Valuing the Global Burden of Civilian Firearm Injuries

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Abstract

Civilian firearm injuries impose substantial economic costs worldwide, yet no systematic cross-country accounting of these losses exists. We estimate the global economic burden of civilian firearm injuries across 204 countries and territories in 2023, distinguishing the welfare cost of mortality risk from medical expenditure on nonfatal injuries. For the mortality component, we construct cause-deleted life tables and apply country-specific valuations of mortality risk to compute full-income losses. For the nonfatal component, we combine injury incidence data with treatment costs observed in 17 countries, using a prediction model to impute costs for remaining locations. The combined global burden totals US$56.81 billion: US$33.23 billion in mortality-related welfare losses and US$23.58 billion in medical expenditure. Interpersonal violence accounts for the largest share of the combined burden, while unintentional injuries account for the largest share of medical spending. Absolute losses are concentrated in North America, whereas losses relative to national income are greatest in several Latin American and Caribbean economies. We separately characterize legal civilian firearm markets using production, trade, and sales data. Together, the estimates establish a common accounting framework for cross-country comparisons and demonstrate how injury patterns, demographic structure, treatment costs, and income-based mortality valuations jointly govern the global distribution of firearm-related economic losses.

1. Introduction

Gun violence is an underrecognized yet urgent global health challenge[29]. Despite global mortality rates decreasing from 3.49 per 100, 000 to 3.07 in the past decade[9], the global burden of gun violence remains alarmingly high and unevenly distributed, with low- and middle-income countries (LMICs) disproportionately affected.

Beyond direct mortality and reduced life expectancy, firearm violence imposes enduring economic burdens on individuals, families, and societies[26, 28, 10, 11,17]. Using a value of lost output methodology, Peters and colleagues (2020) projected that firearm-related fatalities would result in a cumulative GDP loss of approximately US$239 billion between 2018 and 2030 across OECD countries[19]. Such substantial economic losses arise because the impact of firearm violence extends far beyond immediate health-care expenditures, encompassing significant indirect costs, such as reduced productivity from premature deaths and long-term disabilities, decreased workforce participation, and diminished lifetime earning potential, all of which exacerbate economic disparities and instability[12]. Broader societal consequences—including psychological trauma, reduced quality of life, and impaired social cohesion—represent critical yet frequently overlooked dimensions of the economic toll of firearm violence. Nevertheless, the existing evidence base regarding the global economic costs of firearm-related violence remains limited, with notable gaps in geographic scope, an overrepresentation of studies from the USA, and a predominant focus on direct medical expenses associated with firearm injuries[26, 28, 10, 11, 17, 12,13]. Although the estimates by Peters et al. (2020) provide valuable insights into the global economic burden associated with firearm-related fatalities[19], their analysis does not account for lost economic productivity resulting from non-fatal firearm injuries nor the substantial economic and social costs borne by family members and caregivers[8]. Addressing these multifaceted impacts necessitates a more comprehensive, globally inclusive research agenda that systematically captures both direct and indirect economic consequences of firearm-related violence[13].

An understanding of the financial consequences can complement the humanitarian concern to motivate policy change. Evidence based firearm policies can reduce gun-related mortality[20,24]. Income support policies may offer another pathway for violence prevention by addressing poverty—one of the key upstream risk factors for

firearm violence[23]. Continued research is needed to offer more options for effective policies to reduce harms of gun ownership[27]. A lack of research and policy implementation hinders progress toward Sustainable Development Goal 16.1 of the reduction of all forms of violence[18].

This paper estimates the mortality welfare losses and medical expenditure associated with civilian firearm injuries in 204 countries in 2023. The mortality analysis adapts the full income approach of Silva et al. (2021)[25], combining cause deleted life tables with population age structure and monetary valuations of mortality risk. The medical analysis combines injury incidence with observed treatment costs and a model of costs in countries without direct observations. We also apply the policy lens of economic externalities. A gun purchaser pays for the intended "internal" benefits of ownership, but use of the product imposes "external" costs. Some of the costs befall the purchaser through unintentional injury or self-harm. Some of the costs accrue to bystanders. If prices do not include the full social cost of all the harms from a product, consumers have a perverse incentive to over-consume products that create harms to themselves and others.

The analytic framework applied in this study rests on a theoretical tradition that treats mortality as an economic loss measurable through individuals' preferences over survival, rather than merely through forgone earnings and healthcare expenditure. Murphy and Topel (2006)[14] provide the foundational logic: using expected utility theory, they show that reductions in survival probability can be monetized through individuals' willingness to trade consumption for lower mortality risk, establishing the welfare-based foundation that distinguishes this approach from conventional cost-of-illness methods. Nordhaus (2002)[16] extends this reasoning to national accounting, arguing that standard income measures systematically understate living standards by excluding the value of health and longevity, and thereby justifying the treatment of gun-violence-related life expectancy losses as genuine economic costs rather than residuals beyond the production boundary. Building on this tradition, and following Jamison et al., our study extends this apparatus from tuberculosis to civilian firearm mortality across 204 countries and augments it with non-fatal injury costs, which follows the direct-cost component of the cost-of-illness tradition associated with Rice (1966)[21], in support of measurement of treatment resources and expenditure.

This paper makes three contributions to the literature. First, it provides the first geographically account yet assembled of the welfare losses and medical expenditure attributable to civilian firearm injuries, spanning 204 countries on a common 2023 reporting and currency basis. Prior estimates have been limited by geographic selectivity, a disproportionate focus on the United States, and methodological heterogeneity across studies. Second, by estimating welfare losses and medical expenditure as distinct accounts rather than collapsing them into a single aggregate, the analysis makes explicit which inputs drive each component of the burden, namely injury incidence, the valuation of mortality risk, and unit treatment costs. It also shows how differences in these inputs across countries produce divergent cost profiles even where headline mortality rates are similar. Third, the paper places the estimated economic burden of civilian firearm injuries alongside the monetary value of the legal civilian firearm market at the country level. Building on the foundational argument of Cook and Ludwig (2006) that gun violence generates negative externalities whose social costs systematically exceed private costs, this comparison extends their framework to a global setting by providing a concrete, country-level measure of the gap between what gun markets generate in sales revenue and what they impose in welfare losses and medical expenditure[3]. The resulting figures give empirical content to the externality argument that market prices fail to incorporate the full social cost of civilian firearm ownership, and establish the quantitative basis for the policy discussion that follows.

The paper is organized as follows. Section 2 describes the data source and model specifications. Section 3 reports the results and develops the implications for economic analysis of firearm market. Section 4 discusses and concludes.

2. Method

We adapted the economic methodology outlined by the Pacific Institute for Research and Evaluation (PIRE) mode[17]. Our adaptation combined reduced productivity and quality of life into a measure of full income using an approach described by Silva et al. (2021)[25]. In addition, we estimated direct medical costs for the treatment of victims of non-fatal injuries. Our estimates do not include the costs of law enforcement,

criminal justice, and incarceration that are attributable to unlawful ownership and use of guns. This omission is mainly due to a lack of reliable global data.

For direct medical costs we focus only on non-fatal gun-related injuries. This will obviously omit the costs of medical care rendered in fatal cases. However, data limitations in the majority of countries make it impossible to know the proportion of fatal cases that do not survive long enough to receive any medical care. By focusing on non-fatal injuries, we can assume that all cases that are recorded or estimated epidemiologically received medical treatment.

Firearm-related fatality data and non-fatal injury data were derived from the Institute for Health Metrics and Evaluation's Global Burden of Disease (GBD) study, disaggregated by cause (interpersonal violence, self-inflicted injuries, and unintentional firearm injuries), age, and sex, which enabled stratified estimation of economic impact across demographic groups and injury types[9]. We valued the contribution of those deaths towards the elevation of mortality risk and the value of that mortality risk in terms of full income, accounting for the societal valuation of the excess risk and its determinants such as population age structure, productivity, and consumption. By giving more attention to age structure and productive opportunities in each economy, this approach allows for a more consistent comparison across countries than a simple VSL approach which measures the societal willingness to pay to reduce mortality risk with no reference to the age at which deaths occur[10].

Full Income Cost of Fatal Gun Injuries

To construct the full income loss estimates for fatal injuries, we first estimated the excess hazard of mortality due to firearm related deaths by constructing multi-decrement life tables for each country by age interval, eliminating firearm-related excess deaths as a contributor to all-cause mortality. We valued the contribution of excess deaths towards full income losses by first transforming the excess hazard of gun-related civilian mortality to standardized mortality units at each age (D SMUs). One D SMU reflects a 1 in 10 000 change in mortality risk. We re-scaled the population value of mortality risk to the median age of the population. The dollar value of each country's age-weighted gun-related excess mortality risk was estimated by multiplying it by each country's VSL. For countries that did not have published VSLs they were estimated

using benefit transfer based on per capita GNI and the US VSL for 2025[31], assuming an income elasticity of 1.0[22].

Economic Welfare Costs of Non-Fatal Gun Injuries

Distinct from full income value of mortality from gun violence, we also calculated the economic welfare penalty of non-fatal gun injuries using the VSL. We first derived a value of a statistical life year (VSLY) for each country by dividing the respective VSL by the discounted life expectancy of the population at the median age (which we extracted from World Population Prospects - WPP) assuming a 3% discount rate. We multiplied this VSLY value by the Years Lived with Disability (YLDs) due to gun-related injuries reported by GBD.

Non-fatal firearm injury medical cost with uncertainty interval

Country-specific estimates of medical costs per injury are available for 17 countries. We extrapolate unit costs to countries without observed data using an ordinary least squares regression of log medical costs per injury on log GDP per capita. We convert fitted values to monetary units using a parametric log-normal retransformation correction and construct 95 percent prediction intervals that incorporate both estimation uncertainty and residual cross-country variation.

We propagate uncertainty in unit costs and nonfatal injury incidence through Monte Carlo simulation. In each iteration, we draw one unit cost per country from a triangular distribution parameterized by the lower prediction limit, the central cost estimate, and the upper prediction limit. We apply this draw to all three injury causes within the country, preserving a common source of cost uncertainty across causes. We independently draw nonfatal injury cases for each country–cause observation from a triangular distribution defined by its lower, central, and upper incidence estimates. Medical expenditure equals the product of the sampled unit cost and case count. We report the 2.5th and 97.5th percentiles of the simulated expenditure distribution as a 95 percent uncertainty interval. Appendix 1 provides the estimation and simulation details.

The Value of Civilian Retail Firearm Sales

Estimating the value of civilian firearm sales is challenging because no single government agency or international body reports a comprehensive global estimate, and many major manufacturers are privately held and do not disclose sales revenue. We therefore estimated annual legal civilian firearm sales by both a stock-and-turnover approach and added UN data on imports and exports and valued these sales using a U.S.-derived unit-price benchmark, adjusted for differences across countries. The analysis covered 21 countries estimated to account for 95% of global firearm sales (details in Appendix C). We focus on estimating the value of legal sales because it is already a policy goal to eliminate illegal sales through law enforcement. The new questions centre around taxation and tariffs on legal sales.

For each country, annual civilian firearm sales volumes were estimated by multiplying civilian-held firearm stocks, obtained from the Small Arms Survey's 2017 estimates by an assumed annual turnover rate[2]. Because comparable country-specific wholesale unit prices were unavailable, we used an aggregate U.S. wholesale expenditure per firearm as a proxy for the factory-gate price. This benchmark was calculated by dividing the estimated value of the U.S. formal wholesale market for new firearms in 2023 ($5.8 billion, in 2023 U.S. dollars), derived from federal tax data, by approximately 15.8 million background checks identified by the National Shooting Sports Foundation as likely reflective of legal retail firearm sales[4, 15]. This calculation yielded an approximate unit value of $367 per firearm. Country-specific price adjustment factors ranging from 0.8 to 1.2 were applied to account for variation relative to the U.S. benchmark.

The estimated annual wholesale market value for each country was calculated as:

$$V_i^{\text{wholesale}} = S_i \times t_i \times P_{\text{US}} \times a_i,$$

where $S_i$represents civilian-held firearm stocks, $t_i$the assumed annual turnover rate, $P_{\text{US}}$the U.S. unit-price benchmark, and $a_i$the country-specific price adjustment factor. Country-specific retail markup factors ranging from 1.3 to 2.0 were then applied to estimate retail market values.

As a cross check, we examined customs records for internationally traded firearms obtained from UN COMTRADE under Harmonized System codes 9302 (pistols and revolvers) and 9303 (sporting rifles and shotguns)[30]. Import and export values were used to calculate an additional measure, termed "net domestic sales" in this study, as follows:

$$B_i = V_i + M_i - X_i,$$

where B_i denotes the study-defined net domestic sales, V_i the estimated civilian firearm market value, and M_i and X_i the values of firearm imports and exports, respectively.

3. Results

In 2023, the combined medical cost and full income loss from death and lost productivity due to gun injuries was **US$56.81 billion** (95% UI: 44.34-72.74 billion). This can be broken down into estimated full-income losses of US$33.23 billion (95% UI: 28.59-38.32) and medical costs of S$23.58 billion (95% UI: 15.75–34.42 billion). (**Table 1 & Table 2**).

The distribution of these costs differed by cause. For full-income losses, physical violence costs accounted for the largest share (58.6%), followed by self-harm (38.4%) and unintentional injury (3.0%) (**Figure 1A**). Unintentional injuries accounted for the largest share of expenditure, at US$12.38 billion (95% UI: 9.19–16.88 billion), or 52.5 percent of the global total. Physical violence accounted for a further US$10.58 billion (95% UI: 5.41–17.68 billion), representing 44.9 percent. Medical costs associated with self-harm were substantially smaller, at US$0.62 billion (95% UI: 0.46–0.80 billion), or 2.6 percent. (**Figure 1B**). Taken together, these findings show that the global economic burden of gun violence was driven predominantly by interpersonal firearm violence, while the medical care burden was more heavily influenced by unintentional firearm injuries than were full-income losses.

Regionally, the economic burden of gun violence was unevenly distributed. North America accounted for the largest share of global full-income losses, contributing US$20.03 billion of the US$33.23 billion global total (60.3%). Latin America and the Caribbean contributed US$7.38 billion (22.2%), followed by sub-Saharan Africa (US$2.07 billion; 6.2%), Europe and Central Asia (US$1.59 billion; 4.8%), East Asia and Pacific (US$0.88 billion; 2.7%), the Middle East, North Africa, Afghanistan, and Pakistan (US$0.82 billion; 2.5%), and South Asia (US$0.46 billion; 1.4%) (**Table 3; Figure 2A**). Medical expenditure was concentrated in North America and Latin America and the Caribbean, which together accounted for 62.1 percent of the global total. North America had the highest estimated expenditure, at US$8.75 billion (95% UI: 2.23–18.08 billion), followed by Latin America and the Caribbean at US$5.88 billion (95% UI: 2.94–10.09 billion). East Asia and the Pacific accounted for US$3.52 billion, or 14.9 percent of global expenditure, while Europe and Central Asia accounted for US$3.31 billion, or 14.0 percent. The remaining regions collectively represent approximately 9 percent of the total. (**Table 4; Figure 2B**). In addition, such regional

patterns are consistent with the global distribution of firearm injuries and with cross-system differences in treatment costs. In 2023, there were an estimated 267,576 firearm-related deaths (95% UI 205,024 to 355,969) across 204 countries. Most deaths were attributable to physical violence (184,945 [95% UI 140,857 to 248,937]; 69.1%), followed by self-harm (66,447 [95% UI 43,693 to 102,170]; 24.8%) and unintentional injury (15,823 [95% UI 7,288 to 32,124]; 5.9%). (**Table 1**).

By income group, full-income losses from gun violence in 2023 were concentrated in high-income countries, which accounted for US$22.35 billion of the US$33.23 billion global total (67.3%). Upper-middle-income countries contributed US$7.73 billion (23.3%), lower-middle-income countries US$2.74 billion (8.3%), and low-income countries US$0.41 billion (1.2%) (**Table 3; Figure 3A**). High-income countries accounted for US$13.90 billion (95% UI: 7.19–23.37 billion), equivalent to 59.0 percent of global medical expenditure. Upper-middle-income countries accounted for US$7.60 billion (95% UI: 4.33–11.85 billion), or 32.2 percent. Together, these two income groups represented 91.2 percent of the global total. Lower-middle-income countries accounted for US$1.85 billion (95% UI: 1.26–2.54 billion), while low-income countries accounted for US$0.23 billion (95% UI: 0.15–0.33 billion). Their respective shares were 7.8 and 1.0 percent. (**Table 4; Figure 3B).**

By country, full income losses were highest in the United States, Mexico and Brazil. These three countries accounted for more than 75% of the total full income losses in the 204 countries (**Table 5**). The United States had the highest estimated medical expenditure, at US$8.25 billion (95% UI: 1.65–17.50 billion), accounting for 35.0 percent of the reported global total. Mexico ranked second, at US$2.85 billion (95% UI: 0.39–6.84 billion), or 12.1 percent. Brazil, Turkey, and Japan followed, with estimated expenditures of US$1.09 billion, US$1.07 billion, and US$0.78 billion, respectively. (**Table 6**). These economic patterns were consistent with a highly concentrated injury and mortality burden. Of the 204 countries, five contributed to more than 50% of the firearms related death due to all causes (United States, Brazil, Mexico, India and Colombia). Venezuela had the highest death rate per 100,000 of the 15+ year old population (56), closely followed by El Salvador (55) and Honduras (32). Venezuela, El Salvador and Haiti had the highest life expectancy losses at birth (1.16, 1.08 and 0.86 years respectively) due to their respective population age structure and ages at which the deaths were concentrated in (**Table 5**).

On a per capita basis, the highest full income loss was observed in the United States (US$58.23), exceeding by more than twofold the corresponding estimates for Mexico (US$23.48) and Panama (US$23.12) (**Table 7**; **Figure 4**). When expressed as a proportion of per capita GDP, however, the burden was greatest in Haiti (0.52%), El Salvador (0.43%), and Venezuela (0.41%). Per capita medical costs were also highest in the United States (US$24.02) and Mexico (US$21.95), compared with substantially lower estimates in Brazil (US$5.16) and India (US$0.24). Several small island jurisdictions exhibited even higher population-adjusted medical costs, notably the United States Virgin Islands (US$118.18), Bermuda (US$81.15), Puerto Rico (US$52.09), and the Bahamas (US$45.75) (**Table 7**; **Figure 5**). Collectively, these findings indicate that, although aggregate full income losses and medical expenditures were concentrated in a limited number of countries, the per capita burden of firearm violence was distributed more widely, particularly across the Americas and parts of southern Africa.

Market value of civilian firearm sales

For 2023, the 21 countries in our study accounted for an estimated 95% of global civilian firearm purchases (Appendix 2), and together they yield an aggregate civilian firearm market value of US$6.84 billion at producer prices (**Table 8**). This total combines US$6.71 billion in the column labeled domestic production with US$2.37 billion in firearm imports, less US$2.24 billion in exports. Applying the lower and upper endpoints of the country-specific retail multipliers produces aggregate retail valuations of US$10.23 billion and US$13.67 billion, respectively.

The United States dominates the reported aggregate. Its estimated domestic market value is US$7.15 billion at producer prices, comprising a US$5.80 billion base estimate, US$1.70 billion in imports, and US$0.35 billion in exports. Applying the U.S. retail multiplier of 1.3–2.0 implies a retail value of US$10.72–14.29 billion. Among countries with positive estimates, the next largest markets are Canada (US$196 million), India (US$147 million), France (US$131 million), and Pakistan (US$115 million). Russia contributes US$64 million and South Africa US$57 million. Other remaining country estimates were each below US$40 million.

When we examined UN Comtrade data, we found that seven countries recorded

negative trade-adjusted balances: Italy, Turkey, the Czech Republic, Germany, Brazil, Finland, and Australia. The largest negative balances were in Italy (−US$478 million), Turkey (−US$292 million), and the Czech Republic (−US$130 million). Florquin and Mariottini de Oliveira (2025) identify these countries as the leading global small-arms exporters during 2019–2024, and in each case recorded firearm exports exceeded the sum of imports and the stock-based domestic sales estimate[7].

4. Discussion

The global economic burden of gun violence is estimated at US$56.81 billion (95% UI: 44.34-72.74 billion). This comprises full-income losses of US$33.23 billion (UI: 28.59-38.32) from fatal injuries and medical costs of US$23.58 billion (UI: 15.75-34.42) from predominantly non-fatal injuries across 204 countries. These estimates combine fatal and non-fatal costs within a unified framework applicable across high- and low-income settings.

Prior global estimates have relied on cost-of-illness approaches that capture forgone earnings and healthcare expenditure but omit the welfare value of life itself. Peters et al. (2020) estimated that firearm fatalities in OECD countries would generate cumulative productivity losses of US$239 billion over 2018–2030, a figure that understates the true burden by construction because it omits lost economic productivity and the economic and social costs borne by family members and caregivers[19]. Our full-income approach, which monetizes life expectancy gains through VSL methods calibrated to national income, addresses both gaps. The medical cost component similarly advances on earlier US-centric estimates by Miller et al. (2024), which could not be generalized globally without the cross-country cost model we develop here[11].

The decomposition of costs by intent showed that interpersonal violence accounted for the majority of full-income losses globally (58.6%), reflecting the high homicide burden in Latin America and sub-Saharan Africa. Self-harm, however, contributes 38.4% of full-income losses—US$12,729 million—despite accounting for a smaller share of incident cases, because suicide by firearm is overwhelmingly fatal and therefore

generates disproportionate life-expectancy losses.

We can compare the costs of firearm injuries, including self-harm to the benefits of gun ownership as perceived by those who buy firearms. Every purchaser of a firearm, whether motivated by a desire for sports, security, or a new collectible is expressing a willingness to pay that is at least equal to the price paid for their new firearm. With an average factory-gate price of $367 per gun and a count of 18.3 million annual units sold, the wholesale value of civilian global gun sales is approximately $6.84 billion. Applying the retail markups of 1.5 to 2 leads to an estimated retail value of $10.05 to $13.42 billion US (2023 prices). Just the total cost of self-harm to gun purchasers ($13,347.5 million) is nearly as big as the expressed value of the benefits. However, guns and their owners create costs borne by others in the form of physical violence and unintentional injuries.

The broader comparison of aggregate social costs to market value reveals a market failure with a precise economic structure. Total estimated gun violence costs of approximately US$56.81 billion are about 4.2 to 5.6 times civilian legal annual retail gun sales revenue. Gun purchasing is a voluntary act, and standard welfare economics holds that voluntary transactions should, at equilibrium, reflect the full costs and benefits to all parties affected by the transaction. The amounts paid annually by civilian gun purchasers to achieve the benefits they anticipate are a fraction of the cost of annual harms. First, the costs accrue overwhelmingly to parties other than the purchaser: homicide victims, survivors of non-fatal injuries, trauma systems, medical care financing systems, and communities bearing elevated ambient safety risk are not parties to the retail transactions and have no mechanism for recovering their losses from these sales. Second, at the moment of purchase, buyers cannot observe or anticipate their individual contribution to aggregate social cost, and therefore respond rationally to a market price that systematically understates the true social cost of ownership.

This structure where private benefits go to a purchaser while social costs are diffused across non-consenting third parties is the defining feature of an externality. Standard examples are drunk driving, pollution, and second-hand tobacco smoke. The policy literature offers a well-developed repertoire of responses to these common problems. Pigouvian taxation, most familiar in its application to tobacco and carbon emissions, restores the missing price signal by imposing a corrective surcharge on the purchase

that incorporates the expected social cost[1]. For the US market estimates suggest that existing taxes are insufficient to cover the externalities and would need to be 65% of the retail price[5]. While the global average of external cost to benefit has costs 4.2 to 5.6 times the benefit, each country would differ from this global average and each country's corrective policy would need to be individualized accordingly.

Applied to firearms, this instrument would take the form of excise taxes on weapons and ammunition scaled to actuarial estimates of harm per unit sold. Customs officials could apply similarly calibrated tariffs on imported firearms. A more targeted approach would be to require mandatory liability insurance for gun buyers similar to automobile insurance requirements. This would individualize externality pricing at the purchaser level, requiring each buyer to face a premium that reflects their risk profile rather than distributing costs uniformly across public budgets. Extended producer responsibility, which has been pursued in tobacco litigation and is embedded in several environmental regulatory frameworks, holds manufacturers and distributors partially liable for downstream harms and thereby creates commercial incentives for investment in safety technologies such as gun locks. These instruments preserve a right to gun ownership but require that those who benefit from gun ownership internalize the costs. The same corrective principle that underlies fuel economy standards, tobacco excise duties, and pollution permit markets.

The regional and income-group distribution of costs deserves emphasis in its own right. Although absolute burdens are concentrated in North America, the share of GDP lost is highest in Haiti, El Salvador, and Venezuela, countries where institutional capacity for both violence prevention and medical cost absorption is most constrained. These highly affected countries are typically net importers of guns. A regional consensus to impose tariffs would be necessary to stem black market sales of bootlegged firearms if only a subset of countries chose such a policy. This distributional pattern implies that the countries bearing the highest relative burden are also those least equipped to finance a policy response from their own fiscal resources, suggesting that global gun violence control warrants treatment as a collective action problem with an international financing dimension, analogous to the frameworks established for communicable disease control.

Several limitations warrant acknowledgment. The cost estimates do not include the costs of criminal justice administration and incarceration that attend intentional gun

violence. Medical cost estimates for the majority of countries rest on a OLS extrapolation model trained on data from only 17 countries, and the external validity of GDP-based cost scaling depends on the assumption that healthcare market structures are sufficiently similar across income levels to permit extrapolation. The full-income approach captures welfare losses through the VSL metric, which reflects willingness to pay rather than objective economic output and therefore represents a preference-based rather than a production-based measure of burden. Non-fatal injury costs capture direct medical expenditure but omit costs of long-term sequelae, and medical costs for psychosocial care borne by surviving victims and their families, implying that our estimates are conservative with respect to the true social cost. Finally, GBD incidence and mortality estimates carry their own uncertainty, which we propagate through our cost model but which cannot fully account for systematic underreporting in settings with weak civil registration.

In conclusion, gun violence cost US $56.81 billion from global welfare in 2023. This burden fell across 204 countries but was highly concentrated in North America in absolute terms. As a share of national income Central America bears the highest burden. By estimating these costs, we do not aim to distract from a vision of the human toll of lives cut short and the bereavement of those left behind. But expressing the costs monetarily allows us to compare costs to benefits and conclude that the gun market is a failed market beset by externalities that outweigh product value by at least 4.2 to 1. Regulatory pathways that have corrected other failed markets are justified to correct this ongoing waste of human potential.

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Tables

Table 1: Deaths, life expectancy losses and full income losses due to intentional and unintentional injuries from firearms in 2023 in 204 countries – By cause of death. Deaths were estimated as described by GDB 2023. Life expectancy losses were estimated as the gain in life expectancy at birth should gun deaths be eliminated from all-cause mortality risks. Median life expectancy losses at birth are reported along with range corresponding to the upper and lower bounds of deaths reported by GDB 2023. Full income losses for the year were estimated as described in the *Methods* and *Appendix*. Although the GBD estimated counts of deaths are from 2023 we use 2024 as the base year to accrue full income losses. We then use values derived from 2024 and report costs in 2024 US$ millions. Upper and lower bounds values correspond to the upper and lower bounds of deaths reported by GDB 2023.

Cause	***Deaths in 2023***	***Median Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Physical violence	184,945 (140,857 - 248,937)	0.0229 (0.0154 - 0.0412)	$19,445.72 ($16,452.31 - $23,263.78)
Self-harm	66,447 (43,693 - 102,170	0.0143 (0.0055 - 0.0253	$12,728.88 ($10,586.99 - $15,291.57
Unintentional harm	15,823 (7,288 - 32,124)	0.0052 (0.0025 - 0.0104)	$986.56 ($550.75 - $1,705.24)
All causes	267,215 (205,024 - 355,969)	0.0378 (0.0235 - 0.0586)	$33,228.61 ($28,585.77 - $38,324.86)

Table 2: Medical cost of non-fatal injuries based on 2023 estimates of burden applied to unit costs as of 2023.

Cause	Cost (US$ millions indexed to 2023)	Lower	Upper
Unintentional firearm injuries	12,384.2	9,191.8	16,877.4
Self-harm by firearm	618.6	459.4	797.8
Physical violence by firearm	10,577.1	5,408.7	17,681.8
All causes	23,579.9	15,754	34,415.2

Table 3. Deaths, life expectancy losses, and full income losses due to intentional and unintentional firearm injuries in 2023, by World Bank region, by World Bank income group, and globally. Estimates of deaths are from GBD for 2023, but we use 2024 as the basis year for the present value of full income losses and use valuations based on 2024 GDP data.

	Deaths in 2023	Life expectancy loss, years*	Full income loss, 2024 US$ millions
By World Bank region			
East Asia and Pacific	14,699	0.93	883.85
Europe and Central Asia	9,580	1.34	1,586.31
Latin America and Caribbean	103,753	10.67	7,380.75
Middle East, North Africa, Afghanistan and Pakistan	13,985	1.67	818.47
North America	49,134	1.13	20,031.37
South Asia	22,623	0.12	461.26
Sub-Saharan Africa	53,802	4.98	2,066.63
By World Bank income group			
Low income	21,957	2.27	408.15
Lower-middle income	83,680	6.87	2,743.74
Upper-middle income	97,969	6.97	7,727.95
High income	63,970	4.71	22,348.80
Global (204 countries and territories)	**267,576**	**0.0378**	**33,161.2**

Table 4. Medical costs of non-fatal gun related injuries by World Bank region and income group.

	Cost (US$ millions)	Lower (US$ millions)	Upper (US$ millions)
By World Bank region			
East Asia and Pacific	3,523.3	2,126.8	5,235.5
Europe and Central Asia	3,305.5	2,308.9	4,368.8
Latin America and Caribbean	5878.8	2944.3	10086.3
Middle East, North Africa, Afghanistan and Pakistan	1,010.0	679.4	1,379.5
North America	8,752.9	2,227.1	18,081.8
South Asia	422.8	145.9	823.3
Sub-Saharan Africa	686.7	469.8	936.3
By World Bank income group			
Low income	228.4	149.5	332.0
Lower-middle income	1,847.7	1,261.3	2,542.0
Upper-middle income	7,601.0	4,325.2	11,847.4
High income	13,902.8	7,193.7	23,372.1
Global (204 countries and territories)	23,579.9	15,754	34,415.2

Table 5. Deaths, life expectancy losses and economic welfare costs due to intentional and unintentional injuries from firearms, in 204 countries in 2023 – By country. Deaths were estimated as described by GDB 2023. Deaths include those due to physical violence by firearms, self-harm by firearms and Unintentional firearm injuries. Life expectancy losses are estimated as the gain in life expectancy at birth should gun deaths be eliminated from all-cause mortality risks. Full income losses were estimated as described in the *Methods* and *Appendix* and reported in 2024 US$ millions.

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Afghanistan	1194	0.0733	10.59
Albania	91	0.0825	3.49
Algeria	343	0.0230	13.75
American Samoa	0	0	0
Andorra	0	0	0
Angola	661	0.0473	19.61
Antigua and Barbuda	3	0	0
Argentina	2554	0.1544	154.52
Armenia	44	0.0387	1.10
Australia	222	0.0225	65.04
Austria	258	0.0489	42.83
Azerbaijan	44	0.0116	1.44
Bahamas	116	0.8359	40.12
Bahrain	5	0.0080	1.77
Bangladesh	938	0.0148	15.08
Barbados	18	0	1.46
Belarus	43	0.0089	2.56
Belgium	199	0.0359	53.72
Belize	69	0.4291	3.84

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Benin	409	0.0676	6.37
Bermuda	0	0	0
Bhutan	5	0.0132	0.31
Bolivia (Plurinational State of)	524	0.1051	20.40
Bosnia and Herzegovina	31	0.0222	1.02
Botswana	72	0.0702	6.95
Brazil	38003	0.5373	2,478.77
Brunei Darussalam	0	0	0
Bulgaria	81	0.0239	6.60
Burkina Faso	718	0.0727	8.43
Burundi	364	0.0697	1.13
Cabo Verde	28	0.1485	1.23
Cambodia	192	0.0295	4.56
Cameroon	1060	0.0920	25.50
Canada	976	0.0705	209.92
Central African Republic	277	0	0
Chad	840	0.0936	7.63
Chile	625	0.1001	51.12
China	281	0.0010	27.78
Colombia	12362	0.6867	652.45
Comoros	21	0.0623	0.37
Congo	128	0.0544	4.01
Cook Islands	0	0	0
Costa Rica	524	0.3195	70.49

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Cote d'Ivoire	1244	0.0931	27.57
Croatia	102	0.0504	10.06
Cuba	107	0.0233	5.71
Cyprus	14	0.0225	2.18
Czechia	175	0.0328	28.27
Democratic People's Republic of Korea	52	0.0050	0.60
Democratic Republic of the Congo	2623	0.0642	16.91
Denmark	62	0.0194	14.94
Djibouti	57	0.1128	2.75
Dominica	2	0	0
Dominican Republic	1260	0.3080	112.76
Ecuador	3698	0.5995	275.18
Egypt	581	0.0133	20.18
El Salvador	2684	1.0838	123.63
Equatorial Guinea	33	0.0437	4.16
Eritrea	582	0.4604	5.82
Estonia	20	0.0310	4.00
Eswatini	124	0.2216	9.28
Ethiopia	4232	0.0866	57.12
Fiji	0	0	0
Finland	148	0.0565	44.56
France	1896	0.0610	367.86
Gabon	35	0.0378	3.00

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Gambia	33	0.0312	0.38
Georgia	103	0.0625	4.21
Germany	920	0.0173	206.00
Ghana	799	0.0573	16.12
Greece	128	0.0269	19.14
Greenland	15	0.6286	4.57
Grenada	0	0	0
Guam	8	0	3.10
Guatemala	3335	0.4959	206.00
Guinea	441	0.0715	6.55
Guinea-Bissau	92	0.1037	0.92
Guyana	65	0.2016	7.92
Haiti	4389	0.8643	62.00
Honduras	1999	0.4930	84.88
Hungary	60	0.0113	8.17
Iceland	1	0	5.18
India	21085	0.0354	433.68
Indonesia	320	0.0024	17.20
Iran (Islamic Republic of)	920	0.0324	67.81
Iraq	5252	0.3342	336.49
Ireland	26	0.0115	13.90
Israel	177	0.0620	58.95
Italy	609	0.0197	140.35
Jamaica	559	0.4620	27.15

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Japan	50	0.0016	13.42
Jordan	159	0.0421	7.38
Kazakhstan	145	0.0184	12.99
Kenya	2288	0.0952	63.89
Kiribati	0	0	0
Kuwait	15	0.0086	5.64
Kyrgyzstan	28	0.0100	0.44
Lao People's Democratic Republic	166	0.0518	5.57
Latvia	23	0.0268	4.70
Lebanon	142	0.0758	5.38
Lesotho	229	0.1806	4.02
Liberia	170	0.0718	1.60
Libya	84	0.0298	11.44
Lithuania	28	0.0211	5.23
Luxembourg	4	0.0112	0
Madagascar	607	0.0473	4.36
Malawi	1269	0.1618	8.05
Malaysia	159	0.0124	20.23
Maldives	0	0	0
Mali	846	0.0885	11.67
Malta	0	0	0
Marshall Islands	0	0	0
Mauritania	103	0.0577	2.84
Mauritius	0	0	0

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Mexico	28028	0.5946	3,045.70
Micronesia (Federated States of)	0	0	0
Monaco	0	0	0
Mongolia	26	0.0196	1.41
Montenegro	25	0.0890	1.46
Morocco	319	0.0240	11.17
Mozambique	741	0.0563	5.83
Myanmar	585	0.0233	13.57
Namibia	257	0.2153	18.29
Nauru	0	0	0
Nepal	430	0.0348	5.92
Netherlands	74	0.0104	21.97
New Zealand	83	0.0459	24.40
Nicaragua	352	0.1418	7.41
Niger	1165	0.1102	9.82
Nigeria	5707	0.0490	193.67
Niue	0	0	0
North Macedonia	26	0.0332	1.04
Northern Mariana Islands	0	0	0
Norway	73	0.0353	28.72
Oman	5	0.0020	1.11
Pakistan	2062	0.0221	36.16
Palau	0	0	0
Palestine	168	0.0780	6.77

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Panama	520	0.3783	103.10
Papua New Guinea	92	0.0204	3.69
Paraguay	645	0.2566	36.68
Peru	1405	0.1223	100.31
Philippines	6190	0.1273	268.01
Poland	119	0.0080	15.62
Portugal	143	0.0290	25.59
Puerto Rico	570	0.5124	68.34
Qatar	3	0.0022	3.94
Republic of Korea	19	0.0002	5.22
Republic of Moldova	20	0.0133	0.66
Romania	34	0.0042	4.68
Russian Federation	2026	0.0305	211.03
Rwanda	326	0.0598	3.35
Saint Kitts and Nevis	5	0	0
Saint Lucia	24	0.3368	2.78
Saint Vincent and the Grenadines	14	0	1.20
Samoa	0	0	0
San Marino	0	0	0
Sao Tome and Principe	4	0.0472	0.18
Saudi Arabia	625	0.0534	159.58
Senegal	256	0.0365	4.50
Serbia	221	0.0649	11.56
Seychelles	0	0	0

Country Or Region	***Deaths***	***Life Expectancy Loss (Years)***	***Full Income Loss (2024 US$ millions)***
Sierra Leone	316	0.0854	2.72
Singapore	0	0	0
Slovakia	70	0.0287	11.66
Slovenia	40	0.0392	6.48
Solomon Islands	9	0.0304	0.21
Somalia	1277	0.1694	2.63
South Africa	5975	0.2019	525.92
South Sudan	674	0.1292	3.86
Spain	259	0.0129	57.05
Sri Lanka	165	0.0191	6.27
Sudan	440	0.0222	7.18
Suriname	33	0.1446	1.59
Sweden	155	0.0360	35.60
Switzerland	216	0.0489	78.07
Syrian Arab Republic	501	0.0541	3.70
Taiwan	2543	0.0818	172.72
Tajikistan	30	0.0038	9.10
Thailand	27	0.0064	0.21
Timor-Leste	2500	0.0937	189.36
Togo	16	0.0292	0.34
Tokelau	258	0.0647	2.35
Tonga	0	0	0
Trinidad and Tobago	0	0	0
Tunisia	256	0.4928	30.90

Country Or Region	*Deaths*	*Life Expectancy Loss (Years)*	*Full Income Loss (2024 US$ millions)*
Turkey	59	0.0131	1.83
Turkmenistan	62	0.0205	5.90
Tuvalu	0	0	0
Uganda	1908	0.1101	26.42
Ukraine	478	0.0273	15.40
United Arab Emirates	16	0.0054	8.19
United Kingdom	122	0.0035	37.05
United Republic of Tanzania	1433	0.0580	23.65
United States	48059	0.4061	20,001.30
United States Virgin Islands	37	0	6.39
Uruguay	425	0.3390	41.82
Uzbekistan	45	0.0031	0.90
Vanuatu	0	0	0
Venezuela (Bolivarian Republic of)	11189	1.1585	325.68
Viet Nam	609	0.0152	21.18
Yemen	558	0.0404	4.80
Zambia	1007	0.1277	16.76
Zimbabwe	517	0.0780	6.99

Table 6: Medical costs for non-fatal firearm injury cases in 2023, by country

Country	Mean medical cost (million USD)	95% UI lower bound	95% UI upper bound
Afghanistan	4.23	0.59	10.13
Albania	3.14	0.63	6.50
Algeria	43.69	8.21	95.77
American Samoa	0.17	0.03	0.36
Andorra	0.44	0.08	0.99
Angola	22.81	4.53	52.50
Antigua and Barbuda	3.05	0.68	6.55
Argentina	458.50	94.54	1002.43
Armenia	3.17	0.62	6.86
Australia	179.61	32.62	420.97
Austria	57.01	11.19	127.93
Azerbaijan	7.68	1.44	16.93
Bahamas	18.28	3.40	40.98
Bahrain	9.61	2.04	21.75
Bangladesh	33.49	5.98	77.19
Barbados	4.25	0.64	10.03
Belarus	7.67	1.57	17.00
Belgium	65.99	11.81	148.83
Belize	4.48	0.99	9.63
Benin	5.74	1.14	12.94
Bermuda	5.25	0.98	11.44
Bhutan	0.24	0.05	0.52
Bolivia (Plurinational State of)	19.34	4.13	43.67
Bosnia and Herzegovina	2.89	0.57	6.30
Botswana	3.02	0.61	6.63
Brazil	1089.08	210.79	2585.51
Brunei Darussalam	1.68	0.34	3.78
Bulgaria	11.10	2.22	24.34
Burkina Faso	6.74	1.23	15.26
Burundi	1.60	0.24	3.76
CÃ´te d'Ivoire	35.47	6.70	77.25
Cabo Verde	0.36	0.07	0.81
Cambodia	8.62	1.52	19.52
Cameroon	316.11	69.31	691.31
Canada	4.24	0.71	9.94
Central African Republic	1.90	0.36	4.28
Chad	68.61	13.92	152.62
Chile	110.35	23.86	244.96

Country	Mean medical cost (million USD)	95% UI lower bound	95% UI upper bound
China	207.19	35.38	525.74
Colombia	106.26	19.52	228.67
Comoros	0.52	0.09	1.15
Congo	31.12	6.28	69.92
Cook Islands	0.04	0.01	0.09
Costa Rica	9.92	1.80	21.97
Croatia	11.19	2.30	24.18
Cuba	68.97	13.48	149.46
Cyprus	5.53	1.12	12.09
Czechia	28.51	6.38	63.47
Democratic People's Republic of Korea	3.37	0.58	7.77
Democratic Republic of the Congo	14.30	2.45	33.19
Denmark	47.13	9.10	107.93
Djibouti	1.18	0.24	2.68
Dominica	0.32	0.07	0.68
Dominican Republic	132.83	28.59	293.53
Ecuador	120.10	23.27	255.26
Egypt	97.89	21.63	214.91
El Salvador	55.55	11.63	115.79
Equatorial Guinea	1.77	0.35	3.99
Eritrea	1.60	0.27	3.70
Estonia	3.31	0.63	7.34
Eswatini	0.96	0.19	2.14
Ethiopia	34.39	5.96	80.08
Fiji	1.25	0.26	2.71
Finland	37.03	7.64	80.13
France	496.93	89.25	1115.96
Gabon	2.65	0.54	5.80
Gambia	0.64	0.11	1.46
Georgia	4.68	0.92	10.05
Germany	513.16	105.63	1118.28
Ghana	17.95	3.41	40.00
Greece	25.01	4.66	54.95
Greenland	1.15	0.24	2.52
Grenada	0.69	0.14	1.54
Guam	1.45	0.28	3.16
Guatemala	181.74	36.06	389.53

Country	Mean medical cost (million USD)	95% UI lower bound	95% UI upper bound
Guinea	4.79	0.87	10.69
Guinea-Bissau	0.58	0.10	1.32
Guyana	8.72	1.70	19.32
Haiti	42.08	6.99	96.32
Honduras	32.02	6.03	71.49
Hungary	22.60	4.54	48.15
Iceland	3.08	0.60	6.90
India	348.31	75.54	744.59
Indonesia	437.21	76.15	963.84
Iran (Islamic Republic of)	71.80	8.85	176.60
Iraq	132.02	28.67	282.26
Ireland	73.33	13.08	169.33
Israel	63.91	12.13	141.09
Italy	222.90	44.47	488.94
Jamaica	41.28	9.35	81.62
Japan	776.29	158.62	1680.27
Jordan	11.90	2.16	26.54
Kazakhstan	26.61	5.21	58.61
Kenya	27.37	4.46	64.32
Kiribati	0.06	0.01	0.13
Kuwait	33.73	6.99	73.74
Kyrgyzstan	1.32	0.23	2.88
Lao People's Democratic Republic	6.30	1.20	14.08
Latvia	3.57	0.72	7.74
Lebanon	7.51	1.48	16.74
Lesotho	0.54	0.09	1.25
Liberia	0.99	0.17	2.27
Libya	9.37	1.83	20.41
Lithuania	40.66	6.21	117.62
Luxembourg	10.56	1.94	24.19
Madagascar	5.01	0.92	11.60
Malawi	4.39	0.73	10.03
Malaysia	105.69	21.06	233.01
Maldives	2.15	0.39	4.75
Mali	8.07	1.34	18.45
Malta	2.69	0.54	5.88
Marshall Islands	0.06	0.01	0.14
Mauritania	1.68	0.32	3.87

Country	Mean medical cost (million USD)	95% UI lower bound	95% UI upper bound
Mauritius	3.86	0.84	8.73
Mexico	2848.40	390.16	6840.35
Micronesia (Federated States of)	0.08	0.01	0.18
Monaco	1.43	0.23	3.27
Mongolia	1.45	0.29	3.20
Montenegro	0.75	0.15	1.68
Morocco	37.98	7.27	87.27
Mozambique	8.06	1.42	18.57
Myanmar	21.64	3.88	50.45
Namibia	2.18	0.44	4.94
Nauru	0.03	0.01	0.06
Nepal	4.26	0.73	9.78
Netherlands	152.54	30.48	342.17
New Zealand	18.61	2.74	44.56
Nicaragua	7.85	1.58	17.43
Niger	5.13	0.77	11.99
Nigeria	147.65	28.31	328.87
Niue	0.01	0.00	0.01
North Macedonia	1.78	0.34	3.94
Northern Mariana Islands	0.30	0.06	0.64
Norway	65.86	12.21	144.73
Oman	23.49	4.72	51.98
Pakistan	47.64	10.20	106.56
Palau	0.05	0.01	0.10
Palestine	7.07	1.29	15.55
Panama	64.28	12.95	134.95
Papua New Guinea	7.87	1.40	17.69
Paraguay	18.49	3.56	39.60
Peru	156.03	30.96	338.94
Philippines	228.57	46.62	504.84
Poland	98.99	18.76	220.55
Portugal	28.23	5.36	62.05
Puerto Rico	168.87	35.83	354.00
Qatar	55.25	11.08	120.34
Republic of Korea	284.21	53.72	627.50
Republic of Moldova	2.68	0.56	5.98
Romania	33.00	6.18	71.23
Russian Federation	196.69	37.49	424.79

Country	Mean medical cost (million USD)	95% UI lower bound	95% UI upper bound
Rwanda	3.79	0.68	8.59
Saint Kitts and Nevis	2.28	0.42	4.90
Saint Lucia	2.34	0.49	5.01
Saint Vincent and the Grenadines	1.10	0.21	2.35
Samoa	0.05	0.01	0.11
San Marino	0.23	0.04	0.51
Sao Tome and Principe	0.08	0.01	0.17
Saudi Arabia	243.10	46.01	544.43
Senegal	6.97	1.30	15.91
Serbia	11.50	2.43	25.06
Seychelles	0.56	0.12	1.27
Sierra Leone	2.42	0.41	5.53
Singapore	59.54	11.31	137.44
Slovakia	17.90	3.45	39.16
Slovenia	7.61	1.48	16.62
Solomon Islands	0.77	0.14	1.77
Somalia	6.51	1.10	15.13
South Africa	86.21	19.23	191.52
South Sudan	1.16	0.19	2.69
Spain	172.59	31.18	386.55
Sri Lanka	34.33	6.64	76.83
Sudan	9.30	1.71	20.66
Suriname	2.54	0.53	5.49
Sweden	82.41	16.33	181.45
Switzerland	110.14	21.76	253.38
Syrian Arab Republic	6.09	0.99	13.49
TÃ¼rkiye	1067.16	230.47	2338.99
Taiwan	6.14	1.24	13.47
Tajikistan	6.76	0.98	16.33
Thailand	31.83	5.72	71.77
Timor-Leste	0.42	0.07	0.96
Togo	11.65	2.26	25.33
Tokelau	0.00	0.00	0.00
Tonga	0.42	0.08	0.93
Trinidad and Tobago	6.18	1.19	13.33
Tunisia	28.49	1.85	72.28
Turkmenistan	7.12	1.47	15.73
Tuvalu	0.01	0.00	0.03

Country	Mean medical cost (million USD)	95% UI lower bound	95% UI upper bound
Uganda	13.15	2.74	29.65
Ukraine	11.73	2.19	25.76
United Arab Emirates	92.83	19.43	197.24
United Kingdom	470.50	106.05	960.87
United Republic of Tanzania	22.76	4.05	52.03
United States of America	8249.68	1649.03	17500.42
United States Virgin Islands	10.13	2.02	21.62
Uruguay	117.50	24.54	251.89
Uzbekistan	19.09	3.44	43.21
Vanuatu	0.28	0.05	0.61
Venezuela (Bolivarian Republic of)	158.19	30.44	345.61
Viet Nam	129.16	24.87	288.09
Yemen	4.70	0.78	10.82
Zambia	8.25	1.54	18.83
Zimbabwe	3.99	0.80	9.12

Table 7. Full income loss and medical cost per capita in 204 countries

Country	Full income loss per capita	Medical cost per capita
Afghanistan	0.26	0.10
Albania	1.24	1.12
Algeria	0.30	0.95
American Samoa	0.00	3.49
Andorra	0.00	5.46
Angola	0.53	0.62
Antigua and Barbuda	0.00	32.65
Argentina	3.39	10.07
Armenia	0.37	1.08
Australia	2.46	6.79
Austria	4.69	6.24
Azerbaijan	0.14	0.74
Bahamas	100.44	45.75
Bahrain	1.13	6.12
Bangladesh	0.09	0.20
Barbados	5.17	15.07
Belarus	0.28	0.84
Belgium	4.59	5.63
Belize	9.34	10.90
Benin	0.45	0.41
Bermuda	0.00	81.15
Bhutan	0.39	0.30
Bolivia (Plurinational State of)	1.67	1.58
Bosnia and Herzegovina	0.32	0.91
Botswana	2.80	1.22
Brazil	11.74	5.16
Brunei Darussalam	0.00	3.66
Bulgaria	0.97	1.63
Burkina Faso	0.37	0.29
Burundi	0.08	0.12
CÃ´te d'Ivoire	0.88	1.14
Cabo Verde	2.35	0.70
Cambodia	0.26	0.49
Cameroon	0.90	11.14
Canada	5.34	0.11
Central African Republic	0.00	0.37
Chad	0.39	3.55
Chile	2.60	5.61

Country	Full income loss per capita	Medical cost per capita
China	0.02	0.15
Colombia	12.47	2.03
Comoros	0.44	0.61
Congo	0.65	5.03
Cook Islands	0.00	2.96
Costa Rica	13.81	1.94
Croatia	2.58	2.87
Cuba	0.52	6.26
Cyprus	1.62	4.11
Czechia	2.62	2.64
Democratic People's Republic of Korea	0.02	0.13
Democratic Republic of the Congo	0.16	0.14
Denmark	2.51	7.92
Djibouti	2.39	1.02
Dominica	0.00	4.75
Dominican Republic	9.95	11.72
Ecuador	15.30	6.68
Egypt	0.18	0.85
El Salvador	19.59	8.80
Equatorial Guinea	2.25	0.96
Eritrea	1.68	0.46
Estonia	2.93	2.42
Eswatini	7.54	0.78
Ethiopia	0.44	0.27
Fiji	0.00	1.35
Finland	7.96	6.61
France	5.54	7.48
Gabon	1.21	1.07
Gambia	0.14	0.24
Georgia	1.11	1.23
Germany	2.44	6.07
Ghana	0.48	0.53
Greece	1.87	2.44
Greenland	81.72	20.61
Grenada	0.00	5.93
Guam	18.62	8.68
Guatemala	11.37	10.03
Guinea	0.45	0.33

Country	Full income loss per capita	Medical cost per capita
Guinea-Bissau	0.43	0.27
Guyana	9.58	10.55
Haiti	5.33	3.62
Honduras	7.97	3.01
Hungary	0.84	2.33
Iceland	13.37	7.95
India	0.30	0.24
Indonesia	0.06	1.55
Iran (Islamic Republic of)	0.75	0.79
Iraq	7.47	2.93
Ireland	2.67	14.11
Israel	6.37	6.90
Italy	2.36	3.75
Jamaica	9.56	14.54
Japan	0.11	6.24
Jordan	0.65	1.04
Kazakhstan	0.64	1.31
Kenya	1.15	0.49
Kiribati	0.00	0.42
Kuwait	1.17	6.97
Kyrgyzstan	0.06	0.19
Lao People's Democratic Republic	0.73	0.82
Latvia	2.50	1.89
Lebanon	0.93	1.30
Lesotho	1.74	0.23
Liberia	0.29	0.18
Libya	1.57	1.28
Lithuania	1.83	14.25
Luxembourg	0.00	15.87
Madagascar	0.14	0.16
Malawi	0.38	0.21
Malaysia	0.58	3.01
Maldives	0.00	4.08
Mali	0.49	0.34
Malta	0.00	5.05
Marshall Islands	0.00	1.61
Mauritania	0.57	0.33
Mauritius	0.00	3.03
Mexico	23.48	21.95

Country	Full income loss per capita	Medical cost per capita
Micronesia (Federated States of)	0.00	0.73
Monaco	0.00	36.70
Mongolia	0.41	0.42
Montenegro	2.30	1.19
Morocco	0.30	1.01
Mozambique	0.17	0.24
Myanmar	0.25	0.40
Namibia	6.17	0.74
Nauru	0.00	2.36
Nepal	0.20	0.14
Netherlands	1.21	8.43
New Zealand	4.72	3.60
Nicaragua	1.09	1.15
Niger	0.38	0.20
Nigeria	0.85	0.65
Niue	0.00	3.37
North Macedonia	0.57	0.97
Northern Mariana Islands	0.00	6.57
Norway	5.20	11.93
Oman	0.22	4.65
Pakistan	0.15	0.19
Palau	0.00	2.80
Palestine	1.25	1.31
Panama	23.12	14.42
Papua New Guinea	0.36	0.76
Paraguay	5.36	2.70
Peru	2.96	4.61
Philippines	2.33	1.99
Poland	0.40	2.55
Portugal	2.45	2.71
Puerto Rico	21.08	52.09
Qatar	1.32	18.55
Republic of Korea	0.10	5.49
Republic of Moldova	0.22	0.87
Romania	0.24	1.73
Russian Federation	1.45	1.35
Rwanda	0.24	0.27
Saint Kitts and Nevis	0.00	48.68
Saint Lucia	15.51	13.08

Country	Full income loss per capita	Medical cost per capita
Saint Vincent and the Grenadines	11.84	10.87
Samoa	0.00	0.22
San Marino	0.00	6.88
Sao Tome and Principe	0.78	0.33
Saudi Arabia	4.80	7.31
Senegal	0.25	0.39
Serbia	1.71	1.70
Seychelles	0.00	4.40
Sierra Leone	0.32	0.29
Singapore	0.00	10.28
Slovakia	2.11	3.24
Slovenia	3.06	3.59
Solomon Islands	0.26	0.97
Somalia	0.14	0.35
South Africa	8.32	1.36
South Sudan	0.34	0.10
Spain	1.19	3.60
Sri Lanka	0.27	1.49
Sudan	0.14	0.19
Suriname	2.53	4.04
Sweden	3.37	7.81
Switzerland	8.80	12.42
Syrian Arab Republic	0.16	0.26
Taiwan	1.98	12.23
Tajikistan	0.39	0.26
Thailand	0.02	0.65
Timor-Leste	2.64	0.44
Togo	0.25	0.30
Tokelau	0.25	1.25
Tonga	0.00	0.75
Trinidad and Tobago	0.00	4.00
Tunisia	20.56	4.11
Turkey	0.15	2.33
Turkmenistan	0.80	0.97
Tuvalu	0.00	1.43
Uganda	0.54	0.27
Ukraine	0.41	0.31
United Arab Emirates	0.77	8.72
United Kingdom	0.54	6.85

Country	Full income loss per capita	Medical cost per capita
United Republic of Tanzania	0.36	0.34
United States	58.23	24.02
United States Virgin Islands	74.56	118.18
Uruguay	12.34	34.68
Uzbekistan	0.03	0.54
Vanuatu	0.00	0.87
Venezuela (Bolivarian Republic of)	11.51	5.59
Viet Nam	0.21	1.29
Yemen	0.12	0.12
Zambia	0.81	0.40
Zimbabwe	0.43	0.24

Table 8. Global civilian firearms sales, imports, exports, estimated net domestic market, and estimated retail value used for triangulated estimates, 2023

Formula used: Net civilian domestic market = domestic production + civilian imports − civilian exports.

Retail value estimation: Estimated retail value = net civilian domestic market × estimated retail multiplier.

Country	Imports, HS 9302+9303 (US$ million)	Estimated domestic production (US$ million)	Exports (US$ million)	Net civilian domestic market (US$ million)	Estimated retail multiplier	Estimated retail value (US$ million)
United States	1,701.7	5,800.0	354.8	7,147.0	1.5–2.0×	10,720.5–14,294.0
Turkey	8.0	77.5	377.8	-292.3	1.3–1.8×	-380.0 to -526.1
Canada	155.1	73.4	32.0	196.5	1.25×	245.6
Germany	59.4	80.0	246.2	-106.8	1.5–2.0×	-160.2 to -213.6
Brazil	53.8	101.2	239.1	-84.1	1.5×	-126.2
Australia	57.0	26.2	90.6	-7.5	1.5×	-11.3
France	73.5	61.5	3.8	131.2	1.5–2.0×	196.8–262.4
United Kingdom	44.3	13.7	37.4	20.6	1.5×	30.9
Norway	17.9	11.4	1.3	28.0	1.5×	42.0
Finland	13.4	13.7	87.0	-59.9	1.5×	-89.9
Czech Republic	19.9	8.2	157.8	-129.7	1.5×	-194.6
Austria	38.0	12.0	29.0	21.1	1.5×	31.7
Switzerland	28.2	12.2	12.5	27.9	1.5×	41.9
Italy	26.2	49.7	553.9	-478.0	1.4×	-669.2
Serbia	1.7	10.7	9.4	3.0	1.3×	3.9
South Africa	29.1	29.7	1.7	57.1	1.5×	85.7
Mexico	17.2	20.4	0.9	36.7	1.3×	47.7
India	3.1	143.6	0.0	146.6	1.3×	190.6
Pakistan	12.2	103.1	0.0	115.4	1.2×	138.5
Russia	8.2	58.1	1.9	64.5	1.3×	83.9

Notes: Values are reported in **2023 US$ millions**. Net domestic market estimates are presented at the **factory-gate level**; estimated retail values reflect approximate downstream markups based on the stated multiplier. For countries with multiplier ranges, estimated retail values are shown as ranges. Negative net domestic market values indicate that exports exceeded the combined value of domestic production and imports.

Figures

Figure 1. Distribution of cost by cause

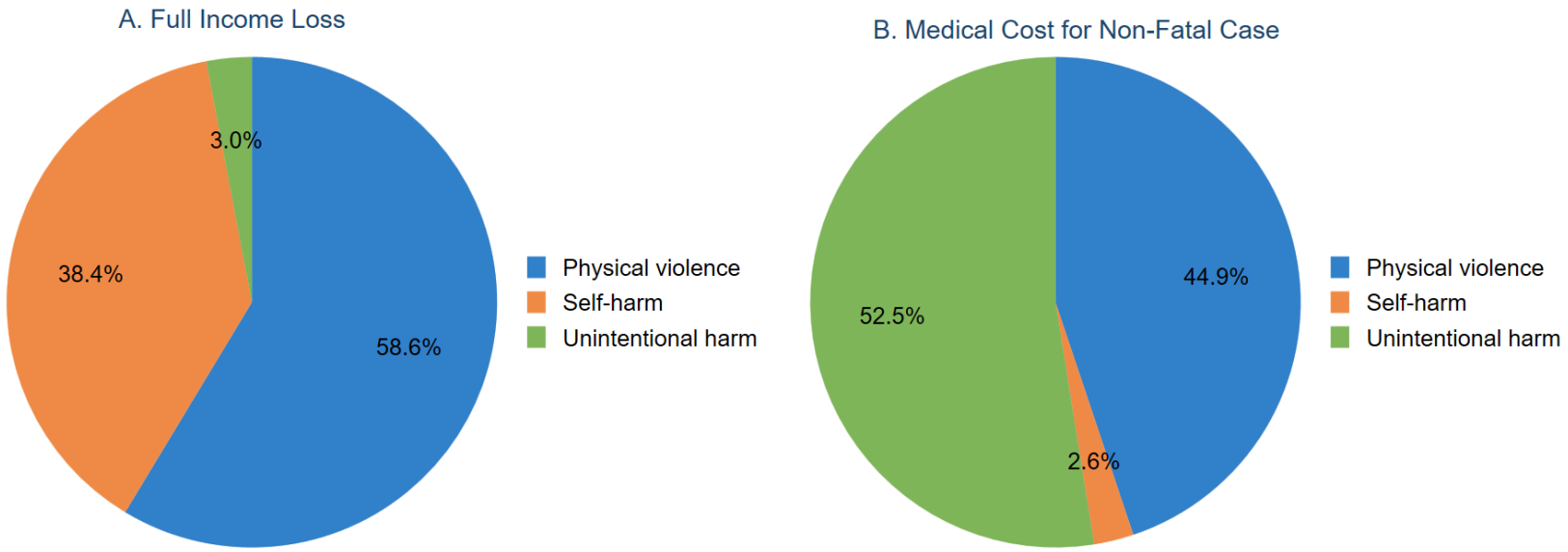


Figure 2. Distribution of cost by regions

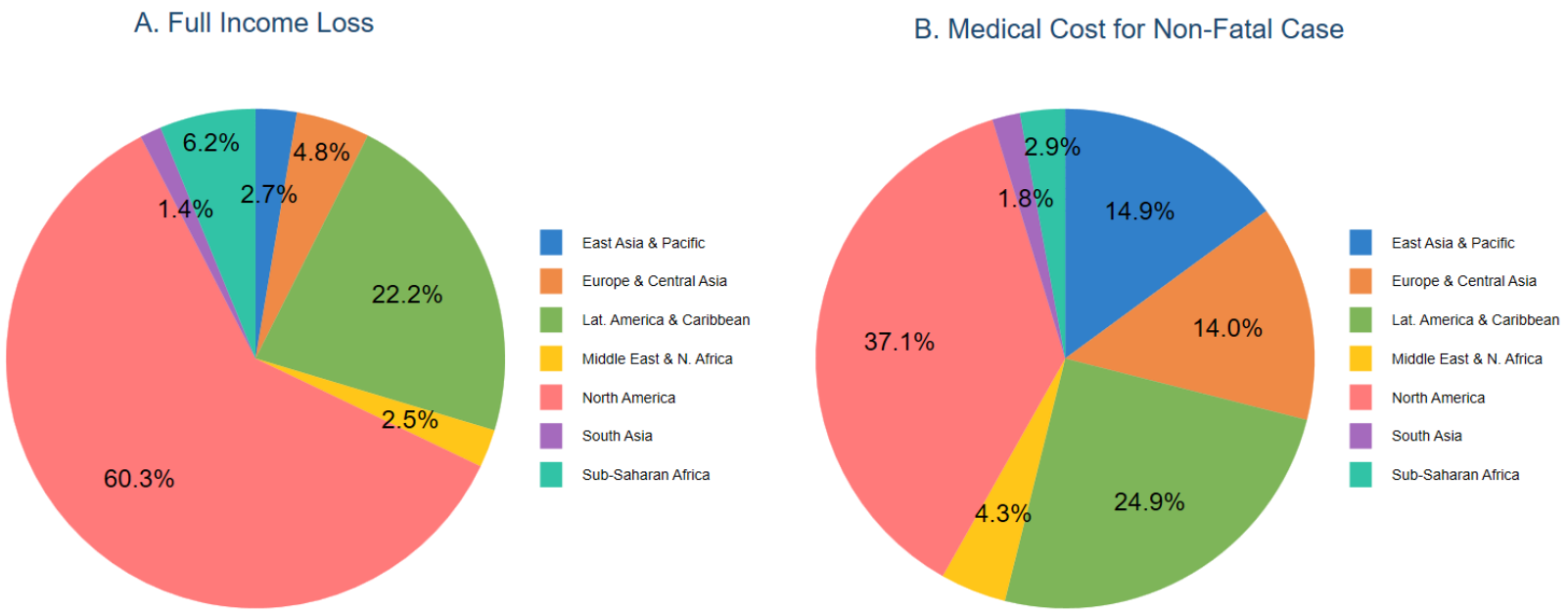


Figure 3. Distribution of cost by income levels

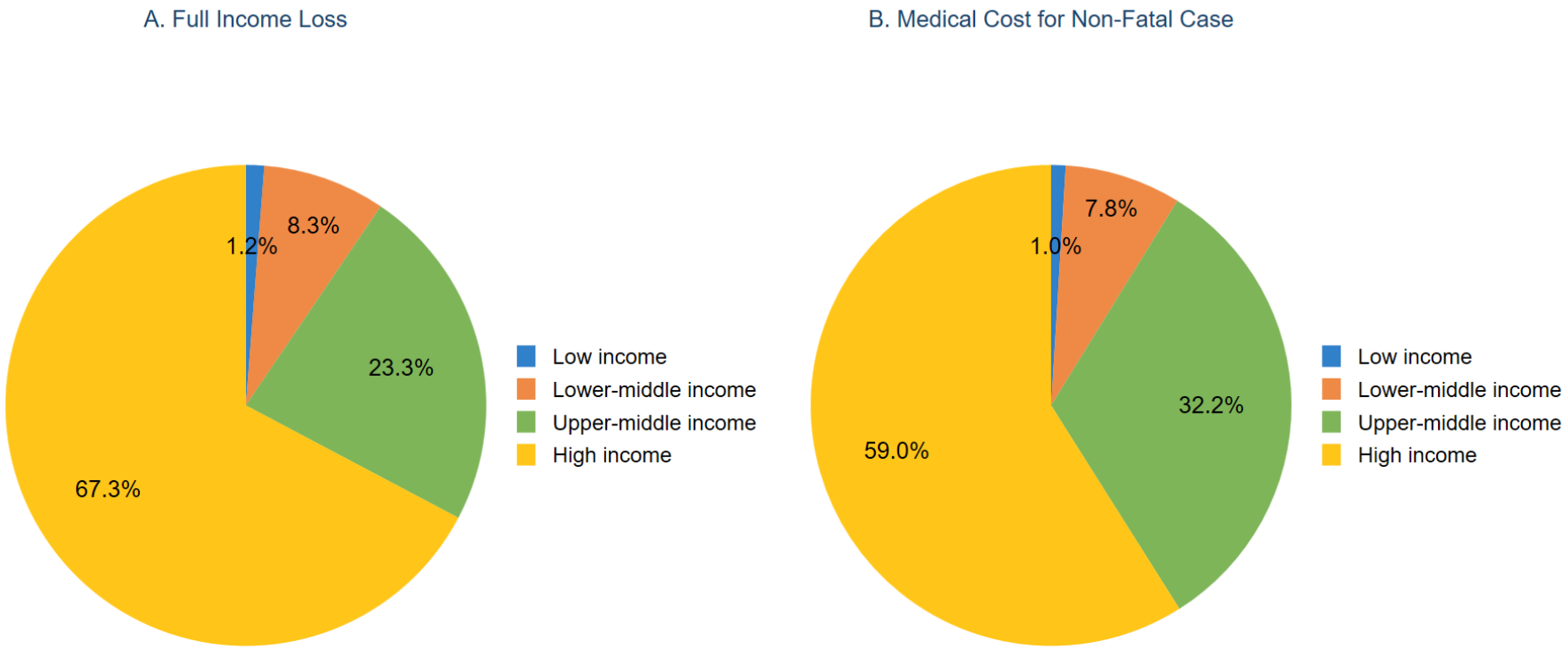


Figure 4. Global distribution in per capita full income loss on firearm injury

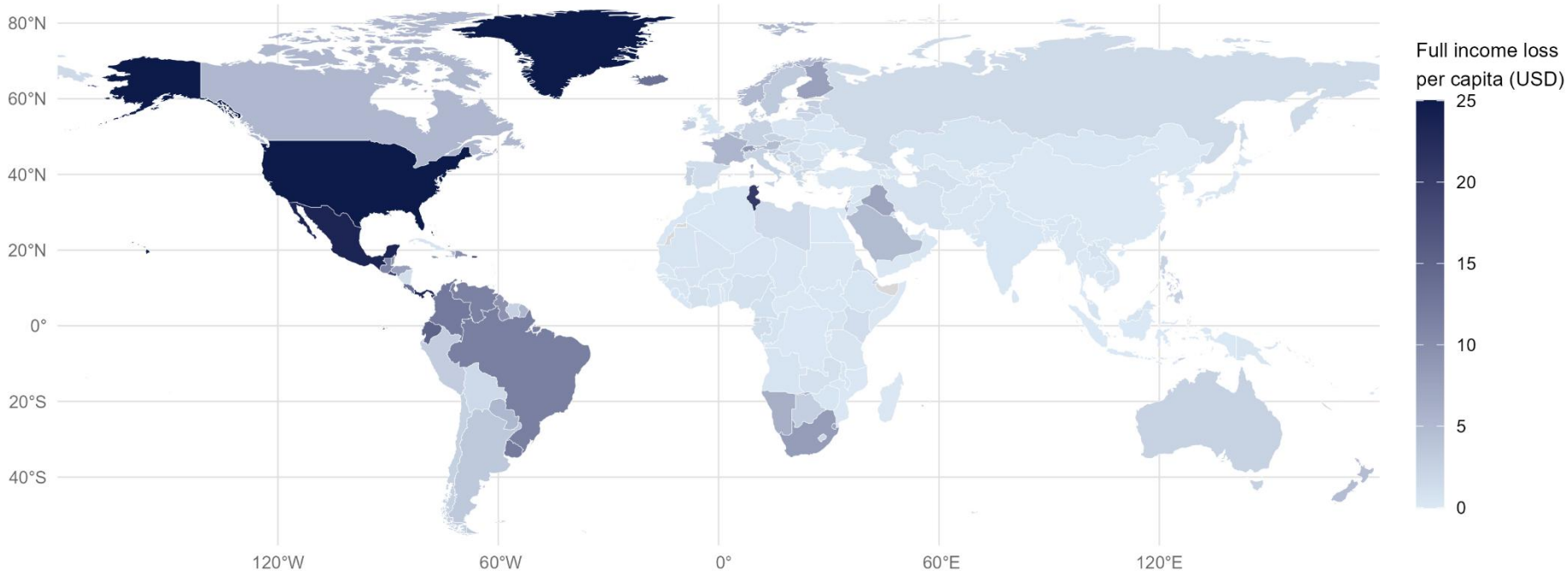
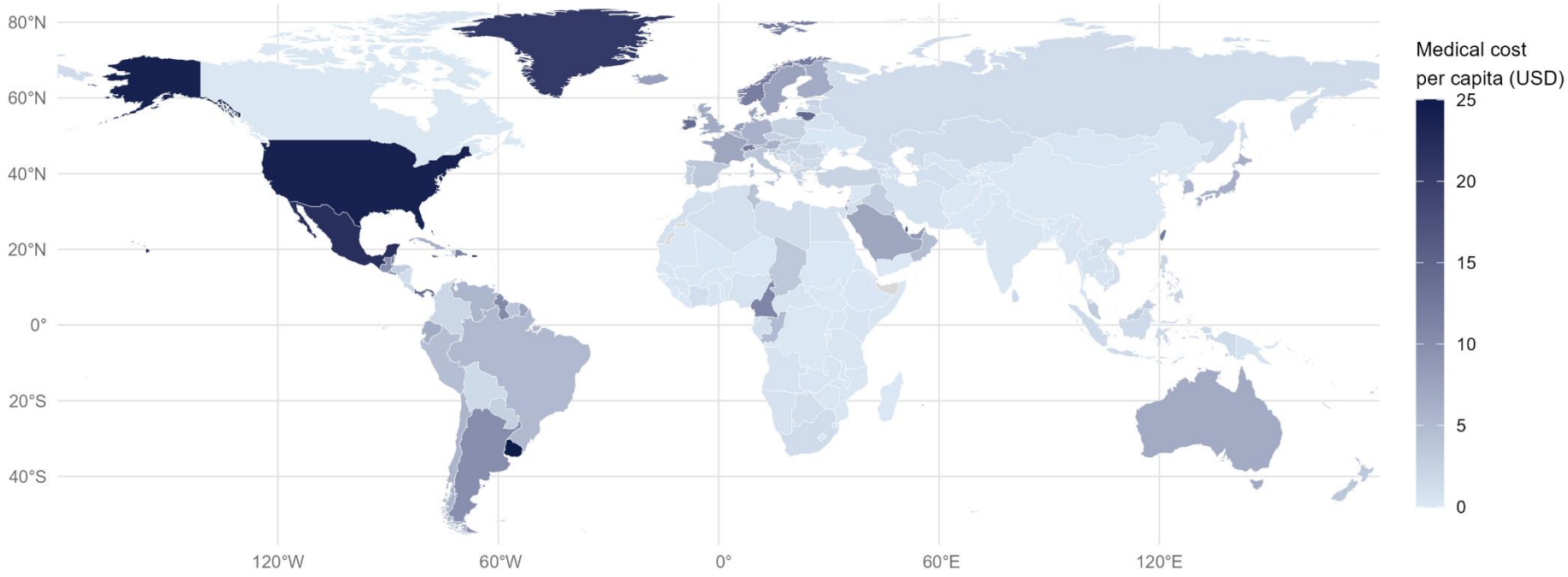


Figure 5. Global distribution in per capita medical cost on firearm injury



Appendix

Appendix A. Valuing Mortality-Related Full-Income Losses from Firearm Injuries

A.1. Overview

We estimate the mortality-related full-income loss associated with firearm injuries across 204 countries and territories in 2023 The analysis combines age-specific mortality and population data with a monetary valuation of mortality-risk reductions. We first construct baseline life tables and a counterfactual mortality schedule that excludes firearm deaths. We then value the resulting mortality-risk differences using country-specific values of a statistical life (VSL), adjusted for remaining life expectancy.

The full-income measure captures the welfare value of mortality-risk reductions rather than losses in earnings or aggregate production. It is therefore conceptually distinct from a human-capital estimate of forgone income. It also excludes medical expenditures and nonfatal injury losses, which require separate estimation.

The counterfactual is an accounting benchmark: mortality in the absence of firearm deaths, holding other mortality hazards fixed.

A.2. Data and Notation

The analysis uses age-specific population counts, all-cause deaths, and firearm deaths from GDB 2023[11]. Firearm deaths comprise interpersonal violence, self-harm, and unintentional injuries. Income per capita is available from the World Bank[23].

Let $c$index countries and $x$denote the lower bound of an age interval of width n Define ${}_nN_{cx}$ as the population in that interval, ${}_nD_{cx}$ as observed all-cause deaths, and ${}_nD^F_{cx}$ as observed firearm deaths. We distinguish observed deaths, denoted by D, from deaths in the synthetic life-table cohort, denoted by d The year subscript is suppressed for notational convenience.

A.3. Baseline Mortality and Life Expectancy

For each country and age interval, the central mortality rate is

$$ {}_nm_{cx} = \frac{{}_nD_{cx}}{{}_nN_{cx}}. \qquad \text{(A1)} $$

The corresponding conditional probability of death is

$$ {}_nq_{cx} = \frac{n \quad {}_nm_{cx}}{1 + (n - \quad {}_na_{cx}) \quad {}_nm_{cx}}, \qquad \text{(A2)} $$

where ${}_n a_{cx}$ denotes the average number of years lived within the interval by individuals dying during that interval.

Starting from a synthetic cohort of $l_{c0} = 100{,}000$, life-table deaths and survivors satisfy

$$ {}_n d_{cx} = l_{cx} \; {}_n q_{cx}, \; l_{c,x+n} = l_{cx} - \; {}_n d_{cx}. \qquad \text{(A3)} $$

Person-years lived within each closed age interval are

$$ {}_n L_{cx} = n \, l_{c,x+n} + \; {}_n a_{cx} \; {}_n d_{cx}. \qquad \text{(A4)} $$

For the terminal open-ended interval, beginning at age ω, we calculate

$$ L_{c\omega} = \frac{l_{c\omega}}{m_{c\omega}}. \qquad \text{(A5)} $$

Remaining person-years and life expectancy are then

$$ T_{cx} = \sum_{u \geq x} L_{cu} \, , \; e_{cx} = \frac{T_{cx}}{l_{cx}}. \qquad \text{(A6)} $$

A.4. Counterfactual Mortality Without Firearm Deaths

We construct a cause-deleted mortality schedule by removing firearm deaths while maintaining other mortality hazards. The fraction of observed mortality remaining after this adjustment is

$$ R_{cx} = \frac{ {}_n D_{cx} - \; {}_n D_{cx}^{F}}{ {}_n D_{cx}}. \qquad \text{(A7)} $$

Under a proportional-hazards approximation within each age interval, counterfactual survival is

$$ {}_n p_{cx}^{-F} = (\; {}_n p_{cx})^{R_{cx}}, \quad {}_n p_{cx} = 1 - \; {}_n q_{cx}. \qquad \text{(A8)} $$

The counterfactual probability of death is therefore

$$ {}_n q_{cx}^{-F} = 1 - \; {}_n p_{cx}^{-F}. \qquad \text{(A9)} $$

We reconstruct the counterfactual life table using equations (A3)–(A6), substituting the cause-deleted mortality probabilities. The difference between counterfactual and baseline remaining life expectancy is

$$\Delta e_{cx} = e_{cx}^{-F} - e_{cx}. \qquad \text{(A10)}$$

This quantity measures the survival gain associated with removing firearm mortality under the maintained assumptions.

A.5. Mortality-Risk Units and Age Adjustment

Let Δr_{cx} denote the reduction in annual mortality probability associated with removing firearm mortality. The annual valuation period is distinct from the width of the demographic age interval: a mortality probability defined over a multiyear interval is not treated directly as an annual risk.

We express risk reductions in standardized mortality units (SMUs), where one SMU represents a mortality-risk change of one in 10,000:

$$\Delta SMU_{cx} = 10{,}000\, \Delta r_{cx}. \qquad \text{(A11)}$$

To account for differences in remaining life expectancy, we apply the age weight

$$w_{cx} = \frac{e_{cx}}{e_{c,35}}, \qquad \text{(A12)}$$

where $e_{c,35}$is remaining life expectancy at age 35. This normalization assigns greater weight to an otherwise identical risk reduction when remaining life expectancy is longer.

The aggregate age-adjusted risk reduction in country $c$is

$$S_c = \sum_x {}_n N_{cx}\, \Delta SMU_{cx}\, w_{cx}. \qquad \text{(A13)}$$

Life-expectancy gains in equation (A10) are reported separately as demographic outcomes.

A.6. Monetary Valuation

We estimate country-specific VSLs through income-based benefit transfer:

$$VSL_c = VSL_{\text{US}} \left(\frac{y_c}{y_{\text{US}}} \right)^{\varepsilon}, \qquad \text{(A14)}$$

where $y_c$is income per capita, VSL_{US} is the reference US valuation, and ε is the income elasticity of the VSL. Income measures and reference valuations are harmonized to a common monetary basis before transfer.

Because one SMU equals a risk change of 10^{-4}, its monetary value is

$$v_c^{SMU} = \frac{VSL_c}{10{,}000}. \qquad \text{(A15)}$$

The annual mortality-related full-income loss is

$$FI_c = \frac{VSL_c}{10{,}000} \sum_x {}_n N_{cx}\, \Delta SMU_{cx}\, \frac{e_{cx}}{e_{c,35}}. \qquad \text{(A16)}$$

Equivalently,

$$FI_c = VSL_c \sum_x {}_n N_{cx}\, \Delta r_{cx}\, \frac{e_{cx}}{e_{c,35}}. \qquad \text{(A17)}$$

To express the valuation as a multiple of annual income, define

$$\gamma_c = \frac{VSL_c}{10{,}000\, y_c}.$$

Equation (A16) can then be written as

$$FI_c = y_c \gamma_c \sum_x {}_n N_{cx}\, \Delta SMU_{cx}\, \frac{e_{cx}}{e_{c,35}}. \qquad \text{(A18)}$$

Here, $y_c \gamma_c$is the monetary value of one SMU. It is not a value per statistical life-year. This distinction preserves consistency between the risk units and the monetary valuation.

Global full-income losses are

$$FI_{\text{global}} = \sum_c FI_c. \qquad \text{(A19)}$$

Appendix B. Medical Cost Extrapolation and Uncertainty Analysis

B.1. Data and Model Specification

Medical costs per injury are available for 17 countries and we standardize reported costs to 2023 U.S. dollars by first converting nominal expenditures at historical exchange rates and then adjusting for U.S. inflation:

$$C_i^{USD,2023} = \frac{C_i}{E_{i,t_i}} \times \frac{CPI_{2023}}{CPI_{t_i}}, \qquad (B1)$$

where $C_i$is the original cost, $E_{i,t_i}$is the annual exchange rate expressed as reported-currency units per U.S. dollar, and $CPI_{t_i}$is the annual-average U.S. CPI-U[4]. For costs already denominated in USD, $E_{i,t_i} = 1$. We assume costs are reported in nominal prices for the stated year; for year ranges, we use the midpoint, rounding half-years upward. Exchange rates are drawn from Penn World Table 11.0 via FRED, except for Portugal, for which we use the OECD annual-average series. Intermediate calculations retain full precision, and final values are rounded to cents[7,14].

Table B1. Reported Costs and Corresponding Values in 2023 U.S. Dollars

Country	Reported year(s)	Currency	Original cost	Cost in 2023 USD
United States[19]	2019	USD	25,554	30,456.26
Canada[16]	2016	CAD	19,722	18,887.95
United Kingdom[2]	2000–2005	GBP	10,307	27,867.83
Mexico[22]	2013–2019	USD	853	1,082.93
South Africa[1]	2005	USD	1,467	2,288.78
Colombia[18]	2003	COP	9,057,057	5,212.22
Brazil[18]	2003	BRL	4,387	2,360.64
Kenya[9]	2007	USD	225	330.65
Bahamas[6]	2022	USD	7,073	7,364.16
Barbados[6]	2022	USD	2,816	2,931.92
Jamaica[6]	2022	USD	3,709	3,861.68
Thailand[24]	2005	THB	27,856	1,080.56
Uganda[15]	1998–2003	USD	284	488.62
New Zealand[21]	2002–2003	USD	6,358	10,528.78
Iran[17]	2003	IRR	2,850,000	575.99
Turkey[20]	2017–2022	TRY	1,943	326.39
Portugal[5]	2009	EUR	4,479	8,837.76

Notes: Original costs are expressed in the reported currency. Conversion follows $C^{USD,2023} = (C/E_t) \times (CPI_{2023}/CPI_t)$, where $E_t$denotes reported-currency units per USD; $E_t = 1$ for USD-denominated observations. For year ranges, the midpoint is used, rounding half-years upward. Converted values are rounded to two decimal places and are not PPP-adjusted.

B.2. Regression Results and Retransformation

We extrapolate unit costs to countries without observed data using GDP per capita, measured in current US dollars, as a predictor. Specifically, we estimate the following specification by ordinary least squares:

$$\ln(c_i) = \beta_0 + \beta_1 \ln(g_i) + \varepsilon_i, \qquad (B2)$$

where $c_i$denotes medical costs per injury and $g_i$denotes GDP per capita in country i. The coefficient $\beta_1$measures the elasticity of medical costs per injury with respect to GDP per capita. The log–log specification ensures positive predicted costs and permits a nonlinear relationship between income and costs.

All 17 countries enter the estimation sample. Figure B1 distinguishes 15 observations from two countries identified in the figure as potentially influential observations (Uganda and Turkey), and these two observations are retained in the reported regression.

Table B2 reports the regression estimates.

Table B2. Association between GDP per capita and medical costs per injury

Variable or statistic	Estimate	Standard error	95% confidence interval
Log GDP per capita	0.9913	0.1956	[0.5744, 1.4082]
Constant	−1.3309	1.8499	[−5.2737, 2.6120]
Observations	17		
R^2	0.6313		
Adjusted R^2	0.6067		
Residual mean squared error	0.8511		
Residual root mean squared error	0.9225		
$F(1, 15)$	25.68		

Notes: The dependent variable is the natural logarithm of medical costs per injury, expressed in 2023 US dollars. GDP per capita is measured in current US dollars. Standard errors are conventional OLS standard errors.

The estimated income elasticity is approximately one: a 1 percent increase in GDP per capita is associated with approximately a 0.99 percent increase in medical costs per injury. The coefficient is statistically distinguishable from zero ($p < 0.001$), while its 95 percent confidence interval includes unity. The model explains approximately 63 percent of the cross-country variation in log medical costs.

To obtain central cost estimates in monetary units, we apply a parametric log-normal retransformation correction:

$$\hat{c}_i = \exp(\hat{\mu}_i) \exp\left(\frac{\hat{\sigma}^2}{2}\right),\ \hat{\mu}_i = -1.3309 + 0.9913 \ln(g_i), \qquad \text{(B3)}$$

where $\hat{\sigma}^2 = 0.8511$ is the regression mean squared error. The resulting correction factor is

$$\exp\left(\frac{0.8511}{2}\right) \approx 1.530. \qquad \text{(B4)}$$

Thus, the retransformation adjustment increases central cost estimates by approximately 53 percent relative to simply exponentiating fitted log costs. Under normally distributed,

homoskedastic log-scale disturbances, this adjustment accounts for the distinction between the conditional mean of costs and the exponentiated conditional mean of log costs.

B.3. Prediction Intervals and Cross-Country Variation

We construct 95 percent prediction intervals that incorporate both uncertainty in the estimated regression coefficients and residual variation across countries. Let $x_i = \ln(g_i)$, $n = 17$, and

where $\bar{x}$is the mean log GDP per capita in the estimation sample. The individual-forecast standard error is

$$s_{f,i} = \sqrt{\hat{\sigma}^2 \left[1 + \frac{1}{n} + \frac{(x_i - \bar{x})^2}{S_{xx}}\right]}. \qquad \text{(B5)}$$

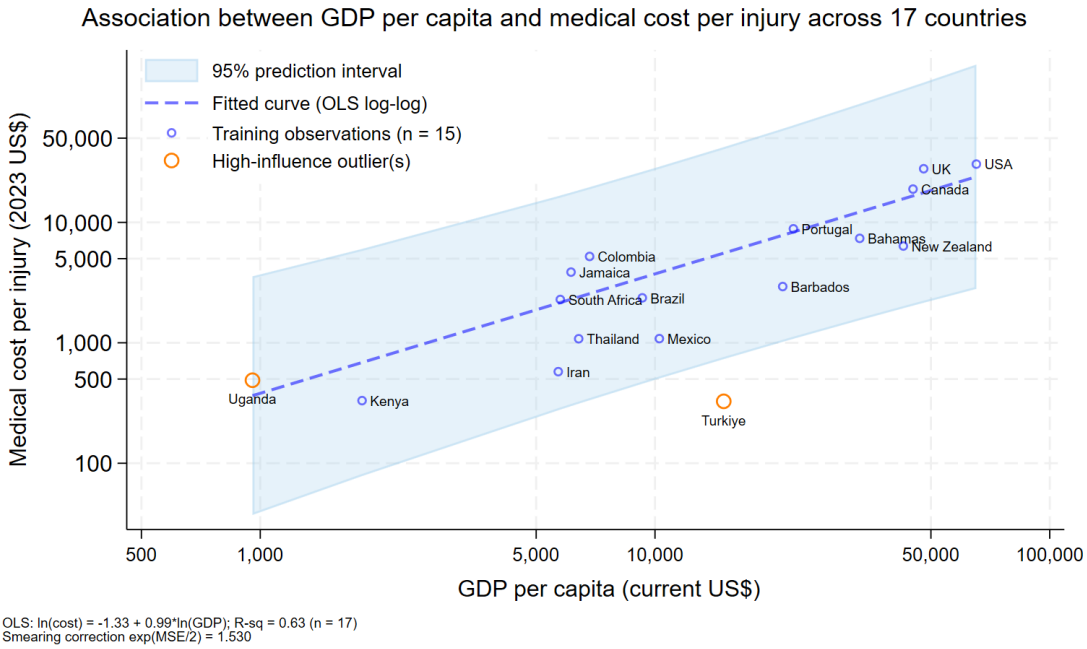
Under the maintained normal-error assumptions, the prediction limits in monetary units are

$$c_i^L = \exp\left(\hat{\mu}_i - t_{0.975,15} s_{f,i}\right),\ c_i^U = \exp\left(\hat{\mu}_i + t_{0.975,15} s_{f,i}\right), \qquad \text{(B6)}$$

where $t_{0.975,15} \approx 2.131$. These endpoints are obtained by exponentiating the log-scale prediction limits; the mean retransformation correction is not applied to the endpoints.

Figure B1 illustrates the positive association between GDP per capita and medical costs per injury, alongside substantial dispersion around the fitted relationship. Türkiye has a notably low observed cost relative to its GDP per capita, whereas Uganda lies near the lower end of the observed income distribution. The residual root mean squared error is 0.9225 log units, indicating considerable variation not explained by income alone. Prediction intervals therefore remain wide and widen further as log GDP per capita moves away from the estimation-sample mean. These intervals characterize uncertainty in country-specific costs rather than uncertainty solely in the conditional mean.

Figure B1. GDP per capita and medical costs per injury across 17 countries.



Notes: Both axes use logarithmic scales. Medical costs per injury are expressed in 2023 US dollars; GDP per capita is measured in current US dollars. The dashed line depicts the fitted log–log OLS relationship, and the shaded region denotes the 95 percent prediction interval. Orange circles identify Uganda and Türkiye, which are flagged as potentially influential observations but retained in the estimation sample. The regression includes all 17 countries and yields an estimated income elasticity of 0.9913 and an R^2 of 0.6313.

B.4. Monte Carlo Simulation

We propagate uncertainty in unit costs and nonfatal injury incidence through Monte Carlo simulation. In each iteration b, we draw a single unit cost for each country:

$$c_i^{(b)} \sim \text{Triangular}\left(c_i^L, \hat{c}_i, c_i^U\right), \qquad \text{(B7)}$$

where the arguments denote the minimum, mode, and maximum, respectively. The central regression-based estimate is therefore used as the mode, not the mean, of the simulation distribution. Using the prediction limits as bounds is an additional modeling assumption: the triangular distribution does not reproduce the regression's predictive distribution and excludes values outside those limits.

The same unit-cost draw is applied to all three injury causes within a country, introducing a shared source of cost uncertainty across causes. For each country–cause observation, we draw nonfatal injury cases independently across observations and independently of unit costs:

$$N_{ik}^{(b)} \sim \text{Triangular}\left(N_{ik}^L, N_{ik}^C, N_{ik}^U\right), \qquad \text{(B8)}$$

where k indexes injury causes and the superscripts L, C, and U denote the lower, central, and upper incidence estimates.

Medical expenditure is calculated as

$$M_{ik}^{(b)} = c_i^{(b)} N_{ik}^{(b)}. \qquad \text{(B9)}$$

For aggregate estimates, expenditures are summed over the relevant countries and causes within each iteration. We report the 2.5th and 97.5th percentiles of the corresponding simulated expenditure distribution as a 95 percent uncertainty interval.

Appendix C. Methods for Estimating Global Market of Civilian Firearm Sales

Our goal was to estimate the annual value of new, legally manufactured firearms sold through formal channels to civilian purchasers. The estimate excludes ammunition, accessories, second-hand transfers, and illicit manufacture. The challenge arises because although international trade is reported to the UN, there is no single agency that measures revenue from domestically manufactured and purchased firearms. Commercial market-research firms have published estimates of the global firearms market that vary from US $7 billion to US $45 billion for the same year[8,10]. These grey literature estimates differ because they do not disclose whether they include military procurement, ammunition, and accessories. Hence this appendix describes an approach to construct an estimate from primary sources.

Global market coverage

To be pragmatic we were able to focus on a subset of countries that are likely to account for 95% of civilian gun sales. The Small Arms Survey estimated a total global stock of 857 million firearms in civilian hands and tabulated ownership for 230 countries[12,3]. Background check data for the US indicate a turnover rate of 3.8% (15 million annual purchases compared to a stock of 393 million)[13]. We assumed turnover rates ranging from 0.1% to 2.0% for other countries. For example, China was assigned a turnover rate of 0.1% because it is known to have a large stock of legacy holdings from the 1900s and negligible formal sales currently. By these assumptions we identified 21 countries that account for 95% of annual sales. The estimate is sensitive to assumptions on the turnover rate and if we assume that USA only turns over 3.0% of its annual stock then the US share of global gun purchases falls from 82% to 79% and our 21 country's coverage falls to 91% of annual gun sales.

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