HHS Public Access

Author manuscript

Ann Emerg Med. Author manuscript; available in PMC 2024 December 01.

Published in final edited form as:

Ann Emerg Med. 2023 December ; 82(6): 666–677. doi:10.1016/j.annemergmed.2023.04.013.

Emergency Department Visits for Alcohol-Associated Falls Among Older Adults in the United States, 2011 to 2020

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Abstract

Study objective: The aim of this study was to examine the epidemiology of alcohol-associated fall injuries among older adults aged ≥65 years in the United States.

Methods: We included emergency department (ED) visits for unintentional fall injuries by adults from the National Electronic Injury Surveillance System-All Injury Program during 2011 to 2020. We estimated the annual national rate of ED visits for alcohol-associated falls and the proportion of these falls among older adults' fall-related ED visits using demographic and clinical characteristics. Joinpoint regression was performed to examine trends in alcohol-associated ED

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Author contributions: Both KY and TH had full access to all study data and take responsibility for its integrity and accuracy of analysis. KY, YH, RL, IS, TH, LN, LZ, YL, and GB conceived and designed the study, interpreted the data, critically revised the manuscript, and reviewed and approved the final manuscript. KY and TH performed data and statistical analysis. KY, YH, and IS drafted the manuscript. IS, GB, and RL supervised the study. KY takes responsibility for the paper as a whole.

Authorship: All authors attest to meeting the four ICMJE.org authorship criteria: (1) Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND (2) Drafting the work or revising it critically for important intellectual content; AND (3) Final approval of the version to be published; AND (4) Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data sharing statement: We have decided not to share the data associated with our study, as it contains sensitive and private information. Although the NEISS-AIP data used in our study are publicly available, the case "narratives" that were utilized to extract alcohol information have been suppressed for confidentiality reasons.

Presentation information: We had partial presentation of results in a podium presentation at the annual conference of the Gerontological Society of America in Indianapolis, Indiana, on November 2, 2022.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

fall visits between 2011 and 2019 among older adult age subgroups and to compare these trends with those of younger adults.

Results: There were 9,657 (weighted national estimate: 618,099) ED visits for alcohol-associated falls, representing 2.2% of ED fall visits during 2011 to 2020 among older adults. The proportion of fall-related ED visits that were alcohol-associated was higher among men than among women (adjusted prevalence ratio [aPR]=3.6, 95% confidence interval [CI] 2.9 to 4.5). The head and face were the most commonly injured body parts, and internal injury was the most common diagnosis for alcohol-associated falls. From 2011 to 2019, the annual rate of ED visits for alcohol-associated falls increased (annual percent change 7.5, 95% CI 6.1 to 8.9) among older adults. Adults aged 55 to 64 years had a similar increase; a sustained increase was not detected in younger age groups.

Conclusion: Our findings highlight the rising rates of ED visits for alcohol-associated falls among older adults during the study period. Health care providers in the ED can screen older adults for fall risk and assess for modifiable risk factors such as alcohol use to help identify those who could benefit from interventions to reduce their risk.

INTRODUCTION

Background

Falls disproportionately affect adults aged 65 years and older. In the United States, more than 1 in 4 older adults report a fall each year.[1] There were 36.7 million falls and 8.9 million fall-related injuries reported in 2020.[1] Annually, older adult fall injuries account for more than 3 million emergency department (ED) visits and cost the US health care system $50 billion with 2 publicly funded payors, Medicare and Medicaid, paying three quarters of the cost.[2,3] The US older adult population is expected to increase from 59 million in 2020 to 74 million by 2030, resulting in an estimated 52 million falls and 12 million fall-related injuries.[4,5]

Gait and balance disorders and the use of medications that affect cognition and physical function are associated with a higher risk of falling or with sustaining an injury from a fall among older adults.[6] Additionally, alcohol consumption may contribute to fall risk as it can lead to gait and balance impairments and cognitive changes.[7] Physiologic changes that occur with advancing age (such as reduced liver function and reduced total body water) make older adults more susceptible to adverse events from substances including medications and alcohol.[8]

Importance

Alcohol use among older adults is increasing. A meta-analysis found that average annual percentage increases in the prevalence of alcohol use and binge drinking (4 or more drinks for women and 5 or more drinks for men on an occasion) were nearly 1% and 3.4% per year, respectively, among adults aged ≥65 years between 2000 and 2016.[9] More recent literature suggest that the prevalence of binge drinking among older men continued to increase significantly from 12.8% in 2015 to 15.7% in 2019 but remained stable for older women (7.6% to 7.3%).[10] Despite the potential effects on physical and cognitive function,

the association of alcohol consumption with fall risk among older adults remains unclear. This uncertainty is due to mixed research findings, limited study on older adults, and the challenges in measuring alcohol consumption prior to a fall.[11–14] However, recent studies on fall injuries among older adults showed an association between the risk of a fall injury and drinking to the point of intoxication,[11] and more head injuries when alcohol is involved in the fall.[15,16] Many studies have looked at the relationship between alcohol consumption and falls in the overall population. A meta-analysis showed that the odds of a fall-related injury increased by 1.25 with every 10-g increase in alcohol consumption.[17] A study using ED data from 18 countries showed a similar dose-response relationship.[18]

Goals of This Investigation

We examined fall-related ED visits using demographic and injury characteristics from 2011 to 2020 and categorized the ED visits for alcohol-associated falls to improve our understanding of the attributes of older adults with alcohol-associated fall-related injuries. We also examined trends in the crude rates of ED visits for alcohol-associated falls from 2011 to 2019 among older adults compared with younger adult age groups. We excluded 2020 data from the trend analysis owing to the effect of the coronavirus disease 2019 pandemic and reduced access to and use of EDs.[19,20] Understanding alcohol use as a potential contributor to fall injuries among older adults can better inform prevention efforts.

MATERIALS AND METHODS

Study Design and Setting

We used data for this cross-sectional study from the National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP). The US Consumer Product Safety Commission operates the system in collaboration with the Centers for Disease Control and Prevention (CDC). NEISS-AIP collects data on all first-time visits for nonfatal injuries treated in a sample of US hospital EDs. The NEISS-AIP sample contains 65 hospitals, a stratified random sample from a pool of around 5,000 hospitals across the United States. Data are weighted by the inverse of the probability of selection to produce national estimates.[21] Trained onsite hospital coders collect data for injury-related ED cases from medical records at NEISS-AIP sample hospitals. Key variables are coded and these data, as well as a brief narrative that summarizes information about how the injury was sustained, are entered into a computer and electronically transmitted to Consumer Product Safety Commission. NEISS-AIP quality assurance coders at the Consumer Product Safety Commission review all data elements and narratives, then classify the cause of injury for each case.

Selection of Participants

We included ED visits among patients aged 21 years (the minimum legal drinking age in the United States[22]) and older with unintentional fall injuries from January 1, 2011, through December 31, 2020. Older adults were defined as patients who were 65 years of age or older. A fall-related ED visit was considered alcohol-associated if the visit narrative included terms such as alcohol, drinking, blood alcohol concentration, ethanol, intoxication, alcohol on breath, or if the name of any type of alcoholic beverage was mentioned.[16] All fall-related visits among older adults in the 2015 NEISS-AIP data set were identified in

a previously published study (n=38,654) and the narratives were manually reviewed by 4 scientists for any mention of alcohol consumption; detailed methodology on manual coding and codebook development were previously described by Shakya et al.[16] We used this previously coded data set as the ground-truth data set and developed a hybrid approach that combined a machine learning model and a rule-based natural language processing tool to extract information.

The machine learning model architecture was based on DistilBERT,[23] a lighter and faster version of BERT (Bidirectional Encoder Representations from Transformers),[24] a transformer-based pretrained natural language model that encodes both semantics learning model and the rich latent structure of sentences and has documented performance on subtle classification tasks.[25,26] We fine-tuned the DistilBERT model by training it on the ground-truth data set and then used it to predict alcohol involvement for all other fall injury narratives from the 2011 to 2020 data.

We developed the rule-based tool using a regular expression syntax that was based on both subject matter expert input and a manual review of the ground-truth data set for fall-related visits. The set of rules included terms that represent alcohol in the text (eg, alcohol and ethanol) and the negation patterns that exclude the case (eg, deny alcohol and quit drinking). The full set of rules is described in Appendix E1 (available at http://www.annemergmed.com). We applied both models to all narratives for fall-related visits. All conflicting results between the rule-based model and the machine learning model were manually reviewed by 4 scientists. Disagreements between reviewers were resolved by consensus. We performed error analyses and iteratively revised and reran both models to improve classification accuracy.

NEISS-AIP assigns up to 3 product codes per case. As a final validation step, we compared our hybrid model results with the product code “1903” (alcoholic beverage) to verify alcohol involvement. Of the 910,357 fall-related ED visits, there were 2,053 (0.2%) conflicting cases between our model results and product code. Two scientists manually reviewed each conflicting case. One hundred ninety-four (194/2,053=9.4%) model results were changed after the review.

Outcome Measures and Variables

The outcomes of interest were the annual national crude rates of ED visits for alcohol-associated falls over the study period (2011 to 2020) and the changes in this rate annually from 2011 to 2019 by age group and sex. We excluded 2020 data from the trend analysis owing to the effect of coronavirus disease 2019 pandemic on health care access and utilization.[19,20] We also assessed the proportion of alcohol-associated falls among older adults, fall-related ED visits by demographic characteristics (age group and sex), the time of visit (day and season of treatment), injury characteristics (diagnosis, the primary body part injured, and traumatic brain injury), and the disposition of patients.

Treatment date was grouped by season and treatment day (weekdays and weekends). Injury diagnosis and the primary body part injured were grouped using the modified Barell Matrix, which classifies injuries based on body region.[27] The injury diagnosis was regrouped as

internal injury (including injuries to the brain, abdominal organs, and thoracic organs that are not due to aspiration or ingestion), flesh wound injury (laceration, puncture wound, and avulsion), superficial injury (contusion, abrasion, and hematoma), fracture/dislocation, and other (strain/sprain, burn, amputation, foreign body, nerve damage, and dental injury). The primary body part injured was regrouped as the head, face (including eyeballs, the mouth, and ears), upper extremity (including shoulders, upper arms, elbows, lower arms, wrists, hands, and fingers), lower extremity (including upper and lower legs, knees, ankles, feet, and toes), upper trunk (including the neck), lower trunk (including the pubic region, which would contain pelvis and hip), and other (including internal, 25% to 50% of the body, and all parts of the body). A case was considered a possible traumatic brain injury if the primary body part injured was the head and the diagnosis was internal injury or concussion, as the definition of traumatic brain injury varies in the literature.[28,29] Patient disposition categories were regrouped as treated and released, transferred/hospitalized, and other (held for observation, left without being seen).

Analysis

We used Python version 3.8 (Python Software Foundation) to develop the machine learning model and rule-based regular expression algorithms to identify ED visits for alcohol-associated falls. We conducted statistical analyses using SAS-callable SUDAAN, version 11.0.3 (RTI International), accounting for sample weights and the NEISS-AIP complex survey design. Unweighted counts, weighted national estimates, percentages, and 95% confidence intervals (CIs) were calculated to describe demographic and injury characteristics of the study sample. We used the SUDAAN RLOGIST procedure to estimate adjusted prevalence ratios (aPRs) with CIs to assess the proportion of ED fall visits that were alcohol-associated in each demographic and injury characteristic category, divided by the proportion in the referent group, adjusted for sex and age group.

For the trend analysis, we reported rates during 2011 to 2019. We used US Census Bureau population estimates as the denominator to calculate age-specific rates per 100,000 population.[30] Trends in ED visits for alcohol-associated falls were assessed using the Joinpoint regression software, version 4.9.0.0 (National Cancer Institute). Joinpoint allows the user to test whether an apparent change in trend is statistically significant.[31] The annual percent change was estimated for each trend segment to indicate the magnitude and direction of trends. All tests of significance were 2 tailed, with the level of significance set at 0.05. This activity was reviewed by CDC and was conducted consistent with the applicable federal law and CDC policy.[32]

RESULTS

Characteristics of Older Adult Study Participants (65+ Years)

From January 1, 2011, to December 31, 2020, an estimated 28,299,259 older adults visited the ED for fall-related injuries. Approximately 2.2% (95% CI 1.7% to 2.8%) or 618,099 of these ED visits were alcohol-associated (Table 1). Among these, 68.1% were men (95% CI 62.5% to 73.2%) and 42.9% were aged 65 to 69 years (95% CI 39.6% to 46.3%). The most frequent injury diagnosis was internal injury (31.8%, 95% CI 27.6% to 36.4%). The

head was the most frequently injured primary body part (44.4%, 95% CI 39.7% to 49.1%), followed by the face (20.2%, 95% CI 18.1% to 22.5%).

The proportion of fall-related ED visits that were alcohol-associated was higher among men than among women (4.3% versus 1.1%, aPR=3.6, 95% CI 2.9 to 4.5). The proportion of ED fall visits that were alcohol-associated decreased significantly with advancing age ($P<.05$) as follows: 5.6% for those aged 65 to 69 years, 3.4% for those aged 70 to 74 years, 2.1% for those aged 75 to 79 years, and 0.7% for those aged ≥80 years. A higher proportion of alcohol-associated falls among fall-related ED visits happened in summer months (June, July, and August) than in winter months (December, January, and February) (2.3% versus 2.1%, aPR 1.14, 95% CI 1.01 to 1.28) and during weekends than during weekdays (2.6% versus 2.0%, aPR 1.3, 95% CI 1.2 to 1.4). Compared with fractures/dislocations, internal injury (3.5% versus 1.4%, aPR 2.2, 95% CI 1.8 to 2.6) and flesh wound injury (3.5% versus 1.4%, aPR 2.2, 95% CI 2.0 to 2.4) occurred with a greater proportion of ED fall visits that were linked to alcohol. Compared with the lower trunk, the head (3.5% versus 0.8%, aPR 3.4, 95% CI 2.8 to 4.1) and face (3.9% versus 0.8%, aPR 3.6, 95% CI 3.1 to 4.2) were more likely to be associated with alcohol involvement. Traumatic brain injuries were documented with a higher proportion of fall-related ED visits that were alcohol-associated compared with ED visits with non-traumatic brain injuries (3.5% versus 1.9%, aPR 1.8, 95% CI 1.6 to 2.1). The percentage of ED visits requiring hospitalization/transfer increased from 29.0% (CI 25.6% to 32.6%) for those aged 65 to 69 years to 33.1% (CI 29.4% to 37.1%), 34.1% (CI 29.7% to 38.8%), and 38.5% (CI 34.9% to 42.2%) for those aged 70 to 74, 75 to 79, and 85 years or older, respectively (Table 2).

Trends in ED Visits for Alcohol-Associated Falls (All Adult Ages)

Annual crude rates of ED visits for alcohol-associated falls for older adults (ie, 65+ years) and those aged <65 years (ie, 21 to 34, 35 to 54, and 55 to 64 years) are shown in Figure 1. Joinpoint analysis showed that between 2011 and 2019, the rates for older adults aged ≥65 years increased from 90.6 per 100,000 population to 156.6 with an annual percent change of 7.5% (95% CI 6.1% to 8.9%), and from 142.4 to 262.4 with an annual percent change of 8.2% (95% CI 7.2% to 9.1%) for adults aged 55 to 64 years. In contrast, ED visits for alcohol-associated falls for adults aged 21 to 34 years and 35 to 54 years increased by 1.4% (95% CI 0.1% to 2.6%) and 3.8% (95% CI 2.7% to 5.0%) per year, respectively, from 2011 to 2017, and then stabilized from 2017 to 2019. Annual crude rate values and rate differences between 2011 and 2019 are included in Table E1 (available at http://www.annemergmed.com).

For men aged ≥65 years, ED visits for alcohol-associated falls increased among all age subgroups, with the annual percent change ranging from 4.9% (95% CI 1.6% to 8.2%) for those aged 75 to 79 years to 9.7% (95% CI 4.6% to 15.1%) for those aged ≥80 years (Figure 2A). For women aged ≥65 years, rates increased significantly from 2011 to 2019 for all age subgroups except for those aged ≥80 years. Notably, rates increased most among women aged 70 to 74 years with an annual percent change of 15.3% (95% CI 8.4% to 22.5%) (Figure 2B).

LIMITATIONS

This study has several limitations. First, we used the NEISS-AIP narratives to identify ED visits for alcohol-associated falls. This method may underestimate the number of ED visits related to alcohol use because of the following aspects: (1) unless there is evidence of noticeable intoxication, EDs do not routinely screen patients for alcohol use upon admission; and (2) patients may not share their alcohol use with their health care providers.[16] Second, NEISS-AIP only includes injuries treated in hospital EDs; it does not include those treated at homes, physician's offices, urgent care centers, or in outpatient clinics. Therefore, the effect of alcohol consumption on fall risk among older adults may be underestimated. Third, because NEISS-AIP does not include International Classification of Diseases 10 coding, we used the principal diagnosis and primary body part to define a traumatic brain injury case for a consistent definition over the 10-year study period. Some cases may have been missed when traumatic brain injury was a secondary diagnosis. Finally, despite our methods achieving higher accuracy than the standard NEISS-AIP product code variable for alcohol, the lack of a gold standard to validate our methods for identifying alcohol involvement from narratives is another limitation.

DISCUSSION

Overview of Results

More than 600,000 ED visits for alcohol-associated falls occurred among older US adults between 2011 and 2020. Our analysis used both machine learning and a rule-based approach to identify ED visits for alcohol-associated falls from the NEISS-AIP data set during 2011 to 2020 and found alcohol-associated with 2.2% of all older adult ED visits for a fall, which is consistent with an earlier study that used 1 year of manually coded NEISS-AIP ED data.[16] We found that the overall number of fall-related ED visits among older adults is higher among women than men in this age group; however, older men had a greater proportion of fall-related visits that were alcohol-associated. Among older adults, the proportion of all fall ED visits that were alcohol-associated declined as age increased. The head and face were the most commonly injured body parts and internal injury was the most common diagnosis among older adult alcohol-associated falls. A potential explanation is that alcohol reduces self-protective reflexes, and as a result, older adults land on their head and face instead of using their arms and hands to stop the fall.[33,34]

We found that the rate of ED visits for alcohol-associated falls among adults aged 65 years and older increased from 2011 to 2019. One third of alcohol-associated ED visit injuries resulted in a traumatic brain injury. Consequences of traumatic brain injuries include prolonged motor and cognitive deficits, and older adults are more likely to experience prolonged sequelae from the injury owing to underlying chronic conditions or anticoagulant use.[35–38]

The trend in ED visits for alcohol-associated falls was different among younger age groups during the study period. From 2011 to 2019, the rate of ED visits for alcohol-associated falls increased among adults aged 55 to 64 years. However, the rate of this type of ED visit began a stable trend in 2017 for adults aged 21 to 34 years and 35 to 54 years. The

increase from 2011 to 2017 coincides with increases in the total annual number of binge drinks consumed per middle aged and older adult (≥35 years).[39] However, the reasons for these diverging trends since 2017 remain unclear. The annual percent change of ED visits for alcohol-involved falls was highest for adults aged 55 to 64 years with an annual percent change of 8.2. Therefore, adults aged 55 to 64 years may be an important age group for which to target fall prevention efforts, including assessing for alcohol consumption as a modifiable risk factor, as they will soon move into the older adult age group (65+ years), placing them at an increased risk of falls. Among older adult subgroups, differences in disposition after ED visits for alcohol-associated falls were similar to those in previous reports for fall-related ED visits (without regard to alcohol associated) using the same data set.[40] Advancing age was associated with increased disposition for additional care (ie, transfer to another care facility or hospitalization).

Differences in the trend of ED visits for alcohol-associated falls by sex and age subgroup (ie, 65 to 69, 70 to 74, 75 to 79, and 80+ years) occurred among adults aged 65 years and older. Adult men aged 80 years and older had the highest annual percent change in the rate of ED visits for alcohol-associated falls between 2011 and 2019. For older women, the rate increased for most age subgroups, with the highest annual percent change for the 70 to 74 year age group. These gender differences may be partially explained by the drinking patterns of older men and women. For example, one study showed that binge drinking increased among older men from 2015 to 2019, whereas it remained stable among older women.[10]

Although the occurrence of alcohol-associated falls among men is well known, the contribution of alcohol to fall risk among women should not be overlooked. Although previous studies showed that older women consume alcohol less frequently and in lower amounts than men, physiologic factors such as less lean muscle mass make them susceptible to the negative effects of alcohol.[11,41,42] Older women are also more likely to take medications that may increase fall risk such as benzodiazepines and antidepressants,[43,44] making them more susceptible to alcohol-drug interactions. Additionally, falls among older women are more likely to result in hip and pelvis fractures than those among older men[45,46] even after accounting for age and body size.[47,48] This may be due to postmenopausal changes in women, resulting in a higher prevalence of osteoporosis compared with older men.[49] Therefore, assessing alcohol use and fall risk among all older adults is an important component of fall risk screening.

Our findings indicate a higher proportion of alcohol-associated falls among fall-related ED visits during summer months, than in winter months, and during the weekend days, than during weekdays. Similar to our findings, a previous study reported on daily fluctuations of alcohol consumption, with an increase in alcohol consumption during weekend days among adults aged 22 to 74 years.[50] Possible explanations for these diurnal variations can be attributed to socially and culturally accepted norms of alcohol consumption and the increased flexibility of weekends than weekdays.[51,52] The cause of seasonal variation in alcohol consumption is not conclusive. Some studies have linked the variation to mood changes or seasonal affective disorders.[53,54] Others have reported racial and ethnic differences in the seasonal variation of self-reported alcohol consumption.[55]

Innovative Study Design

Extracting information from clinical narratives is a fundamental task that enables many downstream research activities. Approaches can be grouped into the following 4 categories: (1) rule-based (eg, regular expressions), (2) traditional machine learning (non–deep learning variants), (3) deep learning, and (4) hybrid approaches.[56] BERT and BERT-based approaches as a deep learning model have achieved state-of-the-art performance for several natural language processing benchmarks including clinical information extraction.[57] The advantage of a rules-based approach is that its inputs and outputs are predictable and interpretable. Domain knowledge can be leveraged simply and effectively, and rules can be improved through manual inspection by subject matter experts. However, rules-based methods tend to ignore the context of words and the relationships between them. As an example, the BERT model successfully found relationships between the words “water” and “drink” for the narrative “patient left to get water and rest, while drinking felt dizzy and fell,” which would be challenging for a rules-based approach. The BERT model also accurately captured new keywords such as specific alcohol beverage brand names and new negation patterns such as “alcohol liver disease.” These words were not included in the training data set. The model being pretrained on a large text corpus for general purpose language understanding supports the generalizability. However, a machine learning model needs a sufficient amount of training cases to perform well on new data, which is commonly understood. The BERT model failed to capture “alcohol withdrawal” as a negation pattern. Very few “alcohol withdrawal” cases in the training data set may be a reason.

We leveraged the advantages of both approaches by proposing a combination of traditional rule-based methods and the state-of-the-art BERT model to build a reliable algorithm. This methodology innovation allowed for efficient and accurate information extraction from about a million narratives.

Clinical Implications

Older adult falls pose a burden to health care systems, individuals, and their caregivers. Severe injuries from falls such as traumatic brain injuries and hip fractures often require prolonged specialized care and placement in long-term care or nursing homes.[40,46,58] Falls are preventable by targeting modifiable risk factors such as strength and balance issues, and medication use.[59,60] Alcohol use may be an additional, potentially modifiable, contributor to an increased risk of falls among older adults. Our study identifies subgroups of older adults with the highest rates of ED visits for alcohol-associated falls and increasing annual percent changes. This highlights the importance of tailoring primary fall prevention, including screening for alcohol use, to these groups.

The American College of Emergency Physicians developed Geriatric Emergency Department Guidelines with the goal of providing guidelines for emergency physicians and staff that are feasible to implement in the ED and would improve emergency care for older adults.[61] One of the recommended policies for a geriatric ED is fall risk assessment for older adult patients. According to the guidelines, appropriate fall treatment requires assessing for injury from the fall, determining the risk factors that caused the fall, and estimating

future risk of falling. The guidelines recommend using an appropriate tool for screening and assessing fall risk.

CDC developed the Stopping Elderly Accidents, Deaths, and Injuries (STEADI) initiative to offer health care providers, in various clinical settings, tools and resources for screening and assessing for fall risk to assist with fall prevention efforts (www.cdc.gov/steadi). STEADI has the following 3 core components: (1) screen older adults for fall risk, (2) assess at-risk older adults for modifiable fall risk factors, and (3) intervene to reduce the identified fall risk. Although initially developed for an outpatient setting, tools and resources can be adapted to different clinical settings, including for use by emergency physicians for all prevention with older adults visiting the ED for treatment. Common ways to assess fall risk factors include evaluating gait, strength, and balance, identifying medications that increase fall risk, and checking the home for potential home hazards. Alcohol use can be an additional component for older adult screening during fall risk assessment in the ED and is recommended by the Geriatric Emergency Department Guidelines. In addition, building on the Community Preventive Services Task Force recommendation,[62] CDC also developed an alcohol electronic screening and brief intervention (https://www.cdc.gov/alcohol/CheckYourDrinking) for adults to check their alcohol consumption, identify barriers and motivators for limiting their alcohol consumption, and make a personalized plan for drinking less.

In conclusion, although ED visits for alcohol-associated falls did not account for many overall fall-related ED visits among older adults, the upward trend in these visits during 2011 to 2019 is of concern. Older adults born between 1946 and 1964 (Baby Boomers who moved into the 65-year and older age group in 2011) have a higher reported alcohol use than previous generations.[63] Alcohol use may be a stronger risk factor for falls among older adults given the physiologic changes that can exacerbate its effects with advancing age. Alcohol-associated falls were associated with more frequent head injuries and internal injuries indicative of traumatic brain injuries, a particular concern in older adults owing to complications and consequences of these injuries. Fall prevention efforts can benefit from expanding into assessing older adults routinely for alcohol use using validated screening practices and educating older adults about the potential risks of alcohol use and falling as they age.[64] In addition, states and communities can create environments that reduce the availability of and access to alcohol through evidence-based alcohol policies (eg, increasing alcohol taxes, regulating alcohol outlet density) to decrease alcohol use and its associated falls.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Funding and support:

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The authors thank Briana Moreland, MPH, (Public Health Analyst) and Ramikrishna Kakara (Health Scientist) from the Centers for Disease Control and Prevention, National Center of Injury Prevention and Control, for their contributions to case definitions and coding of the National Electronic Injury Surveillance System-All Injury Program data.

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Editor's Capsule Summary

What is already known on this topic

Among older adults, falls result in more than 3 million US emergency department (ED) visits annually. Alcohol use among US older adults has increased in the past decade.

What question this study addressed

Has the rate of ED visits for alcohol-associated falls changed for older adults from 2011 to 2020?

What this study adds to our knowledge

Based on national survey data, among adults aged 55 to 64 years and aged 65 years and older, ED visits for alcohol-associated falls increased from 142 to 262 and from 91 to 157 per 100,000, respectively.

How this is relevant to clinical practice

Among older ED patients, attention to alcohol use may improve fall prevention efforts.

Figure 1.

The annual crude rate of ED visits for alcohol-associated falls among adults aged ≥21 years, by age group, National Electronic Injury Surveillance System-All Injury Program, United States, 2011 to 2019. Crude rate calculation: ED visits for alcohol-associated falls were used as the numerator. Bridged-race vintage census population estimates (https://wonder.cdc.gov/bridged-race-population.html) were used as the denominator. Trends were assessed using Joinpoint regression. Data markers represent observed rates and lines are fitted rates based on Joinpoint analysis. APCs are only presented for trends if the 95% confidence interval excluded 0. APC, annual percent change.

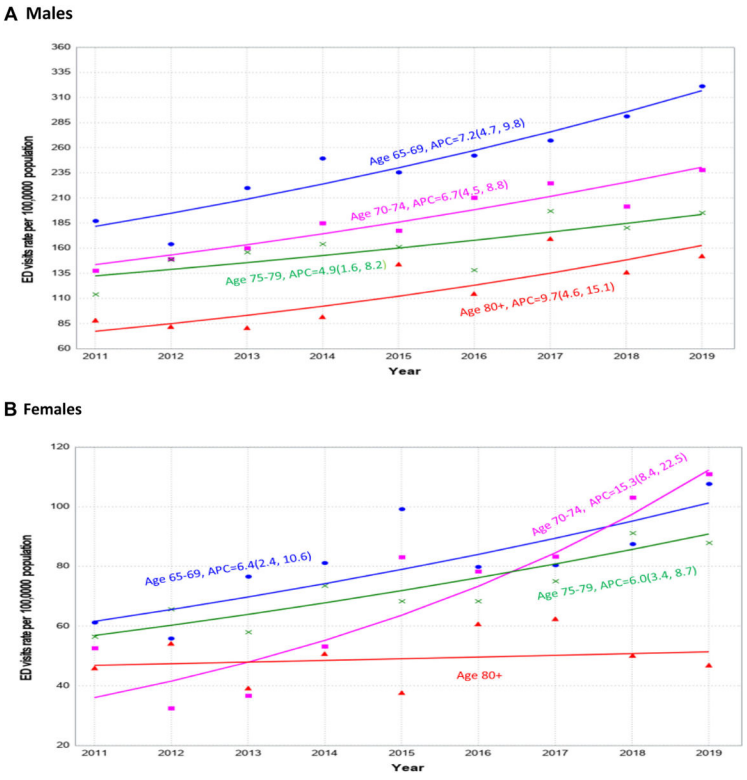

Figure 2.

The crude rate of ED visits for alcohol-associated falls among adults aged ≥65 years, by sex and age group, National Electronic Injury Surveillance System-All Injury Program, United States, 2011 to 2019.Crude rate calculation: ED visits for alcohol-associated falls were used as the numerator. Bridged-race vintage census population estimates (https://wonder.cdc.gov/bridged-race-population.html) were used as the denominator. The trends were assessed using Joinpoint regression. Data markers represent observed rates and lines are fitted rates based on Joinpoint analysis. APCs are only presented for trends if the 95% confidence interval excluded 0.

Ann Emerg Med. Author manuscript; available in PMC 2024 December 01.

Table 1.

All fall-related and alcohol-associated fall injuries treated in the ED for adults aged ≥65 years, by demographic and injury characteristics, National Electronic Injury Surveillance System-All Injury Program, United States, 2011 to 2020.

	ED Visits for All Falls		ED Visits for Alcohol-Associated Falls				Alcohol-Associated Fall/ED Visits for All Falls		Adjusted Prevalence Ratio*	
Characteristics	**Unweighted No.**	**National Estimates No.**	**Unweighted No.**	**National Estimates No.**	**Column % (95% CI)**		**% (95% CI)**		**aPR (95% CI)**	
Total	390,689	28,299,259	9,657	618,099			2.2	(1.7–2.8)		
Sex										
Male	136,631	9,817,000	6,685	420,655	68.1	(62.5–73.2)	4.3	(3.2–5.8)	3.6	(2.9–4.5)
Female	254,058	18,482,259	2,972	197,445	31.9	(26.8–37.5)	1.1	(0.9–1.3)	Ref	
Age group (y)										
65–69	67,573	4,741,462	4,258	265,269	42.9	(39.6–46.3)	5.6	(4.2–7.3)	7.6	(6.4–8.9)
70–74	64,882	4,640,272	2,485	159,898	25.9	(24.6–27.2)	3.4	(2.6–4.5)	4.8	(4.0–5.6)
75–79	64,157	4,687,101	1,500	98,460	15.9	(14.3–17.7)	2.1	(1.7–2.7)	3.0	(2.6–3.4)
80+	194,077	14,230,425	1,414	94,472	15.3	(12.8–18.1)	0.7	(0.5–0.8)	Ref	
Treatment season †										
Spring	96,537	6,823,228	2,392	149,325	24.2	(23.0–25.4)	2.2	(1.7–2.8)	1.09	(1.02–1.18)
Summer	96,680	7,013,528	2,569	161,780	26.2	(24.0–28.5)	2.3	(1.7–3.1)	1.14	(1.01–1.28)
Autumn	96,955	7,122,073	2,393	156,181	25.3	(24.1–26.5)	2.2	(1.7–2.9)	1.09	(1.00–1.19)
Winter	100,517	7,340,431	2,303	150,813	24.4	(22.3–26.7)	2.1	(1.6–2.6)	Ref	
Treatment day ‡										
Weekend	109,522	7,988,198	3,236	208,228	33.7	(32.1–35.3)	2.6	(2.0–3.4)	1.3	(1.2–1.4)
Weekday	281,167	20,311,062	6,421	409,872	66.3	(64.7–67.9)	2.0	(1.6–2.6)	Ref	
Injury diagnosis §										
Internal injury	86,864	5,692,417	3,338	196,846	31.8	(27.6–36.4)	3.5	(2.5–4.8)	2.2	(1.8–2.6)
Flesh wound injury	49,170	3,668,957	1,888	128,587	20.8	(18.7–23.1)	3.5	(2.7–4.5)	2.2	(2.0–2.4)
Superficial injury	87,862	6,764,912	1,744	116,583	18.9	(16.6–21.3)	1.7	(1.3–2.3)	1.1	(0.9–1.3)
Fracture/dislocation	133,233	9,646,385	2,090	136,924	22.2	(19.2–25.4)	1.4	(1.2–1.7)	Ref	
Other	33,560	2,526,587	597	39,159	6.3	(4.8–8.3)	1.5	(1.2–1.9)	0.8	(0.6–0.9)
Primary body part injured ‖										

Characteristics	ED Visits for All Falls		ED Visits for Alcohol-Associated Falls				Alcohol-Associated Fall/ED Visits for All Falls		Adjusted Prevalence Ratio*	
	Unweighted No.	National Estimates No.	Unweighted No.	National Estimates No.	Column % (95% CI)		% (95% CI)		aPR (95% CI)	
Head	117,282	7,928,826	4,508	274,254	44.4	(39.7–49.1)	3.5	(2.5–4.8)	3.4	(2.8–4.1)
Face	44,548	3,211,449	1,925	124,986	20.2	(18.1–22.5)	3.9	(2.9–5.2)	3.6	(3.1–4.2)
Upper extremity	69,941	5,311,634	1,052	70,776	11.5	(10.0–13.1)	1.3	(1.1–1.6)	1.2	(1.1–1.4)
Lower extremity	52,304	3,886,717	553	37,787	6.1	(5.2–7.2)	1.0	(0.8–1.2)	0.9	(0.7–1.0)
Upper trunk	36,067	2,702,240	715	46,677	7.6	(6.2–9.1)	1.7	(1.4–2.1)	1.5	(1.2–1.7)
Lower trunk	68,223	5,091,788	588	40,757	6.6	(5.1–8.4)	0.8	(0.7–1.0)	Ref	
Other	1,077	76,673	284	20,579	3.3	(2.2–5.0)	26.8	(20.0–34.9)	19.1	(13.9–26.2)
Traumatic brain injury ¶										
Yes	85,699	5,620,354	3,299	194,972	31.5	(27.3–36.1)	3.5	(2.5–4.8)	1.8	(1.6–2.1)
No	304,990	22,678,905	6,358	423,127	68.5	(63.9–72.7)	1.9	(1.5–2.3)	Ref	
Disposition #										
Treated and released	255,121	19,042,860	5,821	380,780	61.6	(56.8–66.2)	2.0	(1.6–2.5)	Ref	
Transferred/hospitalized	128,388	8,749,752	3,292	199,826	32.3	(29.1–35.7)	2.3	(1.8–2.9)	1.4	(1.2–1.5)
Other	7,162	505,737	543	37,470	6.1	(2.4–14.5)	7.4	(2.9–17.9)	3.4	(1.8–6.3)

aPR, adjusted prevalence ratio; *CI*, confidence interval; *ED*, emergency department; *Ref*, reference group.

*Adjusted prevalence ratio was estimated to assess the proportion of ED fall visits that were alcohol-associated in each category, divided by the proportion of ED fall visits that were alcohol-associated in the referent group. Prevalence ratio for sex adjusted by age group, age group adjusted by sex, and all the other variables adjusted by both sex and age group.

†Spring: March-May; summer: June-August; autumn: September-November; winter: December-February.

‡Weekends: Saturdays and Sundays; weekdays: Monday-Friday.

§Injury diagnosis was grouped into (1) internal injury (including injuries to the brain, abdominal organs, and thoracic organs that are not due to aspiration, or ingestion); (2) flesh wound injury (including laceration, puncture wound, and avulsion); (3) superficial injury (including contusion, abrasion, and hematoma); (4) fracture/dislocation; and (5) other (strain/sprain, hemorrhage, burn, amputation, foreign body, nerve damage, dental injury, and so on.)

/Primary body parts include (1) the head; (2) the face (including the face, eyeballs, the mouth, and ears); (3) upper extremity (including the shoulder, upper arms, elbows, lower arms, wrists, hands, and fingers); (4) lower extremity (including upper legs, knees, lower legs, ankles, feet, and toes); (5) upper trunk (including the neck); (6) lower trunk (including the pubic region); and (7) other (including internal, 25%−50% of body, all parts of body). Column percentages do not add up to 100% due to 32 visits (0.4%) with an unknown primary body part.

¶Traumatic brain injury: the primary body part is head and the primary injury diagnosis is internal injury or concussion.

#Transferred: treated and transferred to another hospital; hospitalized: treated and admitted for hospitalization within the same facility; other: includes held for observation without treatment involved, left without being seen.

Table 2.

Alcohol-associated fall injuries treated in the ED for adults aged ≥65 years, percentage of disposition by age group, National Electronic Injury Surveillance System-All Injury Program, United States, 2011 to 2020.

	Age Group (y)			
Disposition, column % (95% CI)	**65–69**	**70–74**	**75–79**	**80 +**
Treated and released	64.4 (58.2–70.2)	60.0 (56.2–63.6)	61.0 (54.8–66.8)	57.1 (52.4–61.7)
Transferred/hospitalized *	29.0 (25.6–32.6)	33.1 (29.4–37.1)	34.1 (29.7–38.8)	38.5 (34.9–42.2)
Other †	6.6 (2.4–17.0)	6.9 (3.1–14.6)	4.9 (1.7–13.6)	4.4 (2.2–8.9)

* Transferred: treated and transferred to another hospital; hospitalized: treated and admitted for hospitalization within the same facility.

† Other: includes held for observation without treatment involved, left without being seen.