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Medication Use, Falls, and Fall-Related Worry in Older Adults in the United States

Jonathan H. Watanabe

OBJECTIVE: To compare the prevalence of falls and fall-related concerns of medication users versus nonusers in U.S. seniors.

DESIGN: Cross-sectional study.

SETTING: The National Health and Aging Trends Study.

PARTICIPANTS: U.S. nationally representative sample of Medicare beneficiaries in 2011.

OUTCOMES: Comparing subjects who used medications with subjects who did not in the past month, the outcomes were percentages of subjects who experienced 1) a fall in the past month, 2) worry about falling in the past month, 3) being limited by this worry in the past month, 4) a fall in the past year.

RESULTS: A greater percentage of medication users experienced falls and fall-related outcomes, compared with nonmedication users. Among medication users, 10.29% had a past month fall, compared with 5.42% of non-medication users; 27.69% of medication users worried in the past month about falling, compared with 9.15% of non-medication users; 40.96% of medication users were limited by this worry, compared with 21.21%; 22.82% of medication users had a fall in the past year, compared with 13.15% of non-medication users.

CONCLUSION: Seniors who use medications are more likely to fall and to be concerned about falling. Pharmacist involvement in fall prevention continues to be essential.

KEY WORDS: Falls, Geriatrics, Medications, Pharmacists.

ABBREVIATIONS: CI = Confidence interval, FRID = Fall-risk increasing drugs, GDR = Gradual dose reduction, NHATS = National Health and Aging Trends Study, OR = Odds ratio.

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Introduction

Unintentional falls represent the leading cause of hospital admission and death resulting from injury in seniors.¹ Falls resulting in a hospital stay cost roughly \$25,955 in the United States per victim, and yearly costs per victim of a fall in a long-term care setting were estimated at \$6,859.² Fall costs for community-dwelling seniors were similarly expensive, with yearly costs for those who experience a fall ranging from \$2,044 to \$24,140.²

Seniors are at greatest risk of having a fall, and they represent the most rapidly increasing sector of the U.S. population.^{3,4} Between 2000 and 2010, the U.S. population 65 years of age and older grew 15.1% while the total U.S. population grew 9.7%.⁴ The age 65 and older population is projected to increase from 13% of the U.S. population in 2010 to 19% in 2030 to greater than 20% in 2050 (88.5 million people). The so-called “oldest-old,” those 85 years of age and older, will grow from 5.8 million in 2010 to 8.7 million in 2030 to 19 million in 2050. Consequently, multiple studies in developed countries have documented or forecast an increase in the number of hip fractures annually.^{5,6} In the period between 1986 and 2001, the incidence of hip fracture in Japan increased by 1.6-fold and 1.4-fold for men and women, respectively.⁷ Analysis from the Scottish Hip Fracture Audit database estimated a 45% to 75% increase in hip fractures per annum in the period from 2004 to 2031.³ While hip fracture rates are projected to increase markedly in Asia in the coming decades, the highest rates are currently seen in the North America and Scandinavia.⁶

Pharmacodynamic and pharmacokinetic factors are modified in seniors, increasing the risk of drug-induced adverse effects of medications that may cause falls. Medication use has been targeted as an extrinsic, modifiable risk factor to reduce fall risk in seniors.⁸ Certain categories of drugs deemed fall-risk increasing drugs (FRID) have been associated with statistically significant increases in falls based on meta-analyses and systematic reviews.⁹ The list of FRID includes psychotropics, antipsychotics, sedative hypnotics, benzodiazepines, antidepressants, type 1a antiarrhythmics, digoxin, antihypertensives, opioids, and nonsteroidal anti-inflammatory drugs.⁹⁻¹² It has also been

postulated that antidiabetic agents such as insulins, which increase risk of hypoglycemia, may also elevate fall risk.¹³

The National Health and Aging Trends Study (NHATS) includes a nationally representative weighted sample of seniors who are asked specific questions related to falls and worry about experiencing a fall. The dataset also includes questions to sample persons about medication use and housing type.

The goal of this analysis in seniors was to compare the percentages of falls and fall-related worry outcomes in users of medications versus nonusers of medications overall and by housing type.

Methods

Study Design

The 2011 round one NHATS data were used to conduct a cross-sectional analysis quantifying percentages of sample persons with “yes” response to the following questions:

1) In the last month have you fallen down? 2) In the last month, did you worry about falling down? If the answer is ‘yes’ to question 2, sample person is asked: 3) In the last month, did this worry of falling ever limit your activities? 4) In the last 12 months have you fallen down? These percentages were then compared between medication users and nonusers ascertained via a separate question: In the last month, did you take any medications prescribed by a doctor? Falling down was defined as any fall, slip, or trip in which the sample person loses balance and lands on the floor or ground at a lower level.

The NHATS contains questions for sample person respondents asking if they reside in either: 1) a private residence, 2) a group home, board and care or supervised housing, or 3) an assisted living facility or continuing care retirement community. To further evaluate this association based on housing type, the fall and fall worry percentages were compared for medication users and nonusers separated by housing type.

The NHATS is a resource made available for health researchers for the scientific study of functioning in later life supported by the National Institute on Aging under a cooperative agreement with the Johns Hopkins University Bloomberg School of Public Health. To achieve

these aims, the NHATS gathers information in person from a nationally representative sample of Medicare beneficiaries 65 years of age and older. The initial sample was first interviewed in 2011. The sample represents Medicare beneficiaries 65 years of age and older living in the contiguous United States. Medicare beneficiaries encompass 96% of all persons living in the United States who are in this age group.

This study protocol ID 160343 has been approved for Institutional Review Board exemption by the University of California San Diego Human Research Protections Program.

Statistical Analysis

Frequency analysis was conducted using SAS 9.4 (Cary, NC) survey procedures that incorporated sample design and respondent weighting. Analytic weights and variance values are provided for each sample person respondent to allow appropriate variance structure and standard errors for survey statistical estimation. The round one NHATS public use data support weighted analysis of Medicare beneficiaries 65 years of age and older living in the contiguous United States on September 30, 2010. The survey weights included with the public use file account for differential probabilities of selection and adjust for potential bias related to unit nonresponse. The NHATS data files were constructed to allow for computation of standard errors using the Taylor series linearization approach for complex surveys that uses a mathematical technique to approximate a nonlinear statistic with a linear form. This provided for the computation of variance estimates using observation-level stratum and cluster variables that are provided in the NHATS files.¹⁴

Hypothesis testing was performed via 95% weighted confidence intervals (CI) that used the Taylor series linearization method to generate standard errors of proportions $\alpha = 0.05$ for all analyses.

Results

There were 6,067 respondents in the analysis. After survey weighting was applied, this represented 28,346,995 survey-weighted subjects in the analysis data set. Females made up 55.24% ($n = 15,657,658$) of the weighted

**Table 1. Subject Characteristics
(N = 28,346,995)**

Female, % (n)	55.24 (15,657,658)
Marital Status, % (n)	
• Married	60.83 (17,244,647)
• Living with a Partner	2.00 (567,545)
• Separated	0.94 (266,563)
• Divorced	8.69 (2,462,526)
• Widowed	24.45 (6,929,975)
• Never Married	3.07 (868,937)
Age Category, yrs (n)	
• 65 to 69	29.47 (8,353,652)
• 70 to 74	25.01 (7,090,209)
• 75 to 79	19.78 (5,606,844)
• 80 to 84	14.39 (4,079,212)
• 85 to 89	8.10 (2,295,822)
• 90 years of age and older	3.25 (921,255)
Housing Type, % (n)	
• Private Residence	99.29 (28,145,105)
• Group Home, Board and Care, or Supervised Housing	0.31 (88,209)
• Assisted Living Facility or Continuing Care Retirement Community	0.40 (113,681)

respondents. Married persons represented 60.83% (n = 17,244,647) of the weighted respondents. Respondents 65 to 69 years of age were the largest age category in the data at 29.47% (n = 8,353,652). Those 90 years of age and older were the smallest age category, representing 3.25% of the respondents (n = 921,255). (Table 1). Medication use was highly prevalent, with 90.34% (n = 25,619,749) responding that they used medications in the past month.

Respondents who used medications in the past month demonstrated a statistically significant increase in percentage for all of the four fall and fall-related outcomes. For the outcome “In the last month have you fallen down?” 10.29% of medication users (95% CI 9.40, 11.18) reported they had fallen in the past month,

compared with 5.42% of non-medication users (95% CI 3.36, 7.48). For the outcome of “In the last month, did you worry about falling down?” 27.69% of medication users (95% CI 26.38, 28.99) reported worry about falling in the last month, compared with 9.15% of non-medication users (95% CI 6.54, 11.76). For the outcome of “In the last month, did this worry of falling every limit your activities?” 40.96% of medication users (95% CI 38.30, 43.62) reported that fall worry had limited their activities, compared with 21.21% of non-medication users (95% CI 9.51, 32.91). For the outcome of “In the last 12 months have you fallen down?” 22.82% of medication users (95% CI 21.51, 24.14), compared with 13.15% of non-medication users (95% CI 9.82, 16.48) had a fall in the past year (Table 2).

For respondents living in a private residence, 10.22% of medication users (95% CI 9.34, 11.11) reported they had fallen down in the past month, compared with 5.42% of non-medication users (95% CI 3.36, 7.48). Of the medication users, 27.51% (95% CI 26.20, 28.81) responded that they had worry about falling in the last month, compared with 9.16% of the nonmedication users (95% CI 6.54, 11.77). Of the medication users, 40.63% (95% CI 37.96, 43.29) responded that this fall worry had limited their activities, compared with 21.21% of the non-medication users (95% CI 9.51, 32.91). Of the medication users, 22.82% (95% CI 21.51, 24.14) reported they had fallen in the past year, compared with 13.15% (95% CI 9.82, 16.48) of non-medication users (Figure 1).

Comparisons in the two housing type categories of: 1) Group Home, Board and Care, or Supervised Housing and 2) Assisted Living Facility or Continuing Care Retirement Community were limited by the relative scarcity or absence of respondents of non-medication users for several of the outcomes. This precluded reliable statistical estimation in general for these housing-type categories. Group Home, Board and Care, or Supervised Housing did show increased frequency of reporting they had fallen in the past month, worry about falls in the past month, and having a fall in the past year. For the medication users, 25.81% (95% CI 0, 57.20) reported having fallen in the past month, compared with 0% of the non-medication users (95% CI 0, 0). For the medication

Table 2. Fall and Fall-Related Outcomes for Medication Users Compared with Non-Medication Users*

Outcome	Medication Use	
	Yes, % (95% CI)	No, % (95% CI)
Fallen in the last month	10.29 (9.40, 11.18)	5.42 (3.36, 7.48)
Worry about a fall in the last month	27.69 (26.38, 29.99)	9.15 (6.54, 11.76)
Limited by fall worry in the last month	40.96 (38.30, 43.62)	21.21 (9.51, 32.91)
Had a fall in the past year	22.82 (21.51, 24.14)	13.15 (9.82, 16.48)

Abbreviation: CI = Confidence interval.
 *(Survey weighted values)

users, 63.33% (95% CI 32.51, 94.15) reported having worried about a fall in the past month, compared with 0% of the non-medication users (95% CI 0, 0). For the medication users, 47.79% (95% CI 14.53, 81.05) reported having a fall in the past year, compared with 0% of the non-medication users (95% CI 0, 0).

Discussion

This analysis revealed that pharmacist concerns about increased fall risk in seniors who use medications are well-founded. There was nearly a doubling in falls within the past month for seniors who used medications, compared with non-medication users. Recent users of medications also reported a 10% increase in a past year fall. Equally of concern was evidence of worsened worry about falling and being limited because of worry about falling. Fear of falls in older adults has been isolated as an independent causal factor for impaired quality of life, increased anxiety, disability, and reduced mobility.¹⁵⁻¹⁹ It can also propel additional fall risk because of physical stability deconditioning.²⁰⁻²² It is evident that a cascade of poor outcomes increases in likelihood as fear of falls increases.

Seniors living in private residences produced consistent findings to those seen in the overall analysis. Given that they represented the bulk of the weighted

respondents, this is not surprising. These seniors live in a housing situation devoid of professional assistance, yet almost 25% of the medication users had fallen in the past year. More than 25% of seniors living in private residences who took medications reported worry about falling, and more than of 40% of those seniors reported being limited because of this worry about falling in the past month. Each of these percentages was markedly greater than their non-medication-using counterparts living in private residences.

Because of the relative absence of non-medication users in the categories of group home, board and care, or supervised housing and those living in assisted living facilities or continuing care retirement communities, robust statistical estimation of endpoints was not possible in those subgroup analyses.

The cross-sectional nature of this analysis does not allow causal linkage between medication use and falls to be confirmed. It does establish in a representative, national sample of seniors that medication users are at increased probability of falling and worrying about falls. This affirms the necessity of pharmacists to be involved in fall surveillance and prevention. Given the previously established pharmacologic factors that elevate fall risk, pharmacists must continue medication management in all settings to resolve drug-related problems. The inability

Figure 1. Comparison of Fall Outcomes for Medication Users Compared with Non-Medication Users in Private Residents***Private Residents**

*All pair-wise comparisons were statistically significant in frequency.

to perform comparative hypothesis testing in nonprivate resident settings because of lack of non-medication users reflects the virtual absolute use of medications in seniors in long-term care settings. This serves as a reminder that seniors in extended-care settings must be closely monitored for potential falls and mitigation of fall risk via medication management.

The findings in this study support previous investigations that demonstrated linkage between medications and falls. Tinetti et al. described the association between benzodiazepines, phenothiazines, and antidepressants with falls independent of the dementia and depression syndromes that led to the prescribing of the medications.²¹ This relatively small study of 335 community-dwelling seniors 75 years of age and older found an extremely large association between sedative use and falls in one year of follow-up with a statistically significant adjusted odds ratio (OR) of 28.3. While the small sample size in this multiple regression estimate likely contributed to the large OR, it nonetheless suggested a leading role of medications in the pathway to

falls. A 2014 analysis of polypharmacy and falls in community-dwelling adults 50 years of age and older from the Irish Longitudinal Study on Ageing identified increased adjusted odds of injurious falls for polypharmacy when the medication regimen included benzodiazepines (OR = 1.40) and antidepressants (OR = 1.51).²³ The fear of falling is a prevalent yet poorly understood condition among seniors that has been estimated to affect 55% to 60% of community-dwelling older adults.^{24,25} The

subsequent potential reduction in social interaction, increased inactivity, and depleted physical capability because of worry or fear of falling is postulated to negatively affect well-being both physically and mentally.²⁶ A 20-month prospective study of a subcohort of seniors from the Salisbury Eye Evaluation Project in Maryland found that taking four or more medications was predictive of incident fear of falling by study completion with an OR = 1.68. The investigators also observed that fear of falling at baseline was associated with subsequent falls during the follow-up period, illustrating the dangerous path from fear of falling to actual falls.²⁷ An analysis of type II diabetics found independent associations between use of antidepressants and age with fear-related limitation of outdoor activities.²⁸ Fear of falling will become a critical area of clinical study as the U.S. population ages. This study adds to the prior knowledge base by relating medications to falls and fall worry using a U.S. nationally representative cohort of adults.

Several means are available for pharmacist-provided fall-risk assessment. However, well-designed and better-

powered studies are needed to evaluate their effectiveness in reducing falls. Systematic review of programs that incorporate medication-related fall instruments to evaluate clinically meaningful outcomes is also lacking. The Agency for Healthcare Research and Quality has recommended The Medication Fall Risk Score as a simple instrument for converting a patient medication list to a risk score with score threshold for patients designated as “Higher risk for fall; evaluate patient.” Implementation of an interdisciplinary falls program at the Mercy Health Center in Oklahoma that utilized the Medication Fall Risk Score to evaluate and intervene observed a reduction in the injury fall rate in terms of falls per 1,000 patient-days from preimplementation mean rate of 2.06 falls to a postimplementation mean rate of 1.06 falls over a three-year period, though the authors did not evaluate for statistical significance.^{29,30} Additional medication-review-based risk assessments that focus on falls are the Screening Tool of Older Person’s Prescriptions criteria and High-Risk Medications in the Elderly list developed by The National Committee on Quality Assurance.³¹⁻³⁴ A randomized trial of hospitalized patients in Ireland evaluated the use of the Screening Tool of Older Person’s Prescriptions Criteria versus usual care for fall reduction as a secondary outcome. The percentage of falls was lower in the intervention group compared with the control group, but the differences were not statistically significant (5.8% of the Screening Tool of Older Person’s Prescriptions Criteria group and 8.4% of the usual-care group had at least one fall; $P = 0.41$).³⁵ The American Society of Consultant Pharmacists resource “Senior Care Pharmacy: Resources and Tools for Building a Successful Practice” includes the Home Assessment of Fall Risk Factors that incorporates medication assessment in a suite of fall-risk factors.³⁶ As pharmacists are routinely asked to review the complete medical record and to participate in fall-review panels with an interdisciplinary team, global fall-risk assessment instruments should also be considered and recommended by pharmacists. Two simple, validated instruments include the St. Thomas’s risk-assessment tool in falling elderly inpatients, which partitions subjects into low, moderate, and high fall-risk groups and the Morse Fall Scale that groups patients into

categories of no risk, low risk, moderate risk, and high risk.³⁷⁻³⁹ A before-after analysis conducted in geriatric in-hospital patients in Germany found a reduction in injurious falls with a statistically significant relative risk of injurious falls of 0.84 (95% CI 0.73, 0.92) when St. Thomas’s risk-assessment tool in falling elderly inpatients was incorporated into their fall-management program.⁴⁰ A nursing-led intervention in a Swiss hospital that incorporated the Morse Fall Scale into the fall-reduction program measured a reduction in fall risk for the intervention group. However, the results were not statistically significant with a relative risk of 0.73 (95% CI 0.47, 1.14).⁴¹ The Stopping Elderly Accidents Deaths and Injuries program for older adult fall prevention from the Centers for Disease Control and Prevention provides materials for providers and patients to reduce risk of falls as well as instruments for assessing fall risk.^{42,43}

After determination of increased fall risk has been confirmed via an evidence-based fall-risk metric, the pharmacist should probe the medication regimen for means of reducing FRID, altering dosing to reduce fall rate, or scripting counseling points that improve safe consumption by the patient.^{29,44} Gradual dose reduction (GDR) has been emphasized by the Centers for Medicare & Medicaid Services as an important aspect of medication management with focus on antipsychotics, sedative/hypnotics, and psychopharmacological medications such as benzodiazepines and anxiolytics, virtually all of which have fall relevance.^{9,45} General recommendations include GDR attempts twice in the first year for antipsychotic medications for dementia-related behaviors and psychiatric conditions and for psychopharmacological medications. Quarterly attempts at GDR are designated for sedative/hypnotics used past recommendation of manufacturer.⁴⁵ The Summary of the Updated American Geriatrics Society/British Geriatrics Society Clinical Practice Guideline for Prevention of Falls in Older Persons provides a useful algorithm for fall-risk assessment and also provides a comprehensive summary of interventions by setting.⁴⁶ Pharmacist-directed collaborations with other senior care health care workers have demonstrated reductions in use of potentially inappropriate medications linked to falls.⁴⁷ Maximizing

interdisciplinary efforts remains an important feature in fall prevention.

As previously described, this study was limited by the low number of non-medication users in the nonprivate resident housing types. Older adults living in skilled nursing facilities were not individually issued this version of the survey, so the fall percentages in those medication users was not available for estimation. Future analyses using health care administrative claims databases are currently being explored. Practice-based, randomized fall-risk intervention trials that measure validated fall outcomes are needed. The number of sleep medications for users was not captured in the subject responses. The item determining medication exposure was limited to past month use of medications. The outcomes items for falls included an item for "fall in the past year." It is therefore possible that the respondent was not taking the medication during the time he or she had this past-year fall. Hence, this measurement simply reflects the association between recent medication use and 12-month history of a fall.

It is important to consider the instrumental role that medications play in appropriate and evidence-based care of older adults. These study findings underscore the importance of senior care pharmacists in monitoring for fall risks caused by medications and to explore opportunities for identifying and reducing specific medications that elevate fall risk from medication regimen applying sound clinical judgment.

Conclusion

Older adults in the United States who used medications are more likely to have fallen than non-medication users. A greater percentage of medication users reported being worried about falling and being limited by this fall worry than were non-medication users. Pharmacist involvement in fall-risk assessment, prevention, and management strategies will be critical to fall mitigation as the U.S. population continues to age.

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