Design, application and evaluation of maternal fall risk assessment scale.

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Abstract

Purpose: To provide a scientific and objective basis for clinical nurses and evaluate the maternal fall risk by means of design, application and evaluation of maternal fall risk assessment scale.

Method: The maternal fall risk assessment scale was initially established after documentary research, expert meeting and expert enquiry method. The scale was applied to hospitalized puerperae to evaluate the reliability, validity and predictive ability of the scale.

Result: The recovery rates 2 rounds of expert enquiry questionnaire were 93.8% and 96.7%, respectively. The expert's coefficient of authority was 0.88 and 0.90, respectively and the Kendall'S W for the opinion coordination degrees of experts were 0.24 and 0.45, respectively. The reliability of designed maternal fall risk assessment scale was 0.732 and the discriminant validity was relatively high. The score of positive fall group was significantly higher than that of negative group and the content validity range was 0.126~0.928. When the critical value of the scale was determined as 3, the scale predicts that the maternal fall sensitivity and specificity was 74.7% and 65.8%. The positive and negative predictive value was 50.3% and 74.5%.

Conclusion: The maternal fall risk assessment scale designed in the research is with high scientificity and can provide basis for clinical nurses to evaluate maternal fall risks.

Introduction

In 2006, American Nurses Research Committee defined fall as gusty, involuntary body position change onto the ground or lower surface [1]. The various researches on fall problems were mostly focused on the elder people, lots of researches on evaluation and prevention of falls among aged people have been conducted. Most researchers did not treat puerperae as high fall risk group. However, the fall incidence rate of adult patients in surgical wards in the US is 2.79 cases per thousand per day. While in a women and children's hospital whose monthly delivery is about 500 cases, the incidence rate of maternal fall exceeds the index [2]. Prevent and reduce patient falls is one of ten inpatient safety objectives of our country in 2010, and the Level 3 General Hospital Evaluation Standards (Edition 2010) requires the risk assessment ratio for fall and falling out from bed of high-risk patients on admission shall be ≥ 90%.

There are more than ten kinds of scales [3] which can be used inpatient fall risk assessment, however, there is no one recognized a fall risk assessment tool with good reliability and validity and predictive ability suitable for all groups [4]. Morse Fall Scale (MFS), Hendrich (I) Fall Risk Model and Schmid were currently used in obstetrical department [5], but the tested groups for developing these three scales were general surgical

patients, emergency patients or aged people, patients with different diseases have different physiological and pathological features, the puerperae who are in the special physiological variation period of the normal group, and their fall risk factors were significantly different from those in other patients. With hospitalized puerperae as study objects, the research of a fall risk assessment scale applicable to puerperae was studied. Multi-center investigation and multidimensional detection like reliability, validity, sensitivity, specificity, positive predictive value and negative predictive value detection were conducted and measured to determine scale efficiency, which could provide an object basis for clinical nurses to evaluate maternal fall risk.

Materials and Methods

Object of study

Select hospitalized postpartum puerperae within October 2013 to January 2015 from 8 hospitals, including 5 hospitals of Guangdong Province and 3 hospitals outside provinces by means of convenience sampling. The research adopts convenience sampling. Sample inclusion criteria: postpartum hospitalized puerperae; the puerperae with one or more fall risks in the scale; the puerpera is informed consent and willing

to be included in the research; sample exclusion criteria: the puerperae have cognitive disorder and cannot act spontaneously.

Study out of maternal fall risk indicators

Documentaries were studied on maternal fall risk indicators, which included the searching in domestic documentary library with "maternal", "fall" and "risk assessment scale" as key words, but there were no reports on maternal fall risk assessment scale in the domestic and overseas documents. The document research indicated that the intrinsic factors of maternal fall include: postpartum physical disorders [6], weakness, constipation [7], sudden body position change, squatting too long at urination, anemia, long stage of labor, postpartum hemorrhage, high blood pressure, epileptic seizure [8]. Environmental and nursing factors [6,9] were extrinsic factors. Creating nice ward environment, strengthen maternal health education [6,10], establishing fall risk assessment system and fall prevention system, reinforce nursing [7,8], establishing relevant systems and enhancing training [9] on nurses were all concluded to be the reduction measures of maternal fall. Studies [8-10] had indicated the necessary of establishing the fall assessment system instead of introducing the establishing methods. The importance of fall risk assessment has been recognized but no complete maternal fall risk assessment scale had been established, this is a common phenomenon in domestic obstetrical nursing.

Obstetric Fall Risk Assessment System (OFRAS) was the first vended maternal fall risk assessment scale prepared by Heafner et al. in 2013 and the development of the scale was started with meeting discussion of expert groups which listed various maternal fall risks, and a total of 14 risks after a number of documents reviews were further determined, at last, all risks were classified by congeneric merger the 14 risks indicators into 6 categories, which was scored between 1~3 and the total score of the assessment scale was 18. After OFRAS was prepared, it was tested in the author's hospital, the test result showed that the maternal fall cases in the obstetric wards obviously decreased comparing with the condition before using the scale; however, it was only the result in one hospital which was not typical and was tested for its reliability and validity, moreover, there was no accurate incidence rate of maternal fall nationwide, so concurrent control comparison could not be conducted.

After a number of maternal fall risk factors was obtained, a panel meeting consisting of nursing management experts, obstetrical nursing management, obstetrical nursing education, obstetrical medical experts, who was mainly responsible for subject selection, expert enquiry questionnaire preparation, expert selection, collection, arrangement, recording and analysis of expert advices as well as finally determining maternal fall risk indicators that include 19 risk indicators of 6 categories.

Screening of maternal fall risk indicators and Selection of enquiry expert

A total number of 32 experts who were specialists on obstetrical clinical nursing, management, education were consulted for better study on this research according to Delphi method. The specific expert selection criteria were as follows:

1. Obstetrical nursing management, obstetrical clinical nursing and hospital quality management personnel from hospitals as well as obstetrical nursing education personnel from institutions of higher education
2. People with bachelor or senior degree, vice higher professional title or above
3. People have 10 years' or longer working experiences in the field
4. People who was interested in the research.

Distribution and retrieval of enquiry questionnaire

The questionnaires were distributed by emails and adding, deleting or changing parts of the indicators were reported back to the experts to form the second round of expert enquiry, stop enquire when experts' opinions' tend to be uniform. The research screens indicators with simultaneously satisfying arithmetic mean value>3.50 points, full score frequency>0.20 and variable coefficient<0.25 were set as criteria [11,12].

Application of assessment scale

The weight of each indicator was determined by the expert scoring method according to the last round of Delphi expert enquiry and we gained the risk value of each indicator through statistical analysis to initially form maternal fall risk assessment scale. The maternal fall risk assessment scale was applied to the hospitalized maternal by means of questionnaire.

Statistics analysis

Data analysis were performed by the SPSS17.0 software, the statistical description adopts mean, median, frequency and percentage. The internal reliability of scale was evaluated using Cronbach's α coefficient. In order to evaluate the discriminant validity of the scale, T-text was used in in positive and negative fall group. The content validity of the scale was evaluated through Spearman correlation analysis. Evaluate the predictive ability of the scale with sensitivity, specificity, positive predictive value and negative predictive value as well as area under ROC AUC.

Result

Design of maternal fall risk assessment scale

Most of the experts of the research come from Guangdong Province, and they were all older than 40 years old with a bachelor or higher degree and working experience of more than 20 years (Table 1). They were engaged in obstetrical nursing management field and most of them have a sub-senior

title. The recovery rate of two rounds of expert enquiry questionnaires was 93.8% and 96.7%, respectively; the effective rate of the questionnaires was respectively 100% and 96.6%, which showed that the experts had high enthusiasm in joining in this enquiry.

Table 1. General information of expert.

Item	Number of people (n=32)	Percentage
Age (year)		
30~	8	25%
40~	13	40.60%
50~	10	31.30%
60~	1	3.10%
Degree		
Bachelor	23	71.90%
Master	6	18.80%
Doctor	3	9.30%
Occupation		
Semi-senior	3	9.30%
Sub-senior	18	56.30%
Senior	11	34.40%
Place of employment		
Guangdong	20	62.50%
Jiangsu	5	15.80%
Sichuan	3	9.30%
Beijing	1	3.10%
Shanghai	1	3.10%
Zhejiang	1	3.10%
Shandong	1	3.10%
Working field		
Obstetrical clinical nursing	9	28.10%
Obstetrical nursing management	21	65.60%
Obstetrical nursing education	2	6.30%
Working experience (year)		
10~	4	12.50%
20~	18	56.30%
30~	9	28.10%
40~	1	3.10%

Experts' coefficient of authority

Experts' authority degree was expressed by Cr, and the calculating formula was Cr= (Ca+Cs)/2, in which Ca was the basis for experts to judge indicators; Cs stand for the familiarity of experts to indicators. The mean value of two rounds of experts' coefficient of authority was 0.88 and 0.99. It was generally acknowledged that the experts opinions have a high reliability when the coefficient of authority is ≥ 0.7 [13]. The experts' coefficient of authority in the research was relatively high; therefore the reliability of expert opinions was high. The concordance degree of experts' opinions is expressed by Kendall'S W, which had a range of 0~l. The coefficient represented the concordance degree. The Kendall'S W of two rounds of experts' enquiry in this study was 0.24 and 0.45, respectively, which showed that experts' opinions tend to be more uniform (Table 2).

Table 2. The coefficient of concordance of experts' enquiry opinions.

Investigation round	Kendall'S W		
The first round	0.24	128.16	<0.001
The second round	0.45	326.84	<0.001

The determination of indicator system and weight

Weight refers to the proportion of a certain evaluation indicator in whole indicator system, which shows the indicator's importance, and it is also the quantity value that measures the relative importance of indicators [14]. In general, the larger the weight value is, the more important the indicator is. Table 3 showed the situation of past medical history, sensory perception, conditions in obstetrical department, mobility and medication and all data were analyzed statistically.

Table 3. Maternal fall risk assessment scale.

Category of maternal fall risk indicator	Maternal fall risk indicator	Weight value
Past medical history	Epileptic seizure	10
	Long-term bed-ridden at pregnancy (last for more than 1 week)	9
Sensory perception	Visual disorder	5
	Disturbance of consciousness	3
	Dizziness, headache	5
Conditions in obstetrical department	Anemia	2

	Pregnancy-induced hypertension	2
	Preeclampsia	2
	Eclampsia	3
	Postpartum hemorrhage (hemorrhage is >500 ml 24 hours after partum)	3
	Prolonged or arrested labor	2
	No food intake after partum (more than 6 hours)	2
Mobility	Have leg disability or need to use auxiliary devices	9
	Use of sedatives	4
Medication	Use of antihypertensive drugs	3
	Use of hypoglycemic drugs	3
	Use drugs causing drowsiness	4

Investigation of maternal fall and injury

As it was shown in Table 4, 8 of 419 cases (1.7%) fell onto the ground including 1 case of level II injury which needed medical treatment or nursing like ice compressing, bandaging, stitching or splinting. Others were all level I injuries need no or only need little treatment or observation.

Table 4. Maternal fall or injury condition.

Fall grouping	Maternal fall	Incidence rate	Fall injury	Incidence rate
Negative fall group	People do not fall	221 (52.7%)	-	-
	People do not but tend to fall	141 (33.7%)	-	-
	Held by someone before falling onto the ground	50 (11.9%)	-	-
Positive fall group	Fall onto the ground	8 (1.7%)	Level I injury	7 (87.5%)
			Level II injury	1 (12.5%)
			Level III injury	0

The reliability and validity of the scale

The Cronbach's coefficient of the internal liability of the scale was 0.732. After two samplet t-tests on the total score of two groups of maternal fall risk assessment was conducted, we found that the risk assessment mean value of positive fall group was 6.51, which was higher than that of negative fall group (Table 5). The correlation of each item's score range was 0.126~0.928. Our results showed that dizziness and headache had the highest coefficient of correlation, however, eclampsia had the lowest coefficient of correlation.

The maternal fall was not related to pregnancy-induced hypertension and preeclampsia, since the test of coefficient of correlation among pregnancy-induced hypertension, preeclampsia and x3 has no statistical significance. The ROC AUC of maternal fall risk assessment scale was 0.719 (P<0.01) and the 95% confidence interval was 0.668~0.770 (Figure 1).

Sensitivity, specificity and cut-off value for diagnosis

The sensitivity and specificity of maternal fall was 74.7% and 65.8% when the cut-off value for diagnosis was defined as 3.5 in the maternal fall assessment scale. The cut-off value was the
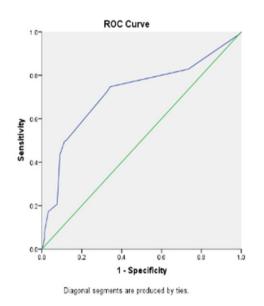

Figure 1. ROC AUC of maternal fall risk assessment scale.

optimal critical value of ROC curve, and the sum of sensitivity and specificity was the largest when using the critical value. The critical value of the scale was determined as 3 points as the risk value of each item was integer. When the maternal fall score was higher than 3, the positive and negative predictive value of the scale was 50.3% and 74.5%, respectively (Table 6).

Table 5. Comparison of scores of two groups of maternal fall risk assessment.

	Positive fall group	Negative fall group	t	P
Score of maternal fall risk assessment scale (point)	6.51 ± 3.78	3.94 ± 2.60	8.158	0

Table 6. Positive predictive value and negative predictive value of the scale.

	Positive fall group	Negative fall group	Positive predictive value	Negative predictive value
High fall risk	148	76		
Low fall risk	50	146	50.30%	74.50%

Discussion

Morse fall assessment scale was to review mass fall event reports of patients and analyze risk factors. In this study, the high missing report rate of adverse events in domestic hospitals was taken into consideration it is hard to review all the maternal fall risk factors and the methods of non-uniform standards of different hospitals on reports of adverse fall events. Documentary research and experts' meeting were used to establish risk indicators of maternal fall event. Delphi method was used to screen on the indicators after establishing indicators. Study had showed that there were non-uniform standards need multidisciplinary and multi-specialty experts to cooperate whole heartedly and Delphi method was found to be the first choice [15,16]. The maternal fall risk assessment scale was formed after three rounds of experts' enquiries. A total number of 32 experts chosen come from a wide range of regions were included in the research including 20 experts from Guangdong Province occupied 62.5% and the other 12 experts from outside the province made up 37.5%. Age, education background and the title of technical post were all rationally distributed to guarantee the scientificity of experts' enquiry opinions. Results in this study showed that the recovery rate of two rounds questionnaires were 93.8% and 96.7%, respectively. Generally speaking, 50% of recovery was basically required by statistical analysis, 60% was preferable, and over 70% was a good standard of research recycling. The coefficient of authority of 0.88 and 0.90 showed that experts had high enthusiasm for the research.

The Kendall'S W of two rounds of experts' enquiry was 0.24 and 0.45, respectively. The coefficient of coordination generally fluctuates within the range of 0.3~0.5 after 2~3 rounds of consultation [17], which showed that the consistency of expert opinions was kept well in this study. Furthermore, expert opinions tended to be more uniform after two rounds of consultation. On the basis of characteristics of clinical maternal fall, there were three fall levels: Level I: have the sign of falling; Level II: when falling, the puerpera is held by someone so as not to fall; Level III: falling onto the ground. The clinical requirements were confirmed by classification method. From the investigation results, the first two types of fall were the majority since the falling of the two types did not happen in the clinical intervention of nurses. Such people should be focused on when conducting fall research [18]. The Cronbach's α coefficient of internal reliability of the scale was 0.732 and the internal reliability of Morse fall assessment scale was 0.16. It was believed that all items, relatively individual, define fall risks from different classification angles, so the internal reliability is relatively low [18], which is the characteristics of the fall assessment scales. The internal reliability was relatively low since the dependency of all factors is inferior and the settings of all items were not fully homogenous.

The average risk score of positive fall group was higher than negative fall group if the discriminant validity of scale was high. And when the content validity of the scale was imbalance, the total coefficient of correlation need to be >0.3 [19]. The finding showed deleting the two items that had no statistical significance based on validity test, one was pregnancy-induced hypertension and the other one was post-eclampsia lead to the content validity of the scale be within the range of 0.107~0.969. It is observed that the items of scale imbalance with the correlation of total score of all dimensions. The predicting inspection of maternal fall risk assessment scale includes sensitiveness, specificity, and area under ROC curve AUC can synthetically judge the diagnostic value. The value range of AUC was 0.5~1 and a larger value showed a higher diagnostic value. The value over 0.9 signifies a high diagnostic value, and the value between 0.7~0.9 means relatively high [20]. The scale positions AUC was 0.719 when the diagnostic cut-off value was located as 3.5 points, correspondingly, the sensitiveness and specificity was 74.7% and 65.8% respectively. The practical clinical risk score was integer. The maternal fall risk critical value is rated as 3, at the same time, the positive predictive value of the scale was 50.3% and the negative predictive rate was 74.5%, which showed that the scale possesses higher diagnostic value.

Conclusion

A large number of documentary researches were studied, experts' meetings and 3 rounds of Delphi expert's enquiry were performed. The maternal fall risk assessment scale was design and questionnaire surveys on 419 hospitalized puerperas from 8 hospitals inside and outside Guangdong Province was conducted. The study out of the indicators in the scale passed screening of three rounds of experts' enquiry and the assessments of the scale went through clinical multi-center studies, furthermore, puerperal was chosen to be the object of

this study which was more targeted. All these above can provide scientific and objective basis for clinical nurse to assess maternal fall risks.

Acknowledgement

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