


# Prospective Associations Between Fear of Falling, Anxiety, Depression, and Pain and Functional Outcomes Following Surgery for Intertrochanteric Hip Fracture

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## Abstract

**Objective:** Fear of falling, anxiety, depression, and pain levels are important risk factors for poor functional outcomes that may potentially be modifiable. We aimed to examine prospective associations between those factors following surgery for intertrochanteric hip fracture. **Methods:** This study is a prospective observational cohort study of patients aged over 65 diagnosed with isolated intertrochanteric hip fracture. Three hundred and seventy patients who underwent intramedullary fixation surgery were screened; 188 cases were included in our final evaluation. Patients with any concomitant fracture, major psychiatric/neurocognitive and neurological disorders and those with any other major disease were excluded from the study. Age, Charlson Comorbidity Index (CCI), Geriatric Depression Scale (GDS), State–Trait Anxiety Inventory (STAI), Falls Efficacy Scale International (FES-I), and Visual Analog Scale (VAS) scores on the day of surgery (baseline) were evaluated as predictors of poor/good outcome at 90 days after surgery, by Harris Hip Score (HHS) with a cut-off score of 70. **Results:** HHS score was significantly predicted at baseline by the full model [ $\chi^2(7) = 18.18, P = .01$ ]. However, only STAI-state scores were significantly added to the model [Exp (B) 95% CI: .92 (.86-.99)]. **Conclusions:** In this prospective cohort study, we found that higher levels of anxiety state on the day of surgery predicts a poor outcome at 90 days following surgery. We did not find significant associations between other variables, including age, GDS, STAI-trait, FES-I, VAS, and CCI. This potentially modifiable psychological factor may inform surgeons and could be a potential mediator. Future prospective studies are needed to replicate these findings. **Level of evidence:** Prognostic level I.

## Keywords

falls efficacy international, fear of falling, functional outcome, intertrochanteric hip fracture, proximal hip nail

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## Highlights

1. Patients at a higher state of anxiety may be prone to poor functional outcomes three months later.
2. Screening patients after hip fracture surgery for symptoms of a state of anxiety using valid and reliable tools, such as STAI, may prompt preventive interventions with the potential to improve the functional outcomes.
3. Modifiable psychological factors may inform surgeons and could be a potential mediator after hip fractures.

## Introduction

Intertrochanteric hip fracture is an important public health problem, affecting mostly older people.<sup>1,2</sup> The treatment of intertrochanteric hip fracture is surgical, and surgical outcomes are generally defined by several factors.<sup>3,4</sup> In the case of hip surgery, the overall and functional outcomes of the patients depend on many independent factors, such as age, gender, premorbid daily activities, and psychological factors.<sup>5</sup> To determine factors predicting the poor/good functional outcomes after surgery is a valuable area for research.<sup>6</sup> Among the psychological factors, depressive, anxious, and cognitive symptoms are the most important.<sup>7</sup> The fear of falling has been shown to affect functional outcomes and has become a hot topic in recent years.<sup>8</sup>

Patients' excessive fear of falling may interfere with their ability to adapt to the rehabilitation process, which may in turn complicate the recovery process, but follow-up studies investigating fear of falling as a risk factor for negative outcomes are limited.<sup>9-11</sup> In our study, we evaluated fear-of-falling symptoms, among others with psychological domain associations, with the functional outcome after surgery for hip fracture. In our study, we aimed to examine prospective associations between fear of falling, anxiety, depression levels, and functional outcome following surgery for intertrochanteric hip fracture. We hypothesized that higher levels of fear of falling after intertrochanteric hip fracture surgery would be associated with poor outcomes.

## Material and Methods

### Study Design, Setting, and Participants

This study is a prospective observational cohort study of patients aged over 65 diagnosed with isolated intertrochanteric hip fracture and who underwent closed intramedullary fixation surgery, considered the preferred method for trochanteric femoral fractures.<sup>12</sup> The study was conducted between September 2018 and December 2021 in the departments of Orthopaedics and Traumatology and

Consultation-Liaison Psychiatry at a level 1 trauma center. All patients who fulfilled the inclusion criteria were included in the study. Any concomitant fracture, history or current diagnosis of major psychiatric/neurocognitive disorder, any patients with hearing, visual, or neurological disabilities, those with less than 5 years of education, and those with any other major disease (malignancy, severe heart failure, severe respiratory failure, polio sequel, muscular diseases, scoliosis) were excluded from the study. This study was evaluated and approved by the ethics committee of our institution (XXX).

Sociodemographic and premorbid levels of functioning were collected at baseline. The premorbid level of functioning was classified with regard to mobility, four levels with regard to needed help, and five levels with regard to accommodation, as suggested by Voshaar, et al.<sup>13</sup> Measurements described below were carried out on the day of surgery. Follow-up examinations and measurements were scheduled at day 90 after surgery.

The study received approval from local ethics committees. After explaining the reasons for the study to the participants, we obtained signed informed consent statements.

### Measurements

**Sociodemographic Information.** Information was gathered as to age, gender, education, length of stay in hospital, post-discharge destination, mortality, and lost to follow-up. For all patients, the Charlson Comorbidity Index (CCI) was calculated.<sup>14</sup> All patients underwent routine preoperative evaluation. Based on psychiatric evaluation, patients with a history of major psychiatric and/or cognitive disorder or any suspected major psychiatric disorder (mental retardation, pervasive developmental disorders, psychotic disorders, bipolar disorders, major depression, substance abuse or dependency, severe personality disorder, severe anxiety disorder, etc.) and/or cognitive disorder (mild to severe dementia) were excluded from the study.

**Depressive Symptoms.** The Geriatric Depression Scale (GDS) is a questionnaire in the form of 30 Yes/No questions. Total scores range from 0-30, with higher scores indicating increasing severity of depressive symptoms. The psychometric features of the GDS were researched by Sağduyu.<sup>15</sup>

**Anxiety Symptoms.** State-Trait Anxiety Inventory was used to assess anxiety levels. STAI scores ranged from 20 to 80, with higher scores indicating more severe anxiety states. There are two versions of the STAI form: STAI-1 was used to assess a state of acute distress and anxiety, while STAI-2 aims at assessing distress and anxiety in general—a trait. A

validity and reliability study of the Turkish version of the questionnaire was performed.<sup>16</sup>

**Fear of Falling.** Falls Efficacy Scale International (FES-I) was used to assess fear of falling.<sup>17</sup> The FES-I is a self-report questionnaire, providing information on the extent of concerns about falls during activities of daily living. The questionnaire contains 16 items scored on a four-point scale (1 = not at all concerned to 4 = very concerned) providing a total score ranging from 16 (absence of concern) to 64 (extreme concern). A validity and reliability study of the Turkish version of the questionnaire was performed.<sup>18</sup>

**Assessment of Outcome.** Pain was assessed by the Visual Analog Scale (VAS).<sup>19</sup> The Harris Hip Score (HHS) was used to evaluate outcome of the surgery. A validity and reliability study of the Turkish version of the questionnaire was performed.<sup>20</sup>

### Statistical Analyses

In this study, first descriptive statistics of the whole group were recorded as mean  $\pm$  SD, n (%) or median (range), depending on the variable. Functional Outcome was classified as poor/good by using HHS with a cut-off at 70. Poor/good outcome groups were compared by using chi-square for categorical variables, Mann–Whitney U test for nonparametric analyses, and student-t test for continuous variables. Correlation analyses were performed using Pearson or Spearman's correlation coefficient for pain severity, depression symptoms, anxiety symptoms, fear of falling, age, CCI, and Harris hip scores. The logistic regression model was used to predict poor/good functional outcomes, using the Enter method, from independent variables GDS, FES-I, STAI-state, STAI-trait, VAS, age, and CCI. The logistic regression model was also used to predict poor/good functional outcomes cross-sectionally at follow-up examination, using the Enter method, from independent variables GDS, FES-I, STAI-state, STAI-trait, VAS, age, and CCI. For all statistical analyses,  $P$ -values  $<.05$  were considered statistically significant. All statistical analyses were carried out using IBM SPSS 21.0 (IBM Corp., Armonk, NY, USA) software.

### Results

Patients screened for our prospective cohort totaled 370, of which 188 cases were included in the final analyses. A flowchart of our study is shown in [Figure 1](#). Age, gender, length of stay at hospital, CCI, and variables (VAS, GDS, STAI, FES-I), HHS and  $HHS \geq 70$  of the group are listed in [Table 1](#).

The samples' independence with respect to accommodations were as follows: living with someone else, 77.7%; living alone, 19.1%; hospitalized, 1.1%; shelter ward, 1.1%; and nursing home, 1.1%. Independence with respect to help needed was as follows: needs no help, 51.1%; needs help once a week, 11.7%; needs some help, 14.9%; and needs help every day, 22.3%. Independence with respect to mobility were as follows: able to walk independently, 53.2%; able to walk with cane or crutch, 23.4%; able to walk with Zimmer frame, 4.3%; able to walk with help from one person, 12.8%; able to make transfers/walk with help, 3.2%; and able to make transfers unaided, 3.2%. All patients enrolled in our study were discharged to their homes.

Comparison of poor and good outcome ( $HHS \geq 70$ ) groups according to age, gender, length of hospital stay, CCI, GDS, STAI-state, STAI-trait, FES-I, and VAS scores are given in [Table 2](#).

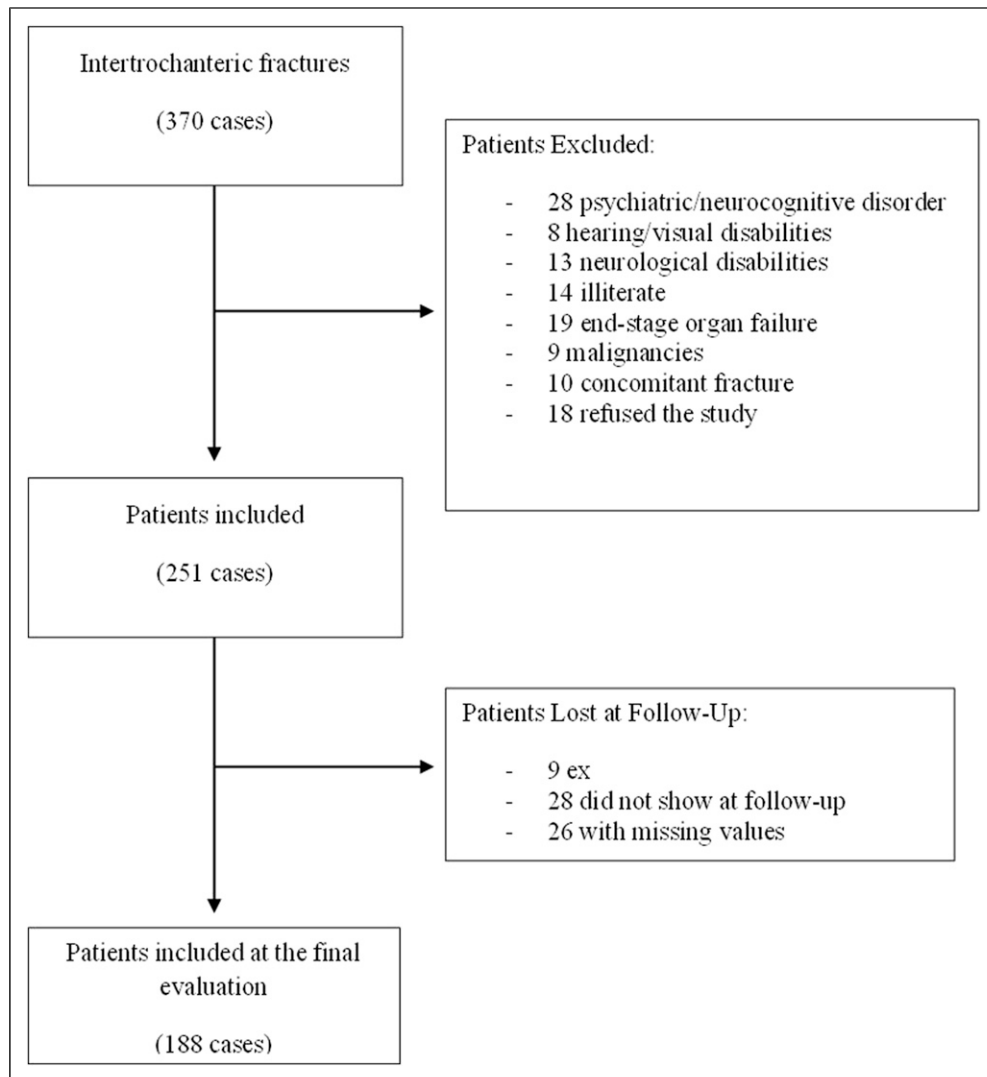
Baseline correlations for FES-I and HHS with baseline GDS, STAI-state, STAI-trait, age, VAS, and CCI are given in [Table 3](#).

A logistic regression was performed to ascertain the effects of age and baseline scores of GDS, STAI-state, STAI-trait, FES-I, CCI, and VAS on predicting good outcome ( $HHS \geq 70$ ) at 90 days following intertrochanteric hip fracture surgery. The logistic regression model was statistically significant,  $\chi^2(7) = 18.18, P = .01$ . The model explained 25% (Nagelkerke  $R^2$ ) of the variance to predict good outcome and correctly classified 67.7% of cases. The results are given in [Table 4](#).

### Discussion

Determining prognostic factors following intertrochanteric hip fracture surgery is a valuable subject for research. Surgical and medical prognostic factors were clearly defined, but the psychological and related factors need further investigation.<sup>3-5</sup> In our study, we aimed to investigate prognostic factors following intertrochanteric hip fracture surgery with a special focus on psychiatric variables. In our prospective cohort study, we found that the full model, consisting of FES-I, STAI-state, STAI-trait, GDS, VAS, CCI, and age, at the day of surgery, significantly predicts poor/good outcomes three months later. However, only STAI-state significantly added to the model. This should be seen as a key finding of our study. Contrary to our hypothesis, we did not find a prospective association between baseline fear-of-falling scores and functional outcome following intertrochanteric hip fracture surgery.

Other variables, such as fear of falling, depression, anxiety-trait, pain, comorbidity index, and age, were not significantly predictive for outcome in the full model. We speculate that the anxiety state may reflect individuals' response to medical/surgical status (in contrast with



**Figure 1.** Flow-chart showing the total number of patients enrolled to the study, patients excluded, patients included at the beginning of the study, patients lost at follow-up and patients included at the final evaluation.

anxiety-trait, which could be considered as a personality-related feature) and could be an important indicator of health status, or simply related to stress and coping with it, which in turn triggers negative health outcomes, possibly by modifying behavioral factors.

Most previous research focused on cross-sectional associations at four weeks or later after surgery for predicting long-term outcomes.<sup>8</sup> To our knowledge, ours is the first cohort study to investigate with a prospective design the associations between fear of falling, anxiety, depression, and pain scores with functional outcome as early after surgery as on the day of discharge from hospital. This time point is important in order to plan interventions earlier and possibly improve surgical outcomes.<sup>11,21-24</sup>

There are studies showing that there is a correlation between the functional results after Fear of falling and

fracture. Nagai et al. states that the fear of falling can continue up to 12 months after the operation and is associated with a decrease in daily living activities. However, the authors also emphasize that this effect is quite minimal.<sup>25</sup> A previous study by Nagai et al. similarly shows that anxiety is related to activities of daily living and functional outcomes.<sup>26</sup>

Fear of falling has been suggested as a risk factor for poor outcomes after surgery for hip fracture.<sup>14</sup> There are conflicting results in the literature, which focused mostly on cross-sectional evaluations.<sup>27</sup> In our study, we found high rates of fear-of-falling scores, when the suggested cut-off score of 24 points was considered.<sup>18</sup> This cut-off score should be considered low for this group of patients, because the Turkish validity and reliability study was undertaken among community-dwelling older persons.

**Table 1.** Demographic Data and Baseline Values for CCI, GDS, STAI-State, STAI-Trait and FES-I Scores.

	Baseline Mean $\pm$ SD; n (%), Median (min-max) <sup>a</sup>
Age	77.42 $\pm$ 11.6
Gender	
Female%	56.9%
Length of stay at hospital (days)	4 (1-9)
CCI	5 (0-11)
GDS	13.31 $\pm$ 6.8
STAI-state	43.83 $\pm$ 11.9
STAI-trait	46.88 $\pm$ 8.8
FES-I	37.08 $\pm$ 13.3

CCI: Charlson comorbidity index, GDS: geriatric depression scale, STAI: Spielberger state trait anxiety inventory, FES-I: falls efficacy scale international.  
<sup>a</sup>Mean  $\pm$  SD; median (min-max), rate (%) are given as appropriately.

**Table 2.** Comparison of Poor and Good Outcome Groups.

	Poor Outcome (HHS <70) <sup>a</sup>	Good Outcome (HHS $\geq$ 70) <sup>a</sup>	P-Value <sup>b</sup>
Age	75.43 $\pm$ 9.1	75.45 $\pm$ 13.1	P = .994
Gender (female%)	63.3%	56.3%	P = .516
Length of stay (days)	4 (2-9)	4 (1-8)	P = .635
CCI	5.5 (2-11)	5 (0-9)	P = .139
GDS	14.9 $\pm$ 6.3	12.44 $\pm$ 7.2	P = .114
Baseline			
STAI-state	49 $\pm$ 13.36	41.65 $\pm$ 10.9	<b>P = .006</b>
Baseline			
STAI-trait	49.17 $\pm$ 9.1	46.14 $\pm$ 8.7	P = .125
Baseline			
FES-I	40.1 $\pm$ 14.2	35.27 $\pm$ 13.2	P = .110
Baseline			
VAS	7 (0-10)	4.5 (0-10)	<b>P = .005</b>
Baseline			

<sup>a</sup>Mean  $\pm$  SD; median (min-max), rate (%) are given as appropriately.

<sup>b</sup>For categorical variables  $\chi^2$ , for nonparametric analyses Mann-Whitney U and for continuous variables Student-t test are used appropriately.

**Table 3.** Baseline Correlations With FES-I and HHS.

	HHS	GDS <sup>a</sup>	STAI State <sup>a</sup>	STAI Trait <sup>a</sup>	Age <sup>a</sup>	VAS <sup>b</sup>	CCI <sup>a</sup>
FES-I	<b>r = -.275,</b> <b>P = .007</b>	<b>r = .512,</b> <b>P &lt; .001</b>	r = .150, P = .121	<b>r = .4, P &lt; .001</b>	r = .149, P = .122	r = .160, P = .096	<b>r = .197,</b> <b>P = .04</b>
HHS	—	<b>r = -.311,</b> <b>P = .002</b>	<b>r = -.317,</b> <b>P = .002</b>	<b>r = -.256,</b> <b>P = .013</b>	<b>r = -.297,</b> <b>P = .004</b>	<b>r = -.341,</b> <b>P = .001</b>	<b>r = -.285,</b> <b>P = .005</b>

<sup>a</sup>By Pearson correlation analysis.

<sup>b</sup>By Spearman correlation analysis.

Indeed, a study by Vischedjik et al. (2013) suggested a cut-off score of 30 in hip fracture patients. We found similar rates of fear of falling in our sample as described above.<sup>27</sup>

In correlation analyses, HHS correlated significantly with all variables except VAS scores. To gain insight into the concept of fear of falling, we conducted correlation analyses

also for FES-I. Baseline FES-I correlated significantly with all variables except STAI-state, age, and VAS scores. In a cross-sectional study, fear of falling was reported to be correlated with anxiety and pain levels but not with depression levels.<sup>27</sup> In contrast, fear of falling was reported as being correlated with depression levels and age in other studies.<sup>5,13</sup> In our



**Table 4.** Logistic Regression Analyses for Good Outcome for Baseline Variables.

	B (SE)	P-Value	Exp (B) (95% CI) <sup>a</sup>
Age	.05 (.03)	.136	1.05 (.98-1.12)
GDS	.06 (.06)	.290	1.06 (.95-1.19)
STAI	<b>-.08 (.04)</b>	<b>.024</b>	<b>.92 (.86-.99)</b>
State			
STAI	.04 (.05)	.393	1.04 (.95-1.14)
Trait			
FES-I	-.04 (.02)	.079	.96 (.92-1.01)
CCI	-.30 (.2)	.128	.74 (.51-1.09)
VAS	-.19 (.11)	.073	.83 (.67-1.02)
Constant	1.84 (2.23)	.408	6.31

<sup>a</sup>R<sup>2</sup> = .25 (Nagelkerke). Model  $\chi^2$  (7) = 18.18, P = .01.

study, fear of falling partially overlaps with depression and anxiety symptoms, and our model could explain only a certain rate of variance, but other psychological and medical factors (such as loss of sense of proprioception and balance) need to be clarified in future studies; such factors possibly play a role in symptoms of fear of falling.<sup>28</sup>

We found statistically significant differences between poor and good outcome groups for baseline STAI-state and VAS scores, follow-up GDS, STAI-trait, STAI-state, FES-I, and VAS scores. The statistically significant difference between groups with respect to STAI-state scores could be viewed as a finding similar to the regression analyses. However, the significant differences between VAS scores are probably due to the appropriate use of non-parametric analyses. We found no statistically significant difference between groups for age, gender, length of stay at hospital, and CCI. This finding could be attributed to the presence of relatively lower comorbidity and better general health conditions in our sample.<sup>27</sup> In our study, an important variable -age- traditionally a well-established risk factor for poor outcomes, remained insignificant in all models.<sup>27</sup> This unexpected finding may be explained by the relatively low comorbidity of our patients.

There are certain important limitations in our study. First, the attrition rate is relatively high and requires consideration. Second, our samples' median comorbidity scores and the proportion of gender of the patients reflect a mildly decreased female/male ratio than epidemiological data have shown. The main reasons for this gender imbalance are cases excluded at baseline, patients lost to follow-up, and mortality rates. Third, the cognitive assessments of patients were done clinically by a psychiatrist without the use of standardized scales, such as mini mental state examination or the Montreal Cognitive Assessment (MoCA), and patients were excluded from the study if a cognitive disorder was suspected, such as dementia. As a result, the cognitive variables could not be included in the analyses, which may have interfered with the results.

Fourth, other psychological and psychosocial factors, such as personality traits and perceived social support, were not considered. Fifth, acute and post-traumatic stress-related symptoms following hip fracture may be associated with the psychological variables, including fear of falling.

Our study also has notable strengths. It is a prospective cohort study conducted at a single center, with a single surgeon and single surgical methods, which theoretically reduces the variance. The psychiatric and cognitive assessments were done by an experienced consultation-liaison psychiatrist to evaluate according to our inclusion/exclusion criteria. Assessments of fear of falling, psychological variables, and functional outcomes were done using gold standard scales.

Our findings do at least indicate that patients at a higher state of anxiety may be prone to poor functional outcomes three months later. Screening patients after hip fracture surgery for symptoms of a state of anxiety using valid and reliable tools, such as STAI, may prompt preventive interventions with the potential to improve the functional outcomes. The concept of fear of falling in relation to hip fracture surgery remains inconclusive in our study. Future well-designed studies are needed to investigate these associations and the potential role of fear of falling.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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### Ethical Approval

We obtained ethical approval from review board of Ankara University Faculty of Medicine (No. 11-475-16).

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