

Predictive validity of the Identification of Seniors at Risk - Hospitalized Patient tool for identifying functional decline

Validade preditiva da *Identification of Seniors at Risk - Hospitalized Patient* para a identificação do declínio funcional

Validez predictiva de la *Identification of Seniors at Risk - Hospitalized Patient* para la identificación del deterioro funcional

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Abstract

Background: Functional decline (FD) affects 30-60% of hospitalized older people. The first step in preventing FD is the identification of patients at risk.

Objective: To determine the predictive validity of the Identification of Seniors at Risk - Hospitalized Patient (ISAR-HP) tool for assessing the risk of FD in hospitalized older people.

Methodology: Longitudinal, observational, and prospective study using a sample composed of 101 patients aged 70 years or older. Functionality was assessed using the Katz Index (KI) at baseline, hospital discharge, and 3-month follow-up and the ISAR-HP tool. FD was defined as the decline in at least one item of the KI.

Results: The receiver operator characteristic curve of the predictive model, at a cut-off of ≥ 2 points, showed an area of 0.7 ($p \leq 0.01$). The sensitivity, specificity, positive and negative predictive values were 93.9%, 36.7%, 44.9%, and 91.7%, respectively.

Conclusion: The ISAR-HP is a valid risk-stratification tool for assessing FD in hospitalized older people, which can be used in clinical practice.

Keywords: aged; hospitalization; functional decline; prediction

Resumo

Enquadramento: O declínio funcional (DF) das pessoas idosas hospitalizadas varia entre 30 a 60%. A primeira etapa na prevenção do DF é a identificação dos utentes em risco.

Objetivo: Determinar a validade preditiva da *Identification of Seniors at Risk - Hospitalized Patient* (ISAR-HP) para avaliar o risco de DF das pessoas idosas hospitalizadas.

Metodologia: Estudo observacional longitudinal prospectivo. Amostra constituída por 101 utentes com 70 ou mais anos. A funcionalidade foi avaliada pela Escala de Katz (EK) em 3 momentos (*baseline*, alta e *follow-up* - 3 meses) e a ISAR-HP. O DF foi definido como o declínio em pelo menos um ponto na EK.

Resultados: A curva *Receiver operator characteristic* do modelo preditivo, para um ponto de corte ≥ 2 , apresentou uma área de 0,7 ($p \leq 0,01$). Os valores da sensibilidade, especificidade, valor preditivo positivo e negativo foram de 93,9%, 36,7%, 44,9% e 91,7%, respetivamente.

Conclusão: A ISAR-HP é um instrumento válido na estratificação do risco de DF das pessoas idosas hospitalizadas, que poderá ser incorporado na prática clínica.

Palavras-chave: idoso; hospitalização; declínio funcional; predição

Resumen

Marco contextual: El deterioro funcional (DF) de las personas mayores hospitalizadas varía entre el 30 y el 60 %. La primera etapa en la prevención de DF es la identificación de los usuarios en riesgo.

Objetivo: Determinar la validez predictiva de la *Identification of Seniors at Risk - Hospitalized Patient* (ISAR-HP) para evaluar el riesgo del DF de las personas ancianas hospitalizadas.

Metodología: Estudio observacional longitudinal prospectivo. Muestra constituida por 101 usuarios con 70 o más años. La funcionalidad se evaluó mediante la escala de Katz (EK) en 3 momentos (*punto de referencia*, alta y *seguimiento* - 3 meses) y la ISAR-HP. El DF se definió como el deterioro en, al menos, un punto en la EK.

Resultados: La curva *Receiver operator characteristic* del modelo predictivo para un punto de corte ≥ 2 presentó un área de 0,7 ($p \leq 0,01$). Los valores de sensibilidad, especificidad, valor preditivo positivo y negativo fueron del 93,9%, 36,7%, 44,9% y 91,7%, respectivamente.

Conclusión: La ISAR-HP es un instrumento válido en la estratificación del riesgo de DF de las personas mayores hospitalizadas y, por tanto, puede incorporarse en la práctica clínica.

Palabras clave: anciano; hospitalización; declive funcional; predicción

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Introduction

Functional decline (FD) affects 30-60% of older people during hospitalization, regardless of the decline associated with the acute illness (Hoogerduijn, Schuurmans, Duijnste, de Rooij, & Grypdonck, 2007). FD leads to reduced quality of life, loss of autonomy, increased length of hospital stay, institutionalization, increased (in)formal caregiving burden, and increased morbidity and mortality risk (Boyd et al., 2008). It is also associated with delirium, malnutrition, pressure ulcers, cognitive deficit, and falls. In addition, this decline is often a long-term condition (Boyd et al., 2008). It is also associated with delirium, malnutrition, pressure ulcers, cognitive deficit, and falls. In addition, this decline is often a long-term condition (Boyd et al., 2008).

The prevention of FD and hospitalization-related complications requires the development of strategies aimed at enabling health professionals, particularly nurses, to promote older people's autonomy. Function-focused care can prevent the functional dependence caused by hospitalization-related complications or causes (Resnick et al., 2016).

One of the models to prevent FD is the Develop strategies Enabling Frail Elderly New Complications to Evade (DEFENCE) model (Hoogerduijn, Weldom, van Barneveld, & Schuurmans, 2013). This model is composed of three sequential steps: 1) to identify older people at risk for decline; 2) to conduct a comprehensive geriatric assessment of patients at risk; and 3) to develop specific interventions for older people at risk. The first step is important since it allows performing a global assessment and adapting tailored interventions to the patients at risk for FD (Hoogerduijn et al., 2007). There are several tools that can be used to identify people at risk for FD (Beaton & Grimmer, 2013). The literature points out the Identification of Seniors at Risk - Hospitalized Patient (ISAR-HP) tool as an easy-to-apply instrument which was specifically designed for hospitalized older people (Hoogerduijn et al., 2012). The use of valid and reliable instruments in clinical practice is essential to stratify FD

risk. Therefore, the general objective is to determine the predictive validity of the ISAR-HP for assessing the risk for FD in hospitalized older people between baseline (up to two weeks before hospitalization) and follow-up (3 months after hospital discharge).

Background

Hospitalized people are at risk for FD due to multiple intrinsic and extrinsic factors. The intrinsic factors that contribute to FD include: the patient's condition before hospitalization (Boltz, Capezuti, Shabbat, & Hall, 2010), multiple comorbidities, advanced age, low functional status before hospital admission, cognitive impairment, depression, and fear of falling (which can lead to self-limitation of activity level; Boltz et al., 2010). Extrinsic factors include iatrogenic effects of treatment, consequences of bed rest (Hoogerduijn, de Rooij, Grobbee, & Schuurmans, 2014), delirium, polypharmacy, and time spent out of bed during hospitalization (Boltz et al., 2010).

In addition, decline is aggravated by environmental factors (when architecture and environment are not adapted to age-related changes) and some hospital practices (bed rest exceeding 48 hours, use of psychotropic drugs, use of urinary catheters for more than 48 hours, use of mechanical restraints, and lack of mobility; Vidán Astiz et al., 2008). Furthermore, nursing care and medical prescriptions contributing to low mobility levels are common during hospitalization and can lead to a cascade of dependency (Boltz et al., 2010).

FD is not exclusively associated with the clinical condition which led to hospital admission; as such, it is not automatically recovered after the medical problem is solved. Therefore, both intrinsic and extrinsic factors can reduce the likelihood of functional recovery during and after hospitalization (Boltz et al., 2010).

The first step in prevention is to identify patients at risk for FD (Hoogerduijn et al., 2007). The ISAR-HP, the Care Complexity Prediction Instrument (COMPRI), and the Hospital Admission Risk Profile (HARP) are

the most frequently used instruments. Heim et al. (2015) conducted a study aimed at identifying the most efficient screening tool to identify older people at risk for adverse outcomes, namely FD. The authors concluded that none of the analyzed instruments had a strong predictive power to be considered a gold standard (i.e., high sensitivity and specificity). These instruments were developed and validated in different populations, such as patients from internal medicine and surgical units and the emergency department, and are designed to predict the risk for FD or related adverse outcomes, namely the need for complex care, frailty at hospital discharge, and extended length of hospital stay. Among these instruments, the ISAR-HP has a greater ability to predict patients at risk for FD, and it seems to be the easiest tool to be used in clinical practice (Hoogerduijn et al., 2014).

Research question

What is the predictive validity of the ISAR-HP for assessing FD?

Methodology

Type of study

Observational, longitudinal, and prospective study using a quantitative approach.

Context and sample

This study was conducted in four internal medicine units of a central hospital located in the Centre region of Portugal. The target population was composed of older people aged 70 years or older, which is considered as the age of onset of functional dependence factors. The sample was selected using the consecutive, convenience sampling method. The following inclusion criteria were applied: older people aged ≥ 70 years, who were capable of understanding and interpreting the questions or, if incapable, had an informal caregiver who could answer some questions for them, and who agreed to participate in the study. The following exclusion criteria were applied: patients who were transferred from the intensive care unit, who had a neurode-

generative or terminal illness, who were totally dependent at baseline (maximum score in the Katz Index), and hospitalized for less than 48 hours. Out of 117 surveyed patients, 10 were excluded because they died during hospitalization, four because they were transferred to other wards, one who lacked baseline data, and one who was hospitalized for more than 48 hours in the short-term inpatient unit. The final sample was composed of 101 patients.

Data collection

Data were collected using a sociodemographic and clinical questionnaire which was completed by the researchers. The questionnaire was applied in four moments: at baseline (up to 48 hours after admission); during hospitalization (between the third and fifth day), at hospital discharge (preferably on the day of discharge); and at follow-up (3 months after hospital discharge). Preferably, researchers would ask for the patient's authorization and information but, if it was not possible, they would ask informal caregivers, with the exception of the questions to which the patient had to answer directly. These questions included the assessment of the patient's cognitive status, fear of falling, pain, and mood. In case of unavailability of clinical data, the researchers asked the collaboration of the health care team (nurses, doctors, and operational assistants) to check the patient's electronic medical and health records. Data were collected between May 1st and October 7th, 2016: baseline, admission, and discharge between May 1st and June 30th, and follow-up between August 5th and October 7th. At the initial contact, patients were asked to complete the questionnaires in three moments (admission, discharge, and follow-up).

Instruments

The data collection instrument included sociodemographic (age, gender, level of education, marital status, and household) and clinical variables (date of hospital admission, diagnosis(es) at admission, multiple comorbidities, number of prior admissions, length of stay, therapeutic attitudes, sensory deficit (hearing and vision), weight loss, and pain). The questionnaire also included the Charl-

son Comorbidity Index (CCI; Mendes, 2008); the Estimated Relative Risk of Mortality (ERRM; Mendes, 2008); the Six-item Cognitive Impairment Test (6CIT; Paiva & Apóstolo, 2015); the Braden Scale for Predicting Pressure Sore Risk (Direção-Geral da Saúde, 2011); the Morse Fall Scale (for identifying hospitalized patients' risk of falling; Costa-Dias, 2014); single-item measures for depression (Mahoney et al., 1994) and fear of falling (Resnick et al., 2016), which were both translated, adapted, and validated (content validity) for the Portuguese population by the researchers; the Confusion Assessment Method (Sampaio, Sequeira, & Sá, 2010); the observation grid for the use of physical mobility restrictions (Faria, Paiva, & Marques, 2012); the Katz Index (Duque, Gruner, Clara, Ermida, & Veríssimo, n.d.); and the ISAR-HP - Portuguese version (Tavares, Grácio, & Nunes, 2016).

The Katz Index assesses six basic activities of daily living (bathing, dressing, transferring, toileting, continence, and feeding) in a dichotomous scale ranging from *independence* (1 point) to *dependence* (0 points). FD is defined as a decline of, at least, one point on the Katz Index between baseline and the two subsequent moments - hospital discharge and follow-up (Hoogerduijn et al., 2012). The three different moments were defined as follows: t0 as the assessment between hospital discharge and baseline; t1 as the assessment between follow-up and hospital discharge; and t2 as the assessment between follow-up and baseline.

The ISAR-HP is a tool used for assessing the risk of FD in hospitalized older people. It consists of four dichotomous items (1 - *yes*; 0 - *no*), has a total score of 5 points (one item scores 2 points), and is rated as: no FD risk (0 to 1 points); FD risk (2 points or more).

The ISAR-HP was validated using a sample of 492 patients hospitalized in internal medicine units (aged ≥ 65 years). Using a cut-off at two points, the sensitivity, specificity, positive, and negative predictive values were 87%, 39%, 43%, and 85%, respectively (Hoogerduijn et al., 2012). The translation, adaptation, and content validation for the Portu-

guese population showed a mean content validity index of 0.97 and interrater reliability of 100% (Tavares et al., 2016).

Data analysis

Data were analyzed using descriptive and inferential statistical techniques. For the descriptive statistics, measures of central tendency (mean and median) and measures of dispersion (standard deviation and variance) were used in continuous variables, while relative frequencies were used in nominal variables. Comparative analysis was performed using the Student's t-test, ANOVA, and the chi-square test with gross odds ratio (OR), or the corresponding non-parametric tests when the normality assumption was not met.

The predictive value of the ISAR-HP for assessing FD in t2 was analyzed with the purpose of eliminating the possible effect of the disease that led to hospital admission. The receiver operator characteristic (ROC) curve was analyzed and, based on the Youden Index, the best combination between sensitivity and specificity was determined, resulting in a cut-off ≥ 2 points, which is similar to that obtained in the original study.

Data were statistically processed using the IBM SPSS Statistics for Windows, Version 23.0. *P*-values < 0.05 were regarded as statistically significant.

Ethical considerations

This study was submitted to and approved by the Ethics Committee of the Coimbra Hospital and University Center (No. 065-14). Data were collected from patients themselves or their informal caregivers, who gave their informed consent after being explained about the study.

Results

Predictive value of the ISAR-HP

In the validation analysis, the ROC curve of the predictive model for FD showed an area of 0.692 ($p \leq 0.01$; 95% CI; 0.59 - 0.79), with a standard error of 0.05. The sensitivity, specificity, positive, and negative predictive values were 93.9%, 36.7%, 44.9%, and 91.7%, respectively (Table 1). The values observed in t1 were relatively close to those observed in t2.

Table 1

Predictive value of the ISAR-HP (≥ 2) in different assessment moments

Moments	ROC Curve	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
t2	0.69	93.9	36.7	44.9	91.7
t1	0.63	96.3	31.1	33.8	95.8
Original (t2)	0.70	89.0	34.0	43.0	84.0

Note. PPV = positive predictive values; NPV = negative predictive values.

Table 2 shows the predictive values of the ISAR-HP based on two age groups (patients aged 70 years or older and patients aged 75 years or older), as in the original study (including and excluding patients who died in the follow-up; $n = 8$). The group of oldest

patients revealed a smaller area under the ROC curve and lower specificity and negative predictive values. The inclusion of deaths had no significant impact on the results when compared to the results when deaths are excluded.

Table 2

Predictive values of the ISAR-HP in subgroups of patients at different ages

Patient subgroups	Functional Decline (n, %)	ROC curve area (95% CI)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
70+ years ($n = 93$)	33 (35.5)	0.69 (0.58 - 0.8)	93.9	36.7	44.9	91.7
70+ years, including deaths ($n = 101$)	40 (39.6)	0.69 (0.59 - 0.79)	95.0	36.1	49.4	91.7
75+ years ($n = 78$)	32 (41.0)	0.63 (0.51 - 0.76)	93.8	28.3	47.6	86.7
75+ years, including deaths ($n = 86$)	39 (45.3)	0.64 (0.52 - 0.76)	94.5	27.7	52.1	86.7

Note. In this table, the patients who died are seen as patients with FD since it was impossible to predict at hospital admission that they would die.

Table 3 shows patients' baseline information concerning their risk for FD. Of the 101 patients, 77 (76.2%) were assessed as being at risk for FD. Of this group, 53.25% had FD. No statistically significant differences were found between true positives (patients at risk for FD and confirmed FD) and false positives (patients not at risk for FD risk but confirmed FD; data not shown, available upon request to the authors). The interquartile range was of -2 to 0 for of patients at risk for FD and of 0 to 0 for patients not at risk for FD, which is

a statistically significant difference ($p = 0.02$). Table 3 shows the different sociodemographic and clinical characteristics of patients at risk and not at risk for FD. Significant correlations were found between older people at risk and the oldest old, those without a partner, and those with the lowest levels of education. Older people at risk scored higher in the CCI and ERRM, and had longer lengths of stay. Taking into account some geriatric conditions, results suggest that older people at risk had hearing problems (OR = 3.6), weight

loss, fear of falling (OR = 12.11), high risk of pressure ulcer (OR = 1.5) and falling, cognitive impairment (OR = 5), and depression. The use of mechanical restraints and institutionalization after hospital discharge were more common in this group of patients. Risk assessment was not influenced by the

variables of gender, institutionalization at the time of admission, vision problems, and delirium (assessed at admission and during hospitalization). No statistically significant differences were found between both groups regarding the variables of prior hospitalization.

Table 3
Comparison between groups of patients at risk and those not at risk for FD

Sociodemographic and clinical characteristics	Patients at risk (n = 77)	Patients not at risk (n = 24)	p/OR
Sociodemographic variables			
Age (x, \pm SD)	84.35 (5.92)	76.42 (4.68)	<0.01 [‡]
Male (%)	34 (44.2)	13 (54.2)	0.48 [‡]
No partner (%)	46 (60.5)	8 (33.3)	0.02 [‡]
Education: 0-2 years (%)	50 (64.9)	8 (33.3)	0.02 [‡]
Living situation: institution (%)	15 (19.5)	2 (8.3)	0.35 [£]
With social support (t0) (%)	16 (25.8)	3 (13.6)	0.37 [£]
Clinical variables			
Diagnosis at admission (%): Infectious disease	32 (41.6)	11 (45.8)	0.05 [‡]
Prior hospitalizations (Me, 1 st and 3 rd Q)	0 (0 - 1)	0 (0 - 1)	0.29 [¤]
No. of drugs (x, \pm SD)	7.74 (4.08)	6.08 (3.22)	0.07 [‡]
Multiple comorbidities (%)	40 (51.9)	12 (50.0)	0.87 [‡]
CCI (Me, 1 st and 3 rd Q)	6 (5 - 7)	5 (4 - 6)	0.01 [¤]
ERRM (Me, 1 st and 3 rd Q)	9.23 (6.38 - 13.37)	9.23 (4.40 - 9.23)	0.01 [¤]
Vision problems (%)	44 (57.1)	12 (50)	0.54 [‡]
Hearing problems (%)	32 (41.6)	4 (16.7)	0.03 [‡] /3.6
Weight loss (%)	60 (77.9)	12 (50.0)	0.01 [‡]
Fear of falling (%)	51 (71.8)	4 (17.4)	<0.01 [‡] /12.11
High risk of falling (%)	41 (85.4)	7 (14.6)	0.01 [‡]
High risk of PUs (%)	32 (42.1)	-	<0.01 [‡] /1.52
Cognitive impairment (%)	38 (50.0)	4 (16.7)	<0.01 [‡] /5.0
Depression (%)	58 (76.3)	10 (41.7)	<0.01 [‡]
Delirium at admission (%)	7 (9.1)	2 (8.3)	1.0 [£]
Delirium during hospitalization (%)	9 (12.5)	1 (4.3)	0.44 [‡]
Use of restraints (%)	29 (40.8)	4 (17.4)	0.04 [‡]

Negative outcomes			
Functional decline (t2) (<i>Me</i> , 1 st and 3 rd Q)	0 (2 - 0)	0 (0 - 0)	0.02 ^o
Length of stay (<i>Me</i> , 1 st and 3 rd Q)	9 (5 - 14)	6 (4 - 9)	0.03 ^o
Destination after discharge: Institution (t1) (%)	18 (23.4)	1 (4.2)	0.02 [£]
Destination after discharge: Institution (t2) (%)	21 (30.4)	1 (4.2)	0.02 [¥]

Note. = mean; *SD* = standard deviation; OR = odds ratio; *Me* = median; Q = quartile; CCI = Charlson Comorbidity Index; ERRM = Estimated Relative Risk of Mortality; PUs = pressure ulcers; ^o = Mann-Whitney U test; [£] = Student's t- test; [¥] = chi-square test; [£] = Fisher's test.

Discussion

FD is one of the most common adverse outcomes during hospitalization. According to the literature, the identification of patients at risk for decline is a strategy to promote the delivery of quality care to older people. The ISAR-HP should integrate clinical practice and, as such, according to its authors, the validity of this tool must be analyzed, which was the objective of this study.

The cut-off point was established based on the best sensitivity and specificity values, which is in line with the study on the predictive validity of this tool in older people admitted to internal medicine units (Hoogerduijn et al., 2012). The sensitivity, specificity, positive and negative predictive values are close to those reported by Hoogerduijn et al. (2012), as well as by the authors of other studies on its predictive validity including various tools (Heim et al., 2015). The positive predictive value of 45% indicates that about half of the patients identified as being at risk will not actually have FD. This tool, which is simple and quick to apply, can be the first step towards the prevention of decline, followed by a more comprehensive evaluation. Therefore, a higher sensitivity value (93.9%) was used, which, similarly to other studies on the ISAR-HP (Hoogerduijn et al., 2012; Hoogerduijn et al., 2014), has resulted in a higher number of false positives. However, the identification of some older people who are not at risk for FD as risk patients is not a very serious problem because they will also benefit from a more comprehensive evaluation and intervention aimed at promoting their functional independence.

The analysis showed that true and false positives were very similar in terms of demo-

graphic and clinical characteristics; hence, false positives meet a set of criteria for FD. Despite the false positives, the ISAR-HP identified 23% of patients not at risk who otherwise would not be eligible for any supplementary intervention aimed at preventing decline.

Overall, higher cut-off values lead to a smaller number of people in the group of patients at risk. Other cut-off values can be applied depending on the context and available resources. A cut-off point higher than or equal to 3 would imply a higher positive predictive value (51.51%) and a lower negative predictive value (85.29%), which would then reduce the number of false positives. Given that the incidence of decline may differ depending on the type of unit (Hoogerduijn et al., 2014), other cut-off values can be considered in future studies in order to obtain better sensitivity and specificity values.

In this study, eight patients died (7.9%), which is a negative result. In the analysis of the predictive values of the ISAR-HP, the sensitivity, specificity, positive and negative predictive values were assessed by including and excluding these patients. These cases were excluded from the analysis to avoid the confusion between the predictive value of the ISAR-HP for decline and mortality. However, the inclusion of these patients had no significant impact on the results. The Portuguese version of the ISAR-HP was also able to predict mortality with a sensitivity of 100%, whereas the original version showed a sensitivity of 81% (Hoogerduijn et al., 2012). This difference between both studies may be explained by the difference in the number of deaths (91 in the validation study of the ISAR-HP and eight in this study).

Similarly to this study, in the development

and validation study of the prediction model, Hoogerduijn et al. (2012) excluded patients who were completely dependent at baseline (Katz = 0). However, in the study of Hoogerduijn et al. (2012), the ISAR-HP identified patients who were vulnerable at the time of hospital admission, including those who were totally dependent on daily life activities (ADLs). Future studies should consider the inclusion of this group of vulnerable patients in order to determine the predictive validity of the ISAR-HP.

This study has shown that the application of a simple risk assessment tool to older people at the time of admission allows identifying two groups of patients (those at risk and not at risk) with different demographic and clinical characteristics and health outcomes.

Individuals who developed FD during hospitalization were those who were initially identified as being at risk for FD. Geriatric conditions, such as depression, hearing problems, weight loss, fear of falling, and cognitive impairment were more common among patients at risk. These factors were also reported in a systematic review on predictors of FD (Hoogerduijn et al., 2007). These results reinforce the fact that the aggregate number of geriatric conditions at hospital admission determines the older patient's individual risk for functional deterioration (Buurman et al., 2012). In this sense, the identification of older people at risk for FD (ISAR-HP ≥ 2) allows identifying those patients who have a greater number of relevant geriatric conditions that require a more comprehensive assessment. Older people at risk were also the patients who showed a higher risk for negative outcomes, such as institutionalization and extended hospital length of stay. This fact is relevant to the extent that FD risk assessment (ISAR-HP) at the time of admission, followed by a targeted intervention, can help to prevent institutionalization. In addition, in case of a patient at risk, the discussion between the patient and both formal and informal caregivers of the patient's needs after hospital discharge can mitigate the caregivers' burden, thus reducing the risk of institutionalization.

This study has shown that patients at risk and those not at risk for FD have different demographic and clinical characteristics at

baseline. Among the group of patients at risk for FD, true positives and false positives have similar characteristics. In view of the above, it can be concluded that the results further reinforce the predictive validity of the ISAR-HP. This study had some limitations, namely the sample size ($n = 117$) and the use of the convenience sampling method. However, sample size was calculated based on the study by Hoogerduijn et al. (2012), taking into account the time period for data collection (2 months). Furthermore, the sample size of 115 participants was calculated using the G*Power software. The sample was composed of older patients admitted to four internal medicine units of a hospital and university center located in the Center region of Portugal. The non-inclusion of other internal medicine units of the hospital, particularly of the General Hospital, as well as of smaller hospitals and/or hospitals located in other regions of the country, limited the generalization of results. The development of further studies using larger samples and focusing on other units (either medical or surgical units) and different types of hospitals from other regions of the country could broaden the understanding of older patients' functional evolution in Portugal. The inclusion of the above-mentioned aspects would strengthen the external validity of the ISAR-HP and allow verifying the results obtained in this study.

Data on functionality were collected through direct interviews with patients, the consultation of patients' electronic records (Alert® and electronic health record), with the collaboration of the nurses and, in specific situations, of relatives/informal caregivers. To some extent, interviews can reflect some inconsistencies in how individuals report the ways in which they perceived the events. The fact that older people and their families tend to underestimate the person's functionality (Beaton & Grimmer, 2013), by reporting lower levels of ADL independence than the actual levels, can be a limitation.

Conclusion

FD is one of the most adverse outcomes of hospitalization; hence, it is essential to iden-

tify older people at risk. This was the first study to confirm the predictive validity of the ISAR-HP for the Portuguese context. The tool showed a ROC curve of the predictive model for FD in hospitalized older people, with an area of 0.7 ($p \leq 0.01$), at a cut-off ≥ 2 points. The sensitivity, specificity, positive and negative predictive values were 93.9%, 36.7%, 44.9%, and 91.7%, respectively. Thus, the ISAR-HP can be used to predict FD after hospitalization in patients aged 70 years or older. The fact that this tool is easy to apply to collect information (four items to be assessed) suggests that it can be integrated into clinical practice as part of the patient's assessment at the time of hospital admission.

Although it is not the main purpose of this tool, the predictive validity of the ISAR-HP for assessing the risk of institutionalization after hospital discharge should be analyzed in future studies. In this research study, risk was dichotomized (patients at risk and those not at risk). The functional classification system, as well as experts' opinion, suggest that care delivery and research require a more suitable approach to identifying different subgroups or categories of older people. Therefore, studies based on the ISAR-HP have stratified patients' risk for FD as low, intermediate, and high, thus identifying different clinical characteristics and health outcomes. Future studies can assess the risk for FD using the three reported risk profiles. The inclusion of patients who are totally dependent in ADLs (Katz = 0) can contribute to strengthening the predictive value of the ISAR-HP.

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