Adult Lumbar Vertebral Fracture Incidence, Etiologies, and Demographics (2010-2018): An Investigation of the National Electronic Injury Surveillance System

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Introduction

Lumbar vertebral fractures are debilitating injuries that are widely associated with significant patient deformity, disability, pain, and neurological deficit (Rajasekaran et al., 2015). In addition to the debilitating clinical impact, vertebral fractures and the low back pain they cause are associated with major economic burden as well. Based on average loss of work productivity, one study estimated that the total cost of low back pain to the United States economy totaled $33 to $66 billion from 1993-2003 (Joish & Brixner, 2004). Although there has been significant investigation into the most common etiologies of cervical fractures (Lomoschitz et al., 2002), there is a paucity of peer-reviewed publications that detail the etiologies of lumbar spine fractures. Hence, the purpose of this study is to investigate the most frequent annual etiologies, incidence rates, and the target demographics of lumbar vertebral fractures in the United States.

Methodology

The NEISS repository uses collected product-related injury data to create a complex probability survey that estimates nationwide injuries in all U.S. emergency departments. The NEISS sample includes 102 hospitals that were originally designated by stratified, randomized sampling of all 5,200 U.S. hospitals with an emergency department, based on location and volume.

A search to isolate injuries categorized as fractures (NEISS Code: 57) located at the lower trunk (NEISS Code: 79) was performed. In the search, specific inclusion criteria included entries with the terms: "Lumba", "Lumb", "Ls spine", "L-spine," "L1," "L2," "L3," "L4," "L5," "Lumbar," "Low Back," "Lower Back," and "Lwr back."

As past literature has shown that lumbar fractures primarily affects elder populations and that pediatric fracture etiologies differ significantly from adult fracture etiologies, this study examined non-pediatric patients and excluded patients 18 years of age and younger from the sample (Waterloo et al., 2012).

The following statistical operations were applied for analysis:

(1) Σ (sample weights) = x
(2) $s^2 = \Sigma(x-u)^2/n$
(3) $CV = \sqrt{s^2}/u$
(4) 95% CI = x ± 1.96(CV)(x)
(5) $t = u-x/s\sqrt{n}$
(6) $y = b_0 + b_1x + b_2x + \ldots$
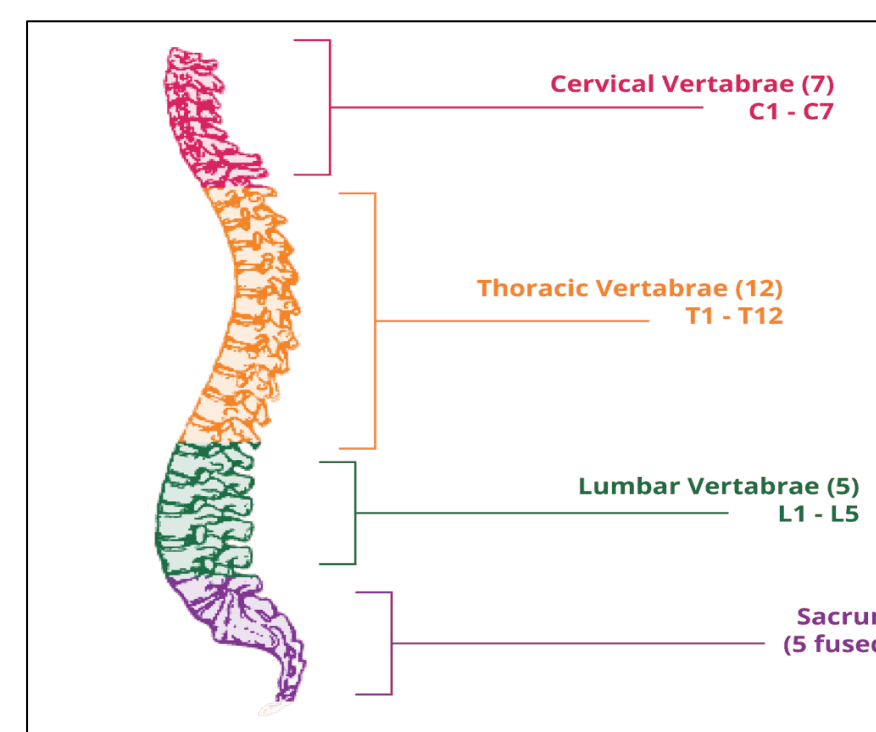

Figure 1. U.S. CPSC NEISS Emblem

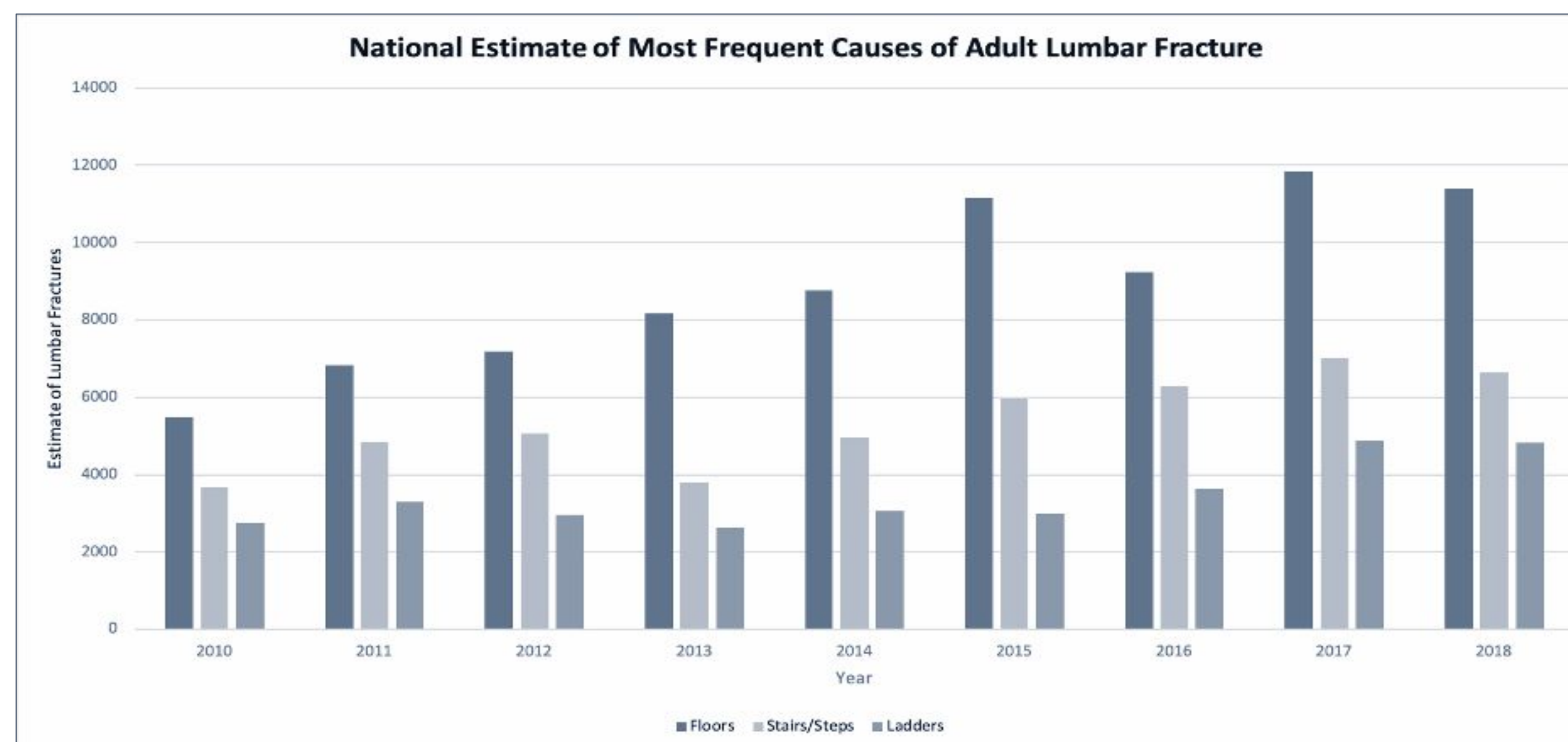**Figure 2.** Diagram Of Spinal Column

Figure 3. National Estimate of Most Frequency Causes of Adult Lumbar Fracture
This figure illustrates fractures are increasingly driven by injuries of floors, steps, and ladders
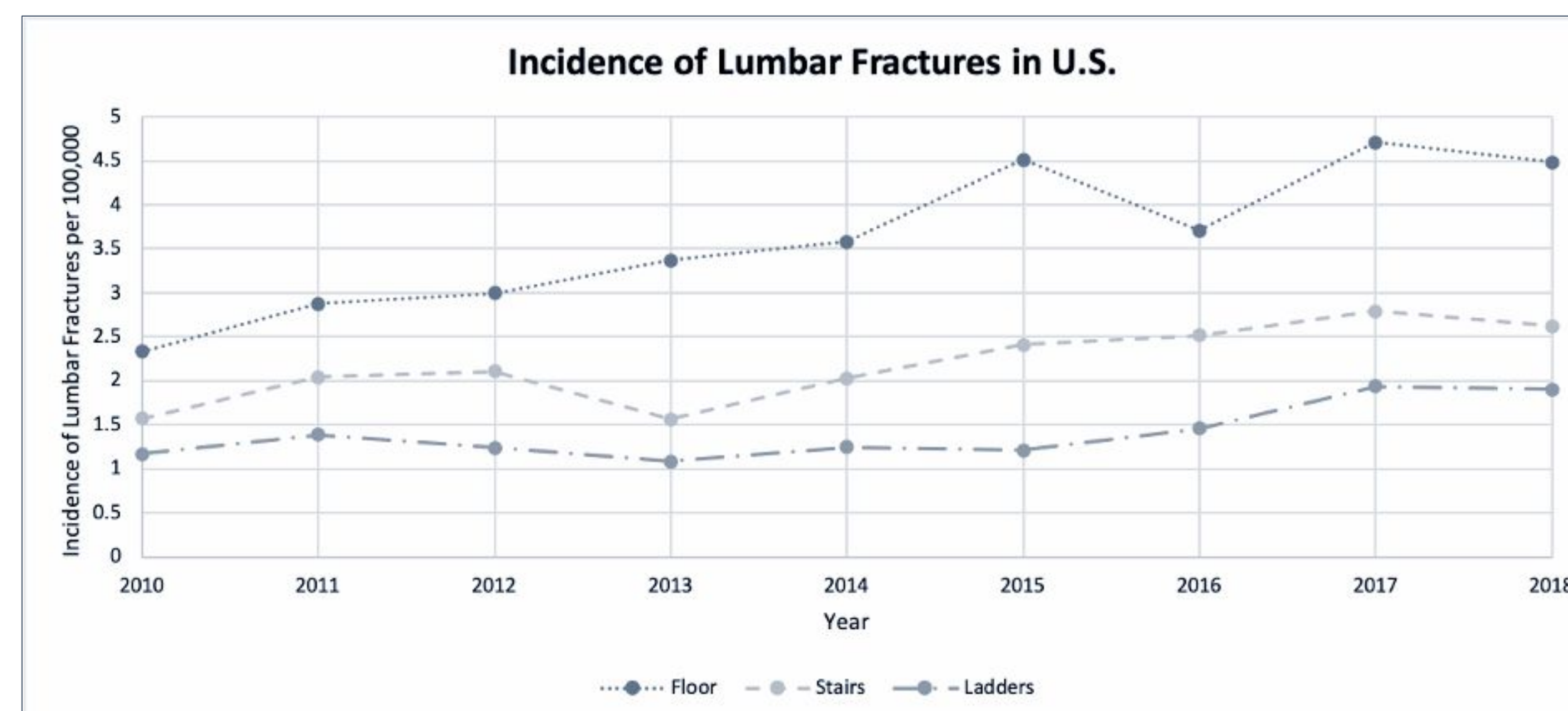

Figure 4. Rising Incidence of Lumbar Vertebral Fracture in U.S. Emergency Departments
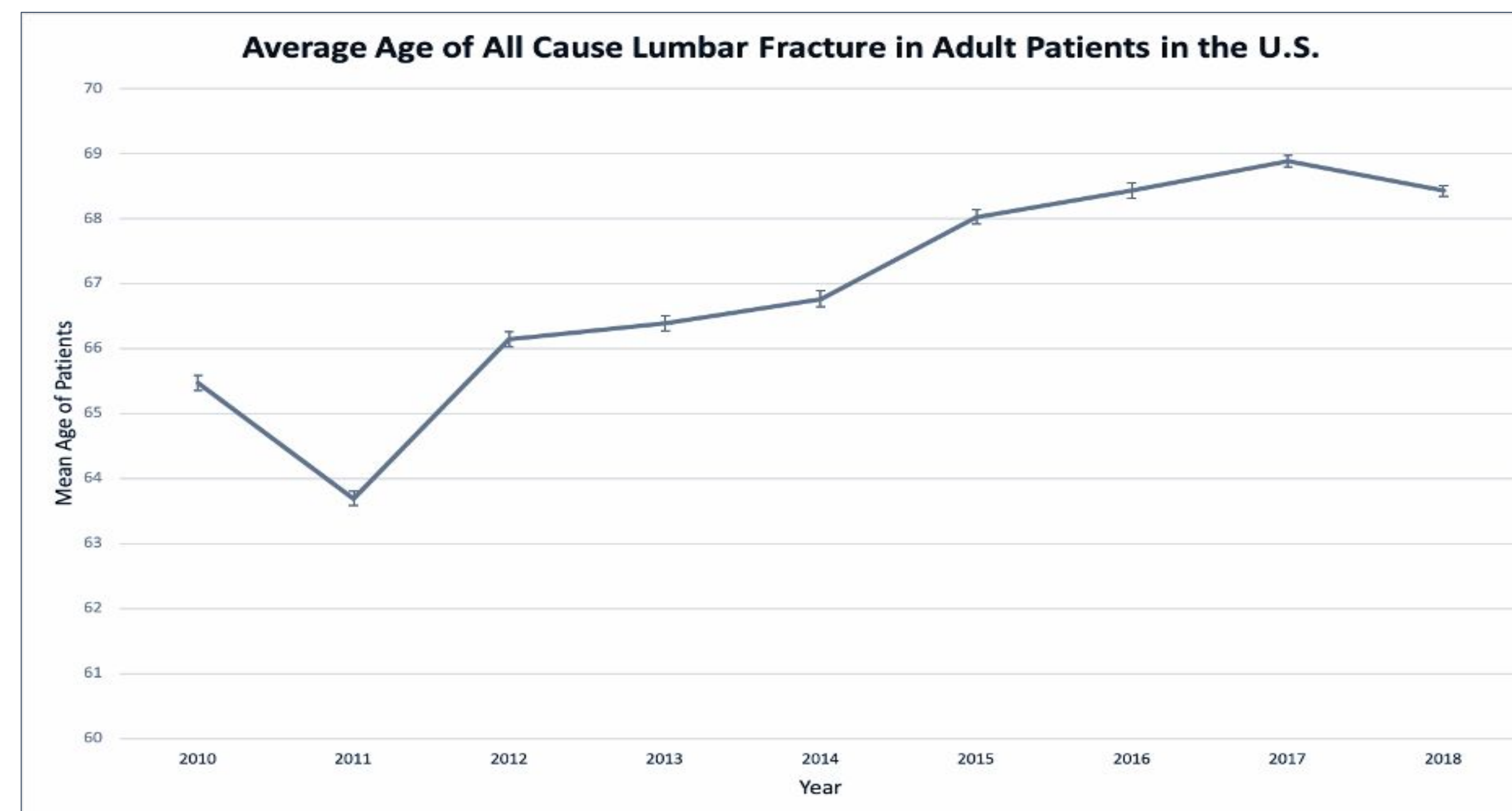

Figure 5. Average Age of All Cause Adult Lumbar Fracture Patients in the U.S.
The figure illustrates the older demographic of fracture patients and the aging U.S. population

Results

The annual incidence rate of total lumbar fractures in the U.S. increased by 54% from 14.6 to 22.5 per 100,000 people from 2010 to 2018. Similarly, lumbar fracture incidence rates due to floors increased by 92%, fractures due to stairs increased by 63%, and fractures by ladders increased by 58%.

Throughout the study period, floors, stairs/steps, and ladders were the three main mechanisms of injury for lumbar vertebral fracture. Across the nine-year time frame, the estimated sum of floor-related fractures was 80,054 (95% CI: 79,986-80,122), stair/step-related fractures was 48,274 (95% CI: 48,209-48,339), and ladder-related fractures was 31,053 (95% CI: 30,987-31,119). At the national level, these three etiologies constituted over 40% of all lumbar fractures.

In the multivariate regression, the p-value=0.0002 was statistically low (<0.05); hence average age and the incidence of ladder-related cases have the most statistically significant correlated increase in fractures between 2010 to 2018.

National Estimate of Male Cases	National Estimate of Female Cases	Fraction of Male Patients	Fraction of Female Patients
154,049 ± 370.23	223,865 ± 542.36	40.23%	59.77%

Figure 6. U.S. Lumbar Vertebral Fractures Breakdown by Sex
The figure illustrates significantly greater female lumbar fractures in U.S. emergency departments.

Discussion

Women are at higher risk of developing osteoporosis and have lower bone density compared to men (Alswat, 2017). This may explain the observed data that more women sustained vertebral fractures than men within the study population.

Our regression analysis identified that the increasing mean age patients was highly associated with the increase in annual number of lumbar vertebral fractures (p-value = 0.002). It is largely accepted that the U.S. population is aging. (Drazin et al., 2016). It is therefore reasonable to suggest that the aging population is a possible contributing factor to the increase in annual vertebral fractures. Moreover, the rates of nonroutine discharge, medical complications, and adverse reactions consistently increase with patients of older age (Drazin et al., 2016). This in mind, it is exceedingly important to recognize the mechanisms of injury to prevent surgical admissions for lumbar fractures, especially in older patients.

Specifically, since the data has identified that floors, stairs/steps and ladders are responsible for 41.6% of all lumbar vertebral fractures between 2010 and 2018, physicians and other advanced providers can be more precise in where they stress caution to their patients. This simple recommendation may prevent unnecessary medical treatment, decrease healthcare costs, and improve workflow for the patient and provider in the American economy.

All in all, this investigation provided a preliminary national estimate of adult lumbar fracture through a straightforward and reproducible methodology.

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