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Geospatial distribution of fall-related hospitalization incidence in Texas

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ABSTRACT

Introduction: With the rapid growth of the aging U.S. population, the incidence of falls and fall-related injuries is expected to rise. We examined incidence and characteristics of fall-related hospitalizations (falls) among Texans aged 50 and older, by geography and across time. *Method:* We calculated fall-related hospitalization incidence rates (65 and older), identified fall 'hot spots,' and examined availability of fall-prevention programming. *Results:* The incidence of fall-related hospitalizations for older adults increased by nearly 20% from 2007 to 2011. There were clusters of 'hot spot' counties throughout the state, many of which lack fall prevention programs. *Conclusions:* Increased efforts are needed to identify older adults at elevated risk for falling and develop referral systems for promoting evidence-based fall prevention programs at multiple levels accounting for geographic settings. *Practical applications:* Geospatial investigations can inform strategic planning efforts to develop clinical-community partnerships to offer fall prevention programming in high risk areas.

1. Introduction

Falls are the leading cause of death (related to injury) among those aged 65 and older (Stevens, 2005, p. 409), with a third suffering a fall each year (Yoshida, 2007). The risk of falls and fall-related injury is highest among the oldest age group (i.e., 80 years and older) (Yoshida, p.3, 2007). Nationally, 21,649 adults aged 65 and older died in 2010 because of falling (Stevens & Rudd, p. 470, 2014). While fall-related deaths are the most dire consequence, non-fatal falls commonly result in serious and costly injuries and bone fractures (Towne, Ory, & Smith, 2014).

In 2013, falls were the leading cause of injuries reported to the emergency department among adults aged 45 and older in Texas (Injury Epidemiology & Surveillance Branch, Texas Department of State Health Services, 2014). The age-adjusted rate of fall-related emergency department visits was nearly double among those aged 65 years and older (Centers for Disease Control and Prevention, National Center for Health Statistics, 2014). This rate was even higher among adults aged 75 and older (Centers for Disease Control and Prevention, National Center for Health Statistics, 2014). Injury and fracture rates also increase with increasing age, especially among those aged 85 and older (Centers for Disease Control and Prevention, National Center for Health Statistics, 2007a; Centers for Disease Control and Prevention, National Center for Health Statistics, 2007b).

1.1. Fall risk factors & prevalence

There are numerous risk factors related to falls, which include both modifiable and immutable determinants. Risk factors associated with falls include: weakness, balance deficit, gait deficit, visual deficit, mobility limitation, cognitive impairment, impaired functional status, and postural hypotension (Rubenstein, 2006, p. ii39). Additional risk factors include: dizziness, infrequent physical activity, having health-related activity limitations, trouble walking 400 meters, and having trouble crouching or bending down (O'Loughlin, Robitaille, Boivin, & Suissa, 1993). Among community-dwelling adults aged 65 and older, factors associated with higher likelihood of falls included: advanced age identified as being aged 80 and older, having at least one chronic disease, history of falling in the past year, and medication use (measured as taking at least four medications) (Pluijm et al., 2006, p. 419; Stalenhoef, Diederiks, Knottnerus, Kester, & Crebolder, 2002). Falls are also associated with specific home environments such as inadequate lighting (Studenski, 1994), stairs, and loose rugs (Norton, Campbell, Lee-Joe, Robinson, & Butler, 1997). The disabilities and a long recovery time resulting from fall injuries, as well as fear of falling (Bell, 2000; Tinetti et al., 1994) hinder quality of life by restricting activities (Vellas, Wayne, Romero, Baumgartner, & Garry, 1997).

There is limited information about the geographic dispersion of falls and fall-related hospitalization rates throughout the United States. One study identified fall-related fatalities varied geographically, with Florida, California, and Texas as having the highest rates (data 2003–2007) (Alamgir, Muazzam, & Nasrullah, 2012). Another Texas study highlighted regional variations in the demographics of those hospitalized for falls (Smith, Ory, Beasley, et al., 2010). The relative lack of state-specific geographic analyses of fall-related hospitalizations limits

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our awareness about fall incidence clusters or area-specific trends. Knowing where fall-related hospitalizations and fatalities occur enables program planners and policy makers to develop intervention strategies that target higher risk areas. As such, the primary purposes of this study were to measure the overall incidence of fall-related hospitalization in Texas among older adults and geographically identify high incidence areas across the state. Secondarily, this study examines changes in fall-related incidence rates over time and the distribution of fall prevention programming relative to high incidence areas for fall-related hospitalization.

2. Methods

2.1. Data sources

We used the 2011 Texas Hospital Inpatient Discharge Public Use Data File (Texas Department of State Health Services, Center for Health Statistics, 2011) to conduct a cross-sectional analysis of fall-related hospitalization in Texas. Our population included all 2011 (most current full year of data at the time of analyses) hospital discharges in Texas. Hospitals were excluded from the public use file if they were located in a county that had less than 35,000 individuals, or if they were in a county within a non-urbanized area with less than 100 licensed hospital beds. In addition, hospitals without insurance payments or government reimbursements were excluded. HIV and drug/alcohol use patients were not included in this analyses because these individuals were coded with broader age groupings than all other individuals in the public use file (i.e., 0–17, 18–44, 45–64, 65–74, 75+), which prevented comparable analyses. Based on these exclusions, our final sample size was 2,676,463 (from 2,937,579) hospital discharges. The Texas A&M Institutional Review Board (IRB) approved this study (IRB2013-0780M).

In addition, we assessed the availability of fall prevention programs by county across the state. We included only A Matter of Balance/Volunteer Lay Leader model (AMOB/VLL) because it was supported by the Texas Association of Area Agencies on Aging (T4A) fall prevention program. For the current study, we identified AMOB/VLL programs that have been shown to have success at improving the risk of falls in older adult populations throughout the United States. AMOB/VLL incorporates cognitive restructuring approach (Peterson, 2002; Tennstedt et al., 1998), to reduce fear of falling among adults age 60 or older and has demonstrated program efficacy (Tennstedt et al., 1998) and effectiveness of the trained volunteer lay leaders (Healy et al., 2008). Participants who attended five or more of the eight possible sessions had significant and immediate improvement in fall efficacy (Healy et al., 2008; Tennstedt et al., 1998), fall management (Healy et al., 2008; Tennstedt et al., 1998), and fall control (Healy et al., 2008), in addition to engagement in physical and social activities (Healy et al., 2008). The program has been successfully implemented across the nation and reaches diverse populations such as Spanish-speaking older adults (Batra et al., 2013).

2.2. Variables

2.2.1. Operational definition of fall-related hospitalization

Fall-related hospitalizations were based on the ICD-9-CM diagnosis code of the primary external cause of injury (i.e., including the 4th and 5th digits, when applicable). Fall-related hospitalization codes included the following: fall on or from stairs or steps (880.0–880.9); fall on or from ladders or scaffolding (881.0–881.9); fall from or out of building or other structure (882.0); fall into hole or other opening in surface (883.0–883.9); other fall from one level to another (884.0–884.9); fall on the same level from slipping, tripping, or stumbling (885.0–885.9); fall on the same level from collision, pushing, or shoving, by or with other person (886.0–886.9); and other and unspecified fall (888.0–888.9).

We included analyses across age group, sex, race, ethnicity, and a measure of geographic residence. Analyses were stratified by patients' sex (i.e., male or female), race (i.e., White or Black), and ethnicity (i.e., Hispanic or non-Hispanic). Ethnicity was coded independently of race, thus each racial category may also include individuals who reported being Hispanic. Patients' age was categorized as follows: 50–64 years, 65–74 years, 75–84 years, and 85 years and older. These age groups were not modifiable and predetermined by the public use data file. A detailed description of the data used can be found in the Texas Department of State Health Services Center for Health Statistics, Health Care Information User Manual (2011) (Texas Department of State Health Services, Center for Health Statistics, 2011).

Analyses across the non-metropolitan–metropolitan continuum were incorporated using Urban Influence Codes (UIC) measured at the county of patients' residence. These codes were taken from the United States Department of Agriculture (USDA) and were separated into metropolitan (UIC 1–2) and non-metropolitan (UIC 3–12) based on the size of population and adjacency to metropolitan areas (United States Department of Agriculture, 2013). Overall, 1,855 observations with a fall-related hospitalization were missing county identifiers preventing us from including these in non-metropolitan/metropolitan analyses.

2.3. Analysis

We used SAS 9.4 (Cary, NC) to perform all analyses (SAS Institute Inc., 2014). ArcGIS 10.2 was used for mapping (ESRI Inc., 2014). Incidence rates were calculated using data from the Texas Department of State Health Services based on U.S. Census data (2011), which were stratified by population characteristics (i.e., age, sex, race, ethnicity). The numerators were obtained from hospital discharges in 2011, and denominators obtained from U.S. Census data available from the Texas Department of State Health Services (Texas Department of State Health Services Census Data).

Incidence rates of fall-related hospitalizations among those aged 65 and older were calculated for geographic analyses. We operationally defined areas with high fall-related hospitalization rates (per 1,000) or 'hot spots' as areas with a rate that was at/above the upper quartile (20.4 per 1,000) among those aged 65 and older. Incidence was calculated by dividing the number of falls among those aged 65 and older by the total population aged 65 and older in the county multiplied by 1,000. Fall-related hospitalizations per 1,000 adults aged 65 and older included 12.1 for the lower quartile, 16.4 for the median, and 20.4 for the upper quartile.

3. Results

3.1. Incidence of falls by selected patient characteristic

Overall, there were 77,086 fall-related hospitalizations in 2011. Among those aged 50 and older, there were 60,405 fall-related hospitalizations representing 78% of all fall-related hospitalizations. This number increased from 2007, where the incidence of fall-related hospitalization was 51,142 among those aged 50 and older (Smith, Ory, Beasley, et al., 2010). The incidence of fall-related hospitalizations among those aged 50 and older increased by nearly 20% from 2007 to 2011 (Smith, Ory, Beasley, et al., 2010). However, the ratio of fall-related hospitalizations

Table 1
Fall-related hospitalizations by sex, Texas (2011).

Age	Female	Male	Total
50–64	6,542	4,564	11,106
65–74	7,627	4,276	11,903
75–84	13,070	6,252	19,322
85+	13,108	4,965	18,074
Total 50+	40,347	20,057	60,405