ACCURACY OF SURVIVAL PREDICTION INSTRUMENTS IN OLDER PATIENTS UNDERGOING HOME-BASED PALLIATIVE CARE IN CURITIBA, BRAZIL

Acurácia dos instrumentos preditivos de sobrevivência em pacientes idosos sob cuidados paliativos em atendimento domiciliar em Curitiba

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INTRODUCTION: Prognostic scores are crucial to avoid unnecessary measures in palliative care, although their use in non-cancer patients undergoing home care in low-income countries lacks evidence. OBJECTIVE: To compare the accuracy of the survival prediction instruments Palliative Performance Scale (PPS), Karnofsky Performance Status (KPS), Palliative Prognostic Index (PPI), and Palliative Prognostic Score (PaP) in the older population treated by a Home Care Service (HCS) program in Curitiba, southern Brazil. METHODS: This is a prospective, observational, diagnostic accuracy study evaluating older adults undergoing HCS-provided palliative care. PPS, The PPS, KPS, PaP, and PPI scores were administered, and after 90 days the patients were evaluated for the outcomes death and hospital admission. RESULTS: The final sample consisted of 53 patients aged \geq 60 years; 28.3\% (n = 15) of those had age \geq 85 years. In the binary analysis, PaP had the best accuracy (79.2\%). In the ordinal analysis, PPI had the best accuracy (58.5\%), but all prognostic scales evaluated the sample similarly, with no significant differences. In both analyses, the patients aged \geq 85 years had similar results compared to the total sample. Although the HCS program is a distinct setting, the study results were similar to those of studies conducted in hospices and hospitals. CONCLUSION: The prognostic scores showed better accuracy when predicting only the outcome death but are less accurate when admission is included. There was no superior scale neither any difference in accuracy regarding age range.

KEYWORDS: aged; home care services; palliative care; palliative medicine; prognosis; survival.

INTRODUÇÃO: Escores prognósticos são cruciais para evitar medidas desproporcionais em cuidados paliativos, mas seu uso em pacientes não oncológicos, em cuidado domiciliar e em países subdesenvolvidos apresenta carência de evidência. OBJETIVO: Comparar a acurácia dos instrumentos preditivos de sobrevivência Palliative Performance Scale (PPS), Karnofsky Performance Status (KPS), Palliative Prognostic Index (PPI) e Palliative Prognostic Score (PaP) na população idosa do Serviço de Atenção Domiciliar (SAD) de Curitiba. MÉTODO: Trata-se de estudo de acurácia diagnóstica de caráter prospectivo e observacional conduzido com idosos em cuidados paliativos no SAD de Curitiba. Aplicaram-se os escores PPS, KPS, PPI e PaP, e após 90 dias os pacientes foram avaliados quanto aos desfechos internamento hospitalar e óbito. RESULTADOS: A amostra final foi de 53 pacientes com idade \geq 60 anos; desses, 28.3\% (n = 15) tinham \geq 85 anos. Na análise do desfecho binário (óbito ou não), foi identificado que a escala PaP teve melhor acurácia (79.2\%). Na análise do desfecho ordinal (óbito, hospitalização ou nenhuma dessas opções), a escala com melhor acurácia foi o PPI (58.5%), mas todas as escalas avaliaram a amostra de forma semelhante, sem significância estatística. Em ambas as análises, os pacientes com idade \geq 85 anos obtiveram resultados semelhantes aos demais. Apesar de o SAD ser um ambiente distinto, obteve resultados semelhantes aos de outros estudos que incluíram hospitais e hospices. CONCLUSÃO: As escalas prognósticas apresentaram melhor acurácia na predição somente de óbito, mas quando usadas para relacionar a hospitalização, perdem sua acurácia. Não houve uma escala superior às demais, e não existiu distinção da acurácia referente à idade.

PALAVRAS-CHAVE: idoso; serviços de assistência domiciliar; cuidados paliativos; medicina paliativa; prognóstico; sobrevida.

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INTRODUCTION

Prognostication is a core medical competency that physicians use to make therapeutic decisions, avoid unnecessary measures, and guide family members, thereby reducing anxiety and suffering. Clinical prediction of survival (CPS) has limited effectiveness as it usually overestimates prognosis. Therefore, the most appropriate method to evaluate prognosis today is by means of prognostic scores. The Palliative Performance Scale (PPS), the Karnofsky Performance Status (KPS), the Palliative Prognostic Index (PPI), and the Palliative Prognostic Score (PaP) are some of the most frequently used.

In 2005, the European Association of Palliative Care published recommendations concerning prognosis in patients with advanced cancer. That literature review describes CPS as a valid prognostic tool as long as it is used together with other tools such as prognostic indices. The need to estimate duration of life is not limited to oncology and should cover the older population undergoing non-cancer palliative care. The most common chronic diseases in palliative care services are advanced dementia, cancer, and cardiovascular disease.

Although some studies have tested prognostic scores in non-hospital settings and in non-exclusively cancer patients, they usually focus on cancer patients and hospital settings. As most of these studies have been conducted in other countries, there is a need for Brazilian studies addressing a heterogeneous population and different settings, such as home care services (HCS).

In Brazil there is a government-funded HCS called Serviço de Atenção Domiciliar (SAD) that serves predominantly older patients with multimorbidities and high rates of bed restriction and care dependence. Thus, there is a close relationship between palliative care, home care, and the older population, making it important to evaluate prognosis in this context.

The present study aimed to compare the accuracy of mortality prediction models (PPS, KPS, PPI, and PaP) and to investigate their association with hospital admission in older patients seen by SAD teams in Curitiba, southern Brazil. Additionally, patients aged ≥ 85 years were contrasted with the total sample to evaluate the accuracy of the prognostic scores in these two different samples.

METHODS

This prospective, observational, diagnostic accuracy study was developed by the Curitiba’s SAD program. The program consists of eight multidisciplinary home care teams (MHCT), which were named and sequenced from 1 to 8. A simple draw was performed using sealed opaque envelopes, and team 7 was randomly selected for patient recruitment in this study. Following selection of the MHCT, all patients in the area meeting the inclusion criteria were recruited. These patients underwent a baseline evaluation. The period for baseline evaluation of the sample was from August 1, 2017 to May 31, 2018.

The study inclusion criteria consisted of primary physician’s referral to palliative care and age ≥ 60 years. The exclusion criteria were inability to obtain a final PPS, PPI, or PaP score, refusal to meet the team during home visit, or no answer to three phone calls after 90 days.

At baseline, 72 patients were screened for inclusion in the study. The final sample consisted of 53 patients; 28.3% (n = 15) had age ≥ 85 years and were used for the secondary objective of the study. Nineteen patients were excluded — one for not signing the informed consent form, four for lacking data for inclusion, and 14 for being unreachable after 90 days. Flowchart 1 shows the process of inclusion.

Study participants completed a semi-structured questionnaire that included sociodemographic and clinical data, as well as prognostic scales.

KPS is a performance scale first used in oncology to rate the patient using a score of 0–100 based on clinical performance (100 = normal, no complaints, and no evidence of disease; and 0 = death).

PPS is a KPS-derived scale that evaluates five functional dimensions: ambulation, activity and evidence of disease, self-care, intake, and conscious level. PPS is subdivided into 11 levels in a series of 10% increases, ranging from 0% (death) to 100% (healthy person). Both cancer and non-cancer patients with PPS = 40 have an estimated survival of 30 days; however, the lower the PPS score, the lower the prediction of survival.

PaP combines KPS functional status, symptoms such as anorexia and dyspnea, CPS, and hematological parameters such as leukocyte count and percentage of peripheral blood lymphocytes. Each of these factors receives a score, and the sum of them represents the PaP score. This score classifies patients into three severity groups: A (< 5.5), B (5.6–11), and C (> 11), with mean life expectancy of 64, 32, and 11 days, respectively. New blood counts were collected from patients whose tests had been performed more than 90 days before the evaluation.

PPI is the sum of PPS and scores for oral intake and presence or absence of dyspnea, edema, and delirium. Based on the score obtained, disease severity can be estimated.
Patients scoring > 6 usually survive less than three weeks; those scoring 4–6 have an estimated survival of three to six weeks; and those scoring < 4 usually survive more than six weeks.\textsuperscript{15}

After 90 days, the patient or family member was contacted via telephone or in person to determine whether readmission or death occurred.

Following data collection, a logistic regression model was fitted using death as response variable.\textsuperscript{16} To identify age range and its interaction with death, a backward variable selection was performed using the likelihood ratio test (LRT). A receiver operating characteristic (ROC) curve was used to assess accuracy, and the model whose covariates were related to the outcome at 5% was maintained.\textsuperscript{17} For the second response variable in the ordinal analysis (alive and not admitted, alive and admitted, dead), an ordinal logistic regression model was fitted, as it has three categories.\textsuperscript{18} The method was the same used in the logistic regression model, except that the ROC curve was not needed to classify the patient, but actually the category most likely to occur. Finally, prognostic scales for a same outcome were compared based on accuracy. R was the software used for data analysis.

For comparison purposes, the McNemar test was used in the binary analysis.\textsuperscript{19} This allowed us to evaluate whether any prognostic scale was significantly different from the others. In the ordinal analysis, in addition to the McNemar test, the Madansky’s test\textsuperscript{20} was used to assess the PPI scale. The other ones were assessed likewise. In the comparison for the ordinal analysis, only the KPS and PPI scales differed; the others evaluated the patient in a similar manner.

The study was approved by the Human Subjects Research Ethics Committee at the Health Sciences Department with certificate of presentation for ethical appraisal no. 72339517.5.0000.0101.

**RESULTS**

As shown in Table 1, the final sample consisted of 53 patients. Of these, 75.4% (n = 40) of patients were female and 28.3% (n = 15) were aged ≥ 85 years. Regarding marital status, most participants were widowed (33.9%, n = 18) or married (28.3%, n = 15), and 79.2% (n = 42) were Caucasian. Regarding income, 16.9% (n = 9) of patients did not receive any financial support, 26.4% (n = 14) received a minimum wage, and 32.1% (n = 17) received up to three minimum wages.

With regard to comorbidities, 64.1% (n = 34) of patients had dementia, 58.4% (n = 31) had hypertension, 26.4% (n = 14) had stroke, 22.6% (n = 12) had heart failure, 20.7% (n = 11) had diabetes, 16.9% (n = 9) had coronary artery disease, 15.1% (n = 8) had chronic obstructive pulmonary disease, and 7.5% (n = 4) had cancer. Most patients (84.9%, n = 45) had been admitted at least once in the past year, and 35.8% (n = 19) had immobilization syndrome.

In this sample, 15 patients died. Of the 38 patients who survived, 15 were readmitted within 90 days of the baseline evaluation.

Table 2 shows the data obtained in the binary analysis of the outcome death. A one-unit increase in the PaP scale is estimated to be associated with a 1.3785-fold higher chance
of death, i.e., the higher the PaP value, the greater the chance that the patient will die. The other prognostic scales were associated with the outcome death as well, but their accuracy was lower. As in the PaP scale, the PPI value is directly related to the outcome death (1.5062-fold higher chance for each one-unit increase), whereas KPS and PPS values were inversely related to death (1.0726- and 1.0806-fold higher chance, respectively, for each one-unit decrease).

Table 3 shows the binary analysis of the outcome death. The PaP scale had the best accuracy (79.2%) to assess the outcome death, with specificity of 89.5% and sensitivity of 53.3%. The PPS scale was the second best, with sensitivity of 93.3%, specificity of 63.2%, and accuracy of 71.7%. The PPI scale had the worst accuracy (64.2%), with sensitivity of 80% and specificity of 57.9%. In the comparative test, only PaP would evaluate the sample in a significantly different manner; therefore, we could not assess an instrument superior to the others.

Figure 1 shows that the higher the KPS and PPS values, the better the representation of older adults who

**Table 1** Summarized data regarding the study sample.

<table>
<thead>
<tr>
<th>Sample characteristics</th>
<th>Total sample</th>
<th>Patients aged ≥ 85 years (28.3%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>24.6% (n = 13)</td>
<td>26.7% (n = 4)</td>
</tr>
<tr>
<td>Female</td>
<td>75.4% (n = 40)</td>
<td>73.3% (n = 11)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>79.2% (n = 42)</td>
<td>73.3% (n = 11)</td>
</tr>
<tr>
<td>Mixed ethnicity</td>
<td>13.2% (n = 7)</td>
<td>20% (n = 3)</td>
</tr>
<tr>
<td>Other ethnicity</td>
<td>7.6% (n = 4)</td>
<td>6.7% (n = 1)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>58.4% (n = 31)</td>
<td>60% (n = 9)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>20.7% (n = 11)</td>
<td>6.7% (n = 1)</td>
</tr>
<tr>
<td>Dementia</td>
<td>64.1% (n = 34)</td>
<td>73.3% (n = 11)</td>
</tr>
<tr>
<td>Stroke</td>
<td>26.4% (n = 14)</td>
<td>26.7% (n = 4)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>22.6% (n = 12)</td>
<td>26.7% (n = 4)</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>19.9% (n = 9)</td>
<td>12.3% (n = 2)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>15.1% (n = 8)</td>
<td>0% (n = 0)</td>
</tr>
<tr>
<td>Cancer</td>
<td>7.5% (n = 4)</td>
<td>12.3% (n = 2)</td>
</tr>
<tr>
<td>Admission in the past year (%)</td>
<td>84.9% (n = 45)</td>
<td>80% (n = 12)</td>
</tr>
<tr>
<td>Immobilization syndrome</td>
<td>35.8% (n = 19)</td>
<td>46.6% (n = 7)</td>
</tr>
<tr>
<td>Survival with no readmission</td>
<td>43.4% (n = 23)</td>
<td>40% (n = 6)</td>
</tr>
<tr>
<td>Survival with readmission</td>
<td>28.3% (n = 15)</td>
<td>20% (n = 3)</td>
</tr>
<tr>
<td>Death</td>
<td>28.3% (n = 15)</td>
<td>40% (n = 6)</td>
</tr>
<tr>
<td>Survival with no readmission</td>
<td>43.4% (n = 23)</td>
<td>40% (n = 6)</td>
</tr>
<tr>
<td>Survival with readmission</td>
<td>28.3% (n = 15)</td>
<td>20% (n = 3)</td>
</tr>
<tr>
<td>Death</td>
<td>28.3% (n = 15)</td>
<td>40% (n = 6)</td>
</tr>
</tbody>
</table>

**Table 2** Summarized results of logistic regression models for the variable death with different prognostic scales.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Standard error</th>
<th>OR</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPS</td>
<td>-0.0701</td>
<td>0.0254</td>
<td>0.9323</td>
<td>0.887; 0.9799</td>
</tr>
<tr>
<td>PPS</td>
<td>-0.0775</td>
<td>0.0261</td>
<td>0.9254</td>
<td>0.8793; 0.974</td>
</tr>
<tr>
<td>PaP</td>
<td>0.321</td>
<td>0.1802</td>
<td>1.3785</td>
<td>0.9683; 1.9625</td>
</tr>
<tr>
<td>PPI</td>
<td>0.4096</td>
<td>0.1569</td>
<td>1.5062</td>
<td>1.1076; 2.0484</td>
</tr>
</tbody>
</table>

CI: confidence interval; KPS: Karnofsky performance status; PPS: palliative performance scale; PaP: palliative prognostic score; PPI: palliative prognostic index; OR: odds ratio.
survived. In turn, the higher the PaP and PPI values, the greater the chance of death (as the blue box on the y-axis is above the red box). Age range had no influence on whether the older adult died or not, as the variation across scales was similar.

In the ordinal analysis, consisting of the outcomes death, patient alive and admitted, and patient alive and not admitted, the accuracy of each method for the three outcomes could be assessed. The PPI scale had the best accuracy (58.5%), followed by PaP (56.6%), PPS (52.8%), and KPS (49.1%); however, PPI was not statistically different from the others. The Madansky’s test of homogeneity was used to compare classifications between the scales, showing that differences were not significant. Thus, the prognostic scales had similar accuracy. A summarized ordinal logistic regression, including the other scores, is shown in Table 4.

A dot plot (Figure 2) was used to represent ordinal analysis results because some categories had low frequency of observations, especially due to patients aged ≥ 85 years and those who were admitted and survived. The hollow circle

| Table 3 | Summarized data on sensitivity, specificity, and accuracy of different prognostic scales. |
|-----------------|-----------------|-----------------|-----------------|
|                | Sensitivity     | Specificity     | Accuracy        |
| KPS             | 73.3%           | 68.4%           | 69.8%           |
| PPS             | 93.3%           | 63.2%           | 71.7%           |
| PaP             | 53.3%           | 89.5%           | 79.2%           |
| PPI             | 80%             | 57.5%           | 64.2%           |

KPS: Karnofsky performance status; PPS: palliative performance scale; PaP: palliative prognostic score; PPI: palliative prognostic index.

Figure 1 Box plot showing the relationship between patient age range and death in different prognostic scales.
represents the mean value in the scale for a given age range and outcome.

**DISCUSSION**

This study found that no prognostic score was superior to the others in the assessment of both the binary and the ordinal outcome. There was no significant difference in the comparison of older adults aged ≥ 85 years with the total sample. When a new variable (admission) was included in the ordinal outcome, scores were significantly less accurate.

Although PaP had the best accuracy (79.2%) in the binary outcome, differences between scores were not statistically relevant. This finding differed from that of a study of 334 patients with advanced cancer conducted at a hospital and hospice in Treviso, Italy, which compared the accuracy of CPS estimated by physicians and nurses with that of PPI.

**Table 4** Summarized results of logistic regression models for the ordinal outcome with different prognostic scales.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Standard error</th>
<th>OR</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPS</td>
<td>-0.0544</td>
<td>0.0176</td>
<td>0.947</td>
<td>0.9149; 0.9803</td>
</tr>
<tr>
<td>PPS</td>
<td>-0.0564</td>
<td>0.0164</td>
<td>0.9451</td>
<td>0.9153; 0.9759</td>
</tr>
<tr>
<td>PaP</td>
<td>0.461</td>
<td>0.191</td>
<td>1.5856</td>
<td>1.0904; 2.3057</td>
</tr>
<tr>
<td>PPI</td>
<td>0.504</td>
<td>0.1384</td>
<td>1.6553</td>
<td>1.2619; 2.1712</td>
</tr>
</tbody>
</table>

CI: confidence interval; KPS: Karnofsky performance status; PPS: palliative performance scale; PaP: palliative prognostic score; PPI: palliative prognostic index; OR: odds ratio.

**Figure 2** Dot plot showing the relationship between age range and outcomes in the ordinal analysis for different prognostic scales.
Objective Prognostic Score (OPS), and PaP. In that study, PaP showed the best accuracy (82%) to predict the outcome death, followed by CPS (76–78%), PPI (72%), and OPS (70%).

Lower PaP values (71.9–74%) were found in a prospective multicenter study of 2,361 patients with advanced cancer involving 58 centers, including hospitals, palliative care centers, and HCS, with the purpose of evaluating accuracy and feasibility of prognostic tests. The feasibility of PPS and Palliative Care Study Predictor Model (PiPS-A) was much higher (> 90%), probably because they do not require serum tests, unlike PaP (80.5%), D-PaP (PaP with delirium included) (80.5%), and PiPS-B (65%). However, accuracy was higher in the three measures requiring serum tests, i.e., PiPS-B (77.4–79.2%), PaP (71.9–74%), and D-PaP (74–76%), compared to PPI (69–72.2%).

A literature review spanning the past 20 years suggested the use of PaP instead of the other prognostic scales; however, other studies, consistent with ours, found no significant differences between the scores. A retrospective documentary study compared the accuracy of PPI, OPS, D-PaP, and PaP prognostic scales at three weeks and 30 days using a sample of 94 palliative care patients from a South Korean hospice. Accuracy results were 63.8–74.5% (PPI), 69.1–66.6% (OPS), 73.4–77.7% (D-PaP), and 74.5–78.7% (PaP). Although PaP had higher accuracy, there was no statistical significance, similar to our findings.

In our study, scores had overall lower accuracy for the ordinal outcome (PPI: 58.5%; PaP: 56.6%; PPS: 52.83%; and KPS: 49.1%). The PPI scale obtained the best accuracy for the three outcomes; however, we could not consider one scale to be best in evaluating the sample in a statistically significant manner. Again, therefore, we were unable to suggest that any of the scales is superior to the others to evaluate these three outcomes. Although PPS is a prognostic scale commonly used in clinical practice as well as the most frequently investigated among the scales in the present study, it did not show better accuracy in any of the evaluations.

In the study sample, 75.4% of the population was female, which is higher than the percentage found in a study of hospice patients in the United States (US), which was 58.6%. Regarding ethnicity, 79.2% were Caucasian in the present study versus 86.5% in the US study. The prevalence of older adults aged ≥ 85 years was 28.3% in the present study versus 47.5% in the US study. The presence of comorbidities (circulatory, heart, and respiratory diseases, stroke, and dementia) was similar, but prevalence rates were different. In the present study, the prevalence of dementia was much higher than that of the US study (64.1 versus 18%, respectively), while the prevalence of cancer was much lower (7.5% versus 27.2%, respectively).

Age is a risk factor for most causes of death such as dementia, cardiovascular disease, stroke, and diabetes. Patients aged ≥ 85 years are highly prevalent in palliative care services. For these reasons, our secondary objective was to evaluate the oldest-old population separately, in order to investigate whether the scores would evaluate this population differently, but there was no change in accuracy in patients aged ≥ 85 years. To our knowledge, there are no studies in the literature comparing prognostic scores of patients aged ≥ 60 years versus those aged ≥ 85 years which could be used to contrast our findings.

This study has some limitations, such as sample size and 90-day period to obtain the outcome. The PPI scale predicts outcome within 3–6 weeks and the PaP scale within 30 days, which may have affected their predictive function.

**CONCLUSION**

There was no statistically significant difference between the prognostic scores in this study. Therefore, we concluded that no prognostic scale was superior to the others to assess the outcome survival in patients undergoing palliative care provided by the Curitiba’s SAD program.

In terms of accuracy to assess both admission and survival, the prognostic scales are less accurate and do not differ significantly from each other. Additionally, the scales did not differ in accuracy for the population aged ≥ 85 years compared to the total sample of older adults.

**CONFLICT OF INTEREST**

The authors have no conflicts of interest to declare.

**REFERENCES**


Use of Prognostic Scores in Home Care


