Geriatric falls: an enormous economic burden compared to firearms

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ABSTRACT

Background This study aimed to assess the medical costs, and the combined costs of fatal firearm injury and fatal falls during a 5 year period. While fatal firearm injury represents a significant public health concern, the healthcare community is faced with the significant challenge of fatal falls, particularly in light of the elderly population growth.

Methods Data were exported from the Web-based Injury Statistics Query and Reporting System database for fatal firearm and falls in patients aged between 15–85 years-old. The primary outcome was medical cost and the secondary outcome was combined costs (combination of medical costs and value of statistical life).

Results The medical cost of fatal falls was significantly higher in 2015–2020 in all age groups. The combined cost was significantly higher in fatal firearm injury overall. We found the combined cost was higher in fatal falls after 2019 for patients in the 45–85+ age range. During 2015–2019, the percentage of fatal falls had a significant increase in all age ranges, with a rise in the slope in 2019 for patients over 65 years. The annual percent change (APC) for the proportion of fatal falls increased from 2015 to 2020, there was a significant increase in the slope after 2019 (2.81% APC before 2019 vs 6.95% after 2019).

Conclusion Geriatric fatal falls have significantly higher medical costs compared with fatal firearm injury. The combined cost for fatal falls exceeded fatal firearm injury after 2019 which highlights the increasing socioeconomic burden of an aging population.

Level of evidence Level III retrospective study.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Falls among older adults is a significant public health issue, affecting millions of individuals each year. The cost of firearm-related injuries and deaths extends beyond the immediate medical expenses and includes long-term costs.

WHAT THIS STUDY ADDS

⇒ This study aimed to assess the medical costs, and combined costs of fatal firearm injury and fatal falls during a 5 year period.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The data and findings presented highlight the pressing need to address geriatric falls as a substantial economic burden. The increase in fatalities, shifting demographics, and stark economic comparisons between fatal falls and other causes of death underscore the urgency of the issue.

INTRODUCTION

Falls among older adults are a significant public health issue, affecting millions of individuals each year. A fall can have a significant impact on the quality of life of an elderly person, leading to injury, disability, and even death.[1] Geriatric falls are particularly concerning due to the vulnerability of older adults to injury, and the increasing risk of falls as people age.[2] Understanding the causes, consequences, and prevention of geriatric falls is crucial to maintaining the health and well-being of the elderly population.[3]

The WHO reports that falls are the second leading cause of accidental or unintentional injury deaths worldwide, with adults over 65 years-old being particularly vulnerable. Falls are responsible for approximately 20% of all injury-related hospital admissions and are a leading cause of traumatic brain injuries.[4 5] Falls can lead to fractures, particularly of the hip, wrist, and spine, which can result in significant disability, chronic pain, and loss of independence. Additionally, falls can have psychological consequences such as anxiety, fear of falling, and social isolation.[6]

The economic burden of geriatric falls is a significant concern for individuals, families, and society. Falls among older adults can result in substantial medical expenses, decreased productivity, and diminished overall quality of life.[7] According to the Centers for Disease Control and Prevention (CDC) the direct medical costs associated with falls among older adults in the USA exceeded $50 billion in 2015,[8 9] encompassing expenses for hospitalization, rehabilitation, and long-term care. The economic burden of geriatric falls extends beyond the healthcare system to include lost wages.

Conversely, the economic burden of firearm injury-related deaths is also significant and far-reaching.[10 11] The cost of firearm-related injuries and deaths extends beyond the immediate medical expenses and includes long-term costs associated with disability, lost productivity, and decreased quality of life.[12] Although the cost of firearm-related injuries and deaths is a significant public health issue, it is often perceived as a more acute problem due to its association with intentional injuries.

Both firearm injuries and falls have been shown to be responsible for the most years of potential life lost (YPLL). Firearm injuries disproportionately affect younger populations, leading to a higher

YPLL and value of statistical life (VSL) compared with falls. Consequently, the combined cost, which incorporates YPLL, is anticipated to be greater for fatal firearm-related injuries overall. However, with the growing geriatric population and the dynamic population pyramid – due to increased quality of medical care and life expectancy – these trends and burdens could change.[13]

Understanding the economic impact of firearm injuries and geriatric falls can provide valuable insights for policymakers and healthcare professionals in prioritizing resources and developing effective strategies to mitigate these risks. This study aims to calculate the associated medical costs and combined costs of fatal firearm and fall-related injuries and to report the alterations in these parameters based on age ranges over a 5 year period in the USA.

METHODS

We exported data from the Web-based Injury Statistics Query and Reporting System database (WISQARS), which is an interactive, online database that provides fatal and nonfatal injury, violent death, and cost of injury data from the CDC.[14] WISQARS is an interactive database developed and maintained by the CDC and provides data on fatal and nonfatal injuries, violent deaths, and cost of injuries in the USA. This database contains information regarding more than 20 causes of injury among different populations and geographic locations and is considered to be a valuable resource for researchers, policymakers, public health officials, and the general public who are interested in understanding and preventing injuries and violence.[14] The key features of WISQARS are:

► Fatal Injury Data: Provides data on deaths resulting from various types of injuries.
► Nonfatal Injury Data: Provides data on nonfatal injuries treated in hospital emergency departments in the USA.
► Violent Death Data: Contains data on violent deaths collected through the National Violent Death Reporting System (NVDRS).
► Cost of Injury Reports: Estimates the economic burden of injuries, including medical costs and lost productivity.

It should be noted that this study was exempt from Institutional Review Board (IRB) review due to secondary analysis of publicly available data.

Using the WISQARS data, we examined patients between the ages of 15 and 85+. For each injury, we collected the number of fatal cases, including unintentional injuries, homicide, suicide, legal intervention, and undetermined cases. We also gathered data on the total number of the population in the USA and the YPLL for both firearm injuries and falls. The medical costs of both types of injuries were then assessed and compared, along with the average medical costs for each injury.

Furthermore, we assessed the combined cost of injuries, which is defined as a sum of VSL (according to YPLL) and medical costs for CDC fatal injuries.[15] For both falls and firearms, all costs are expressed in 2021 US dollars.[16] It should also be noted that according to the CDC, the average life expectancy at birth in the USA in 2019 was 78.8 years.[17] Because WISQARS only allows choosing a YPLL calculation cut-off of 75 or 80 years, we used "80 years" for this calculation as it is closer to 78.8 years.

We should explain that VSL is a monetary estimate of the collective value placed on mortality risk reduction as derived in research studies through revealed preferences (eg, observed wage differences for dangerous occupations) or stated preferences from surveys of an individuals' willingness to pay for mortality risk reduction, and is typically 10 times higher than mortality cost estimates based on foregone employment compensation. For 2021 US dollar values published currently on the WISQARS Cost of Injury website, VSL estimates were assigned by decedent age to WISQARS records as follows[15 18]: 0–17 years, US\$ 16.9 million; 18–65 years, US\$10.7 million and values descending from US\$6 million (aged 66 years) to US\$410,000 (aged ≥100 years), reflecting the estimate for persons aged 18–65 years adjusted for older adults' decreasing general life expectancy, baseline quality of life.

The combined costs of the fatal injuries were compared in all ages. Furthermore, we identified the age range in which an extreme change in the combined cost of both injuries could be observed. All data are presented in 2021 US dollars, adjusted for inflation.

We also assessed the annual percent change (APC) in the affected populations of fatal firearm or falls according to the age range, in which the combined cost of both injuries crossed.

Temporal trends in the data were analyzed using the JoinPoint Program (Version 4.7.0.0). We used JoinPoint regression analysis and the Monte Carlo Permutation method to assess the data. To determine the changes in the fatal injuries for the affected population, we calculated the percentage and standard errors by age group and mechanism of injury for each year.

RESULTS

In the five year period between 2015–2020, a total number of 1454007 people died of injury in the USA. Of them, 230663
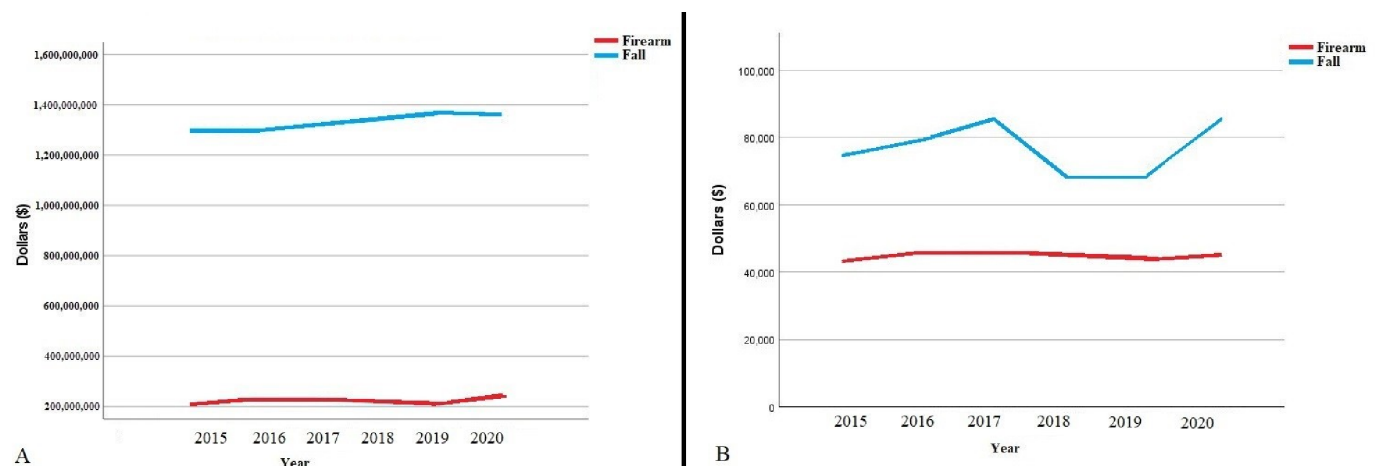

Figure 1 Total and average medical costs of fatal falls and gunshots in all age groups. (A) Total medical costs. (B) Average medical costs per patient.
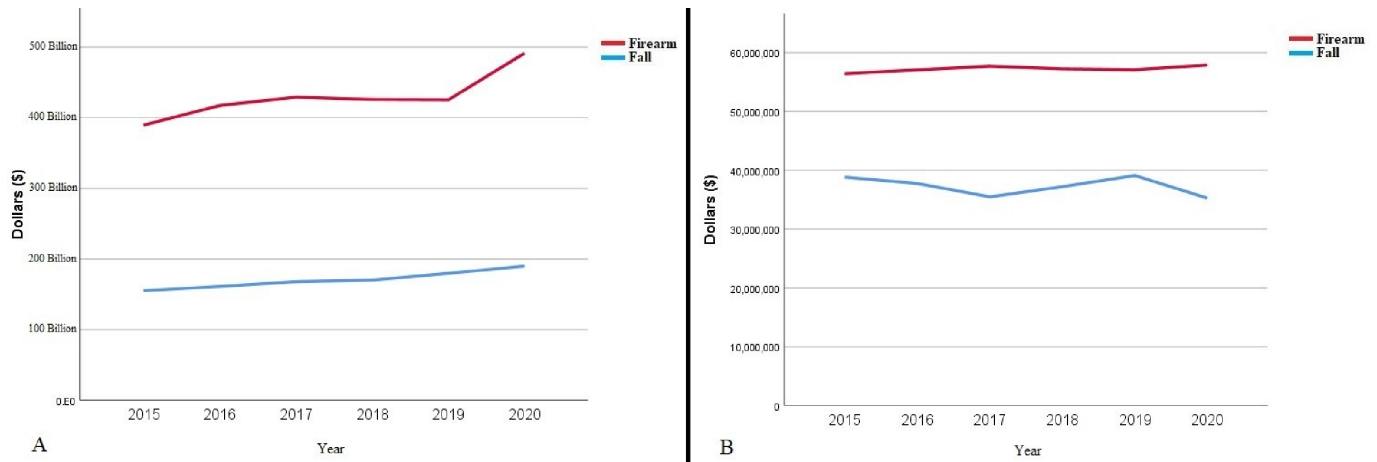
Figure 2 Total and average combined costs of fatal falls and gunshots in all age groups. (A) Total combined costs. (B) Average combined costs per patient.

cases (15.8%) were due to falls (193 643 cases >65 years-old) and 239 352 deaths (15.5%) were due to firearm injury (39 980 >65 years-old). The YPLL of fatal falls in between 2015–2020 was 1 500 900 years while the YPLL for firearms was 8 909 758 years.

On evaluating the medical cost of fatal falls and firearms from 2015 to 2020 across the entire study population of 15 to 85+, we found that the total medical costs of fatal falls were significantly higher than firearms in patients. During 2015 to 2020, the mean total medical costs for fatal falls was $1 427 773 589 and the mean medical costs for fatal firearms was $246 456 666.

Evaluation of average medical costs of fatal falls and firearms per patient showed significantly higher costs in fatal falls compared with firearms. During 2015 to 2020, the mean

average medical cost for fatal falls was $76 982±7818 and for firearms, it was $44 522±986, per patient. Figure 1 shows the total and average medical costs for all fatal injured patients based on mechanism of injury and year of event.

Evaluation of combined costs from fatal injuries showed that the total and average combined cost of firearm injuries exceeds falls overall. Figure 2 indicates total combined costs and average combined costs per patient based on mechanism of injury and year of event.

After categorizing the population into 10 year age ranges, we observed higher combined costs of falls compared with firearms in older age ranges. Following stepwise adding the age groups to the calculations, it was found that after 2019 patients aged 45 to 85+ had higher fatal fall-related combined costs compared
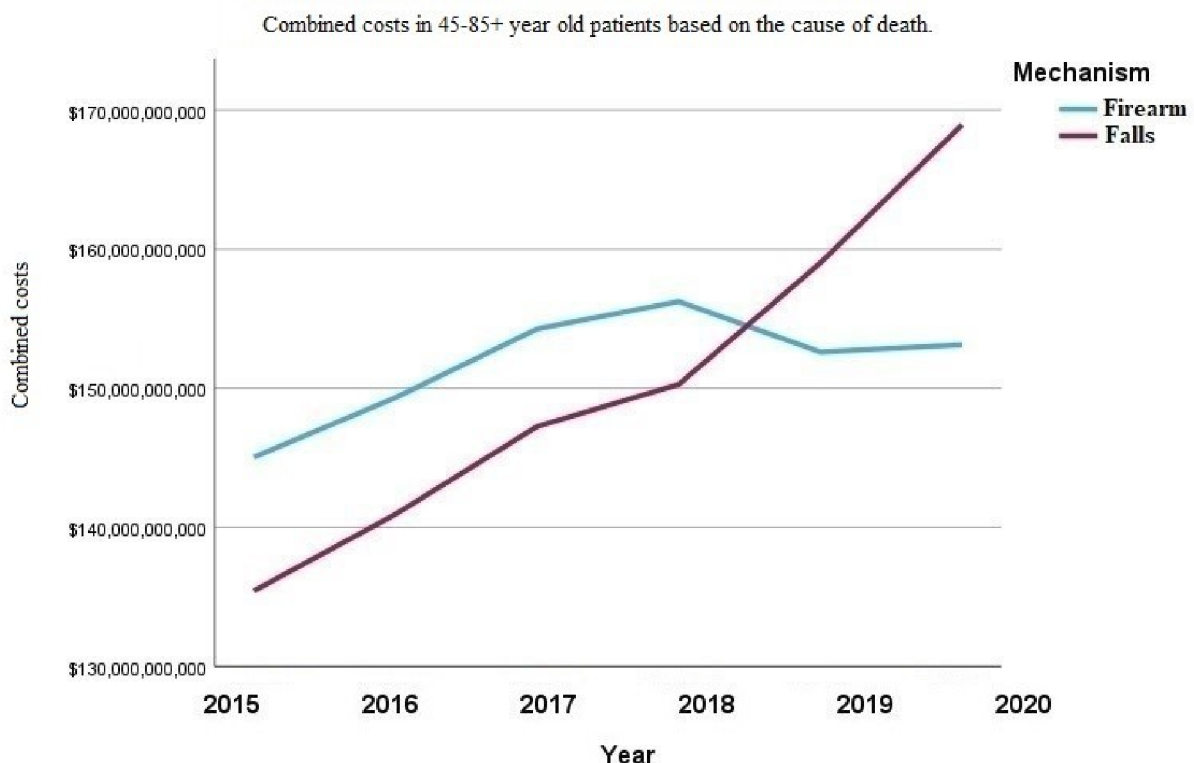

Figure 3 Combined costs for fatal falls and firearms in the 45–85+age range.

Percent of Affected Population by Age Group for Falls
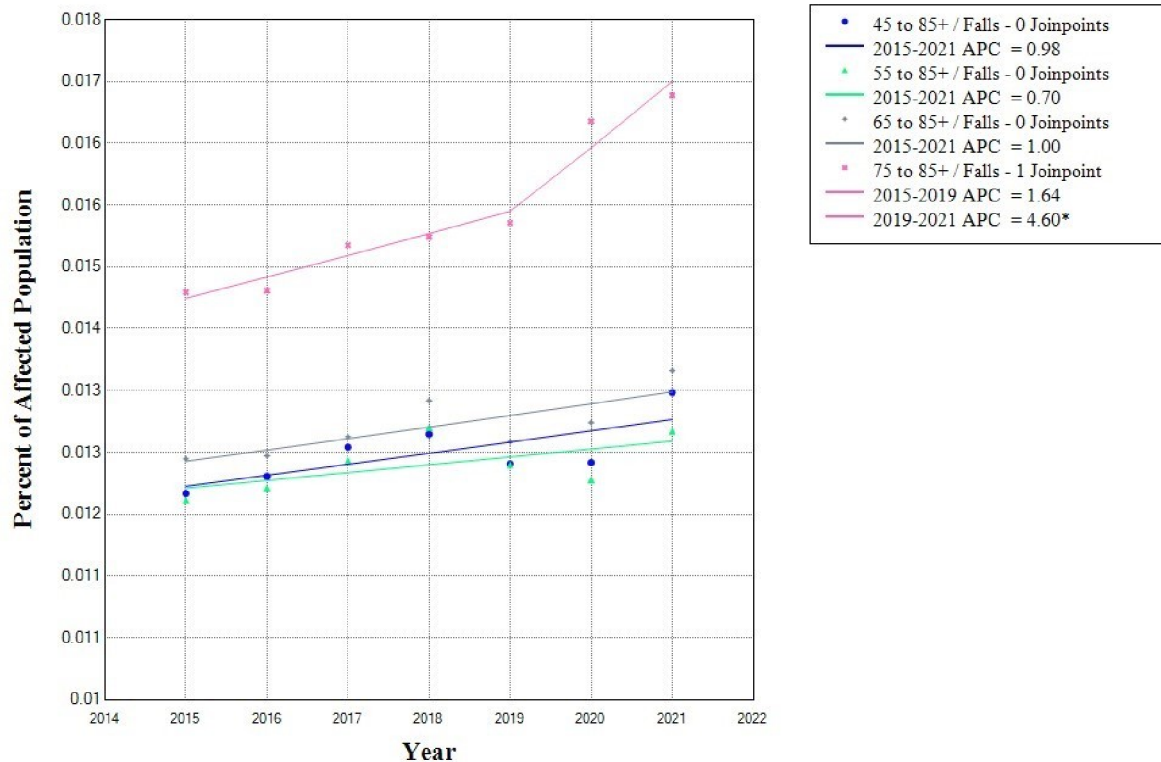

Figure 4 Trend analysis of fatal fall injuries, in the 45 to 85+ age range, 2015 to 2021.

with fatal firearm-related combined costs. We observed that the combined costs of two injuries crossed in 2019 and after 2019 the combined cost for falls remained progressively higher in the 45–85+ age group. Figure 3 is a line graph showing the combined cost for fatal falls and firearm injuries for adults aged 45 to 85+ years old. We observed that total combined cost from fatal firearms were increasing with higher costs in the firearm group until 2019, falling in the following years.

From 2019 to 2021, the APC for the percentage of fatalities increased at a statistically significant level, with a significant change in the slope in 2019 for all in the 45 to 85+ age range, as shown in figure 4.

DISCUSSION

In our retrospective study, we found that while combined costs of fatal firearm injuries still surpassed those of fatal falls overall, the combined cost of fatal falls for the 45–85 age group exceeded fatal firearm injuries. This finding is particularly important since it demonstrates how changing demographics affects the economic burden of healthcare in society. The medical costs associated with fatal falls remains significantly higher than those of firearm injuries across all age groups. This could be attributed to survivability bias, as victims of firearm injuries often die immediately, whereas victims of falls may endure prolonged hospitalization and rehabilitation therapy, leading to higher costs. Both geriatric falls and firearm injuries are pressing public health issues due to their significant impacts on quality of life, mortality, and economic burdens.

Before 2019 the combined costs of firearm injuries were significantly higher in all ages (regardless of grouping) due to a significant portion of the costs being attributed to value of statistical life. We observed that the largest APC for the percentage of

fatalities from falls increased after 2019 and was in the 75 and older age group in particular. A population-based longitudinal analysis conducted in China by Zhang et al., similarly found that fall mortality among the elderly was more prevalent in individuals over 70 years of age and exhibited a sharp increase. The death rates and APCs were highest among the oldest age groups (aged ≥85 years).[19] This variation likely stems from a multitude of factors, including environmental conditions, access to fall prevention activities and healthcare and social determinants of health. It is a known fact that the elderly population inherits multiple comorbidities and is susceptible to polypharmacy that makes them physiologically weaker.[20] Additionally, an increasing number of elderly individuals living alone in the USA can lead to issues such as malnutrition, depression, neglect, and improper medication intake, further complicating their health status and increasing their risk for falls.[21] However, the real reason for the observed change is likely related to demographic change. Between 2010 and 2020, the 65+ population experienced its fastest growth rate, increasing by 38.6% from 40.3 million to 55.8 million.[22] The older population reached 55.8 million or 16.8% of the population of the USA in 2020. Specifically, the age group of 75 to 84 years consisted of 16.3 million individuals in 2020, and this number is expected to rise as more baby boomers enter this age bracket. This demographic shift inherently exposes a larger number of people to a heightened risk of falls, contributing to the increasing APC of fatalities. This change in demographics is likely to follow the shape of the population pyramid in coming years and thus invokes attention as this may change the equations in healthcare economics.

Additionally, in 2019, Hartholt et al., evaluated the trends of geriatric falls in the USA from 2000 to 2016. Based on their evaluations, there was an increasing age-adjusted trend in

mortality from falls among older US adults.[23] Similarly, Zhang *et al.*, reported an increasing trend in mortalities due to falls experienced by geriatric individuals in China.[19] These studies suggest the findings of our study are part of a global and multi-year trend which is likely multifactorial and has roots in health-care improvements, population growth, and increased longevity, among other reasons. With the geriatric demographic expanding at an unprecedented rate, this trend carries the potential for substantial challenges in the years ahead if appropriate policies are not proactively devised and implemented. It is crucial to align our approach with the changing demographics, ensuring that preventative measures and targeted interventions are in place to mitigate the potential repercussions of this concerning trend.

Our study showed that the total and average medical costs for fatal falls are markedly higher than those for fatal firearm injuries across all age groups during the 5 year study period. A comparison of the combined costs in people aged 45 to 85+ years-old caused by falls and firearms reveals a significant shift in the relationship over time. The firearm injuries in this demographic were predominantly of suicidal intent. While firearm injuries accounted for higher combined costs until 2019, fatal falls surpassed them in economic impact thereafter.

Falls and firearm injuries represent significant and escalating threats to both the community and the healthcare system. Despite their distinct natures, both mechanisms of injury have shown a consistent upward trend, impacting quality of life and overall well-being. While public discourse often places an emphasis on issues such as gun violence because of its acuteness, our study underscores the hidden economic burden of geriatric falls. It is noteworthy that geriatric falls not only result in physical harm but also lead to a cascade of medical expenses. From emergency room visits to hospital stays, surgeries, and post-treatment reha-bilitation, the comprehensive healthcare journey following a fall can be extensive and costly. Moreover, falls can lead to chronic health conditions that require ongoing medical management, leading to a sustained financial burden on both individuals and healthcare systems.

We should also note that in our study, we utilized the combined cost of injuries, which is defined as a sum of VSL and medical costs. VSL provides a practical and standardized method for quantifying the benefits of risk reduction, commonly used in policy analysis. VSL also offers a consistent framework for comparing the economic benefits of different risk reduction strategies, crucial for evaluating the cost-effectiveness of inter-ventions. Additionally, VSL reflects broader societal preferences for safety, making it a valuable tool for assessing the economic impact of fatal injuries and supporting the need for improved fall prevention policies.[24 25]

Furthermore, raising awareness about the economic burden of geriatric falls is paramount. Public perception plays a crucial role in shaping healthcare policies and resource allocation. By dispelling misconceptions and highlighting the true cost of falls, societies can foster a more informed discourse that prioritizes preventative strategies and long-term care for the elderly.

This shift in demographics should be a clarion call for poli-cymakers.[26 27] The data illuminates the need for comprehensive policies that cater to the unique healthcare needs of the elderly population. Public health strategies should be formulated to address fall prevention, promote active lifestyles, and provide adequate support for older adults. These policies can range from creating age-friendly environments to ensuring accessible healthcare services that can effectively address the growing demand.[28]

Our study had some limitations that need to be stated. One limitation was that we could not determine the total number of fall incidents based on the data presented in WISQARS. Further-more, we should note that all numbers are accessible only as summary reports on the WISQARS database, and we do not have access to the actual crude numbers. Therefore, we cannot determine the normal distribution of the numbers. We also used value of statistical life and combined that with actual costs to be able to have a fair comparison between the two entities, whereas in reality, costs for fatal falls are actual and statistical value of life is potential. We recognize the presence of a survivability bias in our study as firearm injuries are far more prevalent in younger populations while falls are more common among the elderly. We also acknowledge that firearm injuries are often under-reported, and we have endeavored to interpret the data to the best of our ability. The increasing trends after 2019 can be attributed to the pandemic; however, as our study was conducted using data only up to 2020, we were unable to draw any conclusions regarding trends beyond that point. Another limitation was our inability to evaluate data on non-fatal firearm injuries, as WISQARS does not report the number or costs of such injuries.

CONCLUSION

The data and findings presented highlight the pressing need to address geriatric falls as a substantial economic burden. The increase in fatalities, shifting demographics, and stark economic comparisons between fatal falls and other causes of death under-score the urgency of the issue. Policymakers must recognize geriatric falls as a critical public health challenge and implement proactive measures to prevent falls, provide specialized health-care, and allocate resources strategically.

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REFERENCES

1 Zhang X, Huang P, Dou Q, Wang C, Zhang W, Yang Y, Wang J, Xie X, Zhou J, Zeng Y. Falls among older adults with sarcopenia dwelling in nursing home or community: A meta-analysis. *Clin Nutr* 2020;39:33–9.

2 Hortobágyi T, Teixeira LA, Duysens J, Granacher U, Van Dieën J, Moraes R. Is standing sway an accurate measure of fall risk and predictor of future falls in older adults? *BJMB* 2020;14:1–3.

3 Prabhakaran K, Gogna S, Pee S, Samson DJ, Con J, Latifi R. Falling Again? Falls in Geriatric Adults-Risk Factors and Outcomes Associated With Recidivism. *J Surg Res* 2020;247:66–76.

4 Charles A, Buckinx F, Locquet M, Reginster J-Y, Petermans J, Gruslin B, Bruyère O. Prediction of Adverse Outcomes in Nursing Home Residents According to Intrinsic Capacity Proposed by the World Health Organization. *J Gerontol* 2020;75:1594–9.

5 Cheng P, Wang L, Ning P, Yin P, Schwebel DC, Liu J, Qi J, Hu G, Zhou M. Unintentional falls mortality in China, 2006-2016. *J Glob Health* 2019;9:010603.

6 Søgaard AJ, Aga R, Holvik K, Meyer HE. Characteristics of fallers who later sustain a hip fracture: a NOREPOS study. *Osteoporos Int* 2022;33:2315–26.

7 Irianto KA, Rianto D, Sukmajaya WP, Alina O. Geriatric fractures in single Orthopedic Hospital: The role of domestic fall and comprehensive geriatric assessment. *Bali Med J* 2019;8:689–94.

8 Greenberg M, Jacoby J, Barraco RD, Yazdanyar AR, Surmaitis RM, Youngdahl A, Chow RB, Murillo SM, Zeng AH, Kane BG. Analysis of Falls Efficacy Scale and Vulnerable Elders Survey as Predictors of Falls. *Cureus* 2021;13:e14471.

9 Bergen G, Shakya I. CDC STEADI: Evaluation guide for older adult clinical fall prevention programs; 2019.

10 Rosas S, Gwam CU, Araiza ET, Roche MW, Emory CL, Carroll EA, Halvorson JJ, Plate JF. Economic impact of orthopaedic care for non-fatal gunshot wounds: analysis of a public health crisis. *Ann Transl Med* 2021;9:210.

11 Klein J, Prabhakaran K, Latifi R, Rhee P. Firearms: the leading cause of years of potential life lost. *Trauma Surg Acute Care Open* 2022;7:e000766.

12 Sanchez C, Jaguan D, Shaikh S, McKenney M, Elkbuli A. A systematic review of the causes and prevention strategies in reducing gun violence in the United States. *Am J Emerg Med* 2020;38:2169–78.

13 Arul K, Ge L, Ikpeze T, Baldwin A, Mesfin A. Traumatic spinal cord injuries in geriatric population: etiology, management, and complications. *J Spine Surg* 2019;5:38–45.

14 Control CfD. Prevention. Web-based injury statistics query and reporting system; 2013.

15 Peterson C, Rice KL, Williams DD, Thomas R. WISQARS Cost of Injury for public health research and practice. *Inj Prev* 2023;29:150–7.

16 Peterson C, Miller GF, Barnett SBL, Florence C. Economic Cost of Injury - United States, 2019. *MMWR Morb Mortal Wkly Rep* 2021;70:1655–9.

17 Xu J, Murphy SL, Kockanek KD, Arias E. Mortality in the United States, 2018. *NCHS Data Brief* 2020:1–8.

18 Department of Health & Human Services. Child care and development fund (CCDF) program. *Fed Regist* 2016;81:67438–595.

19 Zhang K, Qi J, Zuo P, Yin P, Liu Y, Liu J, Wang L, Li L. The mortality trends of falls among the elderly adults in the mainland of China, 2013-2020: A population-based study through the National Disease Surveillance Points system. *Lancet Reg Health West Pac* 2022;19:100336.

20 Chang TI, Park H, Kim DW, Jeon EK, Rhee CM, Kalantar-Zadeh K, Kang EW, Kang S-W, Han SH. Polypharmacy, hospitalization, and mortality risk: a nationwide cohort study. *Sci Rep* 2020;10:18964.

21 Abell JG, Steptoe A. Why is living alone in older age related to increased mortality risk? A longitudinal cohort study. *Age Ageing* 2021;50:2019–24.

22 Caplan Z. US older population grew from 2010 to 2020 at fastest rate since 1880 to 1890. United States Census Bureau; 2023.

23 Hartholt KA, Lee R, Burns ER, van Beeck EF. Mortality From Falls Among US Adults Aged 75 Years or Older, 2000-2016. *JAMA* 2019;321:2131–3.

24 Majumder A, Madheswaran S. Meta-analysis of Value of Statistical Life Estimates. *IIM Kozhikode Society & Management Review* 2017;6:110–20.

25 Kenkel D. Using Estimates of the Value of a Statistical Life in Evaluating Consumer Policy Regulations. *J Consumer Policy* 2003;26:1–21.

26 Ağartioğlu Kundakçi G, Yılmaz M, Sözmen MK. Determination of the costs of falls in the older people according to the decision tree model. *Arch Gerontol Geriatr* 2020;87:104007.

27 Barmentloo LM, Olij BF, Erasmus V, Smilde D, Schoon Y, Polinder S. Personal preferences of participation in fall prevention programmes: a descriptive study. *BMC Geriatr* 2020;20:185.

28 Ganz DA, Latham NK. Prevention of Falls in Community-Dwelling Older Adults. *N Engl J Med* 2020;382:734–43.