

# Symptoms of Anxiety and Depression Predicting Fall-Related Outcomes Among Older Americans: A Longitudinal Study

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## Research Article

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# Abstract

## Background

Anxiety symptoms and depressive symptoms are associated with fear of falling and fear of falling-related activity restriction. However, it remains unknown whether anxiety or depressive symptoms alone could predict fear of falling and activity restrictions in older adults. We sought to determine if anxiety and depressive symptoms alone could be an independent predictor of fear of falling and activity restriction in community-dwelling older adults.

## Methods

This longitudinal analysis used waves 5 (time 1, [T1]) and 6 (time 2, [T2], one year from T1) data (N = 6,376) from the National Health and Aging Trends Study (NHATS). We included participants who had completed interviews in both waves. The Generalized Anxiety Disorder Scale – 2 and Patient Health Questionnaire – 2 were used to assess anxiety symptoms and depressive symptoms, respectively. Interview questions included demographics, health-related data, and fall worry levels (no fear of falling, fear of falling but no activity restriction, and activity restriction). Using multinomial logistic regression models, we examined whether anxiety symptoms (T1) predicted fear of falling and activity restriction (T2), after adjusting for depressive symptoms, fall worry levels, and covariates, and also whether depressive symptoms predicted future fear of falling and activity restriction adjusting for anxiety symptoms, previous fall worry levels, and covariates.

## Results

In the first cohort (T1, mean age: 78 years, 58.1% female), 10% and 13% of participants reported anxiety and depressive symptoms, and 19% and 10% of participants experienced fear of falling but not activity restriction and activity restriction in the second cohort (T2), respectively. Participants with anxiety symptoms at T1 had a 1.33 times higher risk of fear of falling (95% CI = 1.02–1.72) and 1.41 times higher risk of activity restriction (95% CI = 1.04–1.90) at T2 after controlling for depressive symptoms compared with participants without anxiety symptoms. show any significance after adjusting for anxiety symptoms.

## Conclusions

Anxiety symptoms seemed to be an independent risk factor for future fear of falling and activity restriction, while depressive symptoms were not. To prevent future fear of falling and activity restriction, we should pay special attention to individuals with anxiety

## Background

Fear of falling has become a major public health issue among older adults over the past decades, with 21–85% having experienced fear of falling with or without falls (1, 2). Fear of falling is commonly defined as the feeling of “afraid or shaky” about falling (3). Although fear of falling may promote fall prevention behaviors, excessive fear of falling may decrease people’s mobility, increase the possibility of falls or injuries, result in social isolation, and lead to fear of falling-related activity restriction (4–7). Activity restriction can further result in impaired balance, functional impairment, and actual falls (7–9). Given these negative outcomes, identifying risk factors of fear of falling and activity restriction is a significant public health concern.

Anxiety symptoms and depressive symptoms are the most common psychological symptoms associated with fear of falling and activity restrictions (9–11), and their prevalence among older adults in the United States can be up to 20% and 49%, respectively (12–15). Most previous studies investigated anxiety symptoms and depressive symptoms as an overall condition or focused on one without considering controlling for the other as a confounding variable, because these two symptoms shared mild primary symptoms such as fatigue or poor attention in the early stage, and they had a high comorbidity rate of 13–30% (16–20). However, it is essential to differentiate these two concepts and explore their independent effects on future fear of falling and activity restriction.

We fully recognized the difference between these two concepts. From the clinical point of view, anxiety symptoms and depressive symptoms were two different concepts. According to the Chinese Classification and Diagnostic Criteria of Mental Disorders, 3rd Edition (CCMD-3), anxiety symptoms were upwardly hyperactive and characterized mainly by nervousness without a clear object or specific content; Depressive symptoms were inhibited downward and dominated by a depressed state of mind that could range from grumpy or grief (21). On the other hand, a prospective study showed that a state of anxiety symptoms alone may be a precursor to developing either depressive symptoms alone or comorbid symptoms of anxiety and depression (22). This suggests that anxiety symptoms need to be separated from depressive symptoms and if the anxiety symptoms alone stage could be screened and action taken, it might be possible to prevent depressive symptoms or comorbid symptoms of anxiety and depression, to reduce falls, other health side effects, and even suicide rate (23).

Studies are rare that examine the independent role of anxiety/depressive symptoms on fear of falling and activity restriction controlling depressive/anxiety symptoms. Several previous studies have indicated that anxiety symptoms are a significant predicting factor for fear of falling and activity restriction without controlling for depressive symptoms (10, 24–26). Only one small cross-sectional study (N = 25) examined the association between anxiety symptoms and fear of falling controlling for depressive symptoms (27). However, due to the nature of the cross-sectional study design, a longitudinal association cannot be made. An extensive body of literature has also identified depressive symptoms as a risk factor for fear of falling and activity restriction (7, 8, 25, 28), and contributed to the understanding of the bidirectional,

mutually reinforcing relationship between depressive symptoms and fear of falling, and/or activity restriction (29, 30). But none of the studies controlled for anxiety symptoms.

Therefore, the purpose of the present study was to examine the independent effects of anxiety symptoms and depressive symptoms on fear of falling and activity restriction among community-dwelling older adults in the United States (U.S.). We examined the independent effects of anxiety symptoms on fear of falling and activity restriction controlling for depressive symptoms first, and depressive symptoms controlling for anxiety symptoms next. We hypothesized that both anxiety symptoms and depressive symptoms can be independent predictors of fear of falling and activity restriction in older adults.

## Methods

### Study design, setting, and sample

We used data from the National Health and Aging Trends Study (NHATS) wave 5 (2015) and wave 6 (2016). Since 2011, the NHATS has collected health information of a nationally representative sample of Medicare beneficiaries aged 65 and older in the U.S. (31), and the sample was replenished in 2015. In our study, a total of 6,397 participants completed the interviews in both waves (time 1 [T1] and time 2 [T2], 1 year from T1). We excluded 21 beneficiaries who had incomplete data on fear of falling or activity restriction. Thus, a total of 6,376 beneficiaries formed the final sample.

### Measurements

#### Independent Variables

Anxiety symptoms were measured by the 2-item Generalized Anxiety Disorder Scale (GAD-2) (31). It screens anxiety symptoms by asking, "Over the last month, how often have you (a) felt nervous, anxious, or on edge, and (b) been unable to stop or control worrying?" Response options were "1 = not at all", "2 = several days", "3 = more than half the days", and "4 = nearly every day." The total score ranges from two to eight, with the cut-off point of five or higher indicating the presence of anxiety symptoms (32).

Depressive symptoms were measured using the 2-item Patient Health Questionnaire (PHQ-2) (31). PHQ-2 measures depressive symptoms by asking, "Over the last month, how often have you (a) had little interest or pleasure in doing things, and (b) felt down, depressed, or hopeless?" Responses were based on a four-point scale (1 = not at all, 2 = several days, 3 = more than half the days, 4 = nearly every day). The total score ranges from two to eight, and a total score of five or higher was used to indicate the presence of depressive symptoms (33).

#### Dependent Variables

Fear of falling and activity restriction were assessed by the two questions, "In the last month, did you worry about falling down?" If the answer was yes, then participants were asked, "In the last month, did this worry ever limit your activities?" Based on the participants' responses, a three-category variable was

created to indicate the fall worry levels: No fear of falling (coded 0), had fear of falling but not activity restriction (coded 1) and had fear of falling-related activity restriction (coded 2).

## Covariates

We included covariates hypothesized to be associated with our outcomes of interest. These included demographic variables such as age, gender (female vs. male); race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, all other); education level (less than high school, high school graduates, some college or vocational school, bachelor or higher); and living arrangement (alone, with spouse/partner only, with others only, with spouse/partner and others).

Health related covariables included (a) the number of chronic illnesses (heart attack/heart disease, high blood pressure, arthritis, osteoporosis, diabetes, lung disease, stroke, and cancer); (b) whether the participants had dementia (yes/no); (c) the number of activities of daily living (ADL) impairment, ranging from 0 to 4 (feeding, bathing, toileting, dressing); (d) the number of instrumental activities of daily living (IADL) impairment, ranging from 0 to 7 (bed transfer, moving inside the house, doing laundry, shopping, preparing meals, taking medication, and managing money); (e) whether the participants were bothered by pain in the last month (yes/no); (f) body mass index (BMI) of the participants (normal/obesity [ $\geq 30$  kg/m<sup>2</sup>]); (g) whether the participants were hospitalized over the past year (yes/no); and (h) whether the participants had problems with balance or coordination in the last month (yes/no).

## Statistical analyses

Continuous variables were presented as mean  $\pm$  standard deviations and categorical variables as frequencies and percentages. We used two-sample t-tests to estimate the distribution of age, ADLs, and IADLs across the fall worry levels. Chi-square tests were used to test the differences among groups of fall worry levels for categorical variables.

To determine whether anxiety symptoms and/or depressive symptoms at T1 could predict the fall worry levels at T2 independently, we performed three sets of multinomial logistic regression models in three steps. First, we modeled the effects of anxiety symptoms at T1 on fall worry levels at T2, in which fall worry levels at wave 6 were treated as the outcome while fall worry levels at T1 were controlled. Next, we conducted similar models replacing anxiety symptoms with depressive symptoms as the main predictor to examine the effects of depressive symptoms on fall worry levels. Finally, we examined the independent effects of anxiety symptoms and depressive symptoms on fall worry levels by including them as main predictors simultaneously in the models. In each model set, we first estimated the crude effects (Model 1), followed by the effects adjusted for demographic variables (Model 2), and finally the effects adjusted for demographic and health-related covariates (Model 3).

To improve the robustness of the results, we performed a sensitivity analysis excluding samples who were interviewed by proxy. Due to the small proportion of missing data and the large sample size, we did not use any techniques to handle the missing data. For all models, relative risk ratios (RRR) and 95%

confidence intervals were reported. P values less than 0.05 indicated statistical significance. All analyses were conducted using Stata/SE 15.0 (Stata Corp., College Station, TX).

## Results

Table 1 summarized the baseline characteristics of the participants based on their fall worry levels. The sample (N = 6,376) was on average  $78 \pm 7.73$  years old. The majority were non-Hispanic White (69.1%) and female (58.1%) with an education level of high school graduates and higher (78.6%). About 10% and 14% of participants reported anxiety symptoms and depressive symptoms at T1 respectively. Approximately 68% of participants had no fear of falling (n = 4,325), 21% (n = 1,353) had fear of falling but not activity restriction, and 11% (n = 698) had activity restriction at T2 (not shown in Table). Participants with activity restriction were the oldest among the three groups. They also had the highest number of ADL and IADL impairment, hospitalization, and falls, and suffered from pain.

Table 1  
 Baseline characteristics of participants stratified by fall worry levels (N = 6,202 ~ 6,376)

Characteristics	No fear of falling	Had fear of falling but not activity restriction	Had activity restriction	<i>P</i> values
<b>Age, M ± SD</b>	77.1 ± 7.48	79.9 ± 7.83	80.5 ± 8.13	.005
<b>Sex, %</b>				< .001
Female	54.4	67.2	67.0	
Male	45.6	32.8	33.0	
<b>Race/ethnicity, %</b>				< .001
White, non-Hispanic	67.8	73.5	70.0	
Black, non-Hispanic	22.4	15.4	16.2	
Hispanic	5.1	6.8	7.9	
Other	2.0	1.8	3.4	
<b>Education, %</b>				.001
Less than high school	20.1	23.2	26.7	
High school graduate	26.1	27.8	25.7	
Some college or vocational school	26.8	25.1	25.7	
College or higher	27.0	23.8	21.9	
<b>Living arrangement, %</b>				< .001
Alone	32.1	39.2	39.8	
With spouse/partner only	41.3	34.3	30.1	
With others only	16.4	19.6	23.5	
With spouse/partner and others	10.2	6.9	6.6	
<b>BMI, %</b>				< .001
Normal (< 30 kg/m <sup>2</sup> )	71.4	66.6	63.3	
Obese (≥ 30 kg/m <sup>2</sup> )	28.6	33.4	36.7	
<b>Pain, %</b>				< .001

Abbreviations: M = mean; SD = standard deviations; BMI = body mass index; ADL = activities of daily living; IADL = instrument activities of daily living.

Characteristics	No fear of falling	Had fear of falling but not activity restriction	Had activity restriction	<i>P</i> values
No	52.0	33.4	22.3	
Yes	48.0	66.6	77.7	
<b>Number of ADL impairment, M ± SD</b>	0.36 ± 0.86	0.66 ± 1.07	1.53 ± 1.36	< .001
<b>Number of IADL impairment, M ± SD</b>	0.68 ± 1.27	1.25 ± 1.55	2.38 ± 1.70	< .001
<b>Hospitalization, %</b>				< .001
No	81.9	74.9	65.4	
Yes	18.1	25.1	34.6	
<b>Fall history, %</b>				< .001
No	74.4	54.8	44.4	
Yes	25.6	45.2	55.6	
<b>Dementia %</b>				< .001
No	94.9	94.5	86.7	
Yes	5.1	5.5	13.3	
<b>Number of chronic illnesses, %</b>				< .001
No	9.7	2.7	1.7	
1–3	71.0	66.3	54.9	
4+	19.3	31.0	43.4	
<b>Problems with balance, %</b>				< .001
No	79.5	46.4	19.0	
Yes	20.5	53.6	81.0	
Abbreviations: M = mean; SD = standard deviations; BMI = body mass index; ADL = activities of daily living; IADL = instrument activities of daily living.				

[Insert Table 1]

Figure 1 showed the multinominal logistic regression results of anxiety symptoms and depressive symptoms at T1 on fall worry levels at T2 without controlling for each other. The RRR of fall worry levels

showed a downtrend from the crude model (Model 1) to the fully adjusted model (Model 3), and a rising trend from the level of “Had fear of falling but not activity restriction” to “Had activity restriction”.

For anxiety symptoms, compared to participants without anxiety symptoms, those with anxiety symptoms were more likely to develop fear of falling in the following year in Models 1 and 2 (RRR = 1.52, 95% CI = 1.21–1.92; RRR = 1.51, 95% CI = 1.19–1.91, respectively), but results became insignificant in the fully adjusted model (Model 3, RRR = 1.25, 95% CI = 0.98–1.60). The RRR of “Had activity restriction” was 1.46 times greater among participants with anxiety symptoms compared to those without anxiety symptoms (95% CI = 1.10–1.94). For participants with depressive symptoms, the results of “Had fear of falling but not activity restriction” showed insignificant in the crude model (Model 1). However, the RRR of “Had activity restriction” became 1.33 times greater compared to those without depressive symptoms in the fully adjusted model (Model 3, 95% CI = 1.01–1.73).

[Insert Fig. 1]

Figure 2 indicated the associations of anxiety symptoms and depressive symptoms at T1 on fall worry levels at T2 controlling for each other. For anxiety symptoms, the results were almost all statistically significant even after controlling for depressive symptoms. Participants with anxiety symptoms had 1.33 and 1.41 times increased risk of the fall worry levels of “Had fear of falling but not activity restriction” and “Had activity restriction” one year later compared to those without anxiety symptoms (Model 3, 95% CI = 1.02–1.72, 1.04–1.90, respectively). However, depressive symptoms showed different patterns. Depressive symptoms presented no statistically significant results in all models at the fall worry level of “Had fear of falling but not activity restriction” in the following year after controlling for anxiety symptoms. The results only showed participants with depressive symptoms had 1.55 times increased risk of having activity restriction in Models 1 and 2 (95% CI = 1.20–2.00, 1.19–2.03, respectively), but became insignificant in Model 3 (RRR = 1.18; 95% CI = 0.89–1.57). Depressive symptoms were less likely to have an independent predicting impact on fear of falling and activity restriction compared to anxiety symptoms.

[Insert Fig. 2]

The results of sensitivity analyses limiting the participants to non-proxy participants only showed similar results with our earlier analyses, supporting that anxiety symptom were an independent factor of future fear of falling and activity restriction. (see Supplemental Table 1).

## Discussion

In this large cohort study, we investigated the independent effects of anxiety symptoms and depressive symptoms on fear of falling and activity restriction using a nationally representative sample of older adults in the United States. We found that (1) 10% and 13% of participants at T1 reported experiencing symptoms of anxiety or depression, and approximately 20% and 11% reported “Had fear of falling but not activity restriction” or “Had activity restriction” at T2, respectively; (2) anxiety symptoms were associated

with a higher risk ratio of “Had fear of falling but not activity restriction” and “Had activity restriction” one year later adjusting for depressive symptoms; and (3) depressive symptoms did not seem to have any association with fear of falling and activity restriction.

Consistent with previous studies (12, 34), our results showed that anxiety symptoms increased the risk of future fear of falling. The reason could be that fear and anxiety symptoms are similar as they are the basis of anxiety disorders (35) and the presence of anxiety symptoms could be the driving factor of fear of falling (34). Moreover, we found that anxiety symptoms remained a significant independent factor that is associated with “Had fear of falling but not activity restriction” even after controlling for depressive symptoms. More specifically, participants with anxiety symptoms were 1.33 times more likely to develop fear of falling in the following year compared to those without anxiety symptoms. This result was consistent with Payette et al’s study (27), a pilot study that concluded the significant relationship between anxiety symptoms and fear of falling while controlling for depressive symptoms, fall risk, and sociodemographic variables. Payette’s study was a small, pilot study (N = 25) with a high proportion of women (88%). However, we can say that the results of our study can be better interpreted and generalizable because of the large sample size and a more balanced female proportion (58.1%) (27).

We also found that anxiety symptoms increased the risk of future activity restriction independently. This result also supported the previous studies (25, 26). For example, Hull and colleagues found that anxiety symptoms measured by the Geriatric Anxiety Inventory were a significant factor of fall-related outcome expectancy in a sample of 205 community-dwelling older adults, and activity restriction was a component of this outcome index (25). Painter and colleagues found anxiety symptoms assessed by the Hamilton Anxiety Scale could predict activity restriction through the indirect influence of fear of falling rather than directly among 99 community-dwelling older adults (26). Though these studies found a significant association between anxiety symptoms and activity restriction, it should be noted that they failed to establish a direct, independent, and longitudinal association. First, they did not use activity restriction as a direct target outcome but measured it via other variables such as fear of falling. Second, they did not control for depressive symptoms. Third, the longitudinal association could not be established due to their cross-sectional study design. Our study not only provided evidence of whether anxiety symptoms were directly and independently related to activity restriction, but presented the significant longitudinal effects of anxiety symptoms for future fall worry levels. Therefore, our results underscored the importance of screening older adults with anxiety symptoms to prevent future development of fear of falling and activity restriction, as well as related adverse health outcomes.

Our results showed that depressive symptoms had no significant associations with fear of falling and activity restriction in the fully adjusted model. This result was a surprise because previous studies showed opposite results (24). For example, Namkee and colleagues found “onset of depression” (no depression at baseline but depression one year later) and “continued depression” (had depression at baseline and continued at one year later) were significantly associated with greater odds of activity restriction at one year after the baseline (30). We speculated that the significant correlation in this study was because both “onset of depression” and “continued depression” were more focused on the

concurrent relationship between depressive symptoms and activity restriction, as opposed to our focus on the longitudinal association between depressive symptoms at baseline and activity restriction one year later. Please be noted that depressive symptoms in our study were measured via PHQ-2 which may have lower acceptable accuracy for screening for depression compared to other tools (36) (e.g., PHQ-9) commonly used in studies investigating the association between depressive symptoms and fall-related outcomes. This could also explain the opposite results.

The different results of the association between depressive symptoms and activity restriction with or without controlling for anxiety symptoms should be highlighted. Taking anxiety symptoms into account, the association between depressive symptoms and activity restriction became insignificant, suggesting anxiety symptoms may weaken the effects of depressive symptoms on activity restriction. Therefore, further investigations are needed to clarify the role of anxiety symptoms on the pathway from depressive symptoms to activity restriction and determine its effect size.

Our findings provided some evidence that anxiety symptoms may be able to predict future levels of fear of falling and activity restriction. This finding has implications for guiding the strategies for preventing fear of falling and activity restriction among older adults from the context of tertiary prevention. First, the knowledge of the scientific relationship of anxiety symptoms and future levels of fear of falling and activity restriction should be shared with and disseminated to the public so that the public, especially older adults and their caregivers, can be aware that anxiety symptoms affect future fear of falling and activity restriction levels, and subsequently may lead to more adverse health outcomes such as falls and functional impairment. Second, it is recommended that anxiety symptoms should be screened for early detection and diagnosis. Then we can identify and treat older adults with a high risk of developing fear of falling and activity restriction better as secondary prevention. Moreover, the assessment tool used in this study (GAD-2) is readily available and easy to use in the community (12) and therefore, may benefit the public. Finally, older adults who already have been evaluated for anxiety symptoms should receive timely and effective targeted interventions. On the other hand, the issue of the high comorbidity of anxiety symptoms and depressive symptoms can not be ignored. Using multiple years of follow-up measurements, as well as different measurement tools, further investigations are needed to examine the effect size of anxiety symptoms and depressive symptoms.

The strengths of this study include its longitudinal design and a large nationally representative sample of the study population. However, several study limitations should be noted. Selected variables were all based on retrospective self-reported interviews. Recall bias may influence the accuracy of the data and may have caused a lack of significant associations between depressive symptoms with fear of falling and activity restriction. The GAD-2 and PHQ-2 were used to measure participants' anxiety symptoms and depressive symptoms respectively. These tools were originally developed for not diagnostic but screening purposes. Therefore, the data may be limited to the state of emotion at the time of the interview only.

## Conclusions

In conclusion, based on this large, nationally representative sample of Medicare beneficiaries, we found that anxiety symptoms was an independent risk factor for potential future fear of falling and activity restriction. Depressive symptoms did not have any associations with fear of falling and activity restrictions. As a future strategy for preventing fear of falling and activity restriction, special attention should be paid to older adults with anxiety symptoms in the communities.

## Abbreviations

T1: time 1;

T2: time 2, one year after time 1;

NHATS: National Health and Aging Trends Study;

U.S.: United States;

GAD-2: Generalized Anxiety Disorder Scale-2;

PHQ-2: Patient Health Questionnaire-2;

ADL: Activities of Daily Living;

IADL: Instrumental Activities of Daily Living;

RRR: Relative Risk Ratio;

CI: Confidence Interval.

## Declarations

**Ethics approval and consent to participate:** NHATS was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board. NHATS participants completed written informed consent prior to being interviewed. The current analyses were deemed exempt from review by the Xiangya School of Nursing Ethic Committee of Central South University. The study was conducted according to the guidelines of the Declaration of Helsinki.

**Consent for publication:** Not Applicable.

**Availability of data and materials:** The data sets analyzed in the current study are publicly available: NHATS (<https://www.nhats.org/>).

**Competing interests:** The authors declare that they have no competing interests.

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**Authors' contributions:** Luo drafted primary manuscript, conceived of study aims, conducted the statistical analyses, and contributed to interpretation of findings. CM, MV, and Liu interpreted the data, and edited the manuscript. All authors contributed, reviewed and approved of the final manuscript.

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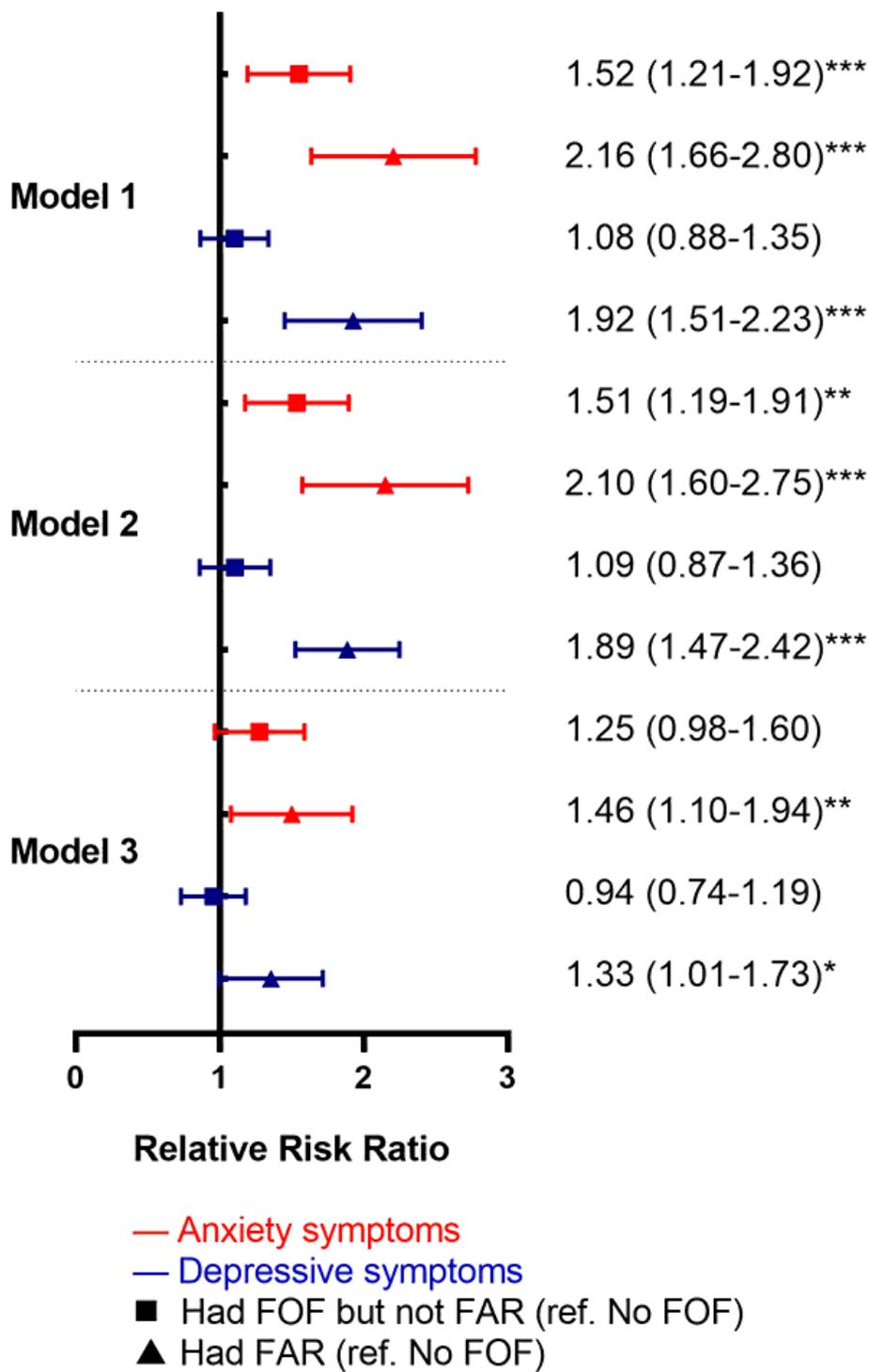
## References

1. Scheffer AC, Schuurmans MJ, van Dijk N, van der Hooft T, de Rooij SE. Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. *Age Ageing*. 2008 Jan;37(1):19–24. Doi: 10.1093/ageing/afm169
2. Vellas BJ, Wayne SJ, Romero LJ, Baumgartner RN, Garry PJ. Fear of falling and restriction of mobility in elderly fallers. *Age Ageing*. 1997 May;26(3):189–93. Doi: 10.1093/ageing/26.3.189
3. Tinetti ME, Powell L. Fear of falling and low self-efficacy: a case of dependence in elderly persons. *J Gerontol*. 1993 Sep;48 Spec No:35 – 8. Doi: 10.1093/geronj/48.special\_issue.35
4. Donoghue OA, Cronin H, Savva GM, O'Regan C, Kenny RA. Effects of fear of falling and activity restriction on normal and dual task walking in community dwelling older adults. *Gait Posture*. 2013 May;38(1):120–4. Epub 2012/11/28. Doi: 10.1016/j.gaitpost.2012.10.023
5. Friedman SM, Munoz B, West SK, Rubin GS, Fried LP. Falls and fear of falling: which comes first? A longitudinal prediction model suggests strategies for primary and secondary prevention. *J Am Geriatr Soc*. 2002 Aug;50(8):1329–35. Doi: 10.1046/j.1532-5415.2002.50352.x
6. Choi NG, Bruce ML, DiNitto DM, Marti CN, Kunik ME. Fall Worry Restricts Social Engagement in Older Adults. *J Aging Health*. 2020 Jun/Jul;32(5–6):422–431. Epub 2019/01/30. Doi: 10.1177/0898264319825586
7. Merchant RA, Chen MZ, Wong BLL et al. Relationship Between Fear of Falling, Fear-Related Activity Restriction, Frailty, and Sarcopenia. *J Am Geriatr Soc*. 2020 Nov;68(11):2602–2608. Epub 2020/08/17. Doi: 10.1111/jgs.16719
8. Deshpande N, Metter EJ, Lauretani F, Bandinelli S, Guralnik J, Ferrucci L. Activity restriction induced by fear of falling and objective and subjective measures of physical function: a prospective cohort study. *J Am Geriatr Soc*. 2008 Apr;56(4):615–20. Epub 2008/02/26. Doi: 10.1111/j.1532-5415.2007.01639.x
9. Gaxatte C, Nguyen T, Chourabi F et al. Fear of falling as seen in the Multidisciplinary falls consultation. *Ann Phys Rehabil Med*. 2011 Jun;54(4):248–58. Epub 2011/05/05. English, French. Doi: 10.1016/j.rehab.2011.04.002

10. Rivasi G, Kenny RA, Ungar A, Romero-Ortuno R. Predictors of Incident Fear of Falling in Community-Dwelling Older Adults. *J Am Med Dir Assoc*. 2020 May;21(5):615–620. Epub 2019/10/11. Doi: 10.1016/j.jamda.2019.08.020
11. Denkinger MD, Lukas A, Nikolaus T, Hauer K. Factors associated with fear of falling and associated activity restriction in community-dwelling older adults: a systematic review. *Am J Geriatr Psychiatry*. 2015 Jan;23(1):72–86. Epub 2014/03/15. Doi: 10.1016/j.jagp.2014.03.002
12. Hull SL, Kneebone II, Farquharson L. Anxiety, depression, and fall-related psychological concerns in community-dwelling older people. *Am J Geriatr Psychiatry*. 2013 Dec;21(12):1287–91. Epub 2013/02/06. Doi: 10.1016/j.jagp.2013.01.038
13. Kroenke K, Spitzer RL, Williams JB, Monahan PO, Löwe B. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med*. 2007 Mar 6;146(5):317 – 25. Doi: 10.7326/0003-4819-146-5-200703060-00004
14. Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005 Jun;62(6):617 – 27. Doi: <https://doi.org/10.1001/archpsyc.62.6.617>. Erratum in: *Arch Gen Psychiatry*. 2005 Jul;62(7):709. Merikangas, Kathleen R [added].
15. Sjöberg L, Karlsson B, Atti AR, Skoog I, Fratiglioni L, Wang HX. Prevalence of depression: Comparisons of different depression definitions in population-based samples of older adults. *J Affect Disord*. 2017 Oct 15;221:123–131. Epub 2017/06/13. Doi: 10.1016/j.jad.2017.06.011
16. Djernes JK. Prevalence and predictors of depression in populations of elderly: a review. *Acta Psychiatr Scand*. 2006 May;113(5):372–87. Doi: 10.1111/j.1600-0447.2006.00770.x
17. Curran E, Rosato M, Ferry F, Leavey G. Prevalence and factors associated with anxiety and depression in older adults: Gender differences in psychosocial indicators. *J Affect Disord*. 2020 Apr 15;267:114–122. Epub 2020/02/08. Doi: 10.1016/j.jad.2020.02.018
18. Porensky EK, Dew MA, Karp JF et al. The burden of late-life generalized anxiety disorder: effects on disability, health-related quality of life, and healthcare utilization. *Am J Geriatr Psychiatry*. 2009 Jun;17(6):473–82. Doi: 10.1097/jgp.0b013e31819b87b2
19. Lenze EJ, Mulsant BH, Shear MK, Alexopoulos GS, Frank E, Reynolds CF. 3rd. Comorbidity of depression and anxiety disorders in later life. *Depress Anxiety*. 2001;14(2):86–93. Doi: 10.1002/da.1050
20. Möller HJ, Bandelow B, Volz HP, Barnikol UB, Seifritz E, Kasper S. The relevance of 'mixed anxiety and depression' as a diagnostic category in clinical practice. *Eur Arch Psychiatry Clin Neurosci*. 2016 Dec;266(8):725–736. Epub 2016/03/22. Doi: 10.1007/s00406-016-0684-7
21. Tiller JW. Depression and anxiety. *Med J Aust*. 2013 Sep 16;199(S6):S28-31. Doi: 10.5694/mja12.10628
22. Chen YF. Chinese classification of mental disorders (CCMD-3): towards integration in international classification. *Psychopathology*. 2002 Mar-Jun;35(2–3):171–5. Doi: 10.1159/000065140
23. Xu JM. Application of antidepressant drugs in the elderly. *China Academic Journal*. 2013;34(4):4–8.

24. Merikangas KR, Zhang H, Avenevoli S, Acharyya S, Neuenschwander M, Angst J. Longitudinal trajectories of depression and anxiety in a prospective community study: the Zurich Cohort Study. *Arch Gen Psychiatry*. 2003 Oct;60(10):993–1000. Doi: 10.1001/archpsyc.60.9.993
25. Painter JA, Allison L, Dhingra P, Daughtery J, Cogdill K, Trujillo LG. Fear of falling and its relationship with anxiety, depression, and activity engagement among community-dwelling older adults. *Am J Occup Ther*. 2012 Mar-Apr;66(2):169–76. Doi: 10.5014/ajot.2012.002535
26. Payette MC, Bélanger C, Benyebdri F et al. The Association between Generalized Anxiety Disorder, Subthreshold Anxiety Symptoms and Fear of Falling among Older Adults: Preliminary Results from a Pilot Study. *Clin Gerontol*. 2017 May-Jun;40(3):197–206. Epub 2017/02/26. Doi: 10.1080/07317115.2017.1296523
27. Austin N, Devine A, Dick I, Prince R, Bruce D. Fear of falling in older women: a longitudinal study of incidence, persistence, and predictors. *J Am Geriatr Soc*. 2007 Oct;55(10):1598–603. Doi: 10.1111/j.1532-5415.2007.01317.x
28. Choi NG, Marti CN, DiNitto DM, Kunik ME. Longitudinal Associations of Falls and Depressive Symptoms in Older Adults. *Gerontologist*. 2019 Nov 16;59(6):1141–1151. Doi: 10.1093/geront/gny179
29. Choi NG, Gell NM, DiNitto DM, Marti CN, Kunik ME. Depression and activity-limiting fall worry among older adults: longitudinal reciprocal relationships. *Int Psychogeriatr*. 2020 Apr;32(4):495–504. Epub 2019/07/18. Doi: 10.1017/S1041610219000838
30. Freedman VA, Kasper JD. Cohort Profile: The National Health and Aging Trends Study (NHATS). *Int J Epidemiol*. 2019 Aug 1;48(4):1044-1045g. Doi: 10.1093/ije/dyz109
31. Luo Z, Li Y, Hou Y et al. Adaptation of the two-item generalized anxiety disorder scale (GAD-2) to Chinese rural population: A validation study and meta-analysis. *Gen Hosp Psychiatry*. 2019 Sep-Oct;60:50–56. Epub 2019/07/12. Doi: 10.1016/j.genhosppsych.2019.07.008
32. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: validity of a two-item depression screener. *Med Care*. 2003 Nov;41(11):1284–92. Doi: 10.1097/01.MLR.0000093487.78664.3C
33. Bahat Öztürk G, Kılıç C, Bozkurt ME, Karan MA. Prevalence and Associates of Fear of Falling among Community-Dwelling Older Adults. *J Nutr Health Aging*. 2021;25(4):433–439. Doi: 10.1007/s12603-020-1535-9
34. Craske MG, Rauch SL, Ursano R, Prenoveau J, Pine DS, Zinbarg RE. What is an anxiety disorder? *Depress Anxiety*. 2009;26(12):1066–85. Doi: 10.1002/da.20633
35. Levis B, Sun Y, He C et al. Accuracy of the PHQ-2 Alone and in Combination With the PHQ-9 for Screening to Detect Major Depression: Systematic Review and Meta-analysis. *JAMA*. 2020 Jun 9;323(22):2290–2300. Doi: 10.1001/jama.2020.6504

## Figures



**Figure 1**

Results of anxiety and depressive symptoms on fall worry levels without controlling for each other.

\*  $P < .05$ , \*\*  $P < .01$ , \*\*\*  $P < .001$ .

Abbreviation: FOF = fear of falling; FAR = fear of falling related activity restriction.

Model 1 adjusted for fall worry level at T1;

Model 2: Model 1 + demographic covariables (age, gender, race/ethnicity, education, living arrangement);

Model 3: Model 2 + health-related covariables (BMI, pain, ADL, IADL, hospitalization, falls, balance, number of chronic illnesses).

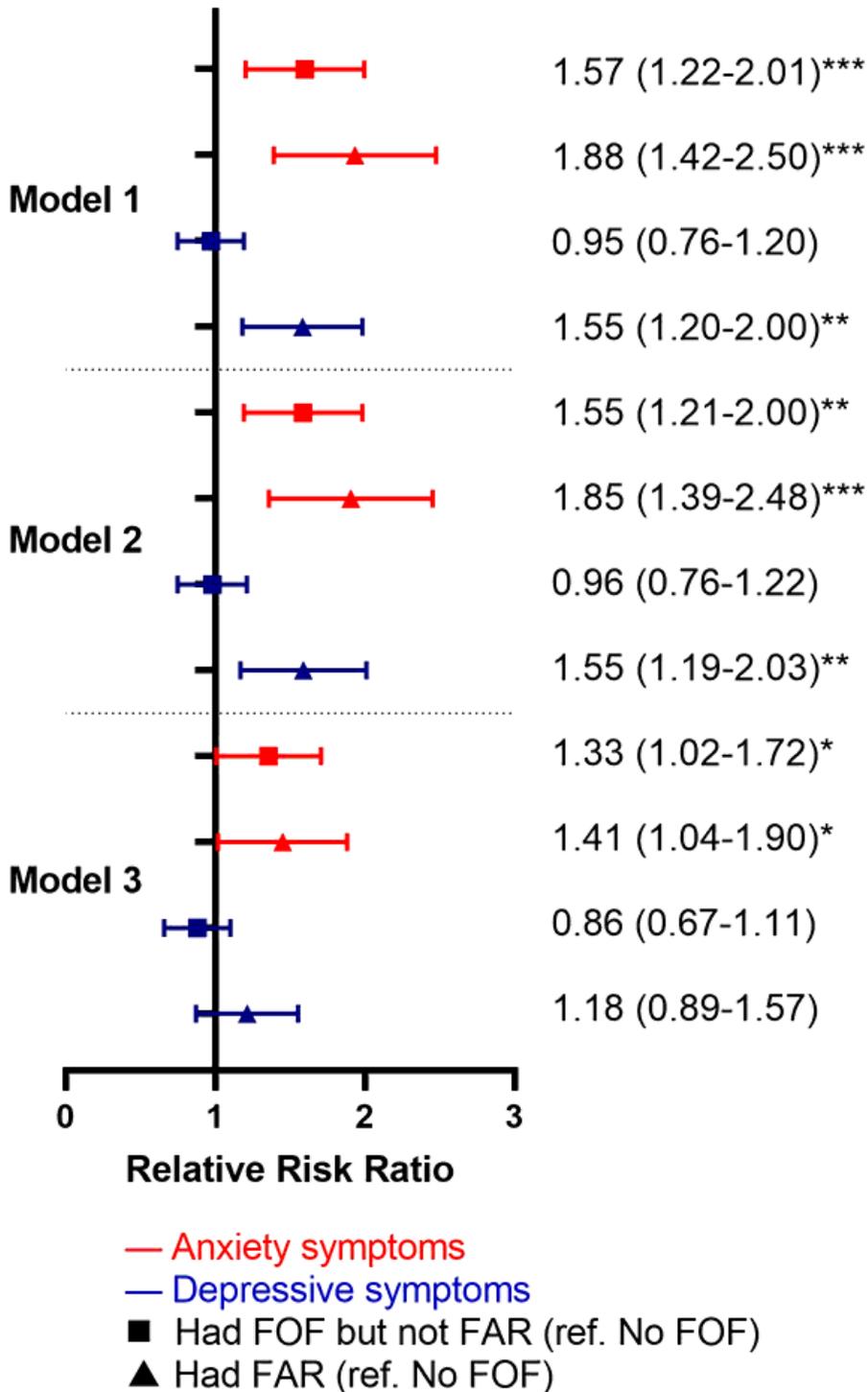


Figure 2

Results of anxiety and depressive symptoms on fall worry levels controlling for each other.

\*  $P < .05$ , \*\*  $P < .01$ , \*\*\*  $P < .001$ .

Abbreviation: FOF = fear of falling; FAR = fear of falling related activity restriction.

Model 1 adjusted for fall worry levels and depressive symptoms/anxiety symptoms at T1;

Model 2: Model 1 + demographic covariables (age, gender, race/ethnicity, education, living arrangement);

Model 3: Model 2 + health-related covariables (BMI, pain, ADL, IADL, hospitalization, falls, balance, number of chronic illnesses).

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementalTable1.docx](#)