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Original Article

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Effect of patient factors and quality of life on ECOG assignment and inter-rater agreement in hospitalized cancer patients

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Abstract

Background: **Assigning the ECOG performance status is critical for decision-making in oncology, but it poses challenges in hospitalized patients due to lower concordance and potential alteration by factors related to admission. This study aimed to evaluate the concordance of ECOG assessments among observers, identify associated factors with assignment, and explore its relationship with quality of life (QoL) in hospitalized oncology patients.**

Methods: **A prospective, observational study was conducted on patients admitted to a Medical Oncology Department. Three oncologists independently assessed the ECOG at admission, with a consensus value (ECOGa) being established. The EQ-5D-5L scale was administered within the first 48 hours. Linearly weighted Fleiss' Kappa (wFK) was used to assess concordance, and ordinal generalized linear mixed regression models were applied to analyze associated factors and to calculate values of model-based Kappa for agreement.**

Results: **A total of 167 patients were included, most of them (76%) with stage IV disease. Overall concordance was wFK 0.773 (95% CI 0.711-0.823). ECOGa was significantly associated with cancer stage ($P = .03$), reason for admission ($P = .01$), age ($P = .04$), and absence of active treatment ($P = .01$). The pain ($P < .001$) and self-care ($P = .01$) subscales of the EQ-5D-5L enhanced the prediction of ECOG performance status, outperforming models based on clinical model or QoL variables. Interobserver agreement, as determined by model-based kappa, was lower in the subgroup of patients with ECOGa = 2 and in patients admitted due to toxicity.**

Conclusions: **Although ECOG assignment showed substantial concordance, both patient- and admission-related factors significantly influence its evaluation in hospitalized oncology patients. QoL measures may provide valuable complementary information for functional assessment in this population. A better understanding of the factors and clinical settings associated with lower interobserver agreement could help improve the functional assessment of cancer patients admitted to the hospital.**

Key words: ECOG-PS; functional status; hospitalized cancer patients; quality of life; agreement

Introduction

The Eastern Cooperative Oncology Group Performance Status (ECOG-PS) scale is widely used to provide prognostic information and guide therapeutic decision-making in oncology.[1] It categorizes patients into five levels (0-4), with 0 indicating full functional capacity and 4 representing total disability. Several studies have demonstrated that the ECOG-PS is a reliable prognostic tool, particularly in patients with advanced malignancies.[2–5]

However, the ECOG-PS is based on the subjective assessment of the healthcare professional, which introduces potential variability. Studies examining the concordance of ECOG-PS application in outpatient oncology settings have shown that, while

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Implications for Practice

- ECOG-PS remains a valuable tool for assessing hospitalized cancer patients.
- Patient and admission factors influence ECOG-PS scores.
- Quality of life measures enhance functional assessments for these patients.
- Early stages or ECOG 2 show more variability in oncologists' ECOG-PS evaluations.

concordance rates are generally acceptable, there is still notable variability among observers.[6–8]

Furthermore, the ECOG-PS provides a simplified snapshot of a patient's functional status, often overlooking critical aspects such as symptoms, quality of life (QoL), and psychosocial factors. These elements are essential for a comprehensive assessment and informed decision-making. Patients who report better functional capacity and QoL tend to respond more favorably to treatment, experience fewer complications, and have longer survival compared to those with poorer functional capacity and deteriorated QoL.[9,10] Among the tools used to assess health-related QoL, the EQ-5D-5L is a straightforward, low-burden instrument that offers social preference values through established conversion methods.[11,12]

Significant discrepancies between patients' self-reported functional status and physicians' assessments have been noted in the literature. Physicians generally tend to overestimate patients' functional abilities.[6,13] These discrepancies may be driven by various factors, including the subjective nature of both patient and physician's interpretations. Additionally, effective communication plays a key role, as patients may struggle to accurately express their functional capacity.[14,15] These differences underscore the importance of incorporating multiple perspectives in the functional assessment process. While patient reported outcomes, such as quality of life scales, offer insights into their subjective experiences and daily challenges, physician evaluations provide a complementary clinical perspective, contributing to a more balanced functional evaluation.[16]

In hospitalized oncology patients, assessing ECOG-PS becomes even more challenging due to several factors. These patients often experience acute medical conditions that temporarily impair their functional status. Hospital-related physical limitations, such as restricted mobility due to medical devices or procedures, as well as emotional stress or anxiety, can affect patients' perception of their own condition, complicating communication about their functional ability.[17,18] Consequently, the assigned ECOG-PS may not accurately reflect their usual functional status. While experienced physicians are suggested to perform this assessment effectively, evidence on interobserver agreement in hospitalized patients remains limited, making it difficult to draw definitive conclusions.[19,20] This study aimed to prospectively evaluate the level of agreement in ECOG-PS assessments conducted by different observers in hospitalized oncology patients. Additionally, it sought to examine clinical and patient-reported factors associated with clinician-assigned ECOG-PS scores in these patients and to explore the relationship between these assessments and patients' QoL. By investigating these aspects, this research intends to improve understanding of ECOG-PS application and inter-rater variability in the inpatient oncology setting.

Methods

Study design

This investigation employed an observational, prospective, consecutive cohort design involving oncology patients hospitalized between March and November 2022. The study was designed and written in accordance with STROBE guidelines.

Study cohort and clinical management

Patients admitted to the Medical Oncology Department of Morales Meseguer University Hospital (Murcia, Spain) were consecutively enrolled based on the following inclusion criteria: (a) a histologically confirmed diagnosis of cancer at any stage, (b) age greater than 18 years, and (c) the ability to respond to questionnaires. Admissions were included when the primary reason for hospitalization was judged to be tumor-related or treatment-toxicity-related. Exclusion criteria included: patients with scheduled hospitalizations, those with severe cognitive impairments unable to complete quality of life assessments, and individuals who were unable or unwilling to provide valid informed consent. All patients received care in accordance with standard clinical practices.

Data collection

Demographic and clinical data were extracted from electronic health records. The following variables were collected: age, sex, primary tumor site, cancer stage, and treatment regimen, all of them at time of admission. Inpatient mortality was also evaluated. To assess ECOG-PS, three physicians independently assigned a score from 0 to 4 to each patient within the first 24 hours of admission. No study-specific training was provided; evaluators were blinded to one another's scores, but assessments were performed in routine inpatient practice with access to the underlying cancer diagnosis and available clinical information (including complementary tests). Missing ECOG data were not imputed; all patients with missed evaluations were excluded from the study. ECOG-PS was evaluated at discharge only by the attending physician.

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Evaluation of patient-reported quality of life

The EQ-5D-5L, a validated instrument for measuring quality of life, was administered to patients within the first 48 hours of hospitalization.[11] Utility or health index (societal preference-based quality of life scores) was calculated according to established methodologies for the Spanish population.[21] A modified visual analogue scale (VAS) for perceived health from 0 to 10 was also administered to every patient at the same time.

Statistical analysis

Descriptive statistics were calculated for categorical variables, expressed as proportions. Continuous variables were assessed for normality using the Shapiro-Wilk test. For normally distributed continuous data, results are presented as means ± standard deviations (SD). For non-normally distributed variables, medians and interquartile ranges (IQR) are reported. The Pearson chi-square test (χ^2) was employed to compare proportions or ordinal variables. Differences in means were evaluated using the Student's *t*-test for parametric data or the Mann–Whitney *U* test for non-parametric data.

To evaluate interobserver agreement in ECOG-PS assessments, first we used the linearly weighted Fleiss' Kappa (wFK),[22] which provides a measure of agreement for ordinal data,[23] along with its 95% confidence interval (CI) calculated via bootstrap (×1000) resampling. Kappa values range from −1 (complete disagreement) to +1 (total agreement), with interpretations as follows: 0.40 to 0.60 indicates moderate agreement, 0.61 to 0.80 indicates substantial agreement, and values above 0.80 indicate excellent agreement. A sample size of 161 subjects was estimated to test a kappa = 0.59 (in the upper limit of moderate agreement) versus an expected kappa = 0.70 (substantial agreement) for three raters and five categories.[24]

In order to better estimate inter-rater agreement and to determine which factors were associated with clinician-assigned ECOG-PS score in hospitalized patients, ordinal generalized linear mixed regression models with crossed random effects were constructed with the *clmm* function of R package *ordinal*. A logit link function was used, and estimations were performed with the Laplace approximation. The models incorporated patients and evaluators as random effects and admission characteristics, tumor type and stage, and quality of life (EQ-5D-5L subscales values) as fixed effects. The ECOG-PS score used as the dependent categorical variable of the model (ECOG at admission or ECOGa) was determined for each patient after consensus among the three observers in cases of disagreement. Categories of cause of admission (tumor-related vs. treatment toxicity), primary tumor diagnosis (breast, lung, hepatobiliary-esophagogastric, others) and tumor stage (I-III vs. IV) were grouped to build the model. The fit of these ordinal generalized linear mixed regression models was assessed using the Akaike Information Criterion (AIC), with lower AIC values indicating better model performance. Comparison between models was conducted using the likelihood ratio test (LLRT). A *P*-value of <0.05 was considered statistically significant for all analyses.

Since Fleiss' kappa is subject to biases derived from imbalance in the prevalence of each category, we used the final model to calculate chance-corrected model-based kappa (a measure of agreement) and model-based weighted kappa (a measure of association).[25] To examine differences in the inter-observer agreement at various ECOG-PS levels at admission (ECOGa) and within specific patient subgroups, model-based kappa statistics were computed for each group following the same methods.

Statistical analyses were performed using SPSS v.21, STATA v.14, and R version 4.2.3, with model evaluation conducted via RStudio (version 2023.03.0). The R packages *irr*, *kappaSize, biostatUZH* (function *confIntKappa*), *ordinal*, and *modelkappa*[25] were used.

Ethical considerations

Written informed consent was obtained from all participants prior to inclusion in the study. The study was approved by the hospital Ethics Committee (Comisión de Ensayos e Investigación Clínica, Hospital Morales Meseguer; reference number: AVAL23/14). All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the Declaration of Helsinki.

Results

Baseline characteristics of patients and cause of admission

Of the 236 potentially eligible patients, a total of 169 consecutive patients were included in the study, all of them hospitalized in the Medical Oncology department of Morales Meseguer University Hospital between March and November 2022. Two patients without complete ECOG evaluation were excluded, for a final sample size of 167. Most patients were male (58.7%), with a median age of 66 years. The main clinical characteristics of the cohort are summarized in Table 1. Regarding the primary cancer origin, the most frequently observed malignancies were lung cancer (32.3%), digestive non-colorectal cancer (23.4%), and breast cancer (7.2%). Additionally, a significant proportion of patients presented with stage IV disease (76.0%), followed by stage III disease (16.2%). At the time of admission, 80.2% of patients were receiving active treatment (Table 1).

The average length of hospital stay was 8 days (IQR: 4.0-11.0). We used a simplified classification of reason for admission distinguishing between tumor-related admissions (tumor progression or tumor-related complications, symptom control, new diagnosis, tumor-related infections or cardiovascular events), which accounted for 78.8% of admissions, and toxicity-related admissions (febrile neutropenia and any other antineoplastic-related toxicities) (21.2%) (Table 1).

Agreement among healthcare professionals and factors related to ECOG-PS assignment in hospitalized oncology patients

Full ECOG-PS evaluation by the three raters was available for 167 patients. A score of 2 was assigned to 66 patients (39.5%), while ECOG-PS 3 was the second most frequently observed functional status, noted in 28.7% of patients. A total of 4 patients

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Table 1. Baseline characteristics of the patients and causes of admission.

		N	%
Age	Median (Q1-Q3)	167	66 [58-73] years
Sex	Female	69	41.3%
	Male	98	58.7%
Primary tumor	Lung	54	32.3%
	Digestive non-colorectal	39	23.4%
	Breast	12	7.2%
	Other	62	37.1%
Stage	Stage I	5	3.0%
	Stage II	8	4.8%
	Stage III	27	16.2%
	Stage IV	127	76.0%
Active treatment	Yes	134	80.2%
	No	33	19.8%
Reason for admission	Tumor-related	132	78.8%
	Febrile neutropenia	14	8.5%
	Other toxicities	21	12.7%

(2.4%) were assigned an ECOG-PS of 0, and 39 patients (23.4%) received an ECOG-PS of 1. The overall concordance among the three evaluators, quantified by the weighted Fleiss' Kappa index (wFKI), was 0.773 (95% CI 0.711-0.823). These results indicate a substantial level of agreement among observers' evaluations.

To characterize clinical and admission-related variables associated with clinician-assigned ECOGa we used ordinal generalized linear mixed-effects regression models, treating both patients and evaluators as random effects, while including tumor stage, reason for admission, absence of treatment, and age as fixed effects. The clinical model (Supplementary Table S1) revealed significant associations between the ECOGa score and several factors: tumor stage ($P = .024$), reason for admission ($P = .053$), age ($P = .002$), and absence of oncological treatment ($P = .055$). The coefficients of the model suggested that patients in more advanced stages of disease, without ongoing antineoplastic treatment, older or admitted due to tumor-related complications or symptoms are assigned higher ECOG-PS scores. The clinical meaning of ECOGa was validated with data of inpatient mortality: 0% for ECOGa = 0, 2.5% for ECOGa = 1, 3.1% for ECOGa = 2, 25% for ECOGa = 3, and 70% for ECOGa = 4. The stability of ECOGa score was substantial at discharge, with 53% patients showing the same ECOG score, 23.9% showing improvement, and 4.1% showing worsening of performance status (Supplementary Figure S1 and Supplementary Table S2).

Influence of quality of life of hospitalized patients on ECOG-PS assignment

The self-reported quality of life scores across each subscale of the EQ-5D-5L are presented in Figure 1. The mean health index based on the EQ-5D-5L was 0.64 (IQR: 0.37, 0.83) for the entire cohort. Additionally, the mean visual analogue scale (VAS) score, which represents the patients' perceived overall health status, was 5.0 (IQR: 4.0, 7.0).

To explore the impact of quality-of-life factors on ECOG-PS scoring, we employed ordinal generalized linear mixed regression models. In these models, patients and evaluators were treated as random effects, while the scores for each EQ-5D-5L subscale were treated as fixed effects. The final model (Supplementary Table S3) demonstrated that all quality-of-life dimensions, except anxiety/depression, were significantly associated with ECOG-PS ($P < .001$), including mobility, self-care, usual activities, and pain/discomfort. The Akaike Information Criterion (AIC) for this model was 778, indicating stronger model performance compared to a model based only on tumor and patient characteristics at admission (AIC, 807). The distribution of ECOGa for each level of the EQ-5D-5L self-care dimension is shown in Supplementary Figure S2.

A combined model, which integrated both clinical factors and quality of life variables (Table 2), demonstrated significant improvements in predicting ECOG-PS scores. Key clinical factors, such as reason for admission ($P = .003$), age ($P = .011$), absence of antineoplastic active treatment ($P = .009$), and disease stage ($P = .030$), along with quality-of-life variables from the EQ-5D-5L subscales—specifically pain ($P = .030$) and self-care ($P < .001$)—were significant predictors. This combined model outperformed a model based solely on quality-of-life variables, as confirmed by the likelihood ratio test (LLR test, $P < .001$) and a lower Akaike Information Criterion (AIC 751 vs. 778). Additionally, the inclusion of quality-of-life variables improved the prediction based only on patient variables at admission (LLRT, $P < .001$; AIC 807 vs AIC 751). In summary, for this population of hospitalized cancer patients, the assigned ECOG was associated not only with quality-of-life variables, but also with patient's characteristics and cause of admission, as exemplified in Figure 2.

Evaluation of concordance in the assignment of ECOG-PS by health professionals according to subgroups defined by patient characteristics, cause of admission, and ECOG category

To further investigate the factors associated with the assignment of ECOG-PS scores by healthcare professionals, we

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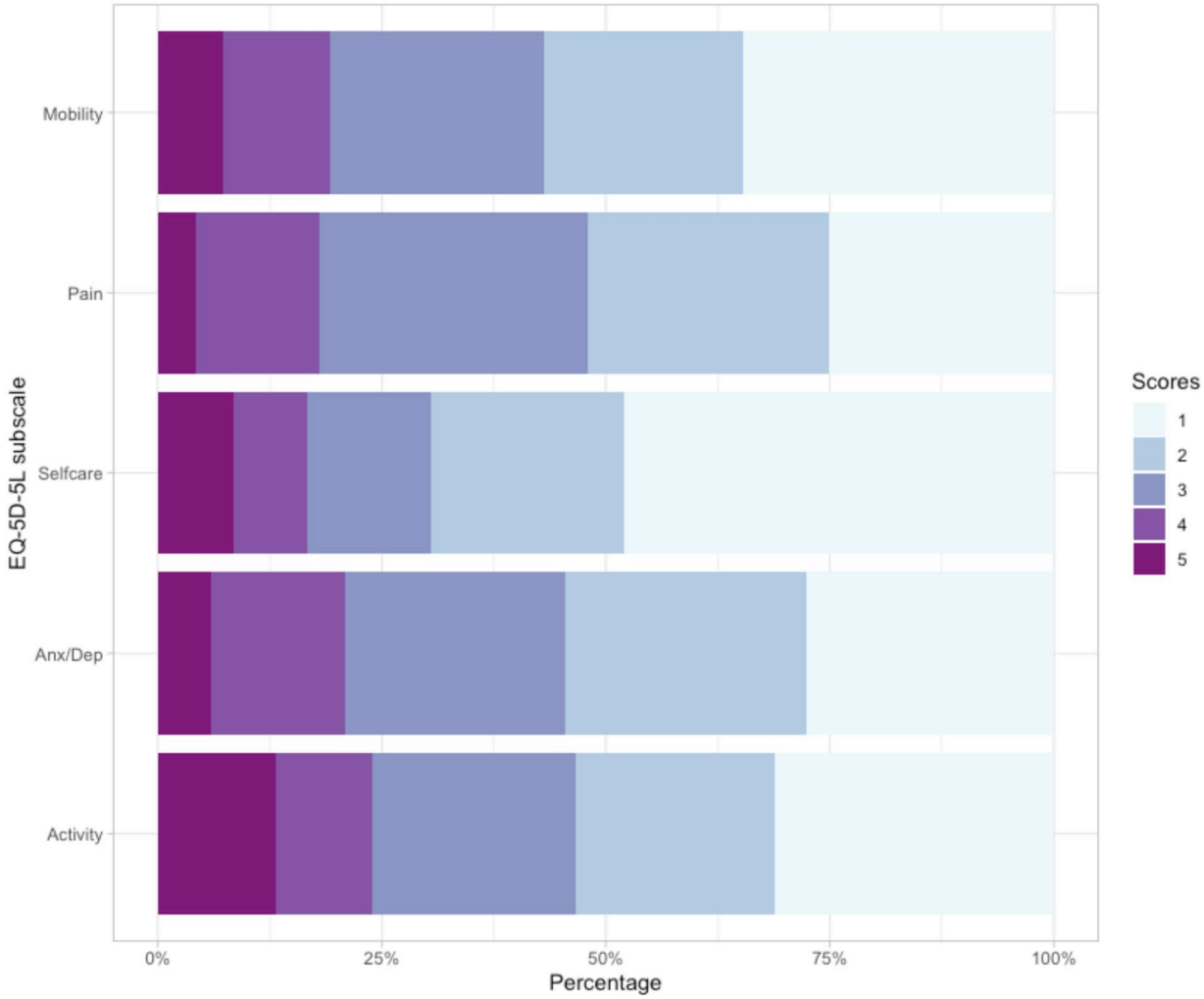

Figure 1. Quality of life characteristics measured by the EQ-5D-5L scale. Bar-graph showing the distribution of scores for each subscale of the EQ-5D-5L scale ($n = 167$).

Table 2. Combined prediction model of ECOG-PS based on clinical and quality of life variables.

Covariate	Coefficient (SE)	*P*
EQ-5D-Pain (L)	6.57 (2.20)	.030
EQ-5D-Self care (L)	9.05 (1.84)	<.001
No antineoplastic treatment	3.69 (1.42)	.009
Cause of admission (tumor-related)	3.98 (1.35)	.003
Stage (C)	2.96 (1.37)	.030
Age	0.13 (0.05)	.011

calculated model-based kappa values for the whole cohort and for each group. In the entire cohort, results from the ordinal generalized linear mixed regression models indicated substantial concordance values for both agreement (model-based kappa 0.75, 95% CI 0.74-0.77) and association (model-based weighted kappa 0.88, 95% CI 0.87-0.89). Evaluator effects were negligible in the final model, with a variance nearly equal to zero.

When evaluating the degree of association within groups defined by patient characteristics and admission criteria, we found that concordance was notably lower for patients classified as stage I-III (mKappa 0.59, 95% CI 0.54-0.65) and for those admitted primarily due to treatment toxicity (mKappa 0.60, 95%CI 0.54-0.66). In both settings, 95% CIs did not overlap with those of stage IV and tumor-related admission. The same pattern was found for model-based weighted kappa in these groups of patients (Table 3).

Moreover, the degree of agreement varied significantly across different ECOG-PS categories. When compared with different

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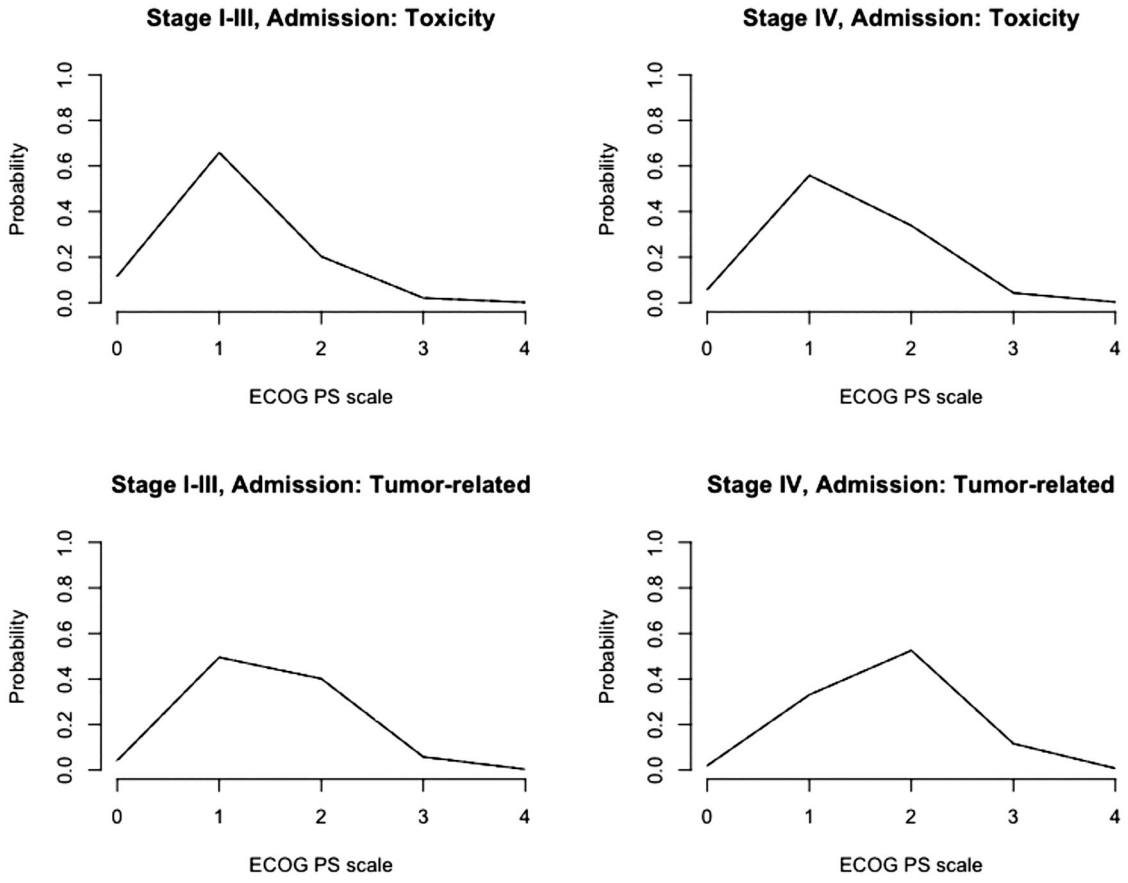

Figure 2. ECOG-PS assignment probabilities for an average evaluator at different conditions of patient and hospitalization. The probabilities of assignment for each level of ECOG were calculated for an average evaluator in specific conditions of tumor stage and cause of admission. Calculation was performed according to the final cumulative linked mixed model including both patient characteristics and quality of life.

cut-offs, assignment of ECOGa 2 exhibited a low concordance among observers (Table 3), with a wide range of assigned ECOG-PS non-concordant values (Figure 3) and high variability of patient-reported EQ-5D-5L scores within this group (Supplementary Figure S3).

Discussion

The functional assessment of hospitalized oncology patients is crucial for guiding healthcare decisions. In this study, we developed a model incorporating clinical variables and patient-reported quality of life to better understand functional evaluation and obtain insights into the factors influencing clinician-assigned ECOG score assignment by health professionals. Our comprehensive model showed improved fit compared with those based exclusively on clinical or quality of life variables. Tumor stage, age, reason for admission, and specific areas of patient-reported quality of life (such as self-care and pain) emerged as key predictors of patients' functional status. Additionally, we identified clinical settings (early-stage cancer and toxicity-related admissions) where interobserver agreement on ECOG scores was lower among hospitalized cancer patients.

Functional capacity and quality of life are well-established predictors of cancer prognosis, and we also showed a correlation of initial ECOG-PS scores with inpatient mortality. Several studies have linked lower ECOG-PS scores to improved treatment outcomes,[26] while tools like the EQ-5D-5L have shown that better quality of life predicts longer survival in patients with advanced cancer.[27] Patients with higher functional capacity and perceived quality of life are also more likely to tolerate intensive treatments, which can improve survival and prognosis. However, our study was not designed to evaluate whether incorporating EQ-5D-5L into routine inpatient ECOG-PS assessment improves downstream outcomes (eg, treatment decisions, toxicity, length of stay or survival). Therefore, our findings should be interpreted as associative with respect to ECOG-PS assignment and agreement.

While some studies have reported moderate to substantial concordance in ECOG-PS scoring among health professionals, others have shown lower agreement.[8] This variability is influenced by factors such as evaluator experience and clinical complexity, with higher concordance observed among experienced evaluators in less complex settings.[26,28] Our finding of a substantial level of inter-rater agreement for ECOG-PS reaffirms the value of the scale in evaluating the functional status of hospitalized cancer patients, despite its limitations. However, the subjective nature of ECOG-PS scoring supports considering patient-reported highlights the importance of considering additional patient-reported measures, such as quality of life, and emphasizes the need for multi-dimensional evaluation beyond

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Table 3. Concordance rates according to primary tumor, stage, reason for admission and ECOG group in hospitalized oncological patients.

		N	mKappa (95%CI)	mwKappa (95%CI)
Global		167	0.75 (0.74-0.77)	0.88 (0.87-0.89)
Concordance according to patient/admission characteristics				
Sex	Male	98	0.74 (0.72-0.76)	0.88 (0.86-0.89)
	Female	69	0.76 (0.74-0.78)	0.88 (0.87-0.90)
Primary tumor	Lung cancer	54	0.78 (0.75-0.80)	0.89 (0.87-0.91)
	Breast cancer	12	0.77 (0.69-0.85)	0.87 (0.80-0.94)
	Hepatobiliary or esophagogastric	39	0.75 (0.71-0.78)	0.88 (0.85-0.91)
	Other tumors	62	0.72 (0.69-0.75)	0.86 (0.84-0.89)
Stage	Stage I-III	40	0.58 (0.52-0.63)	0.75 (0.69-0.80)
	Stage IV	127	0.77 (0.75-0.79)	0.89 (0.88-0.90)
Reason for admission	Tumor-related	132	0.75 (0.74-0.77)	0.88 (0.87-0.90)
	Treatment toxicity	35	0.60 (0.54-0.66)	0.76 (0.71-0.82)
Active treatment	Yes	134	0.75 (0.73-0.77)	0.88 (0.87-0.89)
	No	33	0.80 (0.77-0.83)	0.88 (0.86-0.91)
Concordance according to ECOGa levels				
ECOG 0-2		109	0.49 (0.45-0.53)	0.68 (0.64-0.72)
ECOG 3-4		58	0.72 (0.68-0.75)	0.79 (0.76-0.83)
ECOG 0-1		43	0.32 (0.25-0.39)	0.43 (0.35-0.51)
ECOG 2-4		124	0.60 (0.57-0.63)	0.76 (0.73-0.79)
ECOG 0-1		43	0.32 (0.25-0.39)	0.43 (0.35-0.51)
ECOG 2		66	0.06 (0.04-0.08)	0.10 (0.07-0.13)
ECOG 3-4		58	0.72 (0.68-0.75)	0.79 (0.76-0.83)

mKappa: model-based kappa for agreement; mwKappa: model-based weighted kappa for association.

clinical observation. Prior studies showed that patients with better self-perceived quality of life generally have better treatment outcomes.[29,30] Our analyses evaluated associations with ECOG-PS assignment and did not focus on clinical outcomes. In our dataset, EQ-5D-5L domains were associated with ECOG-PS assignment and contributed to model performance, suggesting that patient-reported information may complement clinician-rated assessment, particularly in contexts where ECOG-PS agreement was lower; prospective studies are required to determine clinical utility and outcome impact.

Interestingly, the anxiety and depression subscale of EQ-5D-5L did not correlate with ECOG-PS scores, likely because ECOG-PS focuses on physical status, whereas psychosocial factors may play a lesser role. In fact, in a study addressing the levels of anxiety and depression in a population of palliative inpatients, higher scores were more prevalent in the group of patients with better performance status.[31] This finding is thereby consistent with other studies recommending complementary tools to address emotional and psychosocial domains, particularly in advanced cancer patients.[32,33]

The observed variability in concordance based on the reason for admission and the disease stage suggests that there are specific groups of inpatients in whom evaluation of performance status might be less consistent. Recognizing this variability is essential for tailoring therapeutic strategies, especially in cases of toxicity-related complications and early stages. Apparently, although patients with advanced tumors exhibit greater heterogeneity in functional status,[34–36] health professionals were able to agree in the assignment of ECOG-PS to patients with advanced tumors and poorer quality of life,[37–40] usually admitted for disease progression or tumor-related complications.

The interobserver variability was particularly high in the ECOG 2 category of our study. The consequences of this lack of agreement cannot be overemphasized since it is precisely this level of ECOG-PS the critical level to make decisions on antineoplastic treatment or intensity of care. Assignment of ECOG 2 may be sufficient to establish the indication for immunotherapy or targeted therapy, which seems to generate similar results in this group of patients when compared with ECOG 0-1 patients.[41,42] Also, a patient with an ECOG 2 may be in some cases a candidate for inclusion in a clinical trial, while ECOG 3 are systematically excluded from investigational studies.[43] Our data show that health professionals do not consistently classify inpatients with intermediate performance status; the exploratory analysis of quality of life traits in this group suggest that ECOG 2 does not mean the same for different oncologists. Accordingly, ECOG-PS 2 should be interpreted cautiously early during hospitalization, and complementary patient-reported information (eg, EQ-5D-5L self-care and pain) may help contextualize assessment uncertainty; prospective studies are needed to determine clinical utility.

Key strengths of our study are the prospective inclusion of a consecutive series of hospitalized oncology patients, providing a realistic assessment of ECOG-PS use in this setting, and an adequately powered sample to demonstrate the level of interobserver agreement with sufficient precision. Additionally, the use of independent evaluators and consensus calculations enhances the robustness of our findings. A model incorporating clinical variables and EQ-5D-5L subscales may be feasible to

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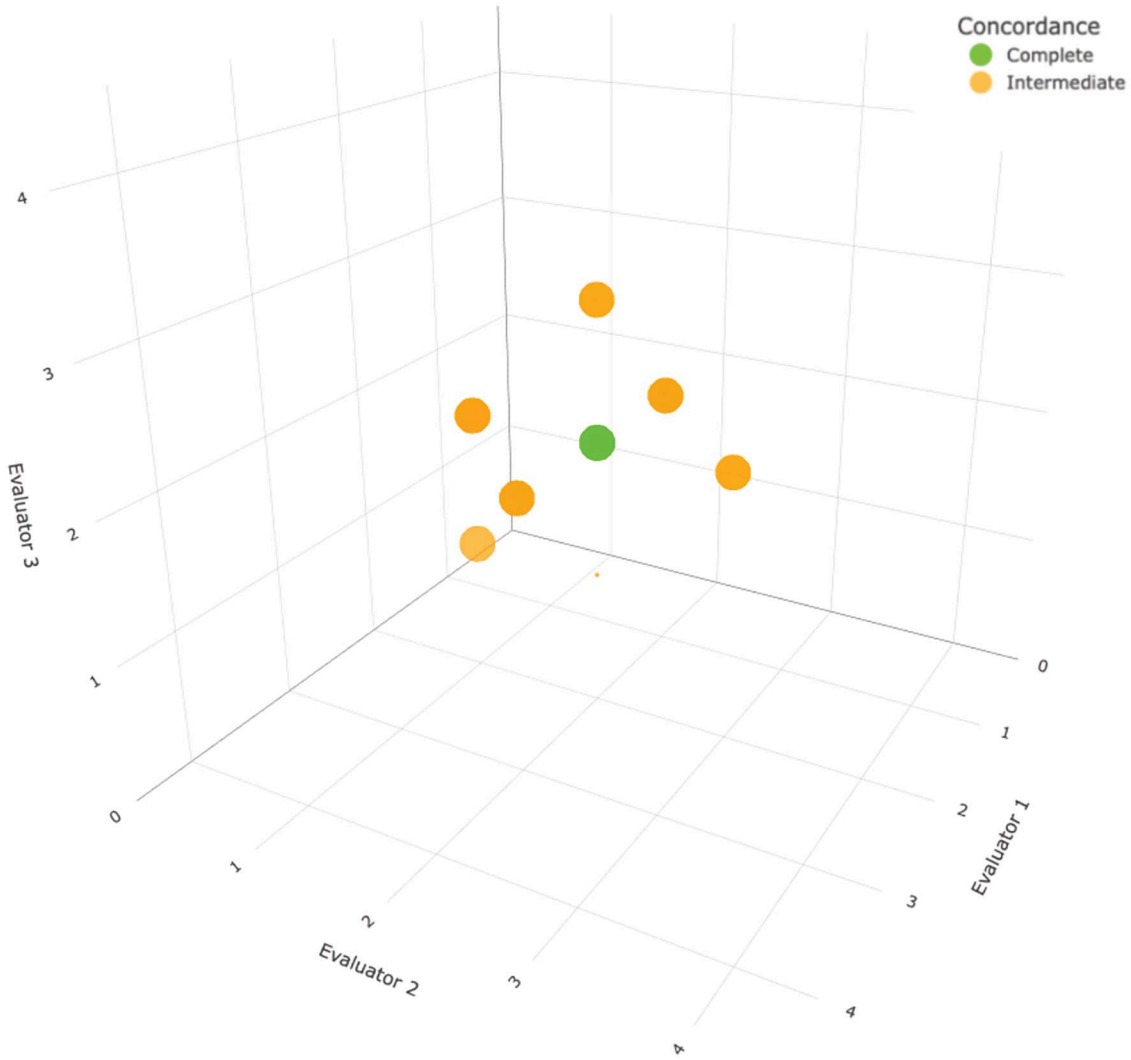

Figure 3. Concordance for ECOG assignment between evaluators in patients with ECOGa = 2. A wide dispersion of combinations and ECOG-PS values is observed, in most cases with intermediate (2 of 3 evaluators; orange) agreement, among patients with ECOGa = 2 ($n = 66$); full agreement (3 evaluators) is shown as green. The size of the points is proportional to the number of observations in each category.

implement in clinical practice, placing minimal burden on patients. However, this study has some limitations. First, the cohort was limited to patients admitted under Medical Oncology; in our hospital, hematologic malignancy inpatients are managed by a separate Hematology service and were therefore not included, which limits generalizability to hematology-led inpatient populations. Second, beyond tumor stage and our prespecified admission categories (tumor-related vs treatment-toxicity–related), disease trajectory at admission (eg, radiographic progression versus stable/responding disease) was not systematically captured and could not be evaluated in relation to ECOG-PS assignment or inter-rater agreement. Furthermore, it was conducted in a single center and department, which may limit generalizability due to the specific admission profile and to the likely uniformity of physician training and attitudes, which might lead to an overestimation of inter-observer agreement. Additionally, the number of raters was only three; however, it is difficult to augment the number of evaluators for the same individual patient in a clinical practice setting. Moreover, all raters were oncologists, and inter-rater variability may differ in multidisciplinary inpatient workflows (eg, internal medicine teams or emergency department clinicians) where performance status is assessed by providers with different training and experience. Indeed, we consider that one of the strength of our study is precisely the obtention of prospective real world data in contrast to other studies based on simulated scenarios or clinical vignettes.[18] Additionally, the subjective nature of both ECOG-PS scoring, and quality of life assessment must be acknowledged.

Taken together, our data and previous results[6,8,13,15–17] point to the three main limitations of ECOG-PS: unidimensionality,[44] lack of agreement between physician's estimation and patient's perceived functional status,[45,46] and subjectivity and lack of concordance between health professionals.[8] While ECOG-PS remains a valuable tool, its reliability could be improved by incorporating instruments that assess other critical dimensions that have an impact on functional status. The inclusion of patient well-being and quality of life measures, by means of our proposal for EQ-5D-5L or of other feasible quality of life scales,

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may partially address this limitation and, at the same time, improve the agreement between patients and health professionals in the evaluation of performance status. Additionally, our identification of admission-related or tumor-related factors as modifiers of the evaluation of performance status by health professionals might contribute to improve the inter-rater agreement for ECOG-PS.

Future studies should externally validate these findings in other inpatient settings and include more diverse, multidisciplinary raters. Longitudinal designs incorporating serial ECOG-PS and patient-reported assessments during hospitalization and after discharge could characterize within-patient trajectories and clarify discrepancies between clinician-assigned and patient-reported functional status, including patient self-rated ECOG-PS.

In conclusion, substantial concordance was observed in ECOG-PS scoring of hospitalized cancer patients by healthcare professionals. Nevertheless, both patient factors and treatment or admission circumstances influenced the scores. Quality of life measures, particularly those related to self-care and pain, alongside clinical variables, were key predictors of ECOG-PS, and may provide complementary information in functional assessments; clinical utility and outcome impact require prospective evaluation. Finally, some specific clinical settings, such as early stages or ECOG 2 status, seem to be particularly prone to variability in performance status evaluation by oncologists. Although further validation of these results in independent cohorts is warranted, the improved understanding of the factors that potentially explain a lower concordant assignment of ECOG-PS should help to refine and contextualize the assessment of functional status in hospitalized oncology patients.

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Author contributions

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Supplementary material

Supplementary material is available at *The Oncologist* online.

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Conflicts of interest

The authors declare no conflict of interest.

Data availability

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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