


# Expert Consensus on Predictive Parameters for the Occurrence of a Fall and a Contralateral Hip Fracture 1 and 3 Years After Hip Fracture: A Delphi Survey

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Alexander Joeris, MD, MSc, HEPM<sup>1</sup>, Anahí Hurtado-Chong, MD, PhD<sup>1</sup>,  
Michael Blauth, MD<sup>2</sup>, Joerg Goldhahn, MD, MAS<sup>3</sup>,  
Nicolas S. Bodmer, MSc<sup>4</sup>, and Lucas M. Bachmann, MD, PhD<sup>4</sup>

## Abstract

**Background:** Early identification of people at risk for a contralateral hip fracture would be desirable to favorably influence patients' prognosis. A recent systematic review failed to depict stringent patterns of risk parameters to be used for decision-making in clinical practice. **Objective:** To perform a consensus study using the Delphi method to reach an expert consensus on predictive parameters for the occurrence of a fall and a contralateral hip fracture 1 and 3 years after hip fracture. **Methods:** A list of potential members of the expert panel was identified based on the authors' list of a recently conducted systematic review. Participating experts were asked to name parameters determining the probability for a fall and a contralateral hip fracture 1 and 3 years after an occurred hip fracture, separately. Additionally, we asked how those stated parameters should be measured. All mentioned parameters were compiled and sent back to the experts asking them to weight each single parameter by assigning a number between 1 (not important) and 10 (very important). The survey was conducted online using the REDCap software package. We defined expert agreement if the interquartile range of attributed weights for a parameter was  $\leq 2$ . A relevant parameter had at least a median weight of 8. **Results:** Twelve experts from 7 countries completed the survey. Presence of fall history and mental and general health status were considered relevant irrespective of the outcome. For falling within 1 and 3 years, the number of medications and residential status were considered relevant, while for fractures within 1 and 3 years, osteoporosis management was considered important. **Conclusion:** Using the insights gained in this consensus study, empiric studies need to be set up assessing the prognostic value of the selected parameters.

## Keywords

osteoporosis, fracture, prediction, Delphi method, expert consensus

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## Introduction

Early identification of people at risk for a contralateral hip fracture would be desirable to favorably influence patients' prognosis.<sup>1,2</sup> However, up to now, no international consensus on predictive parameters has been reached, which in return hampers the evaluation of potentially useful interventions in these patients and complicates the justification for treatment decisions vis-à-vis health insurances.<sup>3</sup> To date, pharmacological and physiotherapeutical interventions after surgery remain the most important measures of secondary fracture prevention.<sup>4</sup>

We recently completed a systematic review identifying papers that investigated the risk factors for contralateral hip fractures.<sup>3</sup> Although we found a considerable number of studies, we were

unable to depict stringent patterns of risk parameters to be used for decision-making in clinical practice. Therefore, we called for a conjoint effort to achieve an expert consensus regarding a critical

<sup>1</sup> AO Clinical Investigation and Documentation, Dübendorf, Switzerland

<sup>2</sup> Department of Trauma Surgery, Medical University of Innsbruck, Innsbruck, Austria

<sup>3</sup> Institute for Biomechanics, ETH Zurich, Zürich, Switzerland

<sup>4</sup> Medignition Inc, Medical Research Consultants, Zürich, Switzerland

## Corresponding Author:

Lucas M. Bachmann, Medignition Inc, Medical Research Consultants, Verena Conzett-Strasse 9, CH-8004 Zurich, Switzerland.

Email: bachmann@medignition.ch



set of parameters for a risk instrument identifying patients bearing an increased risk for contralateral hip fractures early.

In this article, we therefore report the results of a consensus study using the Delphi method, with the aim to reach an expert consensus on predictive parameters for the occurrence of a fall and a contralateral hip fracture 1 and 3 years after hip fracture.

## Methods

We conducted a 2-round online Delphi survey. The Delphi method is based on a structured process for collecting and distilling knowledge from a group of experts by means of a series of short questionnaires interspersed with controlled opinion feedback.<sup>5</sup> Delphi represents a useful communication device among a group of experts and thus facilitates the formation of a group judgment.<sup>5-7</sup>

At initiation, 1 researcher generated a list of potential members of the expert panel, based on the authors' list of a recently conducted systematic review,<sup>3</sup> who were affiliated at university hospitals or tertiary care health-care facilities. Each expert received an invitation to participate. The survey was conducted using the REDCap software.<sup>8</sup>

Participating experts were asked to name parameters determining the probability for a fall and a contralateral hip fracture 1 and 3 years after an occurred hip fracture, separately. Additionally, we asked how those stated parameters should be measured and operationalized.

For the second round, all mentioned parameters were compiled into 4 separate lists, 1 for falls within 1 year, 1 for fractures within 1 year, 1 for falls within 3 years, and 1 for fractures within 3 years. These 4 lists were sent back to the experts asking them to weight each single parameter on by assigning a number between 1 (not important) and 10 (very important). Also, we asked them to comment on the way the parameter should be quantified and operationalized.

To identify the strongest diagnostic and follow-up parameters, the median of the attributed weights and the corresponding interquartile ranges (IQRs) were calculated. We arbitrarily defined the expert agreement if the IQR of a parameter was  $\leq 2$ . The optimal cutoff value of the median attributed weights for a relevant and agreed parameter was calculated, drawing a receiver operating characteristic curve of the medians against an IQR classification of  $\leq 2$ . Based on this assessment, we estimated the optimal cutoff value for a relevant item at a median attributed weight of  $\geq 8$ . Statistical analyses were performed using the STATA 14.1 statistical software package (Stata, College Station, Texas).

## Results

Twenty-five experts were invited to participate in the Delphi survey, and 12 experts from Austria (2), Denmark (1), Israel (1), Italy (2), Switzerland (2), the United Kingdom (4), and the United States (1) responded. The first round revealed 59 parameters grouped into the 4 categories of fall/fracture within 1 year and fall/fracture within 3 years.

Attributed weights for the 59 parameters varied considerably. Table 1 shows the parameters along with the attributed median weight and the corresponding IQR.

Table 2 shows the set of parameters on which experts agreed. Presence of fall history and mental and general health status were considered relevant irrespective of the outcome. For falling within 1 and 3 years, the number of medications and residential status were considered relevant, while for fractures within 1 and 3 years, osteoporosis management was considered important.

The experts agreed that the number and type of medication should be assessed, that the general health status should be operationalized with the Charlson comorbidity index, and that the mental health status should be assessed with the Mini-Mental test. The item presence of fall history should assess the number of falls in the previous year, and delirium at discharge should be explored with the Confusion Assessment Method measured at discharge. The experts defined 3 options for residential status: independent home, residential facility but not nursing home, and nursing home. To assess the presence of osteoporosis, experts agreed on the results of Dual-energy X-ray absorptiometry (DXA) scans.

## Discussion

### Main Findings

This Delphi survey revealed a consistent pattern of parameters for the occurrence of a fall and a contralateral hip fracture 1 and 3 years after hip fracture. The agreement on the item "number of falls in the previous year" was highest, irrespective of the outcome assessed.

### Results in the Context of the Existing Literature

We are unaware of any previous Delphi consensus on this topic. In a recent systematic review summarizing over 40 studies, we noted that empirical evidence on risk parameters pointing at an increased risk for falls and fractures was inconsistent and sometimes of low quality.<sup>3</sup> The most consistently reported parameters found in the review were female gender followed by patients' age, general health, vision, and stroke. While the general health status was also considered very relevant for the experts of the survey, female gender was not. Also, patients' age was inconsistently rated. Interestingly, a low vitamin D level, while obtaining a high median score for fall prevention within 3 years, did not meet our consensus criterion because the scores between experts varied considerably. For the 2 fracture outcomes and falls within 1 year, this parameter was not even mentioned as a candidate predictor in the first Delphi round, although several guidelines recommend vitamin D in fall prevention. Why some of the experts deviated from guideline recommendations remains unclear.

### Strength and Limitations

In a recent paper, Waggoner and colleagues summarized the advantages of Delphi consensus techniques as follows: There are several advantages to using the Delphi technique to obtain consensus—namely, that it eliminates the bias and influence

**Table 1.** Summary of Parameters Pointing at an Increased Risk for Fractures and Falls Within 1 and 3 Years.<sup>a</sup>

Risk Parameters Stated	Median	25th Centile	75th Centile	IQR Range
<b>Fracture within 1 year</b>				
Presence of fall history	9.5	9	10	1
Presence of osteoporosis	9	8	10	2
Other fractures	9	7	10	3
Age	9	6	10	4
General health status	8	6.5	8.5	2
Missing osteoporosis therapy	8	7.5	10	2.5
Comorbidity	8	6.5	8.5	2
Inadequate osteoporosis treatment	8	8	10	2
Postoperative treatment	8	6	8.5	2.5
Medication	8	7	9	2
Missing vision aids	8	7	9	2
Mental health status	8	7.5	9	1.5
Impaired mobility	8	6.5	9	2.5
Polypharmacy	7.5	6.5	9	2.5
Incorrect surgery	7	6	8	2
Characteristics of fall (environment/height)	7	5.5	8	2.5
Female gender	7	5.5	8.5	3
Inadequate treatment	7	3.5	9	5.5
Osteopenia	7	6.5	8	1.5
No assessment by a fracture liaison service	7	6	8.5	2.5
<b>Fracture within 3 years</b>				
Presence of fall history	10	9	10	1
History of fractures	10	8.5	10	1.5
Age	10	6.5	10	3.5
Inadequate osteoporosis treatment	9.5	8	10	2
Presence of osteoporosis	9.5	8.5	10	1.5
Missing osteoporosis therapy	9	8.5	10	1.5
Mental health status	8.5	7.5	9	1.5
Residential status (nursery home)	8.5	7.5	9.5	2
Polypharmacy	8	7	9.5	2.5
General health status	8	7.5	9	1.5
Osteopenia	7.5	6.5	8	1.5
Female gender	7.5	6	8	2
<b>Falls within 1 year</b>				
Presence of fall history	10	9	10	1
Missing vision aids	9	7	9	2
Mental health status	9	8.5	9	0.5
Delirium at discharge	9	8	10	2
Medication	8.5	7.5	9	1.5
Residential status (nursery home)	8	7.5	9	1.5
No assessment by a fracture liaison service	8	5.5	8.5	3
Age	8	6	9.5	3.5
Polypharmacy	8	7.5	9.5	2
General health status	8	7.5	8.5	1
Postop treatment	7.5	6	8	2
Female gender	6.5	4	8	4
Impaired safety awareness	6.5	4	7.5	3.5
Incorrect surgery	5.5	4.5	6	1.5
Presence of osteoporosis	4	1.5	8	6.5
<b>Falls within 3 years</b>				
Presence of fall history	9.5	9	10	1
Age	9	8.5	10	1.5
Residential status (nursery home)	8.5	7.5	9.5	2
Medication	8.5	7.5	9	1.5
Mental health status	8.5	7.5	9	1.5
Polypharmacy	8.5	7.5	9	1.5
Comorbidity	8.5	6.5	9	2.5

(continued)

**Table 1.** (continued)

Risk Parameters Stated	Median	25th Centile	75th Centile	IQR Range
Low vitamin D level	8	6	10	4
Female gender	8	6	8.5	2.5
General health status	8	7.5	9.5	2
Postoperative treatment	4	2.5	6	3.5
Incorrect surgery	2	2	5	3

Abbreviation: IQR, interquartile range.

<sup>a</sup>Parameters are sorted on the median attributed weight. The median weight shows the attributed importance of a parameter on a scale from 1 to 10; a value of 1 indicating not important and a value of 10 very important. The IQR shows the level of agreement between experts.

**Table 2.** Final Set of Parameters With High Attributed Importance (8 or Higher) on Which the Experts Agreed (IQR 2 or Less).<sup>a,b</sup>

Within 1 Year			Within 3 Years		
Criterion	Importance (Median)	Agreement (IQR)	Criterion	Importance (Median)	Agreement (IQR)
<b>Falls</b>					
<b>Presence of fall history</b>	10	1	<b>Presence of fall history</b>	9.5	1
Missing vision aids	9	2	Age	9	1.5
<b>Mental health status</b>	9	0.5	Residential status	8.5	2
Delirium at discharge	9	2	<b>Mental health status</b>	8.5	1.5
Medication <sup>c</sup>	8.5	1.5	Medication <sup>c</sup>	8.5	1.5
Residential status	8	1.5	<b>General health status<sup>d</sup></b>	8	2
<b>General health status<sup>d</sup></b>	8	1			
<b>Fractures</b>					
<b>Presence of fall history</b>	9.5	1	<b>Presence of fall history</b>	10	1
Presence of osteoporosis	9	2	History of fracture	10	1.5
Inadequate or missing osteoporosis treatment	8	2	Inadequate or missing osteoporosis treatment	9.5	2
Missing vision aids	8	2	Presence of osteoporosis	9.5	1.5
<b>Mental health status</b>	8	1.5	Residential status	8.5	2
Medication <sup>c</sup>	8	2	<b>Mental health status</b>	8.5	1.5
<b>General health status<sup>d</sup></b>	8	2	<b>General health status<sup>d</sup></b>	8	1.5

Note. The parameters highlighted in bold were common across all four outcomes.

Abbreviation: IQR, interquartile range.

<sup>a</sup>The median weight shows the attributed importance of a parameter on a scale from 1 to 10; a value of 1 indicating not important and a value of 10 very important.

<sup>b</sup>Way to measure: medication (number and type of medication), general health status (Charlson comorbidity index), mental health status (Mini-Mental test), presence of fall history (number of falls in the previous year), delirium at discharge (Confusion Assessment Method [CAM] at discharge), residential status (independent home, residential facility but not nursing home, and nursing home), presence of osteoporosis (based on Dual-energy X-ray absorptiometry [DXA] scan).

<sup>c</sup>Including polypharmacy.

<sup>d</sup>Including comorbidity.

that can occur in face-to-face meetings as the respondents are to remain anonymous. "This allows for the respondents' opinions to be expressed more freely without any fear of reproach or loss of credibility in their field."<sup>9(p666)</sup> On the other hand, it could be argued that our set of international experts is inappropriate to represent experts worldwide, thus jeopardizing the generalizability of our findings. Indeed, we cannot rule out that another sample of experts might have come up with a different set of agreed parameters. Moreover, expert opinion may be susceptible to common influences, such as a certain set of textbooks and disease paradigms and may thus not reflect a personal review of the literature and own clinical experience. Second, our questionnaire forced experts to weight each of the proposed parameters independently of others. The reply modus hence

discouraged specifying possible patterns of risk parameters. For example, osteoporosis and female gender are strongly correlated. We cannot fully rule out that some parameters were weighted in view of the coexistence of another item.

### Implications for Practice and Research

This article presents an agreed list of parameters that experts consider to be relevant in the risk assessment of contralateral hip fracture. The value of this result is 2-fold. On one side, we contribute to the academic discourse in a situation of unclear empiric evidence. In the absence of formal risk assessment instruments, these parameters may help clinicians in the risk assessment of individual patients. Second, from a research

perspective, the results of this article report the parameters that should be formally assessed in the development and validation of a prognostic instrument using clinical data. Besides data driven, selection of candidate parameters clinical insight and expertise may guide the selection of sensible parameters.<sup>10</sup>

## Conclusion

Using the insights gained in this consensus study, empiric studies need to be set up assessing the prognostic value of the selected parameters empirically. Models using this set of parameters should be compared to data-driven models both in terms of prognostic accuracy and clinical plausibility.

## Declaration of Conflicting Interests

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