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Timing of emergency medical services activations for falls

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Abstract

Objective: Falls are a major challenge to public health, particularly among older adults. Understanding factors that influence fall risk is pivotal in the prevention of falls and fall-related injuries. This study evaluated the timing of emergency medical service (EMS) activations for falls and transport patterns for adults age ≥65.

Methods: A patient care report system at a single fire-based emergency medical service agency in a suburban, Midwest city was retrospectively reviewed. Type of call (lift assist/fall), time of injury (time, day, and month), and demographics (sex, age) were collected for residents age ≥65 who activated 9–1–1 for a lift assist or fall.

Results: 1169 calls met inclusion criteria. Mornings and afternoons were the time of day associated with falls (33 % and 36 % of EMS activations, respectively, vs. 21 % and 10 % for evenings and nights, respectively; $p = 0.002$) while day of the week and month were not associated with falls or lift assists. More males requested lift assists than females (256 vs. 238) and more females called for falls than males (408 vs. 267; $p < 0.001$). Falls were more likely to be associated with transport to the hospital than lift assists (78% vs. 7 %). Female sex was associated with increased risk for transport to the hospital (60 % of females vs. 40 % of males; $p < 0.001$).

Conclusions: Mornings and afternoons were associated with increased risk for falls and sex (female) with increased risk for transport to the hospital.

Keywords

Fall risk; EMS activation patterns; Falls epidemiology; Community-based public health

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Elizabeth Sheridan: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing – review & editing. **Jessica M. Wiseman:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Carmen E. Quatman:** Methodology, Formal analysis, Conceptualization, Writing – review & editing.

Introduction

Worldwide falls are a leading cause of fatal and nonfatal injuries, with greater risk for older adults (Bergen, Stevens & Burns, 2016; World Health Organization, 2021). Annually over 35 million falls in the United States (US) result in greater than 32,000 deaths and $50 billion in medical costs for adults aged ≥65 (Centers for Disease Control & Prevention, 2020, 2021). Despite the availability of a variety of evidence-based prevention tools, the activation of emergency medical services (EMS) for lift assists (requests to restore to a position of mobility) and falls have increased, as has the rate of fatal falls (Hu & Baker, 2010; Quatman, Mondor, Halweg & Switzer, 2018) Concurrently the older adult population is projected to nearly double in size in the US by 2060, making the challenge of falls critical to address (Vespa, Medina & Armstrong, 2018).

Utilization of EMS for lift assists has grown significantly in recent years and may provide an intervention opportunity to prevent future falls (Quatman, Anderson et al., 2018, 2018). In the United Kingdom, EMS agencies have used lift assists as an opportunity to educate and connect patients with community resources, leading to a decrease in EMS activations (Snooks et al., 2017). In the US, an EMS referral of at-risk individuals to a community paramedicine program decreased EMS activations for falls by 66 % and transports to the hospital after a fall decreased by 63 % (Quatman-Yates et al., 2021). Leveraging EMS as an early identifier of adults at risk for falls who would benefit from an intervention or connection with resources, whether transport to further care after activation of 9–1–1 is required or not, may be a powerful upstream community intervention strategy (Agarwal et al., 2019; Faul et al., 2016; Hammouda et al., 2021; Logan et al., 2010; Quatman-Yates et al., 2021; Quatman, Anderson et al., 2018; Snooks et al., 2017).

One such application involves the analysis of extensive EMS activation data to delineate temporal patterns related to falls among older adults. Gaining insight into peak risk periods could facilitate the development of targeted prevention strategies, including safety initiatives, and for enhancing personal awareness among older individuals, prompting proactive measures such as behavioral adjustments to mitigate fall risks.

This study's examination of the timing of EMS activations for lift assists and falls provides insight as to when older adults are most vulnerable to falls. The findings contribute valuable information that can guide public health strategies aimed at reducing falls and related injuries, including fall awareness efforts and the design of targeted interventions. EMS and hospitals may use this data to prepare for potential increases in service demands during specific times of day. To the authors' knowledge, this study represents the first investigation into time-of-day activations of EMS for falls in the US. The objective of this study was to determine the timing of activation of EMS for falls and lift assists and transportation rates.

Materials and methods

Study design and setting

We obtained approval from the Institutional Review Board. We then conducted a retrospective review of a single fire-based, suburban, Midwestern EMS agency's patient care report (PCR) system, ZOLL Fire Reports. Our review focused on assessing timing and transportation trends related to lift assists and falls among adults aged ≥65 between 01 January 2008 and 01 July 2017.

The PCR is used for clinical charting, including documentation of reason for dispatch, patient details, treatment provided, and transport details by EMS for each 9–1–1 run. Both a 'lift assist' and a 'fall' are falls by definition of the word. However, within EMS and EMS research, they are classified as two distinct events. A "lift assist" coding in the PCR occurs when an individual calls 9–1–1 for EMS to return the individual to a position of safety or mobility without transport to further care. A "fall" coding in the PCR occurs when an individual calls 9–1–1 for EMS to provide services for a sudden, unintentional descent, leading to an individual coming to rest inadvertently on the ground or other surface.

Selection of participants

We collected all 9–1–1 calls for a lift assist or fall for community-dwelling individuals aged ≥65 at the date of service from 01 January 2008 through 01 July 2017 from a single fire-based, suburban, Midwestern EMS agency.

Measurements

Data entry occurred at the time of EMS activation by EMTs providing treatment and/or transport to the individual who called 9–1–1 for a lift assist or fall. Data was collected as standard of care and in accordance with the EMS agency's protocols.

Dichotomous measure for fall, lift assist, sex was recorded, and day of week was examined. Age (1=aged 65–74; 2=aged 75–84; 3=aged 85+) and month of injury (1=March–May; 2=June-August; 3=September-November; 4=December–February) were examined. Sociodemographic variables selected were chosen based on previous work that demonstrates sex and age-related differences in falls to determine whether these factors persist in the population studied (Sheridan et al., 2019).

Outcomes

Dichotomous measure for hospital transport was examined. Time of injury (1 = 06:00–11:59 [morning]; 2 = 12:00–17:59 [afternoon]; 3 = 18:00–23:59 [evening]; 4 =24:00–05:59 [night]). The variables for date of injury (time, day, month) were selected to evaluate the timing of EMS activation for lift assists and falls among older adults.

Analysis

During the study period from 2008 to 2017, we evaluated potential influences on our findings, including shifts in community demographics, Emergency Medical Services (EMS) protocols, and the implementation of fall prevention programs. Notably, the analysis

confirmed stability in the suburban Midwestern community's demographics, with no significant changes in community demographics that could skew the observed fall patterns among older adults. Similarly, EMS protocols related to fall response and documentation remained consistent, ensuring that trends reflect actual community occurrences rather than variations in EMS practices. Furthermore, the absence of a specific fall prevention program during this timeframe means that the data presented are uninfluenced by targeted public health interventions aimed at reducing falls. A quality control of data was performed to evaluate for entry duplicates and date entry errors. A descriptive analysis was conducted on the individual characteristics. Chi-square tests of independence were conducted to look at the relationships of lift assist with time, day, and month of injury. Similarly, chi square tests of independence were conducted to look at the relationships of fall with time, day, and month of injury. Chi-square tests of independence were conducted to examine the relationships between sex and fall and then sex and lift assist and transportation to the hospital. Lastly a crosstabulation was created to look at transportation to the hospital for fall and lift assist. SPSS version 28 2021 (IBM, Chicago, IL) was used to conduct all analyses.

Results

Over the study period there were 21,760 distinct 9–1–1 calls and of these, 1169 (5.4 %) met inclusion criteria.

Characteristics of study subjects

Females comprised over half (55.2 %) of the total study population. Of the study population 17.0 % were aged 65–74, 21.8 % were aged 75–84, and 61.2 % were aged 85 or older. Age had no relationship with type of call ($p = 0.442$) or transport to hospital ($p = 0.578$) (Table 1). Age and lift assist/fall showed to have no relationship with any outcomes ($p = 0.442$).

Main results

Time, day, and month of injury—Older individuals called 9–1–1 for a fall call more often in the morning and afternoon compared to the evening and night (Table 2; (33 % and 36 % of fall calls, respectively, vs. 21 % and 10 % for evenings and nights, respectively; $p = 0.002$). Day of the week and lift assist/fall were independent of each other ($p = 0.743$), as were month and lift assist/fall ($p = 0.068$).

Falls and transportation—Table 1 shows calls to 9–1–1 for a fall resulted in 77.7 % of individuals requiring transport to the hospital for treatment, whereas calls to 9–1–1 for a lift assist resulted in only 6.5 % of individuals requiring transport to the hospital. Transport to the hospital and sex (female) demonstrated a relationship (60 % of females transported; $p < 0.001$). Table 1 also features how sex impacted the type of 9–1–1 activations for falls (60 % of females vs. 40 % of males; $p < 0.001$). Females called more often for falls than males in the study period (55 % of total fall calls by females vs. 45 % by males), while males called more often for lift assists (52 % of total lift assist calls by males) (Table 3).

Limitations

This study retrospective nature subjects it to limitations, including the potential for misclassification due to the evolving or inconsistently applied categorization of “lift assist” or “fall” within the PCR influenced by interpretation by individual EMS providers. This variability could skew prevalence estimates and characteristics of the events, impacting our findings’ interpretations. Additionally, our analysis was limited by the exclusion of potential fall risk factors, including medications, balance or musculoskeletal strength, or vitamin D deficiency as these were not captured in the PCR and is a limitation of the data set. The reliance on existing data from medical records introduces the possibility of missing or incomplete data, which may detract from the robustness and comprehensiveness of our findings. Moreover, the risk of confounding is elevated due to unmeasured or unrecorded variables that could influence the outcomes, potentially biasing the associations observed. Inherent to the design of this study is the temporal variability between the occurrence of a lift assist or fall event and the subsequent activation of 9–1–1 services. This interval could span several hours, potentially influencing the necessity for, or the nature of, subsequent hospital treatment. Such a delay may affect the immediate healthcare needs of the individual and the decision to seek hospitalization, thereby impacting the study’s outcomes related to healthcare utilization and emergency medical services’ response strategies. Furthermore, the context of our study—conducted within a single fire-based, suburban, Midwestern EMS agency—may not fully represent the diversity of environmental and societal factors influencing fall occurrences in urban vs. rural settings or across different geographic regions. Variations in infrastructure, emergency medical services availability, and community support systems across such areas could significantly impact the generalizability of our findings.

Future research study #1: To address these issues and enhance the validity of future research, we are exploring the feasibility of a prospective ER-based study. This approach aims to mitigate the highlighted limitations by enabling more systematic data collection, including a broader range of fall risk factors, and ensuring more complete and accurate records. Such a study would offer a more controlled environment to examine the predictors and outcomes of falls and lift assists, providing clearer insights into their dynamics and informing more effective intervention strategies. Future research study #2: The observed temporal patterns of falls among older adults, predominantly occurring during morning and afternoon hours, warrants a deeper exploration into the potential environmental, behavioral, and social factors that may contribute to this increased incidence. Understanding this aspect of falls is critical for developing targeted interventions and preventive strategies that address the multifaceted nature of fall risks.

Discussion

This study found falls were more likely to occur in the morning and afternoon than evening and night. Intuition or cognitive biases may lead to assumptions that falls are most likely to occur at night, since in many contexts, injury risk increases at night (Calabrese et al., 2017; Mustard, Chambers, McLeod, Bielecky & Smith, 2013). A national survey of EMS providers found that, despite their experience responding to such events, they could not achieve consensus on the timing of falls, with similar proportions of respondents claiming

morning and afternoon as the time of day that falls are most likely (23 % and 32 %, respectively) and also least likely to occur (23 % and 37 %, respectively) (Sheridan, Wiseman & Quatman, 2023). However, this study aligns with previous findings that most falls occur during the day (Yoshida-Intern, 2007). One review of ambulance records in Australia found temporal differences based on residential type, with falls peaking in late morning for all residences but an additional peak in falls occurred in the evening for individuals in residential aged care facilities (Cantwell et al., 2016). The increased risk for falls during the daytime hours may be due to greater levels of activity during this time. A study found that most falls occur in the most frequently utilized spaces, further supporting this idea (Campbell et al., 1990).. A Korean study that evaluated self-reported falls among older adults in urban and rural settings found more falls occurred in the afternoon in urban areas whereas more falls occurred in the morning in rural areas (Kim et al., 2020). Environment, behavioral and social factors might all lead to an increased incidence of falls among of older adults. Physical environment such as poor lighting, uneven floor or pavement, morning dew or rain making an outside surface slippery are a few examples of how the physical environment can affect falls. Morning and afternoons are a time known for activity and mobility, both indoors and outdoors. During these times, older adults are more likely to engage in daily routines such as exercise, household chores, and social activities, which inherently increases their exposure to fall risks. Behavioral patterns also play a significant role in the timing of falls. Ones day from waking up until bed can include a range of physical activities, from the relatively sedentary act of reading or watching tv to more physically demanding tasks like gardening or grocery shopping or social outing with friends and family (social factors). The variance in activity levels, coupled with possible fluctuations in medication effects can contributes to the complexity of fall risks during these hours.

Over the study period more males activated EMS for lift assists and more females activated EMS for falls. Female sex is well established as a risk factor for falls (Chang & Do, 2015; Peel, 2011). According to Peel (2011) specifically, differences in muscle mass, strength and hormonal variations, might influence balance and gait stability increasing fall risk among women. Women’s longer lifespan compared to men increases their likelihood of living alone or in settings where assistance is not readily available, thus raising the risk of falls (Chang & Do, 2015) Similar to previous reports the current study also found females were more likely to be transported to a hospital for a fall than males (Weiss, Ernst, Phillips & Hill, 2000). However, this study did not find a relationship between age and transport to the hospital, which diverges from other studies that find a correlate between age and emergency transport (Jones et al., 2017; Wofford et al., 1995). Such studies typically do not mediate probability of transport by reason for EMS activation, which may contribute to the different findings. Yet the finding that age was not related to transport to hospital is surprising since aging itself is significantly correlated with increased risk for falls, and the study results found that falls were associated with transport to further care (Bergen et al., 2016). Rather, age not relating to transport may support the current perspective that falls are not a normal part of aging (Centers for Disease Control & Prevention, 2020).

Lift assists are typically events where an individual who calls 9–1–1 has fallen in some form but does not report an injury; instead, assistance is requested in regaining a position

of mobility (e.g., extraction from the space between a toilet and a wall or a lift from floor to chair). Callers may live alone or live with others who are unable to provide the physical assistance needed, resulting in the 9–1–1 call. Therefore, older adults that request a lift assist from EMS are less likely to require transport, and this was reflected in the study results, where only 6.5 % of lift assists required transport to further care. Recent research suggests that considering lift assists as a sentinel event could enable deployment of targeted interventions by EMS to prevent future decline and falls (Quatman-Yates et al., 2021; Snooks et al., 2017).

Increased risk for falls during the day may inform education efforts targeting older adults to grow awareness about time of day and activity affecting risk for falls. This may lead to modified activities or increased efforts for safe activity. However, it is important that education around falls is focused on promoting safe activity, not on decreasing activity. Reduced physical activity and associated decline in physical strength and balance is likely to increase the risk for falls and fall-related injury (Sherrington et al., 2020). Fall prevention is a top priority for EMS, yet navigating this in the prehospital environment is difficult and requires additional research (Hammouda et al., 2021). An important step to accomplishing this goal is to understand what time of day falls may occur more frequently to inform prehospital fall prevention efforts. EMS can act as an early identifier of adults at risk for falls who would benefit from intervention, whether transport to further care is required or not (Faul et al., 2016; Hammouda et al., 2021; Logan et al., 2010; Quatman, Anderson et al., 2018; Snooks et al., 2017). A better understanding of the timing of falls, derived from EMS activations for lift assists and falls, could inform prehospital fall prevention strategies to connect older adults with resources or to deliver prevention activities directly through community paramedicine.

Conclusion

The study’s findings about the temporal patterns of falls in older adults, with higher incidence occurring during the morning and afternoon, could provide a pivotal shift in our understanding and approach to fall prevention. Contrary to the prevailing assumption that falls predominantly occur at night, our findings suggest that the risk is significantly higher during the day, particularly among females who not only are more likely to experience falls but also more frequently require EMS intervention and subsequent transportation to additional care. This nuanced understanding of fall timings and gender disparities underscores the importance of targeted prevention strategies and the need for public health initiatives to adapt accordingly. Such insights are invaluable for both community health programs and Emergency Medical Services (EMS), enabling these entities to refine their efforts towards mitigating fall risks among older populations.

In response to these findings, community health programs could develop targeted awareness campaigns, focusing on the identified high-risk periods, and to promote activity modification programs aimed at enhancing balance, strength, and flexibility among older adults. Concurrently, EMS could leverage lift assist calls as opportunities for fall risk screenings, potentially integrating community paramedicine programs to assess and improve home safety, thereby directly addressing fall risks at their source.

While the study has limitations, it marks a significant step towards improving fall prevention in older adults, offering potential for enhanced strategies for fall awareness and prevention activities. As such, the study not only challenges existing assumptions about fall risks but also catalyzes a paradigm shift towards more proactive, data-driven strategies in fall prevention, marking a significant stride towards enhancing the safety and well-being of older adults.

Data availability

The data that has been used is confidential.

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Table 1

Age distribution of all fall-related 9–1–1 calls by sex.

Sex N (%)	Age groups			Total
	65–74	75–84	85+	
Female	119 (60)	131 (51.6)	396 (55.3)	646 (55.3)
Male	80 (40)	123 (48.4)	320 (44.7)	523 (44.7)
Total	199 (17.0 %)	254 (21.8 %)	716 (61.2)	1169

Table 2

Gender and time-of-day distribution of EMS activations for lift assists and falls.

	Lift assist	Fall	P-value
Sex			
Female	238	408	<0.001
Male	256	267	
Time of Day			
Morning	134	220	0.002
Afternoon	155	245	0.002
Evening	131	141	
Night	73	66	

Table 3

Hospital transportation rates for EMS calls: lift assists vs. falls.

Type of call N (%)	Transportation to hospital		Total
	Did NOT Require Transport	Required Transport	
Lift Assist	462 (93.5)	32(6.5)	494 (42.2)
Fall	150 (22.2)	526 (77.8)	676 (57.7)
Total	612 (52.3)	558 (47.7)	1170