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# The usefulness of Palliative Prognostic Index in predicting the survival of patients with advanced lung cancer

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**Abstract:**

**BACKGROUND AND AIM:** In advanced cancer patients, life expectancy is essential in making end-of-life decisions for clinicians and patients. Palliative Prognostic Index (PPI) is a prognostic tool commonly used in palliative care for prediction survival. The aim of this study is to evaluate the accuracy of PPI for predicting survival in patients with advanced lung cancer.

**MATERIALS AND METHODS:** Patients with advanced lung cancer hospitalized in a palliative clinic were included in this retrospective study. The PPI score was calculated by the doctor on admission day. The patients were divided into three groups according to their PPI score: group A:  $PPI \leq 4$ , Group B:  $4 < PPI \leq 6$ , and Group C:  $PPI > 6$ . All patients were followed up for up to 3 months. The survival analyses were performed using the Kaplan–Meier analysis.

**RESULTS:** There were 177 (87.2%) men for a total of 203 patients with advanced lung cancer included in the study. The overall mean age was  $64.59 \pm 10.87$  years; 97% of the patients died during the follow-up period. Their overall median survival was 17 days. The median survival for Group A (51 days, 95% confidence interval [CI]: 39.7–62.2) was significantly longer than Group B (16 days, 95% CI: 10.4–21.5) and Group C (6 days, 95% CI: 4–7.9). For a  $PPI \leq 4$  and 6-week survival, the sensitivity and specificity were 82.5% and 75.7%, respectively. For a  $PPI > 6$  and 3-week survival, the sensitivity and specificity were 57.7% and 91.3%, respectively.

**CONCLUSION:** The PPI is a valuable and useful prognostic tool in predicting survival time for advanced lung cancer patients in palliative care.

**Keywords:**

Advanced lung cancer, palliative care, Palliative Prognostic Index, survival

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## Introduction

It is challenging to predict the exact prognosis of patients with a terminal illness. In patients with advanced cancer, accurate survival estimation is critical to selecting appropriate medical approaches and for the patients and their relatives to make future plans. There is little evidence that treatment improves

survival in advanced cancer patients with a median survival of 6 months or less.<sup>[1]</sup> However, numerous studies show that some advanced cancer patients continue to receive chemotherapy or radiotherapy in the last 14–30 days of their lives with two or more emergency admissions and frequent hospitalizations with at least one stay in the intensive care unit.<sup>[2–4]</sup> These aggressive medical approaches bring some problems, such as negatively affecting the quality of

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life of patients toward the end of their life as well as the improper allotment of limited resources. The most commonly used method in determining prognosis, which affects many important personal and clinical decisions, is the clinician prediction of survival (CPS) based on experience and knowledge, but it tends to be misleading and more optimistic than the patient's actual survival.<sup>[5]</sup>

In 2005, the European Association for Palliative Care emphasized that some clinical symptoms and findings and biochemical parameters have prognostic value, especially in patients with advanced cancer. They recommended that prognostic scores consisting of various combinations of these prognostic factors increase the accuracy of CPS and should be used.<sup>[6]</sup> One of these is the Palliative Prognostic Index (PPI) developed by Morita *et al.* in Japan.<sup>[7]</sup> It is a scoring model calculated based on five clinical parameters: performance status, oral intake, edema, dyspnea, and delirium. The PPI score is obtained due to the sum of the scores defined separately for each of these parameters. The higher the score, the worse the prognosis and the shorter the expected survival.

Palliative care services in Turkey started to be provided in a limited number of centers in 2010. The use of well-known prognostic tools such as PPI, which is widely used in advanced cancer patients across the world and provides important advantages to clinicians, patients, and patient relatives in making end-of-life decisions, also in Turkey, could guide us to make appropriate medical decisions in palliative care and to use our health-care system and financial resources efficiently. Therefore, in our study, we wanted to evaluate the accuracy of the PPI in predicting survival in patients with advanced lung cancer hospitalized in our palliative care clinic.

## Materials and Methods

This retrospective study was carried out in the Palliative Care Clinic of Chest Diseases and Thoracic Surgery Training and Research Hospital. The Institutional Ethics Committee approved the study (November 5, 2020-44), and this study was done according to the Helsinki Declaration. Our clinic has 14 beds and was established in November 2016. Since we are a palliative clinic within the Chest Diseases Hospital and mostly take the palliative care of patients with advanced lung cancer, the number of patients with lung cancer is higher than the other organ cancers. Therefore, to obtain a more homogeneous group, we selected patients with lung cancer. All patients with advanced lung cancer aged over 18 years hospitalized in our service between November 15, 2016, and April 15, 2018, who had local or distant spread, and whose oncological treatment had been terminated, were

included in the study. Patients with nonpulmonary cancer under 18 years of age were excluded from the study. The demographic and clinical information of the patients were recorded.

The PPI score was calculated according to the Palliative Performance Scale (PPS), oral intake, presence or absence of edema, dyspnea at rest, delirium, and the sum of the partial scores defined for each of these parameters [Table 1].

PPS is a physical capacity assessment measure based on the Karnofsky Performance Scale and used in palliative care. There are 11 PPS levels ranging 0% to 100% in 10% increments. A value of 100% indicates a fully standing and healthy patient. Every 10% reduction in PPS indicates a very significant decrease in physical function; thus, 0% denotes death.<sup>[8]</sup> The appropriate value was chosen for the patient's current performance status. Delirium was diagnosed according to the criteria specified in the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition (1994).<sup>[9]</sup> The PPI score was calculated by the doctor on the day the patients were hospitalized. The patients were divided into three groups according to their PPI score: group A: PPI ≤4, Group B: 4 <PPI ≤6, and Group C: PPI >6.

All patients were followed up for up to 3 months after the end of the study. The death dates of those who died in the hospital were obtained from the patient files, and the death information of those who were discharged from the hospital was obtained from the National Death Reporting System, and their survival times were determined.

SPSS Statistics for Windows, Version 23.0 (IBM Corp 2015, Armonk, NY, USA) was used for statistical analysis.

**Table 1: The Palliative Prognostic Index**

Performance status/symptoms	Partial score
Palliative Performance Scale	
10-20	4
30-50	2.5
≥60	0
Oral intake	
Mouthfuls or less	2.5
Reduced but more than mouthfuls	1
Normal	0
Edema	
Present	1
Absent	0
Dyspnea at rest	
Present	3.5
Absent	0
Delirium	
Present	4
Absent	0

Descriptive statistics were revealed as number and percentage for categorical variables and mean, standard deviation, minimum, and maximum for scale variables. Comparisons of the two independent patient groups were made by Mann–Whitney U-test. Comparisons of ratios in independent groups were performed with Pearson Chi-square test. The survival analyses were performed with Kaplan–Meier analysis. The significance level was  $P < 0.05$ .

## Results

A total of 203 patients were included in the study: 177 (87.2%) males and 26 (12.8%) females. The overall mean age was  $64.59 \pm 10.87$  years. There were 151 patients diagnosed with non-small cell lung cancer (NSCLC) and 31 small cell lung cancer (SCLC). The cell type of 21 patients was unknown. The characteristics of the patients are summarized in Table 2.

The patients were divided into three groups (Group A:  $PPI \leq 4$ , Group B:  $4 < PPI \leq 6$ , and Group C:  $PPI > 6$ ) considering their PPI scores, and Kaplan–Meier survival

analysis was conducted. The demographic features of the groups are shown in Table 3.

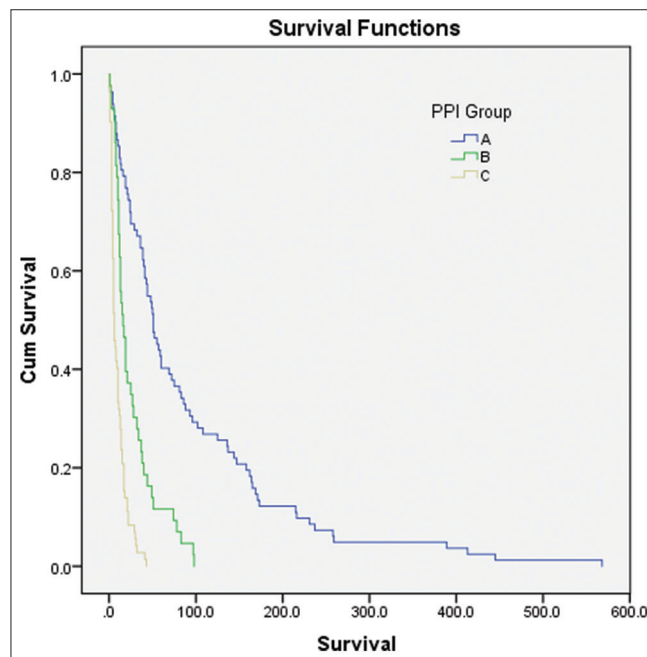
The Kaplan–Meier survival analysis was conducted for each of the groups. The median survival for Group A, Group B, and Group C and the respective 95% confidence intervals (CIs) for these groups are summarized in Table 4. The actual Kaplan–Meier survival curves for the three groups are shown in Figure 1.

The overall median survival was 17 days. The survival of Group A (51 days, 95% CI: 39.7–62.2) was longer than that of Group B (16 days, 95% CI: 10.4–21.5). A Mann–Whitney test indicated that this difference was statistically significant,  $U (N1 = 82, N2 = 43) = 930, z = -4.33, P < 0.001$ . The survival of Group B (16 days, 95% CI: 10.4–21.5) was longer than that of Group C (6 days, 95% CI: 4–7.9). A Mann–Whitney test indicated that this difference was statistically significant,  $U (N1 = 43, N2 = 72) = 750.5, z = -4.616, P < 0.001$ .

**Table 2: The characteristics of the patients**

	n (%)
Age, mean±SD (minimum-maximum)	64.59±10.87 (26-89)
Gender	
Female	26 (12.8)
Male	177 (87.2)
Status	
Excitus	197 (97)
Alive	6 (3)
Lung cancer	203 (100)
Tumor type	
SCLC	31 (15.3)
NSCLC	151 (74.4)
Unknown	21 (10.3)
Metastasis	
Distant	72 (35.4)
Brain	32 (15.7)
Bone	41 (20.1)
Liver	39 (19.2)
Adrenal	18 (8.8)

SD: Standard deviation, NSCLC: Non-small cell lung cancer, SCLC: Small cell lung cancer



**Figure 1:** Survival functions of the different PPI groups

**Table 3: Age, gender and status of the Palliative Prognostic Index patient groups**

	Group A: $PPI \leq 4, n (%)$	Group B: $4 < PPI \leq 6, n (%)$	Group C: $PPI > 6, n (%)$
Age, mean±SD (minimum-maximum)	64.73±9.20 (39-89)	63.67±12.54 (26-86)	64.99±11.70 (35-88)
Gender			
Female	14 (16.3)	6 (13.3)	6 (8.3)
Male	72 (83.7)	39 (86.7)	66 (91.7)
Status			
Excitus	82 (95.3)	43 (95.6)	72 (100)
Alive	4 (4.7)	2 (4.4)	0

PPI: Palliative Prognostic Index, SD: Standard deviation

The log-rank test of equality of survival distributions suggested a significant difference for the different PPI groups ( $P < 0.001$ ).

PPI  $\leq 4$ , survival of more than 6 weeks was predicted with an 82.5% sensitivity and 75.7% specificity. PPI  $> 6$ , survival of  $< 3$  weeks was predicted with a 57.7% sensitivity and 91.3% specificity. The positive predictive value, negative predictive value, sensitivity, and specificity for survival  $> 6$  weeks and  $< 3$  weeks are shown in Table 5.

The overall mean length of hospital stay was 9 (11.03  $\pm$  9.81) days. During the hospitalization, there were 95 deaths. These results for each group are summarized in Tables 6 and 7.

The length of hospitalization stay of Group C was shorter than those of Group A and Group B. A Mann-Whitney test indicated that this difference was statistically significant,  $U = 5845$ ,  $P = 0.005$ .

Pearson Chi-square test suggests that there was a significant difference between different PPI groups regarding in-hospital deaths,  $\chi^2 (2) = 57.67$ ,  $P < 0.001$ . Patients with high PPI were a higher rate to die in the hospital.

## Discussion

This study confirmed that there was a significant difference in survival times in patients with advanced-stage lung cancer hospitalized in the palliative care clinic in groups with different prognostic scores according to the PPI, and the higher the score, the shorter the survival time. The accuracy of the PPI has been tested in palliative care units and hospices in many countries previously, such as Ireland, Italy, Australia, Kuwait, the United Kingdom, and China.<sup>[10-15]</sup> In a recent meta-analysis investigating the validity and accuracy of the different PPI scores in palliative care conditions, it was reported that the sensitivity for 6-week survival was 46%–89%, specificity was 51.7%–84.4%, sensitivity for 3-week survival was 51%–92%, and specificity was 60%–94%.<sup>[16]</sup> Our study results concluded a sensitivity and specificity of 82.5% and 75.7% for 6-week survival and 57.7% and 91.3% for 3-week survival, respectively, which was compatible with the literature.

Inomata *et al.* evaluated the relationship between the PPI and the survival time and the sensitivity and specificity of the PPI separately in patients with NSCLC and SCLC. They found that the sensitivity of the PPI was relatively low in predicting survival of  $< 3$  weeks in patients with SCLC. They noted that this result was probably due to the aggressive course of the SCLC.<sup>[17]</sup> In our patient

**Table 4: Median survival for different groups based on Palliative Prognostic Index score**

	n	Events	Median survival (days)	95% CI for median (lower bound-upper bound)
Group A	86	82	51	39.72-62.28
Group B	45	43	16	10.49-21.51
Group C	72	72	6	4.09-7.91
Overall	203	197	17	12.6-21.4

CI: Confidence interval

**Table 5: Accuracy of predictions using the Palliative Prognostic Index**

	PPV (%)	NPV (%)	Sensitivity (%)	Specificity (%)
PPI $\leq 4$ for $> 6$ weeks	60.5	90.6	82.5	75.7
PPI $> 6$ for $< 3$ weeks	88.9	64.1	57.7	91.3

PPV: Positive predictive value, NPV: Negative predictive value, PPI: Palliative Prognostic Index

**Table 6: Length of hospital stay in days**

	Median	Mean $\pm$ SD	Minimum-maximum
Group A	10	12.09 $\pm$ 11.07	1-60
Group B	12	12.37 $\pm$ 8.72	0-38
Group C	5	8.92 $\pm$ 8.55	0-41
Overall	9	11.03 $\pm$ 9.81	0-60

SD: Standard deviation

**Table 7: Death in hospital**

	Death in hospital	Discharged	Total
Group A	22	64	86
Group B	24	21	45
Group C	62	10	72
Total	95	108	203

group, we had patients whose cell type was unknown. Furthermore, since the number of patients with SCLC in the group, on the whole, was relatively low, we could not evaluate our patients with SCLC and NSCLC separately. Larger sample size is needed to investigate the accuracy of the PPI in predicting survival in patients with SCLC and NSCLC with different clinical courses to offer a more comprehensive interpretation.

The most striking finding in our study was that the specificity was high in the group with a PPI value  $> 6$  and survival expectancy of  $< 3$  weeks. Similar to previous studies, this result shows that the PPI is a good prognostic tool, especially in determining survival of  $< 3$  weeks.<sup>[10,14,17]</sup> However, despite the high specificity value, sensitivity was relatively low, since 47 of the patients included in the study died within the first 3 weeks even though their PPI values were  $< 6$  and survival expectancy was long. This suggests that acute concomitant conditions such as hypercalcemia, newly developed pulmonary or cerebral thromboembolism, infection, acute hemorrhage, and arrhythmia that emerge during clinical follow-up in patients with advanced cancer who have relatively long

survival prospects, may be associated with unexpected deaths.<sup>[18,19]</sup>

Due to the instability of the course of the advanced cancer and the potential for acute emerging changes to alter the prognosis, the accuracy of survival estimates made with instant evaluations on the clinical course has been discussed in recent years. In some studies, it is emphasized that re-evaluating the PPI score at the time of admission and in the following 3–7 days and determining the PPI variability increases the accuracy of the survival predictions by providing additional information about prognosis.<sup>[20-23]</sup> In our study, we analyzed only the PPI values of the patients at the time of admission. Investigating PPI variability in light of the current studies will increase the accuracy of future survival studies in advanced cancer patients.

Assessment of the PPI does not require an invasive procedure, such as blood analysis, and is made according to the patient's clinical symptoms. It is simple and useful enough to be applied at the bedside. Furthermore, the fact that it can be performed by a doctor, nurse, or trained health personnel in the hospital, nursing home, or even home care settings are important advantages.<sup>[7,10,16]</sup>

The limitations that may have affected the generalizability of our study results are that it was a retrospective, single-center study with a limited number of patients that did not take into account comorbid diseases that may affect patients' survival.

## Conclusion

Better survival prediction in end-stage cancer patients has been the focus of attention for years due to its benefits to patients and physicians. Numerous studies are still being conducted on this subject all over the world. Our study represents the first evaluation of the PPI's accuracy in Turkey in advanced lung cancer patients in palliative care. In conclusion, the PPI was demonstrated to be a reliable and convenient prognostic tool in the survival assessment of patients with advanced lung cancer. It offers a useful tool for clinicians to avoid unnecessary medical interventions for these patients. It also helps in the planning of appropriate supportive treatments and to better inform the patients' relatives.

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## Conflicts of interest

There are no conflicts of interest.

## References

1. Salpeter SR, Malter DS, Luo EJ, Lin AY, Stuart B. Systematic review of cancer presentations with a median survival of six months or less. *J Palliat Med* 2012;15:175-85.
2. Anshushaug M, Gynnild MA, Kaasa S, Kvikstad A, Grønberg BH. Characterization of patients receiving palliative chemo- and radiotherapy during end of life at a regional cancer center in Norway. *Acta Oncol* 2015;54:395-402.
3. Haque W, Verma V, Butler EB, Teh BS. Patterns of end-of-life oncologic care for Stage IV non-small cell lung cancer in the United States. *Anticancer Res* 2019;39:3137-40.
4. Colombet I, Bouleuc C, Piolot A, Vilfaillot A, Jaulmes H, Voisin-Saltiel S, *et al.* Multicentre analysis of intensity of care at the end-of-life in patients with advanced cancer, combining health administrative data with hospital records: Variations in practice call for routine quality evaluation. *BMC Palliat Care* 2019;18:35.
5. Christakis NA, Lamont EB. Extent and determinants of error in doctors' prognoses in terminally ill patients: Prospective cohort study. *BMJ* 2000;320:469-72.
6. Maltoni M, Caraceni A, Brunelli C, Broeckeaert B, Christakis N, Eychmueller S, *et al.* Prognostic factors in advanced cancer patients: Evidence-based clinical recommendations – A study by the Steering Committee of the European Association for Palliative Care. *J Clin Oncol* 2005;23:6240-8.
7. Morita T, Tsunoda J, Inoue S, Chihara S. The Palliative Prognostic Index: A scoring system for survival prediction of terminally ill cancer patients. *Support Care Cancer* 1999;7:128-33.
8. Anderson F, Downing GM, Hill J, Casorso L, Lerch N. Palliative performance scale (PPS): A new tool. *J Palliat Care* 1996;12:5-11.
9. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4<sup>th</sup> ed. Washington: American Psychiatric Publishing, Inc.; 1989.
10. Stone CA, Tiernan E, Dooley BA. Prospective validation of the palliative prognostic index in patients with cancer. *J Pain Symptom Manage* 2008;35:617-22.
11. Yoong J, Atkin N, Le B. Use of the palliative prognostic index in a palliative care consultation service in Melbourne, Australia. *J Pain Symptom Manage* 2010;39:e2-4.
12. Maltoni M, Scarpi E, Pittureri C, Martini F, Montanari L, Amaducci E, *et al.* Prospective comparison of prognostic scores in palliative care cancer populations. *Oncologist* 2012;17:446-54.
13. Alshemmari S, Ezzat H, Samir Z, Refaat S, Alsirafy SA. The palliative prognostic index for the prediction of survival and in-hospital mortality of patients with advanced cancer in Kuwait. *J Palliat Med* 2012;15:200-4.
14. Subramaniam S, Thorns A, Ridout M, Thirukkumaran T, Osborne TR. Accuracy of prognosis prediction by PPI in hospice inpatients with cancer: A multi-centre prospective study. *BMJ Support Palliat Care* 2015;5:399-404.
15. Zhou J, Xu S, Cao Z, Tang J, Fang X, Qin L, *et al.* Validation of the Palliative Prognostic Index, Performance Status-Based Palliative Prognostic Index and Chinese Prognostic Scale in a home palliative care setting for patients with advanced cancer in China. *BMC Palliat Care* 2020;19:167.
16. Liu Y, Su L, Wang Y, Liu S, Dong B. The application of the palliative prognostic index in predicting the life expectancy of patients in palliative care: A systematic review and meta-analysis. *Aging Clin Exp Res* 2018;30:1417-28.
17. Inomata M, Hayashi R, Tokui K, Taka C, Okazawa S, Kambara K, *et al.* Usefulness of the Palliative Prognostic Index in patients with lung cancer. *Med Oncol* 2014;31:154.
18. Palomar-Muñoz C, Martín-Zamorano M, Mogollo A, Pascual-Pérez S, Rodríguez-Morales I, Girón-González JA. Assessment of the Palliative Prognostic Index in hospitalized oncologic patients treated by a palliative care team: Impact of acute concomitant diseases. *Oncotarget* 2018;9:18908-15.
19. Bruera S, Chisholm G, Dos Santos R, Bruera E, Hui D. Frequency and factors associated with unexpected death in an acute palliative care unit: Expect the unexpected. *J Pain Symptom Manage*

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- 2015;49:822-7.
20. Arai Y, Okajima Y, Kotani K, Tamba K. Prognostication based on the change in the palliative prognostic index for patients with terminal cancer. *J Pain Symptom Manage* 2014;47:742-7.
  21. Hung CY, Wang HM, Kao CY, Lin YC, Chen JS, Hung YS, *et al.* Magnitude of score change for the palliative prognostic index for survival prediction in patients with poor prognostic terminal cancer. *Support Care Cancer* 2014;22:2725-31.
  22. Kao CY, Hung YS, Wang HM, Chen JS, Chin TL, Lu CY, *et al.* Combination of initial palliative prognostic index and score change provides a better prognostic value for terminally ill cancer patients: A six-year observational cohort study. *J Pain Symptom Manage* 2014;48:804-14.
  23. Subramaniam S, Dand P, Ridout M, Cawley D, Miller S, Valli P, *et al.* Prognosis prediction with two calculations of Palliative Prognostic Index: Further prospective validation in hospice cancer patients with multicentre study. *BMJ Support Palliat Care* 2019;9:326-31.