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The predictive validity of a modified Japanese Nursing Association fall risk assessment tool: A retrospective cohort study

Miki Higaonna *

Gerontological Nursing, School of Health Sciences, Faculty of Medicine, University of the Ryukyus, 207 Uehara, Nishihara 903-0215, Okinawa, Japan

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ABSTRACT

Background: Patient falls are the most common nursing care-related adverse event in hospitals. Extensive literature has been published on the predictive validity of fall risk assessment tools; however, there have been no studies examining the changes in predictive validity at different observation periods among hospital inpatients.
Objectives: To examine the predictive validity of a modified Japanese Nursing Association fall risk assessment tool and to compare its predictive validity at observation periods of 7, 14, 21, and 28 days.
Design: Retrospective cohort design.
Settings: Twelve wards of a 600-bed university hospital in Japan.
Participants: Patients 15 years and older admitted over a six-month period were enrolled. Patients were excluded if they were admitted to the intensive care unit or neuropsychiatry ward, had no fall risk assessment results within two days of admission, or had inconsistent assessment results.
Methods: Falls were observed for 28 days following admission. Predictive validity was evaluated using the area under the receiver operating curve, sensitivity, specificity, and positive and negative likelihood ratios at 7-, 14-, 21-, and 28-day observation points. Faller prevalence in each observation sample was adjusted for consistency using a bootstrap sampling method. All predictive validity indices were then recalculated and compared.
Results: A total of 4144 patients were admitted and 67 patients fell (1.6% faller prevalence) within 28 days of admission. The modified Japanese Nursing Association fall risk assessment tool showed a sensitivity of 0.82, specificity of 0.71, positive likelihood ratio of 2.83, and negative likelihood ratio of 0.26 at a cut-point of $\geq$6, and the area under the receiver operating curve was 0.83. Predictive validity in the 7-day observation sample was significantly higher than the 14- and 28-day samples, but no significant difference was found relative to the 21-day observation sample.
Conclusions: The modified Japanese Nursing Association fall risk assessment tool demonstrated good predictive validity in a Japanese university hospital, but further evaluation is needed for other validity values and reliability. The findings from this study may indicate that predictive validity indices vary by the length of observation period and faller prevalence, but these findings need to be examined further.
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* Tel.: +81 98 895 3331; fax: +81 98 895 1432.
E-mail address: miki51@med.u-ryukyu.ac.jp

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What is already known about the topic?

- Falls are the most common nursing care-related adverse event in hospitals.
- Fall risk assessment tools are incorporated in effective multifactorial fall prevention programs.
- Various fall risk assessment tools have been evaluated for their ability to predict inpatient falls during hospitalization.
- The predictive validity of the Japanese Nursing Association fall risk assessment tool has not been well evaluated.

What this paper adds

- The modified Japanese Nursing Association fall risk assessment tool showed good predictive validity among patients 15 years and older in a Japanese university hospital.
- Predictive validity indices may be influenced by length of observation and faller prevalence.

1. Introduction

Falls account for approximately 40% of nursing care-related adverse events among hospital patients (D'Amour et al., 2014). While 16–34% of inpatient fallers suffer injuries, 1.5–3.9% of hospital falls result in fractures, intracranial hemorrhages, or even death (Schwendimann et al., 2006a; Waters et al., 2013).

A recently published guideline by the National Institute for Health and Care Excellence (NICE, 2013) included the following as risk factors for falls among hospitalized elderly patients: cognitive impairment, continence problems, fall history, unsuitable or missing footwear, medications, postural instability, mobility and/or balance problems, syncope syndrome, and visual impairment. Interventions targeting multiple risk factors identified by a fall risk assessment were shown to reduce the fall rate by 31% in hospital inpatients (Cameron et al., 2012). Chari et al. (2013) also reported that patients who were assessed for fall risks were 40% less likely to have fractures caused by falls compared to the patients whose fall risks were not assessed.

Fall risk assessment tools commonly used and evaluated in multiple hospitals are the St. Thomas Risk Assessment Tool in Falling Elderly Inpatients (STRATIFY; Oliver et al., 1997), the Morse Fall Scale (Morse et al., 1989), and the Hendrich II Fall Risk Model (Hendrich et al., 2003). Among these three tools, a meta-analysis by Aranda-Gallardo et al. (2013) found that the STRATIFY showed the greatest validity in acute hospital settings with sensitivity, specificity, positive likelihood ratio (LR), and negative LR of 0.80, 0.68, 2.47, and 0.33, respectively.

Unfortunately, none of the three tools is commonly used in Japanese hospitals. Furthermore, STRATIFY showed less than optimal validity (sensitivity of 0.65–0.68 and specificity of 0.75, and the area under the receiver operating curve [AUC] of 0.75–0.77) in a Japanese university hospital (Toyabe, 2010). In other Asian countries, the Morse Fall Scale (Chow et al., 2007; Kim et al., 2007, 2011), STRATIFY (Kim et al., 2007), and the Hendrich II Fall Risk Model (Kim et al., 2007) were examined either at acute care or rehabilitation hospitals, but no tool has exhibited both sensitivity and specificity of $\geq$0.70, which are the predictive validity criteria for fall risk assessment tools in clinical practice suggested by Oliver et al. (2004). To explain the low predictive validity in the study, Chow et al. (2007) discussed the possibility of differences in fall risks between Western and Asian populations. Since no published study has examined this difference, the low predictive validity of common fall risk assessment tools suggests the need to develop a tool for patients in Asian countries. Although the Japanese Nursing Association fall risk assessment tool was developed to address risk factors for Japanese patients and was modified for use at a Japanese university hospital, the tool contains multiple risk factors that are likely to apply to Korean inpatients (Kim et al., 2011). Modifications also included items related to treatment stage, patients' personality, and experiences in the hospital environment. These modified factors are not included in STRATIFY, the Morse Fall Scale, or the Hendrich II Fall Risk Model and could be common risk factors for patients in other Asian countries.

Previous systematic reviews and meta-analyses examining the validity of fall risk assessment tools have included studies with various lengths of observation periods for falls. The range was 10 days to two months in Oliver et al. (2008) and 6.8 to 14.6 days in Aranda-Gallardo et al. (2013). However, two recently published studies reported that predictive validity changed with longer observation periods (Bentzen et al., 2011; Duncan et al., 2012). A prospective cohort study by Bentzen et al. (2011) compared the predictive validity of three fall risk assessment methods (modified STRATIFY, staff judgment, and fall history) at 30, 90, and 180 days from assessment among residents in 18 nursing homes in Norway. In all three methods, sensitivity decreased while specificity increased during longer observation periods. Duncan et al. (2012) also prospectively examined the predictive validity of four balance tests at six and 12 months from an assessment of community dwellers with Parkinson's disease and found that predictive validity at six months was better than that at 12 months. Although hospital patients' fall risk factors would change more frequently than nursing home residents or community dwellers, no study has examined the predictive validity of fall risk assessment tools at different observation periods in a hospital setting.

The objectives of this study were to examine the predictive validity of the modified Japanese Nursing Association fall risk assessment tool currently used in a Japanese university hospital and to compare its predictive validity during 7-, 14-, 21-, and 28-day observation periods. The validation of the modified tool will enable other hospitals to adopt this improved assessment tool.

2. Materials and methods

2.1. Study design and setting

This retrospective cohort study was conducted in a 600-bed university hospital in Japan. The hospital is

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