Falling in the Netherlands: prevention, care, and follow-up of fall-related injury
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Chapter 8

Extended Use of the CAREFALL Triage Instrument; identifying modifiable risk factors for falling in community-dwelling older people

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Submitted
Abstract

Background
Slips, trips, and falls from standing position are common and serious threats to older people (i.e. aged 65 years or older). The CAREFALL Triage Instrument (CTI) is an evidence-based and validated questionnaire to assess the risk of recurrent falling in these older people. Until recently, the CTI was only applied to older people who presented to the Emergency Department (ED) after a fall. Little is known, however, about recurrent falling and the value of the CTI in community-dwelling older people.

Objective
The objective was to establish the value of the CTI in assessing modifiable risk factors for recurrent falling in community-dwelling older people.

Methods
For this study, two cohorts were included. The fall-prevention cohort included older people who attended the fall-prevention and intervention program. The ED cohort included patients who presented to the ED of an urban academic teaching hospital after a fall. In total 245 older people in the fall-prevention cohort were matched by age and gender to 245 patients from the hospital ED cohort.

Results
There were 376 women (76.7%), the median age was 77.1 years. The number of individuals with recurrent falling was higher in the ED cohort (60.5%) compared with the fall-prevention cohort (48.6%) (p=0.008). The median number of risk factors per individual was higher in the ED cohort (4; Inter Quartile Range (IQR), 3-5) compared with the fall-prevention cohort (3; IQR, 3-4) (p<0.001). In both the fall-prevention cohort and the ED cohort, the number of risk factors per individual correlated significantly with recurrent falling. In the fall-prevention cohort, each added risk factor accounted for a 36.5% higher chance of sustaining recurrent falls. In the ED cohort, each added risk factor accounted for a 37.5% higher chance of sustaining recurrent falls.

Conclusion
Based on the results of this study, the authors conclude that, although the prevalence of risk factors and recurrent falling is lower in the fall-prevention cohort compared with the ED cohort, the CTI is a useful tool for assessing modifiable risk factors for recurrent falling in community-dwelling older people.
**Introduction**

Slips, trips, and falls from standing position are one of the most common and serious threats to older people (i.e. aged 65 years or older). Every year in the Netherlands, over 70,000 older people present to Emergency Department (ED) after they have fallen.\(^1\) In older people, the high incidence of falls goes hand in hand with a high susceptibility to injury. Twenty-seven percent (4,400 patients) is hospitalized, commonly due to a fracture (79%).\(^1\) In addition, falls in older people are associated with reduced functioning, premature nursing home admissions and even death.\(^2,4,5,6\) This susceptibility might be attributed to the high prevalence of co-morbid disease and related physiological deterioration.\(^7\) In addition, older people who have sustained one fall are at risk of falling again.\(^7\)

Over the years, multiple evidence-based guidelines for fall-prevention have been formulated.\(^8,9\) These guidelines, however, were not incorporated in questionnaires for daily clinical practice. The CAREFALL Triage Instrument (CTI) is an evidence-based self-administered questionnaire that was developed to fill in this niche.\(^10\) The purpose of the CTI is, besides a falls history questionnaire, to identify modifiable risk factors for recurrent falling in older people who present to the ED after a fall. Based on the results of the CTI, patients receive tailored advice to reduce their risk of falling. Furthermore, if indicated, patients were invited to the Fall-Prevention Clinic for further diagnostic evaluation and treatment.

Until recently, the CTI was only developed and validated for secondary prevention in older people who presented to the ED after they had sustained a fall. These patients can be considered as high-risk patients since over 75% presented with recurrent falling.\(^10\) Over 30% of these patients sustained serious consequences such as a fracture.\(^11\) In order to provide a wider prevention of falls, a Dutch initiative was launched to contact older people in their home setting. People were contacted by mail and invited to a special fall-prevention and intervention program as part of a prevention program of their health insurance company. This program consisted of a specially equipped van that stopped at the clients homes. Within this program, the CTI was used to identify modifiable risk factors for (recurrent) falls. Older people with modifiable risk factors were then presented an intervention program based on their identified modifiable risk factors for falling.

Little is known, about the prevalence of modifiable risk factors and their association with (recurrent) falls in this community-dwelling population and possible differences compared with patients visiting the ED after a fall, both measured with the CTI.
Objective

The objective of this study was to determine the value of the CTI in community-dwelling older people. Our hypothesis was that the CTI could also be applied to identify modifiable risk factors for (recurrent) falls in community-dwelling older people with the same certainty as was shown in older people who visited the ED after a fall.

Methods

Patients
For this study, two cohorts were included. The fall-prevention cohort included people who participated in the fall-prevention and intervention program. They entered the program between August 1, 2007 and June 1, 2008. The ED cohort included patients who presented to the Academic Medical Center (AMC) ED, an urban academic teaching hospital, after a fall. These patients visited the ED between November 1, 2004 and October 1, 2008. This study was approved by the Institutional Review Board.

Fall-prevention cohort
Older people, all clients of a Dutch health insurance company, were contacted by mail and invited to participate in the fall-prevention and intervention program. For this study, the clients with a history of falling were distinguished from clients that had never fallen before. Consequently, the clients with a history of falling were asked to complete the CAREFALL Triage Instrument (CTI). A total of 245 older people participated in the fall-prevention and intervention program and completed the CTI. This cohort will further be referred to as the fall-prevention cohort.

ED cohort
As part of a standard procedure at the AMC, the ED charts of all patients aged 65 years and older were reviewed daily by a dedicated research nurse. All patients with an accidental fall from standing height were included in the CAREFALL study and database. Within one week after the ED visit, the included patients received the CTI by mail. The patients were asked to complete and return the CTI in the included pre-stamped return-envelope. The matched patients that were selected from the CAREFALL database as part of this study will further be referred to as the ED cohort.
The CAREFALL Triage Instrument (CTI)
The Dutch Falls Prevention Collaboration developed and validated the CTI as a self-assessment questionnaire. It contains 44 items covering the frequency of falling, the circumstances of the fall, fall history and modifiable risk factors for falling. Based on these questions, the CTI can identify eight modifiable risk factors: ‘medication’, ‘balance and mobility’, ‘fear of falling’, ‘orthostatic hypotension’, ‘mood’, ‘high-risk of osteoporosis’ as a modifiable risk factor for bone fractures, ‘impaired vision’, and ‘urinary incontinence’.

Matching the fall-prevention and ED cohorts
In total, 245 consecutive older people from the fall-prevention cohort were matched to 245 patients in the CAREFALL database. In order to create two comparable cohorts, the fall-prevention cohort and ED cohort were matched by gender and age.

Statistical analysis
Sociodemographic data were expressed as percentages for categorical data, as mean and standard deviation (SD) for normally distributed numerical data, and as median, range, and - where appropriate - inter-quartile range (IQR=25 to 75%) for non-normally distributed numerical data. The Chi² test was used to analyze the differences in dichotomous variables between groups. The Fisher’s exact test was used when small groups were involved. The Students T test was used to analyze differences in normally distributed continuous variables between groups. The Mann-Whitney U test was used for non-normally distributed variables. Correlation between variables was assessed with the Pearson correlation for normally distributed variables and the Spearman correlation for non-normally distributed variables.
In order to identify risk factors for recurrent falling, all possible variables were tested in a univariate (binary) logistic regression analysis. The risk factors that showed a significant correlation (i.e. p<0.05) with recurrent falling were entered in a multivariate logistic regression analysis using a backward stepwise approach.
Outcome measures were number of risk factors associated with recurrent falling in the fall-prevention cohort compared to the ED cohort. Furthermore, the number of community-dwelling older people with recurrent falling, their gender and age distribution, and the prevalence of modifiable risk factors in both cohorts were taken into account.
Data were analyzed using the Statistical Package for the Social Sciences (SPSS®) version 16.0.2 (SPSS Inc., Chicago, Illinois; USA).
Results

Patient characteristics
Table 1 lists the characteristics of the two cohorts. The number of individuals with recurrent falling was higher in the ED cohort (60.5%) compared with the fall-prevention cohort (48.6%) (p=0.008).

Table 1. Patient characteristics and risk factors in the fall-prevention cohort and ED cohort.

<table>
<thead>
<tr>
<th></th>
<th>Fall-prevention cohort</th>
<th>ED cohort</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals</td>
<td>n 245</td>
<td>245</td>
<td>---</td>
</tr>
<tr>
<td>Female</td>
<td>n 188 (76.7%)</td>
<td>188 (76.7%)</td>
<td>---</td>
</tr>
<tr>
<td>Age (years) med (IQR)</td>
<td>76.8 (72.1-82.1)</td>
<td>77.3 (72.2-81.8)</td>
<td>---</td>
</tr>
<tr>
<td>Recurrent falls n 119 (48.6%)</td>
<td>147 (60.5%)</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Balance and mobility</td>
<td>n 237 (96.7%)</td>
<td>226 (92.2%)</td>
<td>0.241</td>
</tr>
<tr>
<td>High risk of osteoporosis</td>
<td>n 141 (57.6%)</td>
<td>161 (65.7%)</td>
<td>0.041</td>
</tr>
<tr>
<td>Impaired vision n 25 (10.2%)</td>
<td>39 (15.9%)</td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td>n 150 (61.2%)</td>
<td>157 (64.1%)</td>
<td>0.338</td>
</tr>
<tr>
<td>Mood</td>
<td>n 67 (27.3%)</td>
<td>85 (34.7%)</td>
<td>0.079</td>
</tr>
<tr>
<td>Medication</td>
<td>N 15 (6.1%)</td>
<td>142 (58.0%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Orthostatic hypotension</td>
<td>n 99 (40.4%)*</td>
<td>84 (34.3%)**</td>
<td>&lt;0.001***</td>
</tr>
<tr>
<td>Fear of falling n 44 (18.0%)</td>
<td>49 (20.0%)</td>
<td>0.491</td>
<td></td>
</tr>
<tr>
<td>Risk factors (number)</td>
<td>med (IQR)</td>
<td>3 (3-4)</td>
<td>4 (3-5)</td>
</tr>
</tbody>
</table>

Table legend: n: Number; med: Median; IQR: Inter Quartile Range; * Assessable in 152 individuals (62.0%); ** Assessable in 210 individuals (85.7%); *** Significantly more prevalent in the ED cohort.

Risk factors in the fall-prevention and ED cohort
Table 1 shows that three of the eight risk factors were more prevalent in the ED cohort. Risk factor ‘orthostatic hypotension’ was more prevalent in the fall-prevention cohort (p<0.001). The median number of risk factors per individual was higher in the ED cohort (4; IQR, 3-5) compared with the fall-prevention cohort (3; IQR, 3-4) (p<0.001).

Risk factors and recurrent falling
Fall-prevention cohort
Within the fall-prevention cohort in the univariate regression analysis, one risk factor (‘impaired vision’) was associated with recurrent falling (Table 2). Therefore, a multivariate binary logistic regression analysis was not attempted. The number of risk factors per individual was associated with recurrent falling (p=0.002). Each added risk factor accounted for a 36.5% higher chance of sustaining recurrent falls.
Emergency Department cohort
Four of the eight risk factors were associated with recurrent falling in the ED cohort (Table 3).

Table 2. Variables associated with recurrent falls in the fall-prevention cohort.

<table>
<thead>
<tr>
<th>Variable</th>
<th>p-value</th>
<th>OR</th>
<th>95% CI (for OR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired vision</td>
<td>0.045</td>
<td>2.458</td>
<td>1.019-5.933</td>
</tr>
<tr>
<td>Sum of risk factors per individual</td>
<td>0.002</td>
<td>1.365</td>
<td>1.118-1.662</td>
</tr>
</tbody>
</table>

Table legend: OR: Odds Ratio; 95% CI: 95% Confidence Interval

Table 3. Variables associated with recurrent falls in the ED cohort.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate regression analysis</th>
<th>Multivariate regression analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value</td>
<td>OR</td>
</tr>
<tr>
<td>High risk of osteoporosis</td>
<td>0.002</td>
<td>2.434</td>
</tr>
<tr>
<td>Impaired vision</td>
<td>0.046</td>
<td>2.195</td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td>0.035</td>
<td>1.793</td>
</tr>
<tr>
<td>Fear of falling</td>
<td>&lt;0.001</td>
<td>5.168</td>
</tr>
<tr>
<td>Sum of risk factors per individual</td>
<td>0.001</td>
<td>1.375</td>
</tr>
</tbody>
</table>

Table legend: OR: Odds Ratio; 95% CI: 95% Confidence Interval

Multivariate binary logistic regression analysis revealed that ‘high risk of osteoporosis’ and ‘fear of falling’ were individually associated with recurrent falling. The number of risk factors per individual was associated with recurrent falling. Each added risk factor accounted for a 37.5% higher chance of sustaining recurrent falls.

Figure 1 shows that the risk of recurrent falling within the ED cohort increases as the number of risk factors per individual is increased. This increasing risk was observed in both the fall-prevention cohort and the ED cohort.
This article compares the prevalence of risk factors for falls and recurrent falling in a fall-prevention cohort with an ED cohort. It showed that the CAREFALL Triage Instrument (CTI) is a useful tool for assessing risk factors in community-dwelling older people. The CTI, a 44 question self-assessment questionnaire, was originally developed in patients who visited the ED after a fall. This was the first time the CTI was used in a population of community-dwelling older people that did not necessarily visit the ED after a fall.

These two cohorts were chosen because they were considered to represent the highest risk for (recurrent) falling (ED cohort) and the lowest risk of (recurrent) falling (fall-prevention cohort) with the population of older people. This consideration proved to be correct. The number of individuals with recurrent falling was significantly lower in the fall-prevention cohort compared with the ED cohort. Also, the number of risk factors per individual was significantly lower in the fall-prevention cohort compared with the ED cohort.

In the fall-prevention cohort, the CTI proved to be a valuable tool for assessing risk factors for a fall and for (recurrent) falls in community-dwelling older people. Within the fall-prevention cohort, the number of risk factors per individual correlated significantly with recurrent falling. This is in line with literature. The risk of recurrent falling increased with the number of risk factors. This is mainly observed in the individuals with two to six risk factors. In both cohorts the number of individuals with two or less risk factors or with six or more risk factors was low.

Figure 1. The risk of recurrent falls as a function of the number of risk factors per patient.
A few limitations of this study need to be addressed. First, the CTI is a self-assessment instrument which may have consequences for some of the answers as the cognition of the patients could not be tested equally in both cohorts, which might have influenced the reliability of the questionnaire. This might have influenced these findings because cognitive impairment has been associated with recurrent falling. De test-retest reliability of the CTI and other properties of the CTI have been published elsewhere.\textsuperscript{10} Second, the fall-prevention cohort may consist of patients with recurrent falling that dated from longer ago than the ED cohort because they did not present immediately after the fall. This time frame may have influenced their answers as it may have influenced their recall. But, since the majority of questions in both cohorts are related to recent experiences, the influence of the time frame may be of minor relevance for the outcome of this study. However, for reasons of clarity we left this out of the analyses of this study.

Multiple studies and guidelines have focussed on multifactorial fall-risk assessment in order to provide single or multiple interventions aimed at reduction of the risk of recurrent falling.\textsuperscript{8,13,14} It was shown that the combination of risk factors, rather than individual risk factors, counts for the risk of recurrent falling. Although the ongoing discussion about the effect of multiple interventions to prevent new falls to occur is still in the scope of an international discussion, broader prevention in community-dwelling older people should delay the occurrence of injury and ED visits.

\textbf{Conclusion}

Based on the results of this study, we conclude that the prevalence of risk factors and recurrent falling is lower in the fall-prevention cohort compared with the ED cohort. The CTI is a valuable and valid tool for assessing modifiable risk factors and recurrent falling in community-dwelling older people. A self-assessment instrument like the CTI may increase the awareness in older people. It is a useful tool in prevention of falls and case-management of older people with or without multiple risk factors.
References

1. Consumer Safety Institute. [Incidents; numbers and costs: fall-incidents (>55 years)]. www.veiligheid.nl. 2007. 16-7-2007. Ref Type: Internet Communication


