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The predictive validity of the Morse Fall Scale in hospitalized patients in the Czech Republic

Trafność prognostyczna skali upadków Morse'a u pacjentów hospitalizowanych na terenie Republiki Czeskiej

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STRESZCZENIE

TRAFNOŚĆ PROGNOSTYCZNA SKALI UPADKÓW MORSE'A U PACJENTÓW HOSPITALIZOWANYCH NA TERENIE REPUBLIKI CZESKIEJ

Cel pracy. Głównym celem badania było przetestowanie skali upadków Morse'a w czeskiej populacji hospitalizowanych pacjentów oraz określenie trafności prognostycznej tej skali poprzez ocenę jej swoistości, czułości, wartości predykcyjnej dodatniej, wartości predykcyjnej ujemnej i punktów odcięcia.

Materiał i metody. Badanie było prospektywnym badaniem kontrolnym. W badaniu wzięło udział dziesięć oddziałów leczenia przypadków nagłych i opieki długoterminowej w dwóch wybranych szpitalach. Próba badanych składała się z 4383 pacjentów. Do oceny ryzyka upadków pacjentów wybrano skalę upadków Morse'a (MFS). Pacjenci byli oceniani przy przyjęciu na oddział.

Wyniki. Rzetelność skali upadków Morse'a mierzona współczynnikiem alfa Cronbacha wyniosła 0,484. Stosując punkt odcięcia 35, czułość wynosiła 61,1%, a swoistość 53%. Dodatnia wartość predykcyjna wynosiła 10,5%, a ujemna wartość predykcyjna 90,6%.

Wnioski. Wyniki badania wykazały jedynie umiarkowaną dokładność prognostyczną skali upadków Morse'a.

Słowa kluczowe: przypadkowe upadki, pacjenci hospitalizowani, skala upadków Morse'a, trafność prognostyczna

ABSTRACT

THE PREDICTIVE VALIDITY OF THE MORSE FALL SCALE IN HOSPITALIZED PATIENTS IN THE CZECH REPUBLIC

Aim. The main aim of the study was to test the Morse Fall Scale (MFS) in the Czech population of hospitalized patients and to determine the predictive validity of the scale by assessing its specificity, sensitivity, positive predictive value, negative predictive value and cut-off points.

Material and methods. The study was a prospective follow-up study. Ten acute and long-term care units in two selected hospitals participated in the study. The sample consisted of 4383 patients. To assess the patients' risk of falls, the MFS was chosen. The patients were assessed on admission.

Results. The reliability of the Morse Fall Scale measured by Cronbach's alpha was 0.484. Using a cut-off point of 35, the sensitivity was 61.1% and the specificity was 53%. The positive predictive value was 10.5% and the negative predictive value was 90.6%.

Conclusions. Results of the study revealed only moderate predictive accuracy of the Morse Fall Scale.

Key words: accidental falls, hospitalized patients, Morse Fall Scale, predictive validity

INTRODUCTION

Falls rank as the second most common cause of fatal unintentional injuries worldwide [1]. Falls in hospital are frequently reported safety incidents in hospitalized patients [2]. They can happen to patients of all ages except unconscious patients and infants who are unable stand [3]. It is known that falls affect patients in many ways. The impact of falls on patients is well-documented, as they can result in extended hospital stays, increased healthcare expenses, and reduced quality of life. Extensive research has been conducted on falls for several years.

Although decreasing, hospital falls are a significant patient safety problem [4].

There are many studies concerned with intervention programs to prevent falls. Major systematic reviews of fall prevention identified some benefits of multifaceted interventions [5-9], as multifactorial interventions may reduce rate of falls. One of the important components of multifactorial interventions is fall risk assessment.

Although many fall risk assessment tools have been developed in the last years, none have consistently high predictive validity. The fall risk assessment tools include a list of fall risk factors and a rating system that evaluates the cumulative impact of known fall risk factors. A screening tool should have high values of sensitivity and specificity. There are differences among fall risk assessment instruments in sensitivity, specificity and feasibility of use. Scott et al. [10] recommended to perform validation of fall risk assessment tools in all settings by analyzing their specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV) and using receiver operating characteristic (ROC) curve analysis to select an optimal cut-off point. An integrative review of fall risk assessment tools for older adults living in long-term care facilities based on 13 reviewed studies concluded that only the Morse Fall Scale (MFS) demonstrated high predictive values and could be completed in less than a minute [11]. Several systematic reviews on instruments for measuring risk of falls have been published [12-15]. In their meta-analysis, Haines et al. [14] revealed that the STRATIFY, MFS and clinical judgment of nurses produce the similar levels of accuracy. Another research team [12] found that the MFS showed greater sensitivity and significantly lower specificity than the STRATIFY. A systematic review of instruments for assessing the risk of falls in acute hospitalized patients [13] found that the STRATIFY scale was the best tool. Other studies have examined the predictive validity of Stopping Elderly Accidents, Deaths, and Injuries (STEADI) and showed fair sensitivity and poor specificity for prospective fall prediction [16]. Currently, no tool exists that can be reliably applied across different settings to predict the risk of falling accurately [10]. For elderly, instead of a single scale, two instruments used together are recommended for better fall prediction [17].

Janice M. Morse created the MFS in 1989 as a technique for assessing patients who were at risk of falling [18]. The MFS is a quick and easy way to determine whether a patient is in a higher risk of falling. It contains of six variables, and both predictive validity and interrater reliability have been confirmed [3,19]. The scale has been shown to have good specificity and sensitivity [12]. It is easy to use in clinical practice and can be used in hospitalized patients in facilities providing acute and long-term care. It is, however, recognized that the MFS does not screen for accidental and unanticipated physiological falls because these are unpredictable events. The scale has been translated into several languages. As of 2009, the author mentioned Danish, Spanish, German, French, Japanese, Korean, Mandarin, Filipino and Persian versions [3], also a Chinese [20] and Slovak [21] versions of the MFS were recently published. The MFS was not previously translated into Czech language nor validated.

The main aim of the study was to test the MFS in Czech hospitalized patients and to determine its predictive validity by assessing the specificity, sensitivity, PPV, NPV and cut-off scores.

MATERIALS AND METHODS

The study was a prospective follow-up study. Acute and long-term care units in two selected hospitals in the Czech Republic agreed to participate. The subjects were adult patients (18 years of age or older) admitted or transferred to acute or long-term care units. The MFS was chosen to evaluate the risk of fall in hospitalized patients. The scale has six items [3]: a history of falling, secondary diagnosis, ambulatory aid, intravenous therapy / saline lock, gait, mental status. The total scores ranged from 0 to 125. The scores of 0-24 were considered as low risk, scores 25-45 as moderate risk and scores 46 and more as high risk of falls in the present study.

Morse [3] recommended a cut-off point of 45. However, calibration of the scores for patient symptoms and health setting is advised. Permission to translate the MFS into the Czech language was obtained from the author of the original instrument prior to the translation process. The forward-backward translation process consisted of the following steps: creation of two separate forward translations by two translators; creating one reconciled version; creation of a back translation from Czech into English by another translator; comparison between the back translation and the source text; and pilot testing.

Nurse raters from ten acute care hospital units and long-term care hospital units were trained on rating the MFS. Their training included clarification of the purpose of the study and description of MFS scoring. Online video training material developed by Morse was also used as a part of the training. The video involved description of each item and explanation of rating with examples.

Data collection period lasted 12 months, from June 2014 till May 2015 as part of a bigger study. During the admission process, the patients were assessed for fall risk using the MFS on admission. All falls, as well as the circumstances, were recorded in protocols over the follow-up period of 12 months. Demographic data were also collected.

Descriptive statistical analysis involved the calculation of means, standard deviation (SD), absolute frequencies, and relative frequencies. The sensitivity, specificity, PPV

and NPV of the MFS were examined for different cut-off points. Spearman correlations were used to test correlations between items of the MFS. Internal consistency of the MFS was established by computing the Cronbach's alpha coefficient. A principal component analysis with orthogonal varimax rotation was conducted to perform a factor analysis.

A chi-squared test was used to assess differences between groups of patients with low, moderate and high risk of fall. A p-value < 0.05 was considered significant. Statistical analysis was performed using the statistical software Stata v. 13 (SPSS Inc., Chicago, IL, USA).

ETHICAL CONSIDERATIONS

The research was approved by the Ethics Committee of the Faculty of Medicine, University of Ostrava, Czech Republic (no. 16/2012 and 15/10/2013). The study was conducted in accordance with the Declaration of Helsinki.

RESULTS

Sample

The sample consisted of 4383 patients admitted to ten acute and long-term care units in two Czech hospitals. Of the sample, 2476 (56.5%) patients were from acute care units and 1907 (43.5%) were from long-term care units (Table 1). The average length of hospitalization was 21.9 (SD 30.3) days. In the entire sample, 490 patients' falls and 117 fall-related injuries were recorded. The most common reasons for admission were uncontrolled diabetes mellitus, dehydration and gastrointestinal diseases.

The mean MFS score on admission was 41.87. The mean MFS scores in acute and long-term patients were 41.61 and 42.20, respectively. At the time of their admission, most patients were identified as having a moderate risk of falls (Tab. 1). Statistically significant differences were found between patient groups with low, moderate and high risk of falls. The majority of patients experiencing falls (74%) were at high risk of fall (a score of 46 or more) according to the MFS. A moderate risk of fall (a score of 25-45) was noted in 24.3% of patients who sustained falls during their hospital stay and only 1.7% of patients with falls had a low risk of fall (a score of 0-24).

Tab. 1. Sample characteristics (n = 4383)

Characteristics		n	%
Acuity of patients	Acute care patients	2476	56.5
	Long-term care patients	1907	43.5
Total number of falls		490	
Total number of fallers		359	
Fall-related injuries		117	
Morse Fall Scale scores on admission (n = 4222)	Low risk (0-24)	664	15.8
	Moderate risk (25-45)	2050	48.5
	High risk (46 or more)	1508	35.7
Pearson chi-squared = 8.5464; p = 0.014			

Correlations between the MFS items are presented in Tab. 2. The low correlations were observed between secondary diagnosis and total MFS (0.2760), and mental status and total MFS (0.2232). The low negative correlations were between history of falling and intravenous therapy (-0.2537), and mental status and intravenous therapy (-0.2752). Moderate positive correlations were between total MFS and gait (0.5725), total MFS and history of falling (0.5618), and between total MFS and ambulatory aid (0.5615). The highest correlations was observed between items gait and ambulatory aid (0.7042). Both items are included in factor 1 (Tab. 3). This was the only high correlation. Other correlations were negligible.

Tab. 2. Correlation matrix for the MFS items

	MFS total	History of falling	Secondary diagnosis	Ambulatory aid	Intravenous therapy	Gait	Mental status
MFS total	1.0000						
History of falling	0.5618*	1.0000					
Secondary diagnosis	0.2760*	0.1066*	1.0000				
Ambulatory aid	0.5615*	0.0652*	0.0959*	1.0000			
Intravenous therapy	0.1910*	-0.2537*	-0.1289*	-0.1248*	1.0000		
Gait	0.5725*	0.0685*	0.1020*	0.7042*	-0.1095*	1.0000	
Mental status	0.2232*	0.1608*	0.0918*	-0.0861*	-0.2752*	-0.0285	1.0000

* Correlation is significant at the 0.05 level

Reliability

The reliability of the MFS as measured with Cronbach's alpha was 0.484.

Validity

Principal component factor analysis yielded two factors with eigenvalues greater than 1. The first factor had an eigenvalue of 1.7, while the second one had an eigenvalue of 1.5. Factor loadings are shown in Table 3. Factor 1 comprised of the ‚ambulatory aid' and ‚gait items'. The item ‚ambulatory aid' had the highest factor loading. Factor 2 comprised ‚a history of falls', ‚a secondary diagnosis', ‚intravenous therapy' and ‚mental status'.

Tab. 3. Results of factor analysis of the Morse Fall Scale

Variable	Factor 1	Factor 2
Item 1: a history of falls		0.6192
Item 2: a secondary diagnosis		0.3823
Item 3: ambulatory aid	0.9054	
Item 4: intravenous therapy/saline lock		-0.7261
Item 5: gait	0.8959	
Item 6: mental status		0.6820

Tab. 4. Predictive validity of Morse fall scale for the different cut-off values at admission

Cut-off points	25	35	45	50	55	60	65	70
Sensitivity	86.1%	61.1%	41.2%	38.4%	21.3%	16.2%	10.2%	8.8%
Specificity	17.5%	53.0%	64.7%	72.2%	80.5%	87.8%	90.4%	92.5%
PPV	8.6%	10.5%	9.5%	11.1%	9.0%	10.7%	8.8%	9.6%
NPV	69.3%	90.6%	94.6%	95.4%	97.7%	98.4%	99.0%	99.1%
Accuracy	17.2%	51.8%	64.2%	71.3%	80.4%	87.5%	90.4%	92.4%
AUC	0.518	0.5703	0.5293	0.5527	0.50901	0.52	0.5034	0.5068

Abbreviation: PPV – positive predictive value, NPV – negative predictive value, AUC – area under the curve

According to the original MFS, patients were identified as having a low, moderate or high risk of falling [3]. For clinical practice, however, it is more important and useful to determine the cut-off points that distinguishes patients at risk of falling from those who are not at risk [22]. Subsequently, those patients at risk for falls will receive interventions for fall prevention in addition to their standard care. Based on the decision tree method, sensitivity and specificity were calculated for different MFS cut-off points (Tab. 4). Sensitivity indicates that the MFS is able to identify "true positive" patients or the percentage of patients who fell and had been predicted to fall (were identified as high risk). Specificity indicates that MFS is able to identify "true negative" patients or the percentage of patients who did not fall and were not predicted to fall (identified as low risk).

The cut-off point is where the decision is made as to whether or not a person is at risk of falling. This value can separate those at low risk of falling from those at high risk of falling who need more fall prevention interventions [22].

The area under the ROC curve (AUC) ranged from 0.518 to 0.5068. An AUC equal to 1 indicates a strong screening tool that distinguishes between patients at risk for falls from those who are not; an AUC level close to 0.5 represents an accidental risk using the screening tool; an AUC close to 0 classifies a patient as low risk and a non-faller as high risk indicating a misclassification in which the patient is classified as low risk and the non-faller is classified as high risk. The accuracy ranged from 17.2% to 92.4%. At the recommended cut-off point of 45, the sensitivity of the MFS was 38.4% and the specificity was 64.7%. The highest sensitivity (86.1%) was achieved for a cut-off point of 25, but the specificity was very low (17.5%). At a cut-off point of 35 and above, the sensitivity decreases and specificity increases. At a cut-off point of 35, the sensitivity and specificity of this scale were 61.1% and 53%, respectively. The PPV was 10.5% and the NPV was 90.6%. Based on the results (see Tab. 4), a cut-off point of 35 for hospitalized patients using the Czech version of the MFS would be optimal.

DISCUSSION

The objectives of the study were to test the Czech version of the MFS and to determine its predictive validity. The MFS contains six easily identified and quickly scored variables. They are a history of falling, presence of secondary diagnosis, ambulatory aid, administration of intravenous therapy, type of gait (normal, weak or impaired) and mental status [23]. The present study assessed its reliability and validity. Reliability refers to the repeatability, stability or internal consistency of the MFS. The internal consistency of the MFS in the study was 0.484, which can be interpreted as moderate reliability. However, in a study by Chapman et al. [24], the internal consistency of the MFS was 0.72. Different internal consistency values have been found in other studies. The lowest internal consistency of 0.16 was found in the original study [18]. A similar internal consistency (0.26) was reported for the Chinese version of the MFS [20]. The low value of alpha coefficient may be explained by a low number of questions [25]. It is crucial to understand that alpha is specific for the specific sample and it should be calculated each time the test is administered.

Further, we wanted to know the construct validity of the MFS. Validity is an important indicator in determining the clinical usefulness [26]. Factor analysis may identify the dimension of test. Factor analysis revealed a two-factor solution of the MFS in this study. Three factors were found in the Chinese study [20]. Some studies did not report the results of factor analysis.

According to Watson et al. [22], it is principal to determine the optimal cut-off point for distinguishing between patients at risk for falling and those not at risk.

To evaluate the predictive validity of the MFS, the scale's cut-off point was assessed. The cut-off point should refer to the score which the health care institution considers acceptable to provide standard care and regular fall prevention interventions. Effective nursing care in terms of fall prevention requires precise screening of patients with a high risk of fall [27]. Gaining the high-risk score should tell nurses that along with the standard care, advanced fall prevention interventions should be implemented. Even though the recommended cut-off point is 45 points, indicating that patients with higher scores are at higher risk for falls, clinicians are encouraged to adjust the scale for each specific domain depending on the type of patients on the ward, as the risk varies widely across patient populations. Morse [3] recommended to stay within a 25-55 score range. Morse [3] further emphasized that in some areas of acute care hospitals, where there are only high-risk patients, the risk score can be as low as 25, as all fall prevention strategies need to be implemented to protect this group. In the assessment of MFS in the Chinese population, the sensitivity and specificity of this scale were 31% and 83%, respectively when the cut-off point was 45 [20]. For the Korean population, the MFS showed

relatively high predictive performance with the best cut-off point of 51 [26]. While McCollam [28] recommended a cut-off point of 55, other studies confirmed a cut-off point of 45 when testing sensitivity and specificity [29, 30, 31]. In another Korean study in acute care setting MFS's sensitivity was 85.7%, and specificity 58.8% at 50 points [32]. MFS's sensitivity was 85.7%, and specificity was 58.8% at 50 points. In a Canadian study [22], using a cut-off value of 25, the sensitivity was as high as 98%; but the specificity was very low (8%).

Borikova et al. [27] in their review based on analysis of 14 studies focusing on the predictive value of the MFS measuring tool on hospitalized patients reported that the lowest sensitivity was 31%, while the highest 98%; the lowest specificity was 8% and the highest 97%. The tool's sensitivity and specificity values determine its diagnostic accuracy.

The present study revealed that the most optimal cut-off point was 35, showing fairly good sensitivity (61.1%) and moderate specificity (53%). Hospitalized patients with higher MFS scores are at a real risk of falling. The lower specificity of the MFS can be explained by the fact that falls are affected by many other factors, some of which are not included as MFS items. The higher sensitivity means that patients with falls had been categorized on admission as having a moderate to high risk of falls. This does not mean, however, that all patients identified by the MFS as being at a high risk of falling during hospitalization will necessarily fall. On the other side, the MFS had lower specificity. Therefore, the MFS did not identify all patients who did not fall during hospitalization. The accuracy and cut-off score of the MFS are problematic [31]. The optimal cut-off point is generally where the sensitivity and specificity are highest on the curve [22]. Setting the level of a risk point too low is costly and advanced fall prevention strategies in that case will be implemented for patients who are less likely to fall. On the other side, if the risk point level is set too high, the patient will be unprotected and will fall and injure himself. In that case, there are too many false negatives [3]. Morse [3] warned that the high-risk score should never be set higher than 55, due to the possibility that false negatives become too high. Since the intention of using fall risk assessment tools is to identify high and low fall risks rather than to reduce fall risk, highly sensitivity and highly specific tool should be used [17]. The differences in findings between the present and other studies confirm that the MFS needs to be tested in each clinical setting prior to its use. The differences may be caused by the diversity of patient population and hospital settings.

It is always necessary to bear in mind that the MFS identifies patients who are physiologically prone to expected falls, and does not predict accidental falls or unexpected physiological falls [18]. As Aranda-Gallardo et al. [13] concluded in their systematic review, it is difficult to accurately predict the risk of falls in hospitalized adult patients who are exposed to external risk factors, specific to the hospital environment that are not considered in fall risk rating scale [13]. The sensitivity, specificity, PPV and NPV of fall risk assessment tools are known to vary by patient populations and settings [26]. The sensitivity and specificity determined in this study may be affected by the different settings of acute care and long-term care, as well as by differences in patient age groups. Clinical fall risk assessment often involves questionnaires and functional assessment. Although clinical evaluation contains a quick summary of fall risks, they are often subjective [31].

A perfect falls risk assessment tool with high sensitivity and specificity is not yet available. Therefore, the available instruments should be used after careful consideration of all advantages and disadvantages.

CONCLUSIONS

This is the first study in the Czech Republic to evaluate the use of the MFS in a big sample of hospitalized patients. As a result, we were able to identify most, but not all, of the patients prone to falls. Only moderate predictive accuracy of the scale was confirmed. The most optimal fall risk assessment tool is still not available. The MFS identifies patients at risk of anticipated physiological falls. The tool may be used bearing in mind that not all falls can be predicted in hospitalized patients. Future studies may be useful to examine the MFS and continue to improve the predictive validity for fall prediction.

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