

Study of the cut-off point of the Morse Fall Scale (MFS)

Estudo do ponto de corte da Escala de Quedas de Morse (MFS)

Estudio del punto de corte de la Escala de Caídas de Morse (MFS)

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Abstract

Theoretical framework: The Morse Fall Scale (MFS) is a scale for assessing fall risk. It is designed for adults and widely used in Portugal. The scale should be calibrated for each particular setting so that fall prevention strategies are targeted to patients most at risk.

Objective: To analyse the cut-off point of the scale that best distinguishes between people with and without fall risk in a hospital inpatient setting.

Methodology: The receiver operator curve (ROC) was used to determine the optimal cut-off point. The predictive validity of the MFS was assessed through sensitivity and specificity, positive and negative predictive values, the ROC area under the curve (AUC) and also the Youden Index.

Results: The cut-off point of 45 was identified as the optimal cut-off value, where 78% of the participants were identified as true positives and 22% as false negatives. It presented an OR of 3.8 (95%CI = 2.17-6.51).

Conclusion: The MFS is a good instrument for identifying patients with high fall risk in hospital settings, particularly in medical and surgical, long-term and palliative care inpatient wards.

Keywords: accidental falls; risk management; hospital services.

Resumo

Enquadramento: A Escala de Quedas de Morse (MFS) é uma escala de avaliação do risco de queda, desenhada para adultos e amplamente utilizada no nosso país. A escala deve ser calibrada para cada contexto para que as estratégias de prevenção sejam dirigidas aos doentes que estão em maior risco.

Objetivo: Analisar o ponto de corte da escala que melhor discrimine as pessoas sem risco das com risco de queda quando internadas em contexto hospitalar.

Metodologia: Foi utilizada para definir o melhor ponto de corte a *receiver operator curve* (ROC). A validade preditiva da MFS foi avaliada através da sensibilidade e especificidade, do valor preditivo positivo e negativo, da área abaixo da curva (AUC) de ROC e ainda através do Índice de Youden.

Resultados: O ponto de corte 45 foi identificado como o melhor ponto de corte, no qual 78% dos participantes são identificados como verdadeiros positivos e 22% como falsos negativos e apresenta um OR de 3,8 (IC95% = 2,17-6,51).

Conclusão: A MFS revela ser um bom instrumento para identificar doentes com alto risco de queda, em contexto hospitalar, particularmente em internamentos médico-cirúrgicos, de cuidados continuados e paliativos.

Palavras-chave: acidentes por quedas; controle do risco; serviços hospitalares.

Resumen

Marco contextual: la Escala de Caídas de Morse (MFS) es una escala para evaluar el riesgo de caídas, diseñada para adultos y ampliamente utilizada en Portugal. La escala debe ser calibrada para cada contexto, con el fin de que las estrategias de prevención se dirijan a los pacientes que están en mayor riesgo.

Objetivo: identificar el punto de corte de la escala que mejor discrimine a las personas que no tienen riesgo de caída de las que sí lo tienen cuando están internas en un contexto hospitalario.

Metodología: para determinar el mejor punto de corte, se utilizó la curva del receptor operador (ROC). La validez predictiva de la MFS se evaluó por medio de la sensibilidad y la especificidad, del valor predictivo positivo y negativo, del área bajo la curva (AUC) de ROC y también a través del Índice de Youden.

Resultados: el punto de corte de 45 fue identificado como el mejor punto de corte, en el que se identifica el 78 % de los participantes como verdaderos positivos y el 22 % como falsos negativos, y tiene un OR de 3,8 (IC95% = 2,17-6,51).

Conclusión: la MFS es un buen instrumento para identificar pacientes con alto riesgo de caídas en el ámbito hospitalario, sobre todo en pacientes hospitalizados en servicios médicos y quirúrgicos, así como de cuidados continuos y paliativos.

Palabras clave: accidentes por caídas; control de riesgo; servicios hospitalarios.

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Introduction

Fall risk assessment scales are tools that assign numerical values to various risk factors. They are added up to assess the patient's likelihood of falling. Assessing the predictive validity of scales (Morse, 2009) allows to identify whether they fulfil their purpose, i.e., if they distinguish well enough between patients with and without risk of falling in a given population (Oliver, Healey, & Haines, 2010). The Morse Fall Scale (MFS) is one of most commonly used scales, taking into account its extensive development and comparative studies in patients hospitalised in different hospitals (Schwendimann, De Geest, & Milisen, 2006).

As any other assessment tool, a fall risk assessment scale needs to be culturally and linguistically adapted and validated for Portuguese to be used in our contexts (Almeida, Abreu, & Mendes, 2010). Ideally, scales should be calibrated for each unit, so that fall prevention strategies are targeted to those most at risk, i.e., the cut-off points or values that distinguish between patients with and without fall risk may differ depending on whether the scale is being used in acute or chronic care settings. Even within the same organisation, the scale may have different cut-off points (Morse, 2009). Fall risk varies according to the type of patient, the different periods of the day and the patient's situation (Morse, 2009). The cut-off points as defined by the author of the scale are set between 25 and 55 points, suggesting that the high fall risk cut-off point in acute or surgical care settings where few patients have a high fall risk, is set at score 25. On the contrary, in hospitals or units for patients with chronic or cerebrovascular diseases, the author suggests that the high risk of falling be at score 45. Morse (2009) also recommends that the cut-off point of the scale should not to be above 55 points. This value was identified by Schwendimann et al. (2006) in a cohort prospective study carried out in two medicine inpatient departments of a hospital for acute patients as the most appropriate cut-off point for patients hospitalised in these services.

According to Morse (2009), the best method to define the cut-off point is to assess the fall risk of patients who are hospitalised in a given service and analyse the distribution of risk, thus obtaining the scale's sensitivity scores (true positives, or the proportion of fallers correctly classified as high fall risk) and the

specificity scores (true negatives, or the proportion of non-fallers correctly classified as without or low fall risk), as well as the positive predictive values (likelihood that a person assessed with fall risk has of falling) and negative predictive values (likelihood that a person assessed with no fall risk has of not falling).

The purpose of this study was to analyse the cut-off point of the MFS for acute adult inpatient services of a hospital in central Lisbon.

Theoretical Framework

Lamb, Jorstad-Stein, Hauer, and Becker (2005) define accidental fall as an unexpected event in which the patient comes to rest on the ground, floor, or lower level. Falls are the most common non-fatal injuries in acute care hospitals (Perell, Nelson, Goldman, Prieto-Lewis, & Rubenstein, 2001), affecting mainly the elderly (Oliver, 2007) and being an adverse event that is preventable. Simple risk assessment scales can predict up to 70% of falls (Oliver, Daly, Martin, & McMurdo, 2004). The first stage of any fall intervention program is risk assessment. The nurse ought to use adequate assessment tools to identify both real and potential risks for patients, a competence that is defined by the *Ordem dos Enfermeiros* (Nurses Association) (2004) at care management level within the safe environment domain. The MFS is one of the most widely disseminated and used scales in Portugal (Soares & Almeida, 2008). Its predictive validity and interrater reliability have been demonstrated (Morse, 2006; Morse, 2009).

The MFS is described by its author as a simple and quick method to assess the patient's likelihood of falling, and counts with two decades of research. It was developed by Janice Morse in 1985 in Canada, at the University of Alberta, to identify fall-prone patients (Morse, Morse, & Tylko, 1989).

The scale was developed based on a study composed of a random sample of 100 fallers and 100 non-fallers. The scale consists of six assessment items: (1) previous history of falling; (2) secondary diagnosis; (3) ambulatory aid; (4) intravenous therapy; (5) gait and transferring; (6) mental status.

Items 1, 2, 4 and 6 are measured on a dichotomous scale (No/Yes). A 'No' answer is always scored zero, while a "Yes" answer is scored 15 (in items 2 and 6), 20

(item 4) or 25 (item 1). Possible answers for item 3 are as follows: 'None/nurse assist/bed rest/wheelchair' (0), 'Crutches/Canadian crutches/walking cane/walker' (15) or 'Grasps onto the furniture' (30). Finally, possible answers for item 5 are 'Normal/bed rest/immobile' (0), 'Weak' (10) and 'Impaired' (20).

The total score of the scale ranges between 0 and 125 and individuals are distinguished according to their fall risk, i.e., without fall risk (0-24), low fall risk (25-50) and high fall risk (≥ 51).

In the original study, the sensitivity of the scale was 78%, the positive predictive value was 10.3%, and the negative predictive value was 99.2% (Morse et al., 1989).

The scale was tested on a sample of elderly patients in hospital settings two years following its design. It demonstrated a specificity of 51%, sensitivity of 72%, positive predictive value of 38%, negative predictive value of 81%, and accuracy of 57% (Eagle, Salama, Whitman, & Evans, 1999).

In 2006, Schwendimann et al. studied the cut-off point of the MFS on a population of 368 patients: 60% were female, with a mean age of 70 years ($SD \pm 18.5$), who were hospitalised for more than 48 hours due to different medical reasons. Forty-seven participants of the study registered a total of 69 falls. Participants with fall risk ranged between 89.4% for a cut-off value of 20 points and 20.7% for a cut-off value of 70 points. According to the different cut-off points of the study, the sensitivity of the MFS ranged between 91.5% and 38.3%. Specificity ranged between 81.7% and 10.9%. The positive predictive value ranged between 12.5% and 22.5% and the negative predictive value between 90.2% and 95.7%. False positives (participants with fall risk who did not fall) ranged between 87.5% for the cut-off value of 20 points and 75.9% for the cut-off value of 60 points.

In 2011, the Portuguese Version of the MFS was built and validated for the Portuguese population using a sample of 200 patients. Its publication is still pending. As a result of the validation process, a version that was semantically and culturally equivalent to the original one was created, having good reliability and validity (significant correlations with the Glasgow Coma Scale and the Barthel Index). Reliability was tested using the level of agreement of the scores independently provided by three nurses. The level of agreement ranged between 0.62 and 0.96 and its interclass correlation coefficient was 0.84, which was

associated with a confidence interval of [0.80; 0.88]. Hence, a high interrater agreement was confirmed. Oliver (2007) mentions that the predictive validity of a scale is measured through sensitivity, specificity, positive and negative predictive values, and accuracy.

Methodology

A case-control study was conducted including 100 records of fall incidents of a total of 134 cases reported from 1st January to 31st December, 2012 by five adult inpatient services in the medical and surgical, long-term and palliative care areas, identified as A, B, C, D and E. In 2012, an incidence of 2.4 falls per 1000 beds/day was registered. Cases correspond to records of people who fell during their hospitalisation. For each case, two matched controls were randomly selected by age and gender among the records of adult individuals who were hospitalised during the same period and did not fall during hospitalisation.

Data were entered into a database that was developed using the statistical software SPSS® - Statistical Package for the Social Sciences, version 18.0 for Windows®. A univariate analysis of data was performed using measures of central tendency and dispersion, as well as a bivariate analysis using risk measures, namely the odds ratio (OR), with a confidence interval of 95%. The metric properties of the scale were assessed using the sensitivity and specificity of the scale for a number of possible cut-off points, using pairs of sensitivity and specificity for each cut-off point. To determine the optimal cut-off point, the receiver operator curve (ROC) was used and the effectiveness of the MFS was assessed through the ROC area under the curve (AUC), the accuracy (ACC) and the Youden Index with a confidence interval of 95%. The AUC presented an interval that ranged between 0.5 and 1.0, the highest scores indicating greater adjustment. The Youden Index (J) is the sum of sensitivity and specificity minus one. J ranged between 0 and 1, with scores close to 1 indicating perfect accuracy and 0 indicating accuracy no better than chance alone (Schisterman, Perkins, Liu, & Bondell, 2005).

All ethical requirements related to this type of study were met, and the study was approved by the Ethics Committee for Health of the hospital where it was carried out.

Results

Most falls occurred during the months of May (11) and January (11). On the contrary, December (4), February (6), April (6) and August (6) registered the lowest number of falls. The mean of falls per month was 8 ($SD \pm 2.64$), the mode was 6 and the median was 9, with a minimum of 4 falls and a maximum of 13 falls per month.

More falls were recorded in males (56%) than in females. Table 1 shows the sample characteristics. The mean age of participants was 76 years ($SD \pm 11.13$), the mode was 75 years, the median was 77 years, the minimum age was 26 years, and the maximum was 94 years. Of the participants, 34% (103) were aged between 70 and 79 years. In cases, the mean age was 76 years ($SD \pm 11.1$), the mode was 79 years, the median 77 years, the minimum age was 28 years, and the maximum was 92 years. Most falls occurred in

service B with a total of 42% (42) of the cases. This corresponds to an inpatient service for patients in need of convalescence and rehabilitation, or with an incurable, progressive and advanced chronic disease. In 37% (42) of the situations, patients were hospitalised for medical reasons and, in 26% (26) of the cases, for palliative care needs. In controls, hospitalisation was owed to surgical reasons in 34.5% (69) of the cases and medical reasons in 33.5% (67) of the situations. Oncologic diseases are the primary diagnosis in 27% (27) of the cases and in 13% (39) of the controls. Table 2 shows that 57% of patients had fallen by the 6th day of hospitalisation and 72% by the 15th day of hospitalisation. More than half of the participants fall by day 4.5 following hospitalisation, but the highest absolute record of falls (mode) takes place during the first 24 hours. It should also be mentioned that 11.0% of patients (11) fell on the 27th day of admission or later on.

TABLE 1 – Sample characteristics (n=300)

Variables		Cases		Controls	
		No.	%	No.	%
Age	≤ 39 years	1	1.0	2	2.0
	Between 40 and 49 years	2	2.0	4	2.0
	Between 50 and 59 years	3	3.0	6	3.0
	Between 60 and 69 years	21	21.0	40	20.0
	Between 70 and 79 years	34	34.0	69	35.5
	Between 80 and 89 years	32	32.0	64	32.0
Services	≥ 90 years	7	7.0	15	7.5
	A	3	3.0	6	3.0
	B	42	42.0	84	42.0
	C	28	28.0	56	28.0
	D	26	26.0	52	26.0
Reason for Hospitalisation	E	1	1.0	2	1.0
	Medical	42	42.0	67	33.5
	Surgical	19	19.0	69	34.5
	Long-term Care	12	12.0	17	8.5
	Palliative Care	26	26.0	41	20.5
Primary Diagnosis	Other	1	1.0	6	3.0
	Cardiovascular Disease	10	10.0	21	7.0
	Respiratory Disease	11	11.0	10	3.3
	Urologic Disease	4	4.0	11	3.7
	CNS Disease*	18	18.0	17	5.7
	Osteoarticular Disease	4	4.0	21	7.0
	Oncological Disease	27	27.0	39	13.0
	Gastrointestinal Disease	10	10.0	30	10.0
	Infectious Disease	6	6.0	14	4.7
	Psychiatric Disease	2	2.0	1	0.3
	Other+	8	8.0	36	12.0

*Neurodegenerative and Cerebrovascular Disease;

+ Vascular, liver, kidney, endocrine or abdominal wall diseases, pregnancy, aesthetic surgery or subdural hematoma.

TABLE 2 – Days of hospitalisation when falls occurred

<i>Days of occurrence of falls</i>	<i>No.</i>	<i>%</i>	<i>M</i>	<i>Mo</i>	<i>Md</i>	<i>SD</i>	<i>Min-Max</i>
≤ 2 days	33	33.0	10.3	1.0	4.5	± 15.2	1-113
Between 3 and 6 days	24	24.0					
Between 7 and 10 days	15	15.0					
Between 11 and 14 days	8	8.0					
Between 15 and 18 days	3	3.0					
Between 19 and 22 days	3	3.0					
Between 23 and 26 days	3	3.0					
≥ 27 days	11	11.0					

Table 3 shows the fall risk assessment using the MFS. In the first topic related to previous history of falling, Table 3 shows that 31% (31) of the cases already had a previous history of falling over the last 3 months prior to hospitalisation, or had been admitted to hospital emergency due to the fall. The same was true for 17% (34) of the controls. There is a statistically significant correlation between previous falls and fall risk ($X^2=74.456; gl=2; p=0.000$). In fact, 94% (61) of people with previous falls had a high fall risk. In addition, 92% (92) of the cases presented a secondary diagnosis. This was also true for 80.5% (161) of the controls.

With regard to the need for ambulatory aid, it was found that 42% (42) of the cases and 66.5% (133) of the controls could walk without help, were only assisted by a nurse, used wheelchairs, or remained lying down and never left the bed. In addition, in 37% (37) of the cases and 18.5% (37) of the controls, people used furniture for support. Finally, in 21% (21) of the cases and 15% (30) of the controls, patients used forearm Canadian crutches, canes or other devices to assist their ambulation.

In terms of Intravenous (IV) therapy, it was found that 58% (58) of the cases required an indwelling or intermittent catheter, as it was the case with 63% (126) of the controls.

Concerning gait and transferring, 38% (38) of the cases presented weakness in walking, in which cases people walked bended over, but were still able to raise their heads while walking, without losing balance. They took short steps and could drag their feet. The same assessment applied to 24.5% (49) of the controls. To be impaired and depend on aid to walk (having difficulty in getting up from a chair, standing up, finding support on the arms of a chair or balancing),

put the head down and look to the floor, walk holding to furniture, a person or assistive devices, or even not be able to walk without assistance were identified in 34% (34) of the cases and 22.5% of the controls. It was also found that 28% (28) of the cases had a normal walk, which was characterised by the person walking with the head erect, arms swinging freely at the side and striding without hesitant. This assessment was also found in 53% (106) of the controls.

The last topic assesses mental status, being true that 50% (50) of the cases were aware of their abilities. This assessment was based upon the person's self-assessment of his/her own ability. Also, 50% (50) of the people overestimated their abilities and forgot their limitations. With regard to controls, 65% (130) of them were also aware of their abilities.

It was observed that people with previous history of falling ($OR=2.19$; $CI=1.25-3.83$), who used walking aids ($OR=2.22$; $CI=1.15-4.28$) and forgot their limitations ($OR=1.86$; $CI=1.14-3.03$) were twice more likely to fall. People who presented a secondary diagnosis ($OR=2.79$; $CI=1.25-6.22$), who grasped onto the furniture for support to walk ($OR=3.17$; $CI=1.79-5.63$), had a weak posture in terms of walking and transferring ($OR=2.94$; $CI=1.62-5.32$), depended on aid ($OR=2.86$; $CI=1.56-5.26$), or presented a compromised posture ($OR=2.70$; $CI=1.73-4.86$) were three times more likely to fall.

The assessment of the six items of the MFS confirms the patient's risk level. In this regard, 65% (65) of the cases had high fall risk and 41.5% (83) of the controls had low fall risk. The score of the scale varied between a minimum of 0 and a maximum 125, with a mean of 54 ($SD \pm 29.04$), which indicates high fall risk. The risk score was above 50 for half of the participants.

TABLE 3 – Fall risk assessment of cases and controls and calculation of the odds ratio

Fall Risk Assessment	Cases		Controls		OR
	No.	%	No.	%	
History of falling					
No	69	69.0	166	83.0	
Yes	31	31.0	34	17.0	2.19[1.25;3.83]
Secondary Diagnosis					
No	8	8.0	39	19.5	
Yes	92	92.0	161	80.5	2.79[1.25;6.22]
Ambulatory aid					
No help/Nurse assist/bed rest/wheelchair*	42	42.0	133	66.5	-
Crutches/Canadian crutches/ cane/walker	21	21.0	30	15.0	2.22[1.15;4.28]
Grasps on furniture for support to walk	37	37.0	37	18.5	3.17[1.79;5.63]
IV					
Without IV	42	42.0	74	37.0	
With IV	58	58.0	126	63.0	n.s.
Gait/Transferring					
Normal/bed rest/immobile*	28	28.0	106	53.0	-
Weak	38	38.0	49	24.5	2.94[1.62;5.32]
Impaired	34	34.0	45	22.5	2.86[1.56;5.26]
Mental Status					
Oriented to own ability	50	50.0	130	65.0	
Overestimates/forgets limitations	50	50.0	70	35.0	1.86[1.14;3.03]

*reference class n.s. = non-significant

Using as reference class the variable without fall risk, it was observed that participants with low fall risk were 3 times more likely to fall. However, participants with

high fall risk proved to be 7 times more likely to suffer from falls during hospitalisation (Table 4).

TABLE 4 – Risk level of cases and controls and calculation of the odds ratio

Level of risk	Cases		Controls		OR
	No.	%	No.	%	
No risk*	5	5.0	42	21.0	-
Low risk	30	30.0	83	41.5	3.04[1.09;8.39]
High risk	65	65.0	75	37.5	7.28[2.72;19.49]

*Reference class

Based on these indicators, the sensitivity of the scale was 65%, which means that it allowed identifying 65% of people at risk of falling who actually fell. Its specificity was 63% as it allowed identifying 63% of people who did not fall and were not at risk of falling. It had a positive predictive value (PPV) of 46%, which allowed identifying that 46% of people with fall risk were likely to fall, and a negative predictive value (NPV) of 78%, as it identified that 22% of people without fall risk were also likely to fall.

The MFS was tested using the sensitivity and specificity for a number of possible cut-off points, and using pairs of sensitivity and specificity for each

cut-off point. Based on the various cut-off points, sensitivity ranged between 96% and 47%, specificity between 75% and 11%, the PPV between 35% and 48% and the NPV between 84% and 74%. False positives (participants with fall risk, without falls) ranged between 89.5% (cut-off point: 20) and 25.5% (cut-off point: 70). False negatives (participants without fall risk, with falls) ranged between 5% (cut-off point: 20) and 53% (cut-off point: 70). Accuracy (ACC) ranged between 39% and 65%. The AUC ranged between 0.533 and 0.608 and the Youden Index (*J*) between 0.070 and 0.300 (Table 5).

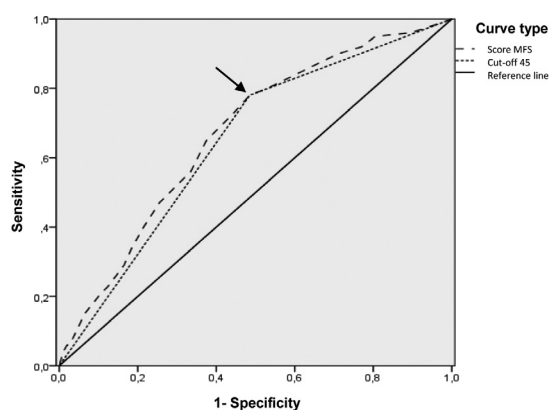
TABLE 5 – Predictive validity of the MFS cut-off points (n=300)

Cut-off Points	20	25	35	45	50	55	60	65	70
<i>Sensitivity</i>	96%	95%	90%	78%	73%	65%	56%	51%	47%
<i>Specificity</i>	11%	20%	29%	52%	56%	63%	67%	71%	75%
<i>PPV^a</i>	35%	37%	39%	45%	45%	46%	46%	47%	48%
<i>NPV^b</i>	84%	89%	85%	82%	80%	78%	75%	74%	74%
<i>ACC^c</i>	39%	45%	49%	60%	61%	63%	63%	64%	65%
<i>AUC^d</i>	0.533	0.573	0.595	0.648	0.643	0.638	0.613	0.610	0.608
<i>J^e</i>	0.070	0.150	0.200	0.300	0.290	0.280	0.230	0.220	0.220

^aPositive predictive value; ^bNegative predictive value; ^cAccuracy; ^dArea under the ROC curve; ^eYouden Index

The optimal cut-off point which had the highest sensitivity (78%) was 42.5, with a specificity of 49% and an area under the ROC curve of 0.670 (95% CI=0.61-0.73). However, given the values presented by the scale, this cut-off point has no practical utility. Therefore, the cut-off point of 45 was considered the optimal cut-off point, for it presented an equal sensitivity (78%), an area under the ROC curve of 0.648 (95% CI=0.58-0.71), which was considered

reasonable, a $J=0.30$ (95% CI=0.11-0.48), and an acceptable specificity of 52% (higher than the specificity of the cut-off point: 42.5), with a negative predictive value of 82% and an equally acceptable accuracy of 60% (Graph 1). With regard to this cut-off point, 78% of the participants were identified as true positives and 22% as false negatives. It presented an OR of 3.8 (95% CI = 2.17-6.51).



The arrow indicates the highest peak with the cut-off point of 42.5 and 45.

GRAPH 1 – ROC curve with the trade-off between the sensitivity and specificity of the cut-off point of the scale score and the cut-off point of 45.

Discussion

Preventing falls in older adults is a recognised health priority. In this study, a retrospective analysis of the sensitivity and specificity of the MFS in hospitalised patients was carried out. With a view to defining the optimal cut-off point of the MFS, the age of the target population had higher absolute and relative frequencies of 75 years. The age group between 70 and 79 years had the highest number of participants

and counted with 34% of falls. These results had already been corroborated by both national (Pina et al., 2010) and international studies (Oliver et al., 2010). Participants' mean age (76 years) was higher than the 70-year old mean age found in the study of Schwendimann et al. (2006).

The ageing process, which is associated with changes in physical and cognitive abilities, as well as comorbidity, which is associated with chronic diseases, have an impact on hospital settings. In fact, as in this

study, in which 84% of patients have a secondary diagnosis, many hospitalised patients are elders with various health issues.

At present, Portugal falls under the same reality as other countries, for instance the United Kingdom, where 60% of hospital admissions are for people aged 65 or more years and 70% of the beds are occupied by people in this age group (Oliver, 2008). Many of these patients are weakened by the disease process and have some level of cognitive impairment, which makes them more prone to fall. Individuals who participated in this study proved to have this fall risk, given that 40% of them were assessed using the MFS as forgetting their limitations, thus being 1.86 times more likely to fall ($OR=1.86$; $95\% CI=1.14-3.03$).

Results show that men fell more often than women. This reality has already been corroborated by other studies (Oliver et al., 2010).

Most falls (42%) took place during the hospitalisation of patients in need of convalescence and rehabilitation care, or with an incurable, progressive and advanced chronic disease. Indeed, authors have already mentioned these areas as more risky (Morse, 2009; Oliver et al., 2010). In our study, 52% of the patients admitted to this service had a high fall risk, 90% had a secondary diagnosis, 51% were forgetful of their limitations, 29% had previous history of falling, 33% had a weak posture while walking, 25% depended on aid, 21% grasped onto the furniture for ambulation support, and 17% used walking aids.

In this sample, 36% of the participants were hospitalised for medical reasons. When compared to patients hospitalised for surgical reasons, their risk scores were relatively stable, improving throughout the hospitalisation process whenever their health status also improved (Morse, 2009).

The oncological disease was the most common diagnosis in 22% of the patients. On average, patients with this diagnosis fell on the 10th day of admission. However, the mode was on the 2nd day and 48% of the patients had a high fall risk. These results were in line with other studies (Stone, Lawlor, Savva, Bennett, & Kenney, 2012). Falls are more common in adults with advanced oncological diseases, particularly in patients with cerebral metastases or primary brain tumours (Stone et al., 2012). Using multivariate analyses, retrospective studies conducted in hospitalised patients with advanced cancer showed that a previous history of falling over the last 3 months is a predictive

factor for falls in these patients (Stone et al., 2012). Indeed, 26% of cancer patients fell during their hospitalisation period. The previous history of falling was associated with a 2.19 times higher likelihood of falling for all participants in this study ($OR=2.19$; $95\% CI=1.25-3.83$).

Based on sensitivity and specificity pairs for different cut-off points, the cut-off point of 45 was chosen. However, using the scores obtained in the MFS assessment, 42.5 was identified as the optimal cut-off point.

This cut-off point was chosen because each item was scored as zero, five or multiple of five and, therefore, 45 was the most appropriate cut-off point. This value was also suggested by the scale's author (Morse, 2009) and other studies (Chow et al., 2007).

In addition to this factor, it matters to clarify that these two cut-off points have the same sensitivity (78%) and similar specificity (52% *vs.* 49%).

Other studies conducted during hospitalisations in medicine wards identified the optimal cut-off point of 55, with a sensitivity of 75% and a specificity of 66% (Schwendimann et al., 2006). This cut-off point was mentioned by the scale's author as the maximum possible score for the cut-off point (Morse, 2009).

In this study, the negative predictive value was 82% compared to 95% in the study of Schwendimann et al. (2006). Therefore, it was better than in our study. In the same study, the AUC was 0.701 and the ACC 67%, whereas in this study the AUC was 0.648 and the ACC 60%, representing again better scores than the ones found in our study.

The final decision was also based on the fact that the 0.3 Youden Index identified in this study for the cut-off point of 45 was the best that was found in relation to other cut-off points. Other studies identified lower values (Haines, Hill, Walshe, & Osborne, 2007), thus adopting a critical opinion on the use of fall risk assessment scales, particularly the MFS.

Therefore, we recommend that both the MFS and the cut-off point of 45 be used in certain contexts, which are identical to those of the present study. However, their use ought not to be generalised, given that it may not bring significant benefits other than a proper clinical assessment by nurses on the patients' fall risk. Nurses must focus more on prescribing interventions that aim at determining appropriate resources for patients at risk.

In terms of study limitations, we consider that conducting a case-control study with participants

matched by age and gender may have conditioned the identification of correlations between fall risk and age or gender. Matching has also made it difficult to find the appropriate controls for all cases and, therefore, we have not included some participants over the year in which the study took place. It was even more difficult to find controls for participants who fell more than once, as it was not possible to select controls for these participants. Hence, the study did not include people who had fallen more than once.

Conclusion

Fall risk assessment scales should be used in a critical way. It is necessary to understand their limitations and whether they distinguish well enough between patients with and without fall risk in a given population. Sensitivity, specificity and positive and negative predictive values are not mere theoretical details; rather, they have real implications for nursing practice. Given the similar values identified in this study and in other international studies, we may say that the MFS has a moderate capacity to predict fall risks in the type of hospitalisations under analysis. For adults who are admitted to medical-surgical and long-term and palliative care services, it is recommended that the cut-off point of 45 be applied. This value is also suggested by the author of the scale. It is also recommended that the cut-off points of the scale be studied in each specific reality or context.

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