evaluation II (APACHE II) is a severity of disease score usually used in estimation the prognosis of the critically ill patients were recorded. The APACHE II scale appoints 0 to 4 numerical values to 12 clinical and biochemical variables including the worst body temperature, mean arterial blood pressure, heart rate, respiratory rate,

oxygenation, arterial pH, serum sodium, potassium, creatinine, white blood cell, hematocrit, and Glasgow Coma Scale parameters following the first 24 h of admission. Age group and pre-existing illnesses are also assigned. The combination of these variables composes the Acute Physiology Score of APACHE II. The score <10 points indicates relatively mild illness, while >15 points indicate moderate to severe illness. Increased scores are associated with increased mortality.[17]

The Sequential Organ Failure Assessment (SOFA) Scoring system is also valuable in prognostication of critically ill patients.[18] The score is based on the worst values of six different clinical data and laboratory results, one each for the respiratory, liver, cardiovascular, coagulation, renal and neurological systems.

The Charlson Comorbidity Index (CCI) predicts the 10-year mortality. Each comorbid condition is awarded 1, 2, 3 or 6 points depending on the risk of death.[19]

In addition, the QoL scores of the patients as obtained using the following instruments were noted.

The SF-12 health survey is a shorter version of the SF-36 consisting of 12 items about physical functioning, physical role, bodily pain, general health, vitality, social functioning, role emotional, and mental health. The scores range from 0 to 100, and higher scores indicate better health. The SF-36 has been validated in the Turkish language,[20] and SF-12 has been used in various disease groups in Turkey.[21-23] There are items from each of the eight SF-36 subscales in the SF-12. Data from all items are used to build up Physical Component Scores (PCS) and Mental Component Scores (MCS). The SF-12 has adequate test-retest reliability and construct validity, and the PCS and MCS obtained with the SF-12 is reported as diligently similar to those obtained with the original SF-36.[11,24]

The EQ-5D-5L consists of two parts: the EQ-5D-5L descriptive system and the EQ-VAS. The descriptive system measures 5 dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression) in 5 levels ranging from no problem to extreme problems. The person surveyed indicates his/her own health state by marking the box against the most fitting statement. In EQ-VAS a 20 cm vertical VAS is used. The scale has endpoints labelled as the best or the worst health that one can imagine. Full health is given a score of one (the maximum). Originally the respondent is asked to consider "today". In our study, the respondent was asked to recall previous four weeks and answer the questions accordingly. The EQ-5D-5L has been validated in several populations from different countries, different patient groups, and different chronic conditions.[12] It has been also validated in Turkish patients with acute coronary syndrome.[25]

Outcomes

The ICU mortality rate, length of ICU stay, and length of hospital stay were recorded.

Endpoints

The primary endpoint of this study was to compare the pre-admission QoL scores between survivors and non-survivors. The secondary endpoint was to define a cut-off value of QoL scores to predict survival.

Statistical analysis

Study power analysis and sample size calculation were performed using the G*Power version 3.1.9.2 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). Accordingly, the study power was 99.9% and minimum 105 subjects were needed.

Statistical analysis was performed using the IBM SPSS version 24.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max) or number and frequency. The Kolmogorov-Smirnov test was used to analyze whether the quantitative variables were normally distributed. Continuous variables between independent groups were compared using the Student's t-test, when the hypothesis was fulfilled and using the Mann-Whitney U test, when the hypothesis was not fulfilled. The chi-square test and Fisher's exact test were used to compare the categorical data between the groups. Possible alternative cut-off points for the scales of both severity and QoL were investigated using the area under the curve (AUC) statistics. The prognostic ability of QoL scales were evaluated with both univariate and multivariate logistic regression analyses with forward method. The Hosmer-Lemeshow test was used to check model fit for logistic regression model. The Kaplan-Meier and log-rank tests were used for survival analysis. Overall survival was defined as the time from ICU admission to the time of any proven clinical progression, relapse, or death from any cause. To analyze correlations between each exposure and risk of mortality, odds ratios (ORs) and 95% confidence intervals (95% CI) were calculated. The internal consistency (different questions, same

construct) was used for reliability. The internal consistency was measured using the Cronbach's alpha (α) and an α of ≥0.8 was accepted. A post-hoc power analysis was performed on SF-12 MCS and SF-12 PCS scores. A *p* value of <0.05 was considered statistically significant.

RESULTS

Of a total of 256 patients screened during the study period, 105 were included. Of these patients, 28.5% (n=30) died during hospitalization. A total of 25.5% conscious patients assessed their pre-admission QoL, while the forms were filled by the first-degree relatives of the remaining patients, due to either unconsciousness or cognitive impairment. Most of the patients were hospitalized due to respiratory failure (54.5%), followed by gastrointestinal disorders (8.5%) and hemodynamic instability (6.6%). Of a total of 105 patients, 28 (26.4%) had any type of malignancy. The use of home mechanical ventilation was also comparable between the groups (2.8% among survivors vs. 11.5% among non-survivors, respectively; p>0.05). Baseline demographic and clinical data of the patients are shown in Table 1.

The laboratory findings, liver and renal function test results, and serum electrolyte levels were similar between survivors and non-survivors, while hemoglobin levels and platelet counts at the time of admission were

TABLE 1
Demographic and clinical characteristics of patients

	Prognosis									
	Alive			Dead			Total			
	n	%	Mean±SD	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			59.4±17.8			56.6±17.7			58.6±17.7	0.471**
Sex										0.805*
Female	37	72.5		14	27.5		51	48.6		
Male	38	70.4		16	29.6		54	51.4		
Social insurance										0.503*
Extended	64	72.7		24	27.3		88	83.8		
Limited	11	64.7		6	35.3		17	16.2		
Marital status										0.477*
Married	47	69.1		21	30.9		68	64.8		
Single	28	75.7		9	24.3		37	35.2		
Alcohol consumption										**0.041***
None	72	74.2		25	25.8		97	92.4		
Yes	3	37.5		5	62.5		8	7.6		
Smokers										1.000*
None	40	71.4		16	28.6		56	53.3		
Yes	35	71.4		14	28.6		49	46.7		
Education (years)										0.964*
Low (<5)	52	72.2		20	27.8		72	68.6		
Intermediate (5-8)	9	69.2		4	30.8		13	12.4		
High (>8)	14	70.0		6	30.0		20	19.0		
Income level										0.507*
Lower than minimum wage	26	72.2		10	27.8		36	34.3		
Minimum wage	36	75.0		12	25.0		48	45.7		
Higher than minimum wage	13	61.9		8	38.1		21	20.0		
Working status										0.006*
Not working	45	80.4		11	19.6		56	53.3		
Retired	22	73.3		8	26.7		30	28.6		
Working	8	42.1		11	57.9		19	18.1		
Body mass index (kg/m^2)			27.4±9.0			26.4±11.3			27.1±9.7	0.629**
Hospital length of stay (days)			16.3±12.9			18.5±15.7			16.9±13.8	0.467**
ICU length of stay (days)			5.9±7.1			8.0±6.0			6.3±6.8	0.113**

SD: Standard deviation; ICU: Intensive care unit; * Chi-square test; ** Mann-Whitney U test.

TABLE 2
Laboratory parameters among survivors and non-survivors

	Alive (n=75)	Dead (n=30)	
	Mean±SD	Mean±SD	*p*
Hemoglobin (g/dL)	11.3±2.8	9.3±1.8	0.001
White blood cell count (mm^3)	11,620±8,870	11,990±8,785	0.846
Platelet count ($10^5/\mu L$)	234±146	172±107	0.019
AST (U/L)	77±186	126±227	0.293
Serum creatinin (mg/dL)	1.4±1.4	1.6±1.4	0.474
Serum Na level (mmol/L)	136±6	136±4	0.907
Serum K level (mmol/L)	4.3±0.8	4.5±1.2	0.486
C-reactive protein (mg/L)	9.2±10	20.9±13.9	0.001
Activated partial thromboplastin time (sec)	29.3±15.9	40.1±20.1	0.012

AST: Aspartate aminotransferase; Na: Sodium; K: Potassium.

significantly lower and serum C-reactive protein levels and activated partial thromboplastin time levels were significantly higher in the non-survivors ($p<0.05$) (Table 2). The development of HAP/VAP and sepsis during hospitalization were also similar according to mortality (6.9% vs. 11.5% for HAP/VAP and 6.9% vs. 7.7% for sepsis among survivors and non-survivors, respectively; $p>0.05$).

The internal consistency was performed for the QoL scales and the value which was defined by the Cronbach α was 0.83 for SF-12 questionnaire and 0.92 for EQ-5D-5L. The comparison of severity scales and QoL scales between survivors or non-survivors is presented in Table 2. The APACHE II, CCI, and SOFA scores were significantly higher and all QoL scores (SF-12 PCS, MCS, and EQ-5D-5L) were significantly worse among the non-survivors ($p<0.05$) (Table 3).

According to the receiver operating characteristic (ROC) analysis, the disease severity index with the highest sensitivity (90%) and specificity (75%) was the APACHE II score which revealed an AUC of 0.876 with a ≥21.5 cut-off value. Among the QoL scales, SF-12 MCS scores resulted in an AUC of 0.842 with the highest sensitivity (80%) and specificity (82%) with a cut-off value of ≥34.5. The results with the other severity and QoL scales are presented in Table 4 and Figure 1.

TABLE 3
Distribution of severity and quality of life scales according to prognosis

	Alive	Dead	Total	
	Mean±SD	Mean±SD	Mean±SD	*p*
Severity scales				
Charlson Comorbidity Index	5.0±2.5	8.0±2.6	5.8±2.8	0.0001**
APACHE II score	17.6±7.2	29.8±8.9	21.1±9.5	0.0001**
SOFA Score	5.7±3.5	10.8±4.1	7.1±4.4	0.0001**
Quality of life scales				
SF12 PCS score	38.9±6.1	31.5±7.0	36.8±7.2	0.0001*
SF12 MCS score	39.7±6.7	30.2±7.0	37.0±8.0	0.0001*
EQ-VAS score	40.8±23.7	21.2±14.4	35.2±23.2	0.0001**
EQ-5D-5L score	0.144±0.447	-0.264±0.225	0.027±0.437	0.0001**

SD: Standard deviation; APACHE II Score: Acute Physiology and Chronic Health Evaluation II; SOFA Score: Sequential Organ Failure Assessment Score; SF-12 PCS: Short Form-12 Physical Component Summary; SF-12 MCS: The Short Form-12 Mental Component Summary; EQ-VAS: EuroQoL Visual Analog Scale; EQ-5D-5L: EuroQoL Five-Dimension, Five-Level Scale; * Independent t-test; ** Mann-Whitney U test; $p<0.05$ statistically significant.

TABLE 4
Cut of points, sensitivity and specificity values of severity scales and quality of life scales obtained by ROC analyses

	AUC	Cut off point	Sensitivity (%)	Specificity (%)
Charlson Comorbidity Index	0.798*	6.5	73	71
APACHE II Score	0.876*	21.5	90	75
SOFA Score	0.829*	7.5	77	74
SF12 PCS Score	0.797*	35.9	77	72
SF12 MCS Score	0.842*	34.5	80	82
EQ-VAS Score	0.745*	27.5	60	67
EQ-5D-5L Score	0.782*	-0.041	87	67

AUC: Area under curve; APACHE II Score: Acute Physiology and Chronic Health Evaluation II; SOFA Score: Sequential Organ Failure Assessment Score; SF-12 PCS: Short Form-12 Physical Component Summary; SF-12 MCS: The Short Form-12 Mental Component Summary; EQ-VAS: EuroQoL Visual Analog Scale; EQ-5D-5L: EuroQoL Five-Dimension, Five-Level Scale; * p<0.001.

The multivariate logistic regression analyses adjusted for sex, age, education status, having any comorbidity, and APACHE II scores showed that pre-admission functional status as assessed by the SF-12 MCS (OR: 12.4; 95% CI: 2.5-61.7), SF-12 PCS (OR: 9.8; 95% CI: 1.9-50.5), and EQ-5D-5L (OR: 8.3; 95% CI: 1.6-44.1) were found to be independently associated with mortality (Table 5).

According to survival analyses, the length of ICU stay was found to be significantly shorter in the patients who had lower QoL scores (12.8 days vs. 23.7 days for SF-12 PCS and 12.9 days vs. 20.0 for SF-12 MCS and 13.0 days vs. 22.5 days for EQ-5D-5L, respectively; p<0.05) (Figure 2).

DISCUSSION

In this study, we showed that pre-admission QoL, which can be easily measured by either SF-12 or EQ-5D-5L scores, is an important surrogate of mortality in critically ill patients. Incorporating QoL measures in addition to routine severity scores may improve the accuracy of mortality prediction in the ICU practice.

Although QoL evaluation in critically ill patients is not a new concept, many authors have focused on the QoL after ICU discharge.[13,26-30] Several implementations have been proposed to improve QoL in post-intensive care syndrome.[31,32] However, QoL

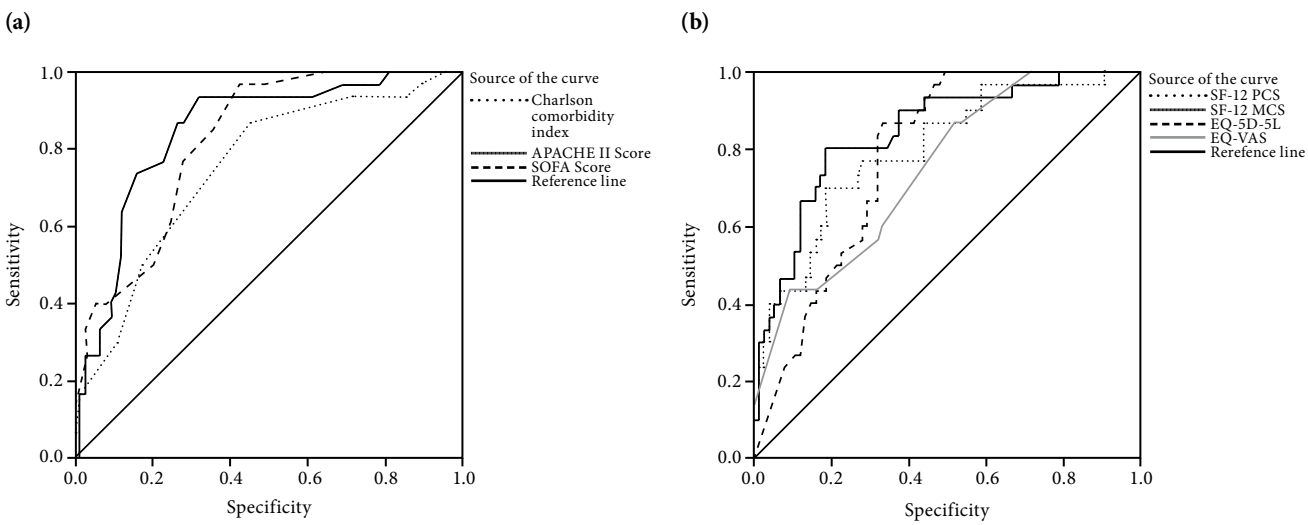

Figure 1. ROC analysis. **(a)** Of severity scales. **(b)** Of quality of life scales.

ROC: Receiver Operating Characteristics; APACHE II Score: Acute Physiology and Chronic Health Evaluation II; SOFA Score: Sequential Organ Failure Assessment Score; SF-12 PCS: Short Form-12 Physical Component Summary; SF-12 MCS: The Short Form-12 Mental Component Summary; EQ-5D-5L: EuroQoL five-dimension, five-level scale; EQ-VAS: EuroQoL Visual Analog Scale.

TABLE 5
Logistic regression analysis results

	B	SE	OR	95% CI	*p*
Sex					
Male	0.444	0.912	1.6	0.3-9.3	0.957
Education (high)					
Intermediate	0.580	1.248	1.8	0.2-20.6	0.580
Low	1.215	1.473	3.4	0.2-60.9	0.628
Comorbidity	-0.687	0.999	0.5	0.1-3.6	0.608
Age (>64)	-1.574	0.839	4.8	0.9-26.1	0.061
SF12 PCS (>35.9)	2.285	0.835	9.8	1.9-50.5	0.006*
SF12 MCS (>34.5)	2.515	0.820	12.4	2.5-61.7	0.002*
EQ5D5L (>-0.045)	2.116	0.852	8.3	1.6-44.1	0.013*
APACHE II (high)	2.480	0.902	11.9	2.0-70.0	0.006*
Constant	-5.538	1.199			0.004*

B: Unstandardized coefficient (This value represents the slope of the line between the predictor variable and the dependent variable); SE: Standard error; OR: Odds ratio; CI: Confidence interval; SF-12 PCS: Short Form-12 Physical Component Summary; SF-12 MCS: The Short Form-12 Mental Component Summary; EQ-5D-5L: EuroQoL Five-Dimension, Five-Level Scale; APACHE II Score: Acute Physiology and Chronic Health Evaluation II; * p<0.05 statistically significant; p=0.728 Hosmer-Lemeshow test (indicates a poor fit if the significance value is less than 0.05).

analysis before ICU admission received less attention to date. One of the main factors of this issue is the problematic nature of QoL evaluation before ICU admission due to several reasons. First, the instrument used for QoL should be directly correlated with the patient's baseline status prior to ICU admission. Second, it must be easily completed by the proxies, since many of the ICU patients are unable to fill out a survey due to being ventilated or comatose. Third, QoL assessment is a multi-dimensional concept which covers the functional status, physiological conditions, affective states, and usual activities; however, it is challenging to find a valid method for this analysis.[4] Thus, several different tools, some of them developed for this purpose, have been used to date for the QoL evaluation before ICU admission and most of them showed a strong link with increased mortality.[5,6,10] In a previous study, Baldwin et al.[10] derived a model from medical records including data of 1,526 consecutive patients more than 65 years old and, then, validated the model in more than 1,000 patients. As a result, they showed that pre-admission functional status was independently related to six-month post-discharge mortality (OR: 2.39; 95% CI: 1.73-3.30, p<0.001). In another retrospective cohort study which classified patients into three groups and assessed functional status in three discrete categories based on performance of basic living activities (i.e., fully independent, partly dependent, and completely dependent), functional status was found to be associated with increased mortality among critically ill patients.[5] Also, mild to moderate disability and severe disability were correlated with more than two (adjusted hazard ratio [HR], 2.41; 95% CI: 1.29-4.50) and three-fold (adjusted HR, 3.84; 95% CI: 1.84-8.03) mortality risk within one year of ICU hospitalization.[6]

In addition to these novel QoL evaluation methods developed by the authors, instruments formerly used for other purposes have been used for pre-ICU QoL analysis. A previous large cohort which analyzed QoL before ICU admission with the QoL survey score and Therapeutic Intervention Scoring System (TISS) in 8,685 patients indicated that, although the QoL prior to ICU stay was linked to hospital mortality, it contributed very little to the discriminatory power of the APACHE III prediction model.[4] However, the ICU care significantly improved over years in parallel with the global development and it is known that the predictive performances of the instruments deteriorate over time. In another study, Rodríguez-Villar et al.[33] showed that functional status before ICU admission was related to the improvement of functional status after ICU discharge. Another Spanish trial using the Modified Glasgow Outcome Scale also demonstrated that patients with restricted functional status before ICU stay had a higher risk of death than predicted.[34] Functional status score have also been used to evaluate QoL in ICU.[35,36] In another recent report, WHO Disability Schedule 2.0 was performed to evaluate pre-admission functional condition in ICU patients.[37]

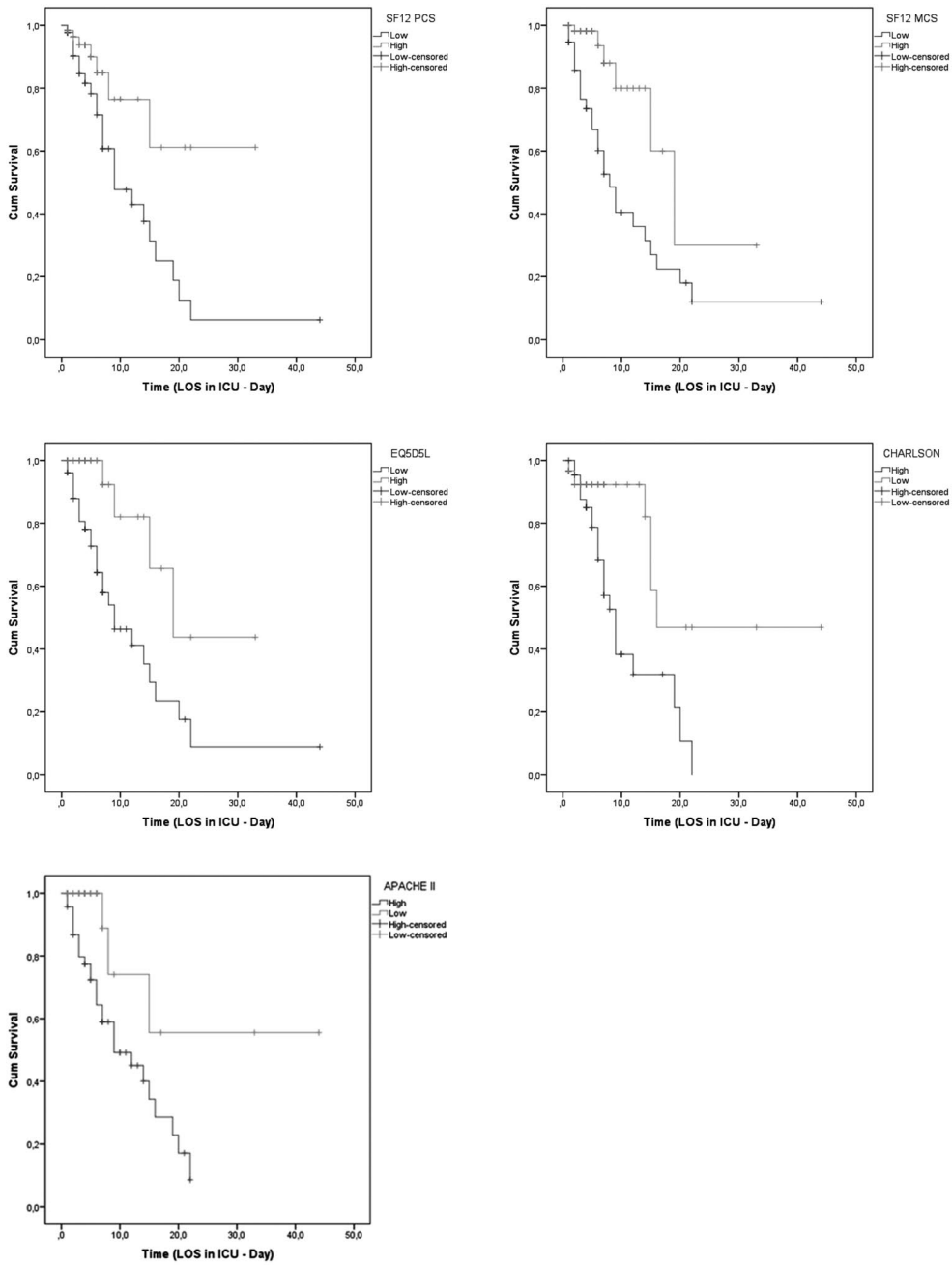

Figure 2. Survival curves of quality of life and severity scales.
ICU: Intensive care unit; LOS: Length of stay.

However, none of these instruments were accepted as a reference method and placed in routine practice to date.

The SF and EQ scores have been used in a number of reports for evaluating the QoL among several populations outside the ICU.[7] Parlevliet et al.[38] assessed the link between health-related QoL (HRQoL) measured by EQ-5D score at admission in hospitalized older adults who were acutely ill. In this study, higher HRQoL at the time of admission was related to less mortality risk and functional decline.[38] However, the data regarding the use of SF and EQ scores on QoL in ICU patients are extremely limited. In a previous study, QoL was assessed pre-morbidly and at 3, 6, and 12 months after ICU admission using the SF-36 and EQ-5D scores.[39] The authors showed that poor

premorbid QoL was related to worse prognosis. Later, Bukan et al.[8] confirmed these results in a prospective, observational study including 318 ICU patients. In this study, using the physical component summary of SF, the AUC was found to be comparable with that of APACHE II (0.70; CI: 0.62-0.77 vs. 0.74; CI: 0.67-0.82, respectively). As a result, the authors concluded that SF-12 score was as good as APACHE II score in predicting mortality and this could aid decision making on ICU acceptance. In this study, we showed that pre-admission functional status which was shown by the SF-12 MCS (OR: 14.2; 95% CI: 2.5-79.0), SF-12 PCS (OR: 10.6; 95% CI: 1.8-62.7), and EQ-5D-5L (OR: 8.0; 95% CI: 1.5-44.5) were independently related to mortality. Our results also confirm the Bukan et al.'s[8] study in terms of SF-12 PCS score which was as good as APACHE II score in predicting ICU prognosis. In addition, we showed that the importance of mental score (SF-12 MCS) with a higher specificity than APACHE II, SOFA, and CCI scores to predict ICU mortality. We also determined cut-off values for all of these QoL scales with valuable AUC values in the ROC analyses.

The QoL before ICU admission is an underestimated phenomenon in the ICU. The SF-12 and EQ-5D-5L scores are simple, easily applied, reliable, and valuable tools to assess pre-admission QoL in these patients. Our study showed that worse pre-admission QoL was a strong predictor of mortality in critically illness. In addition, we, for the first time, showed the key value of pre-admission mental score to in these patients. Pre-admission QoL analysis should be added in routine clinical practice in the ICUs.

Resources for an excellent health service is limited in the whole world and, although it is not explicitly stated, it is not uncommon that healthcare professionals provide more careful and intense service to patients with better general condition and less comorbid diseases. This is a bias and is done unintentionally. The early rehabilitation and mobilization approach are one of these services and the data on the effectiveness of early mobilization are still insufficient. In our study, we showed the relationship between the mortality and QoL before ICU admission. Probably, it would be more cost-effective to appreciate the pre-admission QoL with standard and structured scales in each patient, define the patients who are likely to gain most benefit from rehabilitation, and offer more intense rehabilitation opportunities to these patients.

Provision of rehabilitation to critically ill patients early in their ICU stay is endorsed by critical care experts.[40] While evaluating and tailoring a treatment plan, physical medicine and rehabilitation specialists steering the rehabilitation team would bear the aforementioned QoL issues in mind to minimize disability and maximize independence. Goals can be set proper according to the patient's needs and the level of required rehabilitation interventions would be better set.[41] As early mobilization and ICU programs continue to improve and become a part of usual of care, physical medicine and rehabilitation specialists who are experts in recovery, QoL, and participation assessment would have much to contribute to this developing field. A multi-specialist approach may provide insight into organizing better care for critically ill patients.[42,43]

Nonetheless, our study has certain limitations. First, there might have been a recall bias in which an earlier state could not be precisely recalled due to the memory effects. This might be a consequence of general memory problems due to the passage of time or cognitive impairment.[44] However, an earlier report showed that total hip arthroplasty patients could accurately recall their preoperative QoL and function for up to three months.[45] Second, most of the data were obtained from the proxies due to patients' unfavorable clinical status and this may be considered a limitation. Nevertheless, a previous report showed that QoL scores which were completed by the proxies had adequate internal consistency in ICU patients.[46] Finally, this is a single-center study with a limited sample size and the results should be further confirmed in larger cohorts.

In conclusion, the reported cut-off values of QoL scores can be used to better predict ICU prognosis in critically ill patients which may lead to the better use of ICU sources, particularly in the limited area. However, further clinical trials with larger cohorts are required to elucidate the most valuable pre-admission QoL score to predict ICU prognosis.

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