Association Between Sleep Medications and Falls and Fall-related Worries in Community-Dwelling Older Adults in the United States

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Abstract

Background

Falls are the leading cause of unintentional fatal and nonfatal injuries in seniors. Sleep medications are associated with adverse events risk in older adults. The objective of this study is to quantify the relationship between different levels of sleep medication use with falls and fall-related worries in United States adults aged 65 years and older using a nationally representative sample.

Methods

Using the 2011 National Health and Aging Trends Study, survey-weighted multiple logistic regression was used to determine the association between participants who reported sleep medication use and the outcomes: falls in the last month, falls in the last year, multiple falls in the last year, fall-related worries, and limitation of activities due to fall-related worries.

Results

In adjusted analyses, older adults who used sleep medications every night compared to non-users of sleep medications were at increased odds of falls in the last year with an odds ratio (OR) of 1.51 (95% confidence limit [CL] 1.27, 1.78) and of multiple falls with an OR = 1.67 (95% CL 1.35, 2.06). For those who used sleep medications less than every night compared to non-users, there were no statistically significant increased odds of fall outcomes. Older adults who used sleep medication most nights (5-6 nights per week) and every night compared to non-users had increased odds of having fall-related worries with an OR = 1.61 (95% CL 1.06, 2.45) and an OR = 1.32 (95% CL 1.11, 1.58), respectively.

Conclusion

Older adults who use sleep medication every night are at greater odds of experiencing falls and having fall-related worries. Increased involvement by pharmacists in the community setting and pharmacist-led comprehensive medication reviews are efforts that may reduce sleep medication use and result in fewer falls in older adults.

Keywords
accidental falls, aged, sleep/drug effects, hypnotics and sedatives

Introduction

Unintentional falls are the lead cause of both fatal and nonfatal injuries among adults aged 65 years and older. Roughly 20 to 30 percent of falls result in moderate to severe injuries, such as hip fractures, internal organ injuries, and head injuries. In addition, falls are associated with substantial functional decline, nursing home placement, and reduced quality of life in older adults. Hence, identifying and targeting risk factors for falls is necessary to reduce falls and improve patient well-being. Moreover, the United States is experiencing unprecedented growth in the number of older adults that will translate to people 65 years and over outnumbering those under 18 years by 2035. Insomnia and sleep difficulties are also common in adults aged 65 and older. Presence of chronic medical conditions, stress, and physiologic changes pose challenges for older adults to initiate and maintain sleep. Poor sleep is associated with impaired cognitive function, increased risk of medical and mental disorders, increased caregiver burden, and also increased risk of falls. Therefore, proper management of sleep disturbances is necessary. Current guidelines for the management of chronic insomnia from the American Academy of Sleep Medicine (AASM) and the American College of Physicians (ACP) generally recommend psychological and behavioral interventions, including cognitive behavioral therapy (CBT) for all patients with insomnia as first line treatment for insomnia in older adults. However, pharmacotherapy, both prescription and over-the-counter (OTC), are commonly used as first-line options to manage sleep problems in older adults despite associated risks.

Use of certain medications known as fall-risk increasing drugs (FRID) in seniors has been associated with increased odds of falls. Importantly, many of the offending medications are psychotropic drugs such as sedative-hypnotics, benzodiazepines, or antidepressants that are sometimes used for insomnia treatment. Yet, these pharmacologic treatments have shown little efficacy in improving sleep in seniors. In one meta-analysis, nonbenzodiazapine hypnotics, including zolpidem and eszopiclone, even at greater than normal doses were shown to improve total sleep time by a mere 11 minutes. The limited clinical benefit is also coupled with elevated risk attributable to adverse events in the aged population.

Both hypnotic and benzodiazepine use are found to impair cognitive and psychomotor function in the elderly, resulting in increased risk of hip fractures, automobile accidents, and symptoms of dementia. The minimal efficacy in insomnia treatment coupled with high adverse event profile has encouraged guidelines such as the American Geriatric Society’s Beers Criteria to discourage benzodiazepine and non-benzodiazapine hypnotics for
sleep in seniors. Similarly, many of the OTC medications used for sleep, including diphenhydramine and doxylamine, are also considered inappropriate in older adults because of the anticholinergic properties and the risk of developing tolerance and are not recommended by the AASM guideline and the Beers Criteria. Despite the evidence of adverse events and limited efficacy of hypnotics in seniors, these drugs continue to be routinely used in the older population. A population-level retrospective US study found that 8.7% of adults aged 65 to 80 years used benzodiazepines in 2008. Another study found new sleep medication prescriptions were initiated by 7.7% of adults aged 50 years and older.

In addition to FRID use, fear of falling (FOF) is an established risk factor for future falls. Patients often respond to FOF by limiting their activities leading to physical deconditioning. In addition, seniors with FOF generally have fewer social contacts, reduced mobility, and greater functional decline. History of falls have been shown to be an important factor associated with FOF, but FOF has also been shown to be prevalent in non-failers, indicating multiple causal factors.

Given the frequent sleep issues in older adults and continued prevalence of sleep medication use in this population, we sought to determine the association between sleep medication use, falls, and fall-related worries using a comprehensive, nationally representative dataset of community-dwelling older adults.

Methods

Study Design & Study Population

Round one data from the 2011 National Health and Aging Trends Study (NHATS) was used for this cross-sectional study. The NHATS is a publicly available resource for health researchers for the scientific study of functioning in later life. It is conducted by Johns Hopkins University Bloomberg School of Public Health and supported by the National Institute on Aging. In-person interviews by trained staff were used to collect data from a nationally represented sample of Medicare beneficiaries aged 65 years and older within the contiguous United States. Medicare beneficiaries represent 96% of all adults in the United States aged 65 years and over. The NHATS used a stratified three-stage sample design, with oversampling of non-Hispanic black and those aged 85 years and over, and the first sample was collected in 2011. Analytical weight was provided for each respondent to allow appropriate variance structure and standard errors for survey statistical estimation. More information about the NHATS study design and data collection is available online. Those who did not complete the in-person interview (N=168) and respondents that were missing values required for the regression model were excluded (N=519).

Outcome Variables

The outcomes of interests were those relating to falls and falls-related worries. The five primary outcome variables were based on the responses to the following items: 1) “In the last month have you fallen down?” 2) “In the last 12 months have you fallen down?” 3) “In the last 12 months have you fallen down more than one time?” 4) “In the last month did you worry about falling down?” 5) “In the last month, did this worry ever limit your activities?” Responses to each question were “yes” or “no.” In NHATS, a fall was defined as any fall, slip, or trip in which the participants lost balance and landed on the floor or ground at a lower level.

Exposure Variables

NHATS included one question regarding sleep medication use. The exposure variable was based on the response from the following item: “In the last month, how often did you take medication to help you sleep?” Categorical response options were every night, most nights (five to six nights per week), some nights (two to four nights per week), rarely (once a week or less), or never.

Of note, no definition of “medication to help you sleep” was included in the NHATS survey. At the time this survey was administered, suvorexant had not received FDA approval and is likely not represented in the survey data. Additionally, the sublingual dosage form of zolpidem was approved in 2011 and may not be reflected in the survey results.

Confounders

Demographic and personal characteristics that are potential influential factors for falls were adjusted for in this analysis. These confounders included age, self-identified race, gender, education, income, marital status, and smoking status. Age was categorized into five-year intervals, 65 to 69, 70 to 74, 75 to 79, 80 to 84, 85 to 89, and 90 years or older, as labeled in NHATS. Race was categorized into non-Hispanic white, non-Hispanic black, and others. Education was categorized into no education, less than high school, high school, more than high school, and do not know/refuse to answer. Total family income was based on the participant’s response, if available. For those with missing income data, an imputed income variable contained by NHATS was used. Income was then categorized into four categories (less than $15,000, $15,000 to less than $30,000, $30,000 to $60,000, and more than $60,000). Marital status was categorized into married/partner or other. Smoking status was categorized into non-smoker, current smoker, and past smoker.

Other risk factors for falls included environmental factors. In this study, environmental factors included as covariates were whether the participants lived alone and whether a walking aid (cane, walker, wheelchair, or scooter) is used. Both factors have been demonstrated to be risk factors for falls in previous studies. Medical factors including overall health status, body mass index (BMI) category, and the presence of a variety of health conditions were included as covariates. Patient self-reported their overall health and responses were dichotomized into excellent/very good/good versus fair/poor. BMI was calculated from height and weight measurement and categorized into underweight, normal, overweight, and obese, based on standard thresholds. Medical conditions used as covariates included heart attack, heart disease, high blood pressure, arthritis, osteoporosis, diabetes, lung disease, stroke, dementia, cancer, broken or fractured hip, other diseases, depressive symptoms, anxiety symptoms, vision impairment, and presence of pain.

Depressive symptoms and anxiety symptoms were determined using the validated instruments, the Patient Health Questionnaire-2 (PHQ-2) and General Anxiety Disorder Screener (GAD-2). Subjects were considered positive for depressive symptoms or anxiety symptoms if the scores for the two questions totaled three or greater. Participants were considered to have vision impairment if
Results

After applying survey weighting to the final sample size (N = 7,090), the sample represents 33,189,250 community-dwelling older adults in the United States. Population demographics are summarized in Table 1. In this population, 10.47% (95% CL 9.77, 11.23%) of older adults reported a fall in the last month, 29.94% (95% CL 28.74, 31.17%) reported a fall in the last year, and 13.49% (95% CL 12.78, 14.24%) reported more than one fall. For fall-related worries, 27.16% (95% CL 25.94, 28.41%) of the population reported worrying about falls in the last month and 11.41% (95% CL 10.52, 12.36%) reporting limiting their daily activities due to fall-related worries. Any sleep medication use was reported by 30.18% of the participants. Of those who reported sleep medication use, 41.39% reported using it every night.

Falls within the last year were more prevalent in certain groups. Fall prevalence increased with age and decreased with increasing education level. Falls were more frequent in women compared to men. Participants that were married or with a partner were less likely to experience a fall than those that were not. Falls were also more common in participants who rated their health as fair or poor compared to good/very good/excellent. Similar results were seen in participants with various comorbidities, with limitations in mobility, with limitations in ADLs, and with limitations in IADLs (See Table 1).

Table 2 reports unadjusted and adjusted ORs between sleep medication use, and the five outcomes of interest: falls in the last month, falls in the last year, multiple falls in the last year, fall-related worries, and limitations due to fall-related worries. Compared to those who reported no sleep medication use, those who reported sleep medication use had increased odds of fall in the last 12 months, multiple falls, fall-related worries, and limitations in daily activity in unadjusted analysis.

In adjusted analyses, no statistically significant association was seen between sleep medication use and falls in the last month compared to those who used no sleep medication in the last month. Statistically significant increased odds for falls in the last 12 months, multiple falls, and worry about falls was observed in those who used sleep medication every night compared to those who did not use sleep medication.
Table 1: Population characteristics for the total weighted population (N = 33,189,250) and divided into those who reported a fall in the last twelve months and those who did not report a fall

| Age Interval | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|--------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| 65-69        | 28.7 (27.7-29.7)                         | 29.7 (28.3-31.2)                                         | 26.1 (23.7-28.7)                                         | P < 0.0001  |
| 70-74        | 25.3 (24.4-26.2)                         | 26.7 (25.4-28.1)                                         | 22.0 (20.2-24.1)                                         | P < 0.0001  |
| 75-79        | 19.1 (18.2-20.0)                         | 19.2 (18.0-20.3)                                         | 18.9 (17.2-20.8)                                         | P = 0.1176  |
| 80-84        | 14.4 (13.7-15.1)                         | 13.6 (12.6-14.7)                                         | 16.1 (14.9-17.5)                                         | P < 0.0001  |
| 85-89        | 8.7 (8.0-9.3)                            | 7.5 (6.8-8.2)                                            | 11.5 (10.0-13.1)                                         | P < 0.0001  |
| 90+          | 3.9 (3.5-4.4)                            | 3.4 (2.9-3.9)                                            | 5.3 (4.5-6.2)                                            | P < 0.0001  |

| Gender       | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|--------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| Male         | 44.0 (42.6-45.4)                         | 46.1 (44.3-47.8)                                         | 39.1 (36.8-41.5)                                         | P < 0.0001  |
| Female       | 56.0 (54.6-57.4)                         | 53.9 (52.2-55.7)                                         | 60.9 (58.5-63.2)                                         | P < 0.0001  |

| Race         | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|--------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| Non-Hispanic white | 80.7 (78.9-82.4)               | 80.0 (78.1-81.8)                                         | 82.3 (79.7-84.6)                                         | P = 0.1176  |
| Non-Hispanic black  | 8.01 (7.2-8.9)                 | 8.3 (7.5-9.3)                                             | 7.2 (6.4-8.2)                                            | P < 0.0001  |
| Others        | 11.3 (9.8-13.0)                         | 11.6 (10.1-13.4)                                         | 10.3 (8.4-13.0)                                          | P < 0.0001  |

| Marital Status | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|----------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| Married/together | 58.1 (56.7-59.5)          | 60.7 (59.1-62.3)                                         | 51.9 (49.1-54.7)                                         | P < 0.0001  |
| Other          | 41.9 (40.5-43.3)                         | 39.3 (37.7-40.9)                                         | 48.1 (45.3-50.8)                                         | P < 0.0001  |

| Education      | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|----------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| Less than high school | 10.3 (9.1-11.7)          | 9.1 (8.0-10.4)                                           | 13.2 (11.1-15.5)                                         | P < 0.0001  |
| High School     | 38.3 (36.6-40.0)                         | 38.6 (36.7-40.6)                                         | 37.5 (35.2-40.0)                                         | P < 0.0001  |
| More than high school | 50.2 (48.1-52.3)          | 51.1 (48.8-53.3)                                         | 48.3 (45.5-51.0)                                         | P < 0.0001  |
| Do not know/ refuse to answer | 12 (0.7-1.8)            | 12 (0.8-1.8)                                             | 11 (0.5-2.1)                                             | P < 0.0001  |

| Income Category | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|-----------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| <$15,000        | 20.5 (19.0-22.1)                         | 18.6 (17.1-20.2)                                         | 24.9 (22.5-27.4)                                         | P < 0.0001  |
| $15,000-$29,000 | 24.7 (23.3-26.1)                         | 23.7 (22.2-25.2)                                         | 27.0 (25.0-29.2)                                         | P < 0.0001  |
| $30,000-$60,000 | 28.6 (27.2-30.0)                         | 29.4 (27.9-30.9)                                         | 26.7 (24.0-29.6)                                         | P < 0.0001  |
| >$60,000        | 26.3 (24.4-28.2)                         | 28.3 (26.5-30.2)                                         | 21.4 (18.6-24.5)                                         | P < 0.0001  |

| Smoking Status | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|----------------|------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|-------------|
| Non-smoker     | 47.3 (45.6-49.0)                         | 47.1 (45.3-48.9)                                         | 47.8 (45.5-50.1)                                         | P = 0.7683  |
| Past-smoker    | 44.2 (42.5-46.0)                         | 44.5 (42.5-46.4)                                         | 43.6 (41.2-46.0)                                         | P < 0.0001  |
| Current smoker | 8.5 (7.7-9.4)                            | 8.4 (7.5-9.5)                                            | 8.7 (7.2-10.4)                                           | P < 0.0001  |
|                        | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|------------------------|------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------|--------------|
| **Lived Alone**         |                                           |                                                        |                                                               |              |
| With someone            | 71.1 (69.8-72.4)                          | 72.3 (70.9-73.6)                                       | 68.4 (65.7-70.9)                                              | P = 0.0069   |
| Alone                   | 28.9 (27.7-30.2)                          | 27.7 (26.4-29.1)                                       | 31.7 (29.1 - 34.3)                                            |              |
| **Walking Aid**         |                                           |                                                        |                                                               |              |
| None                    | 76.9 (75.8-78.0)                          | 83.8 (82.8-84.9)                                       | 60.8 (58.3-63.1)                                              | P < 0.0001   |
| Cane/walker             | 16.3 (15.3-17.3)                          | 12.2 (11.3-13.2)                                       | 25.8 (23.9-27.8)                                              |              |
| Wheelchair              | 4.5 (4.0-5.1)                             | 2.6 (2.2-3.1)                                          | 9.0 (7.6-10.5)                                                |              |
| Scooter                 | 2.3 (1.9-2.7)                             | 1.3 (1.0-1.7)                                          | 4.5 (3.5-5.8)                                                 |              |
| **Overall Health**      |                                           |                                                        |                                                               |              |
| Excellent/very good/good| 75.1 (73.7-76.5)                          | 80.3 (78.7-81.8)                                       | 63.0 (60.2-65.7)                                              | P < 0.0001   |
| Fair                    | 18.2 (17.1, 19.3)                         | 15.4 (14.2-16.7)                                       | 24.7 (22.8-26.7)                                              |              |
| Poor                    | 6.7 (5.9, 7.6)                            | 4.3 (3.6-5.1)                                          | 12.3 (10.6-14.1)                                              |              |
| **BMI**                 |                                           |                                                        |                                                               |              |
| Underweight             | 2.2 (1.9-2.5)                             | 1.7 (1.4-2.1)                                          | 3.2 (2.6-3.9)                                                 | P = 0.006    |
| Normal                  | 30.7 (29.3-32.1)                          | 31.3 (29.6-33.1)                                       | 29.1 (26.9-31.6)                                              |              |
| Overweight              | 36.9 (35.7-38.2)                          | 37.6 (36.0-39.1)                                       | 35.3 (32.9-37.8)                                              |              |
| Obese                   | 30.3 (28.7-32.0)                          | 29.4 (27.8-31.0)                                       | 32.3 (29.7-35.1)                                              |              |
| **Heart Attack**        |                                           |                                                        |                                                               |              |
| Heart Disease           | 14.0 (13.0-15.0)                          | 12.3 (11.3-13.4)                                       | 17.9 (15.9-20.1)                                              | P < 0.0001   |
| Stroke                  | 17.3 (16.3-18.4)                          | 15.0 (13.8-16.3)                                       | 22.6 (20.7-24.6)                                              |              |
| **Hypertension**        |                                           |                                                        |                                                               |              |
| Arthritis               | 9.9 (9.1-10.8)                            | 7.8 (71-8.6)                                           | 14.8 (13.2-16.5)                                              | P < 0.0001   |
| Osteoporosis            | 63.7 (62.3-65.0)                          | 61.8 (60.3-63.3)                                       | 68.1 (65.8-70.23)                                             |              |
| Diabetes                | 53.5 (52.1-54.9)                          | 48.5 (47.1-49.9)                                       | 65.2 (62.7-67.7)                                              |              |
| Lung Disease            | 20.9 (20.0-21.9)                          | 18.1 (16.9-19.4)                                       | 27.5 (25.6-29.5)                                              |              |
| Dementia                | 23.9 (22.6-25.1)                          | 21.5 (20.2-22.9)                                       | 29.3 (27.2-31.5)                                              |              |
| Cancer                  | 15.4 (14.4-16.4)                          | 13.4 (12.3-14.5)                                       | 20.0 (18.7-21.3)                                              |              |
| Hip Fracture            | 4.1 (3.7-4.6)                             | 2.6 (2.2-3.2)                                          | 7.6 (6.4-8.8)                                                 |              |
| Pain                    | 25.8 (24.7-27.1)                          | 24.9 (23.4-26.5)                                       | 28.1 (26.2-30.0)                                              |              |
| Other Disease           | 4.0 (3.5-4.5)                             | 2.9 (2.4-3.5)                                          | 6.4 (5.3-7.6)                                                 |              |
| Anxiety Symptoms        | 52.8 (51.3-54.2)                          | 46.3 (44.5-48.0)                                       | 68.1 (65.5-70.6)                                              |              |
| Depressive Symptoms     | 30.0 (28.3-31.8)                          | 27.2 (25.3-29.1)                                       | 36.5 (34.0-39.2)                                              |              |
|                        | 44.0 (42.6-45.4)                          | 38.0 (36.3-39.8)                                       | 57.9 (55.4-60.3)                                              |              |
|                        | 43.8 (42.5-45.2)                          | 37.7 (36.1-39.2)                                       | 58.3 (55.7-61.0)                                              |              |
| Vision Impairment Mobility disability index Score | Total Population % (95% confidence limit) | No falls in the last 12 months % (95% confidence limit) | At least 1 fall in the last 12 months % (95% confidence limit) | Chi² P-value |
|-----------------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|--------------|
| 0                                             | 5.3 (4.7-5.9)                          | 4.0 (3.4-4.7)                          | 8.2 (7.1-9.5)                          | P < 0.0001   |
| 1                                             | 2.1 (1.7-2.7)                          | 1.0 (0.7-1.5)                          | 4.6 (3.6-5.8)                          | P < 0.0001   |
| 2                                             | 4.0 (3.5-4.5)                          | 2.1 (1.7-2.7)                          | 8.3 (7.0-9.8)                          |              |
| 3                                             | 3.7 (3.3-4.1)                          | 2.5 (2.2-3.0)                          | 6.4 (5.4-7.4)                          |              |
| 4                                             | 3.0 (2.6-3.5)                          | 2.1 (1.7-2.5)                          | 5.3 (4.3-6.4)                          |              |
| 5                                             | 3.4 (3.0-3.8)                          | 2.3 (1.9-2.7)                          | 5.9 (4.9-7.1)                          |              |
| 6                                             | 3.3 (2.9-3.8)                          | 2.8 (2.4-3.2)                          | 4.6 (3.8-5.4)                          |              |
| 7                                             | 3.4 (3.0-3.8)                          | 2.8 (2.4-3.3)                          | 4.7 (3.9-5.7)                          |              |
| 8                                             | 3.8 (3.3-4.3)                          | 3.5 (2.9-4.1)                          | 4.4 (3.7-5.3)                          |              |
| 9                                             | 4.5 (4.0-5.1)                          | 4.1 (3.5-4.8)                          | 5.4 (4.4-6.6)                          |              |
| 10                                            | 6.0 (5.2-6.8)                          | 5.7 (4.9-6.7)                          | 6.6 (5.3-8.1)                          |              |
| 11                                            | 9.9 (9.2-10.7)                         | 10.3 (9.5-11.2)                        | 9.1 (7.8-10.6)                         |              |
| 12                                            | 18.0 (17.0-19.1)                       | 19.7 (18.4-20.9)                       | 14.2 (12.6-16.1)                       |              |
|                                               | 35.1 (33.7-36.5)                       | 41.2 (39.7-42.8)                       | 20.7 (18.2-23.5)                       |              |

| Impairments ADLs | None | 1-2 | 3-5 |
|------------------|------|-----|-----|
| 70.6 (69.4-71.8) | 78.1 (76.8-79.3) | 53.2 (50.7-55.7) |
| 20.2 (19.3-21.1) | 16.6 (15.6-17.6) | 28.6 (26.4-30.9) |
| 9.2 (8.5-9.9)   | 5.3 (4.7-6.0)    | 18.2 (16.4-20.1) |

| Impairments IADLs | None | 1-2 | 3-5 |
|-------------------|------|-----|-----|
| 28.7 (27.3-30.1)  | 31.7 (30.0-33.3) | 21.6 (19.7-23.7) |
| 34.9 (33.5-36.3)  | 36.5 (35.0-39.1) | 31.1 (28.7-33.5) |
| 36.5 (34.9-38.1)  | 31.8 (30.1-33.6) | 47.3 (44.5-50.1) |

| Sleep Medication Use Frequency | None | Rarely (once a week or less) | Some (2 to 4 nights per week) | Most (5 to 6 nights per week) | Everyday |
|-------------------------------|------|-----------------------------|-------------------------------|-------------------------------|----------|
| Total Population % (95% confidence limit) | 69.8 (68.5-71.1) | 7.9 (7.2-8.7) | 6.9 (6.2-7.6) | 2.9 (2.5-3.5) | 12.5 (11.6-13.5) |
| No falls in the last 12 months % (95% confidence limit) | 73.7 (72.4-74.9) | 8.0 (7.0-9.1) | 6.5 (5.7-7.4) | 2.5 (2.1-3.1) | 9.4 (8.5-10.4) |
| At least 1 fall in the last 12 months % (95% confidence limit) | 60.9 (57.9-63.8) | 7.7 (6.6-8.9) | 7.8 (6.6-9.3) | 3.8 (2.9-5.0) | 19.8 (17.8-21.9) |
| Chi² P-value | P < 0.0001 | P < 0.0001 | P < 0.0001 | P < 0.0001 | P < 0.0001 |
Table 2: Results from unadjusted and adjusted multiple logistic regression for the exposure sleep medication use frequency and the five falls-related outcomes

| Sleep Medication Use Frequency | Unadjusted Odds Ratio (95% confidence limit) | Adjusted a Odds Ratio (95% confidence limit) |
|--------------------------------|----------------------------------------------|----------------------------------------------|
| **Outcome: Falls in the last month** |                                              |                                              |
| None                           | Reference 1.143 (0.857-1.524)                | Reference 1.038 (0.761-1.416)                |
| Rarely (once a week or less)   | 1.333 (0.871-2.039)                          | 1.075 (0.687-1.681)                          |
| Some Nights (2 to 4 nights per week) | 1.395 (0.995-1.957)                          | 1.001 (0.682-1.469)                          |
| Most Nights (5 to 6 nights per week) | 2.241 (1.744-2.880)*                          | 1.299 (0.984-1.714)                          |
| Every Night                    |                                              |                                              |
| **Outcome: Falls in the last 12 months** |                                              |                                              |
| None                           | Reference 1.162 (0.907-1.489)                | Reference 0.987 (0.769-1.268)                |
| Rarely (once a week or less)   | 1.464 (1.142-1.878)*                         | 1.119 (0.865-1.446)                          |
| Some Nights (2 to 4 nights per week) | 1.835 (1.330-2.523)*                         | 1.325 (0.935-1.878)                          |
| Most Nights (5 to 6 nights per week) | 2.553 (2.188-2.979)*                         | 1.505 (1.269-1.784)*                         |
| Every Night                    |                                              |                                              |
| **Outcome: Multiple falls in the last 12 months** |                                              |                                              |
| None                           | Reference 1.221 (0.937-1.592)                | Reference 1.069 (0.775-1.476)                |
| Rarely (once a week or less)   | 1.755 (1.293-2.383)*                         | 1.298 (0.931-1.809)                          |
| Some Nights (2 to 4 nights per week) | 2.122 (1.403-3.213)*                         | 1.517 (0.953-2.416)                          |
| Most Nights (5 to 6 nights per week) | 3.262 (2.752-3.867)*                         | 1.670 (1.353-2.062)*                         |
| Every Night                    |                                              |                                              |
| **Outcome: Fall-related worries** |                                              |                                              |
| None                           | Reference 1.450 (1.152-1.825)*               | Reference 1.214 (0.933-1.580)                |
| Rarely (once a week or less)   | 1.545 (1.177-2.028)*                         | 1.070 (0.695-1.440)                          |
| Some Nights (2 to 4 nights per week) | 2.508 (1.726-3.643)*                         | 1.608 (1.056-2.449)*                         |
| Most Nights (5 to 6 nights per week) | 2.803 (2.384-3.294)*                         | 1.323 (1.111-1.576)*                         |
| Every Night                    |                                              |                                              |
| **Outcome: Limitations due to fall-related worries** |                                              |                                              |
| None                           | Reference 1.448 (1.071-1.957)*               | Reference 1.256 (0.857-1.841)                |
| Rarely (once a week or less)   | 1.718 (1.275-2.314)*                         | 1.096 (0.790-1.521)                          |
| Some Nights (2 to 4 nights per week) | 2.423 (1.488-3.947)*                         | 1.508 (0.874-2.602)                          |
| Most Nights (5 to 6 nights per week) | 3.193 (2.854-3.945)*                         | 1.213 (0.958-1.535)                          |

*Model included adjustment for age, race, gender, education, income, marital status, smoking status, whether the patient lived alone, use of a walking aid, health status, BMI, a number of health conditions listed in the methods section, impairments in ADL, impairments IADL, and an index for mobility disability.

*Indicates confidence limit does not cross 1.0
Pharmacists should be aware of the benefits and risks of pharmacologic treatment for insomnia. The Beers list to be avoided in older adults recognizes hypnotics as having a high risk for adverse events in older adults and are recommended by the 2015 ACP recommendations for sleep aids. The pharmacist should perform a comprehensive interview in adults seeking sleep aids. The ACP recommends less than five weeks of use for these pharmacological therapies. The AASM considers these pharmacologic agents (at lower doses) to be appropriate in older adults; however, these hypnotics are recognized to have a high risk for adverse events in older adults and are recommended by the 2015 ACP recommendations for sleep aids. Therefore, the benefits and risks of pharmacologic treatment for insomnia in older adults need to be individually assessed based on the severity of insomnia, comorbidities, and the potential for adverse effects and drug-drug interactions.

Based on current guidelines, we believe sleep medication should be initiated only in older adults who failed behavioral therapy. In addition, sleep medication should only be used short-term in most patients. Patients who are taking sleep medication chronically, defined as greater than five weeks, are at elevated risk of inappropriate therapy management. Older adults on chronic sleep medication should reassess frequently with their providers to determine if they need to continue on sleep medication or if non-pharmacologic measures can be applied.

In this nationally representative study, almost one-third of seniors reported using medication to help with sleep, and almost one in every eight older adults use sleep medication every night with an increased likelihood of falling. Pharmacists are uniquely positioned at the time of dispensing to educate patients on adverse effects of sleep medications, potential drug-drug interactions, assess if their medication therapy is appropriate, and to provide information regarding sleep hygiene to help improve sleep. Patient education on sleep hygiene and other non-pharmacologic therapy have been shown to reduce sleep latency, improve sleep efficacy, and reduce frequency in hypnotic drug use in adults. Pharmacists can also potentially identify contributing medications, comorbidities, and behaviors that may be playing a role in the patient’s sleep disturbance and encourage patients to talk to their doctor about the potential for deprescribing and tapering off potentially inappropriate medication use.

While the NHATS data does not provide details regarding the specific medications to help with sleep, previous studies shown that both prescription and OTC sleep medication are commonly used in older adults. Both prescription and OTC medications used for sleep are associated with increased risk of adverse events, therefore increased efforts to identify inappropriate use of sleep medication and encouraging reduce use of sleep medication may improve outcomes.

Since pharmacists are routinely the sole health care providers who interact with patients regarding OTC medication use, they are in a critical position to consult with patients regarding appropriate medication use and to provide an alternative, non-pharmacologic sleep treatment options. While some adults may visit a health care provider regarding their sleep issues, many adults may choose instead to self-treat. One study found that more than two million adults over 60 years of age take OTC sleep medication at least once a month, with one-third using it more than 20 days in a month. Similarly, other studies found that 7 to 15% of older adults use non-prescribed sleeping pills. The Gerontological Society of America (GSA) points out that pharmacists have an important role in guiding adults seeking sleep aids. Pharmacists should perform a comprehensive interview in adults seeking recommendations for sleep aids. The pharmacist should seek to understand the type, frequency, and severity of the patient’s sleep issues, identify medical comorbidities and medications that may be causing or contributing to the sleep issues. Pharmacists should educate the patient on sleep hygiene and make suggestions on nonpharmacological changes the patient can attempt to improve their sleep challenges. In a previous study, 62% of older adults who took sleep medications containing diphenhydramine or doxylamine were unaware of the safety risks of these medications.
OTC sleeping aids about possible side effects, pharmacists can contribute to the reduction in potentially inappropriate use of OTC sleep medications.

In addition, pharmacist-led medication reviews have the potential to identify patients with potentially inappropriate sleep medication use and target them for intervention. The objectives of medication review are to provide patient education, improve adherence, ensure all syndromes receive appropriate therapy, identify duplicate and potentially inappropriate medication use of both prescription and OTC medications, and identify adverse drug reactions.\textsuperscript{14,24} Medication review can help identify medication-related issues and develop interventions to improve patient health. A randomized, controlled, multicenter trial of 65 care homes (nursing, residential, and mixed) in the United Kingdom showed pharmacist clinical review led to more drug changes and a decrease in falls compared to controls with 0.8 to 1.3 falls per patient (p<0.01).\textsuperscript{44} A separate study found that community pharmacy-based medication review in older adults led to reduced drug-related problems with a mean reduction of 16.3\% compared to patients without medication review.\textsuperscript{45} These reviews must be comprehensive with a review of all of the medications, assessment of adherence to the medications, and screening for potential drug-drug interactions, duplications in therapy or medications without an appropriate indication. Systematic pharmacist-led medication reviews hold promise to identify patients where a reduction in sleep medication use can be attempted to reduce drug-related falls in older adults.

Limitations

Due to the cross-sectional design of the study, causality between medications used for sleep and falls in seniors cannot be determined. Rather, this study illustrates an association. Specific information about the therapeutic category, medication name, dose, and length of use is not provided in the NHATS. This database does not provide detail regarding whether the drug treatment is indicated. Also, no statistically significant relationship was shown between sleep medication use and fall risk within one month or limitations due to fall-related worries in one month. It is possible that individuals who have fallen within the past month were actually hospitalized or died and there may be a potential bias in measuring long-term outcomes over short-term outcomes in the study.

Conclusion

This study associates the use of medication for sleep with an increased probability of falls and fall-related worries in older adults. Pharmacists can play a critical role in ensuring appropriate sleep medication use and insomnia management for older adults by providing education regarding adverse effects and sleep hygiene. Increased pharmacist involvement with seniors initiating sleep medication in the community setting has the potential to reduce medication misuse. In addition, identifying inappropriate sleep medication use through effective pharmacist-led medication reviews by pharmacists and suggesting appropriate interventions to educate and encourage discontinuation these medications may reduce drug-induced falls in older adults.

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