

## Estimating the Economic Burden of Quality-Adjusted Life Years (QALYs) Losses from Road Accidents in Algeria (2020–2023)

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### Abstract

Road accidents in Algeria pose a significant public health and economic challenge, yet their full impact remains underexplored. This study estimates the Quality-Adjusted Life Years (QALYs) lost due to traffic injuries and fatalities from 2020 to 2023, alongside their economic burden. Using a retrospective observational design, data from national safety and health records were analyzed to calculate QALY losses by age and sex, with economic costs derived via a wage-based approach. Findings reveal a rise from 128,118 QALYs lost in 2020 to 175,539 in 2023, with fatalities driving 81% of the \$923 million cost in 2023. Males and young adults (20–29) bore the heaviest burden. Results underscore the urgent need for enhanced road safety measures in Algeria.

### Keywords:

QALYs;  
Road Accidents;  
Economic Burden;  
Algeria.

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## 1. INTRODUCTION

Road accidents represent a persistent global challenge, claiming lives, causing injuries, and imposing substantial economic and social costs. In regions like Algeria, a municipality grappling with its unique traffic and infrastructure dynamics, the toll of such incidents extends beyond immediate losses to long-term health and economic burdens. Quality-Adjusted Life Years (QALYs) offer a robust metric to quantify this impact, blending life expectancy with quality of life to assess the true cost of injuries and fatalities. This paper delves into the economic burden of QALY losses from road accidents in Algeria between 2020 and 2023, aiming to illuminate a critical yet underexplored dimension of road safety in this context.

### 1.1 Understanding QALY and Its Role in Road Accidents Burden

QALYs serve as a cornerstone in health economics, providing a standardized measure to evaluate the health outcomes of diseases, injuries, or interventions. Developed to capture both the quantity and quality of life, one QALY equates to a year lived in perfect health, with values decreasing based on health impairments (Torrance, 1986). In the context of road accidents, QALYs prove particularly valuable because they account for the diverse consequences (fatalities, permanent disabilities, and temporary injuries) that affect survivors and their communities. Research highlights that road traffic injuries rank among the leading causes of QALY losses globally, with significant implications for low- and middle-income settings where safety measures often lag (Murray & Lopez, 1996).

In Algeria, factors such as dense traffic in urban centers like Algiers, coupled with challenging rural road conditions, likely

amplify this burden. QALYs allow researchers to capture not only the immediate human cost but also the economic ramifications, including healthcare costs, lost productivity, and reduced quality of life (Peden, et al., 2004). Studies underscore that such losses strain national economies, making QALYs a vital lens for understanding road accident impacts. This framework sets the foundation for examining Algeria’s specific experience, where the interplay of health and economic costs demands closer scrutiny. The next step lies in pinpointing why this analysis is urgently needed (Bougueroua & Carnis, 2016).

## **1.2 Research Problem**

Although road accidents are acknowledged as a global crisis, detailed studies quantifying their economic burden through QALYs remain limited at the national level, especially in countries like Algeria. Official statistics report thousands of road deaths and injuries annually in Algeria, yet these numbers rarely translate into comprehensive health-economic assessments (World Health Organization, 2018). National aggregates often obscure regional variations and fail to capture the nuanced burden in a country with diverse geographic and socio-economic landscapes. Existing research tends to prioritize high-income settings or urban-focused analyses, leaving middle-income nations like Algeria underexplored (Luoma & Sivak, 2014).

Further complicating the issue, economic evaluations of road accidents in Algeria typically focus on direct costs (medical expenses or property damage) while overlooking the broader implications QALYs reveal, such as long-term disability or workforce losses (Drummond, Sculpher, Claxton, Stoddart, & Torrance, 2015). The period of 2020 to 2023, shaped by pandemic-induced shifts in mobility and potential changes in

accident patterns, adds urgency to this gap. Without localized QALY-based estimates, policymakers lack the evidence to design cost-effective interventions or allocate resources efficiently. This study addresses that shortfall, seeking to illuminate the hidden costs of road accidents in Algeria and provide a basis for informed action. The research objective naturally emerges from this pressing need (Laouar, Benmechiche, Benaissa, & Bennacer, 2024).

### **1.3 Research Objective**

This study aims to estimate the economic burden of Quality-Adjusted Life Years (QALYs) losses stemming from road accidents in Algeria over the period of 2020 to 2023. The objective involves calculating total QALYs lost due to fatalities and injuries, breaking down results by sex to explore gender-specific impacts, and converting these losses into economic terms using established valuation techniques. This approach seeks to integrate health outcomes with financial costs, offering a holistic view of the burden that traditional metrics often miss.

Focusing on 2020–2023 allows the study to capture a dynamic period, potentially influenced by reduced travel during pandemic lockdowns followed by a rebound in traffic. The analysis intends to equip Algerian stakeholders (government agencies, health planners, and safety advocates) with actionable data to prioritize road safety measures. Building on the understanding of QALYs and the identified research gap, this objective drives the investigation forward, contributing to both scholarly discourse and practical decision-making in Algeria. Subsequent sections will detail the methodology and findings, linking these health losses to their economic significance in a national context.

## **2. Literature Review**

Understanding the economic burden of road accidents in Algeria requires a robust framework, and Quality-Adjusted Life Years (QALYs) provide a widely accepted metric to bridge health losses with their financial implications. This section reviews the foundational aspects of QALYs, tracing their definition and evolution, exploring their calculation, assessing their role in road safety, and evaluating their strengths and limitations. Such an analysis establishes the theoretical grounding for estimating QALY losses in Algeria, offering context for the study's methodology and findings.

### **2.1 Definition, Development, and Significance of QALY**

QALYs emerged in the 1970s as a tool to measure health outcomes in a way that combines both survival and quality of life, addressing limitations of crude mortality metrics (Kaplan & Hays, 2022). Researchers define a QALY as one year lived in perfect health, with values ranging from 0 (death) to 1 (optimal health), adjusted for health states between these extremes (Rankin, Rowen, Howe, Cleland, & Whitty, 2019). The concept evolved through contributions from health economists seeking to standardize cost-effectiveness analyses, gaining traction with the rise of economic evaluations in healthcare (Weinstein & Stason, 1977). Today, QALYs hold significant relevance in health economics, enabling comparisons across diseases, injuries, and interventions.

The significance of QALYs lies in their ability to quantify the broader impact of health conditions, making them indispensable for resource allocation decisions. Studies highlight their adoption in national health systems, such as the United Kingdom's National Institute for Health and Care Excellence,

where QALYs guide funding priorities (Brazier & Tsuchiya, 2015). In the context of Algeria, where road accidents strain both health and economic resources, QALYs offer a lens to assess these dual burdens. This foundational understanding naturally leads to exploring how QALYs are calculated, a critical step for applying them to road accident data.

## 2.2 Calculation of QALY

Calculating QALYs involves a straightforward yet nuanced formula (Lancsar, et al., 2020):

$$QALY = \sum Q_i * T_i$$

Where:

- $Q_i$  represents the quality-of-life weight (on a scale from 0 to 1, with 0 indicating death and 1 perfect health)
- $T_i$  denotes the time spent in each health state, such as years living with an injury.

Quality weights typically derive from standardized tools like the EQ-5D questionnaire or preference-based surveys, reflecting patient or population perceptions of health states (Brooks, 1996). Time estimates, meanwhile, come from clinical data or life expectancy tables adjusted for injury severity.

Applying this formula to road accidents requires specific inputs: fatality yields a QALY of 0, while injuries (ranging from minor fractures to permanent disability) receive intermediate  $Q_i$  values based on their impact. Research demonstrates that accurate QALY calculations enhance transparency in economic analyses, allowing stakeholders to replicate and trust findings (Swanson, et al., 2020). For Algeria, where data on injury duration and severity may vary, this method provides a structured approach to quantify losses. The calculation process thus connects directly to QALYs'

practical application in road safety, which the next subsection explores.

### **2.3 Importance of QALY in Addressing Road Safety**

QALYs play a pivotal role in road safety by translating the human cost of accidents into a metric that informs policy and intervention strategies. Globally, road traffic injuries rank among the top causes of QALY losses, with studies estimating significant burdens in middle-income countries like Algeria (Olofsson, Gerdtham, Hultkrantz, & Persson, 2019). Research linking QALYs to road safety interventions such as helmet laws or speed enforcement shows their value in evaluating cost-effectiveness, revealing how preventive measures can reclaim lost QALYs (Chisholm, Naci, Hyder, & Tran, 2012). In Algeria, where urban congestion and rural road hazards coexist, QALYs highlight the stakes of inaction.

Evidence suggests that QALY-based analyses shift focus from mere accident counts to their long-term consequences, aiding prioritization of safety investments (Murray & Lopez, 1996). For instance, interventions reducing severe injuries yield higher QALY gains, offering economic justification for infrastructure upgrades. This perspective underscores the need to estimate Algeria's QALY losses, setting the stage for a critical evaluation of the metric, as its strengths and limitations shape its applicability.

### **2.4 Strengths and Limitations of the QALY Measure**

QALYs boast several strengths, including their versatility across health conditions and their integration of quality and quantity of life into a single measure. Scholars praise their consistency, enabling cross-national comparisons and cost-utility

analyses that guide policy (Gold, Siegel, Russell, & Weinstein, 1996). In road safety, QALYs excel at capturing the economic burden of non-fatal injuries, often overlooked in traditional metrics (Peden, et al., 2004). However, limitations persist. Assigning  $Q_i$  values can be subjective, relying on population-specific utilities that may not fully reflect Algeria's context (Drummond, Sculpher, Claxton, Stoddart, & Torrance, 2015).

Data availability poses another challenge, as incomplete accident records or inconsistent injury classifications (common in middle-income settings) can skew QALY estimates (Luoma & Sivak, 2014). These limitations bear directly on this study, where Algeria's road accident data from 2020–2023 may lack granularity. Despite these hurdles, QALYs remain a gold standard, balancing robustness with adaptability. This review thus provides the theoretical backbone for estimating Algeria's economic burden, informing the methodology to follow.

### **3. Methodology**

This section outlines the approach used to estimate the economic burden of Quality-Adjusted Life Years (QALYs) lost due to road accidents in Algeria from 2020 to 2023. It details the research framework, data sources, QALY computation procedures, and analytical methods, ensuring a systematic and reliable evaluation. The study aims to produce accurate and policy-relevant estimates, providing valuable evidence for road safety improvements and resource allocation in Algeria.

#### **3.1 Study Design**

This study uses a retrospective observational approach to evaluate QALY losses and economic impacts from road accidents in Algeria from January 1, 2020, to December 31, 2023. It covers

fatal and non-fatal incidents to reflect health and financial burdens fully. Results will guide policymakers, health experts, and transport officials in prioritizing prevention, infrastructure upgrades, and mitigation to lessen road crash effects in Algeria.

### **3.2 Data Collection**

This study utilizes data from reliable institutional sources to ensure a comprehensive assessment of road traffic accidents in Algeria. The main data sources include:

- National Delegation for Road Safety (NDRS): Provides detailed annual reports on accident occurrences, injury severity, and demographic profiles.
- National Office of Statistics (ONS): Supplies population data and life expectancy estimates, disaggregated by age and gender, to support QALY calculations.

These datasets offer a robust foundation for analyzing the 2020–2023 period, linking accident characteristics to health outcomes and economic costs.

### **3.3 QALY Calculation**

The Quality-Adjusted Life Years (QALYs) is calculated with the formula:

$$QALY = Q_{(s,a,y)} * T_{(s,a,y)}$$

Where:

- $Q_{(s,a,y)}$  is the quality-of-life weight for sex (s), age (a), and year (y), ranging from 0 (death) to 1 (perfect health).
- $T_{(s,a,y)}$  represents the duration spent in an impaired health state due to injury or the years of life lost due to fatal accidents, where s denotes sex, a denotes age, and y denotes the year of occurrence.

**Table 1.** Assumed Quality-of-Life Weights (Q) by Age and sex

Age Group	Q (Males)	Q (Females)
<5	0.85	0.85
5-9	0.90	0.90
10-14	0.88	0.88
15-19	0.80	0.82
20-24	0.75	0.78
25-29	0.73	0.77
30-34	0.70	0.75
35-39	0.68	0.74
40-44	0.65	0.72
45-49	0.60	0.70
≥ 50	0.55	0.68
Unknown	0.70	0.72

**Source:** Author's own compilation

Quality-of-life values (Q) are based on recent international benchmarks and adjusted through expert consultation to reflect Algeria’s healthcare accessibility and injury profiles. Fatal cases are assigned  $Q=0$ , while non-fatal cases receive age- and sex-specific weights.

**Table 2.** Estimated Recovery Durations (T) by Age and sex (Years)

Age Group	T - Males	T - Females
<5	2.5	2.8
5-9	2.0	2.3
10-14	1.8	2.0
15-19	1.5	1.8
20-24	1.3	1.6
25-29	1.2	1.5
30-34	1.0	1.4
35-39	0.9	1.3
40-44	0.8	1.2
45-49	0.7	1.0
≥50	0.6	0.9
Unknown	1.0	1.2

**Source:** Author's own compilation

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For fatal cases,  $T$  is determined using age-adjusted life expectancy from ONS records, while for non-fatal injuries, it is estimated by Algerian medical experts based on local recovery trends. Recovery times vary by injury severity, ranging from 0.5 years for mild injuries to 10 years for permanent impairments. Notably, young males aged 15–34 may experience greater QALY losses due to their higher involvement in road crashes.

The combination of  $Q$  and  $T$  values ensures accurate QALY loss estimates, forming the basis for economic costing and statistical analysis.

### 3.4 Statistical Analysis

Data analysis employs descriptive techniques to characterize accident patterns and QALY reductions across population segments. Counts and averages illustrate injury distribution by age, sex, and severity, while QALY estimates follow the specified formula. Median values and interquartile ranges (IQR) clarify data variability, particularly for injury durations and economic impacts. The economic assessment uses GDP per capita as a proxy for lost productivity. These methods ensure a transparent, reproducible evaluation of the burden, strengthening policy guidance with robust findings.

## 4. Results

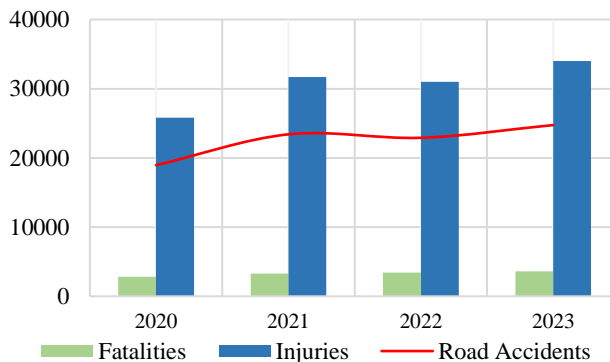
This section unveils the outcomes of the study, detailing the trends and impacts of road accidents in Algeria from 2020 to 2023. It presents descriptive statistics on accidents, fatalities, and injuries, followed by estimates of Quality-Adjusted Life Years (QALYs) lost due to these incidents. The analysis culminates in key findings, highlighting QALY losses by age and sex, alongside the

escalating economic costs, which signal an urgent call for enhanced road safety measures.

#### 4.1 Descriptive statistics

The figure 1 illustrate the trends in road accidents, fatalities, and injuries in Algeria from 2020 to 2023, revealing a concerning escalation in traffic-related incidents. Road accidents rose from 18,949 in 2020 to 24,751 in 2023, an increase of 30.6%, with a notable spike between 2020 and 2021 (23.5% rise to 23,409) followed by a slight dip in 2022 (22,908) before climbing again. This upward trajectory suggests growing traffic exposure or worsening safety conditions over the period.

**Fig.1.** Road Accidents, Fatalities, and Injuries in Algeria (2020–2023)



**Source:** (National Center for Road Safety and Prevention, 2020); (National Delegation for Road Safety, 2023);

Fatalities followed a similar pattern, increasing steadily from 2,844 in 2020 to 3,628 in 2023, a 27.6% rise. The largest annual jump occurred between 2020 and 2021 (15.8% to 3,293), with consistent growth thereafter, indicating a persistent challenge in reducing traffic deaths. Injuries also surged, from 25,836 in 2020 to 33,995 in 2023, a 31.6% increase, peaking at 31,675 in 2021 before a slight decline in 2022 (30,977) and a rebound in 2023. This mirrors the accident trend, reflecting higher injury risks alongside rising incidents.

Overall, the figure highlights a mounting burden, with 2023 recording the highest figures across all categories. The data underscore the urgent need for enhanced road safety measures in Algeria to curb this growing public health and economic issue.

#### **4.2 Estimated QALY losses**

To estimate the Quality-Adjusted Life Years (QALY) lost due to traffic accidents, both non-fatal injuries and fatalities are considered. QALY loss captures the impact of injuries on health-related quality of life over the duration of recovery, as well as the life years lost due to premature mortality.

For non-fatal injuries, QALY loss is calculated using the formula:

$$QALY\ lost_{injury} = \sum (N * (1 - Q) * T)$$

- N is the number of injury cases,
- Q is the quality-of-life weight (ranging from 0 to 1, where 1 represents full health), and
- T is the average duration of disability in years.

For example, if 100 individuals suffer an injury with a quality-of-life weight of 0.7 and a recovery duration of 3 years, the total QALY loss for that group would be 90. Since Q and T values are adjusted for local conditions, calculations are conducted separately for each age and gender category. Special attention is given to high-risk groups, such as males aged 15-24 and individuals aged  $\geq 50$ , where lower Q values reflect greater functional impairment and longer recovery periods.

For fatalities, QALY loss is estimated by calculating the remaining life expectancy at the time of death, adjusted for the assumption that those years would have been lived in full health. The formula used is:

$$QALY\ lost_{Fatality} = \sum D * LE$$

where:

- D is the number of deaths in each demographic group, and
- LE is the remaining life expectancy at the age of death.

Summing QALY losses from both injuries and fatalities provides an overall estimate of the burden of traffic accidents in Algeria. This comprehensive assessment informs public health interventions, resource allocation, and policy decisions aimed at improving road safety and rehabilitation services.

### 4.3 Key findings

This section outlines the study's main results, highlighting Quality-Adjusted Life Years (QALYs) losses from road accidents in Algeria from 2020 to 2023. It examines QALY losses due to injuries and fatalities across age and sex, alongside rising economic costs, underscoring the pressing need for road safety action.

- **QALY lost due to injury**

The analysis of annual QALY losses due to traffic injuries in Algeria from 2020 to 2023 reveals a steady burden across different age groups and sexes. Males consistently experienced higher QALY losses than females, reflecting their greater involvement in road traffic incidents. The most affected age groups were 15-24, with QALY losses exceeding 3,000 annually for males, highlighting the risks young adults face due to higher mobility and exposure. Similarly, children aged 5-9 showed a notable increase in QALY losses over the years, emphasizing their vulnerability in road environments.

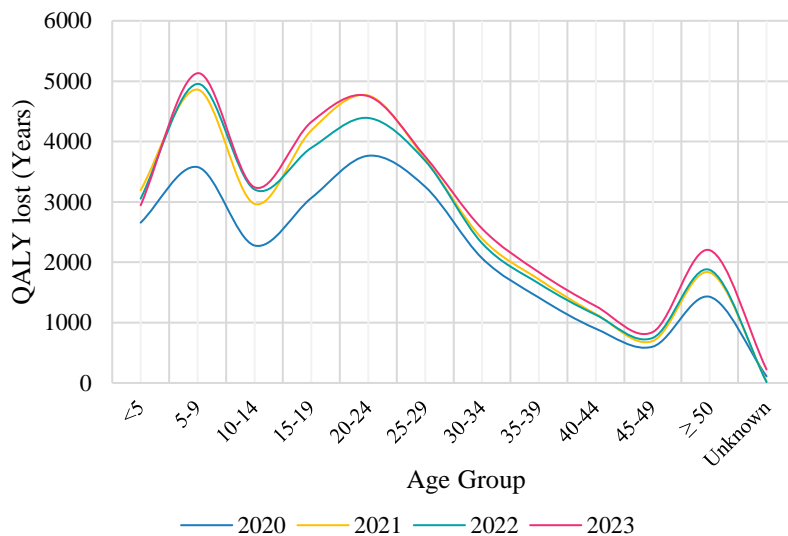
Total QALY losses for males increased from 19,139.78 in 2020 to 24,571.50 in 2023, while female losses fluctuated but

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remained above 8,000 in recent years. This trend suggests persistent challenges in road safety and post-injury recovery. The increase in QALY losses among older adults ( $\geq 50$ ) further underscores the long-term impact of injuries on quality of life, likely due to slower recovery and higher disability rates.

These findings highlight the need for improved road safety measures, including targeted interventions for high-risk groups, enhanced emergency response systems, and rehabilitation programs. Addressing these factors can help mitigate the long-term health burden of traffic injuries in Algeria.

**Fig.2.** Yearly QALY Losses from Traffic Injuries by Age (2020–2023)



**Source:** Author’s analysis based on QALY loss data.

- **QALY lost due to fatality**

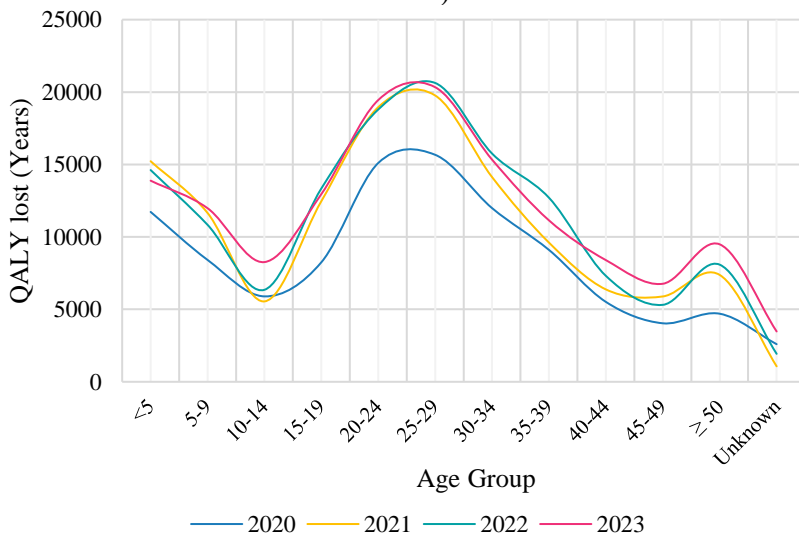
The analysis of annual QALY losses due to traffic fatalities in Algeria (2020–2023) reveals significant disparities by age and sex. Males consistently faced higher losses, reflecting greater road exposure. The highest losses occurred in the 20–29 age group, exceeding 17,000 QALYs annually for males, highlighting young

adults' vulnerability. Substantial losses were also noted in those aged 50 and above, emphasizing their heightened risk.

A notable year-to-year variation is evident, with total QALY losses increasing from 84,160.60 in 2020 to 118,901.11 in 2023 for males and from 18,845.58 to 23,559.58 for females. The rise suggests worsening road safety conditions or increased traffic exposure over time. The sharp increase in QALY losses among young children and older adults also points to the need for targeted interventions, such as stricter traffic regulations and improved pedestrian safety measures.

These findings emphasize the urgent need for road safety strategies, particularly for high-risk demographics. Addressing these issues through infrastructure improvements, enforcement of traffic laws, and public awareness campaigns can help mitigate the long-term burden of traffic-related fatalities on public health.

**Fig.3.** Yearly QALY Losses from Traffic Fatalities by Age (2020–2023)



**Source:** Author’s analysis based on QALY loss data.

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- **The economic cost of QALY**

The economic burden of traffic-related injuries and fatalities in Algeria has increased significantly from 2020 to 2023. The total QALY losses due to injuries and fatalities have risen each year, with fatalities contributing the largest share. In 2023, total QALY losses reached 175,539.4, with 81% attributed to fatalities. Males consistently accounted for the majority of losses, reflecting their higher exposure to traffic risks.

**Table 3.** Economic Cost of QALY losses Due to Traffic Accidents

Category		2020	2021	2022	2023
GDP per Capita (USD)		3,794.41	4,216.25	5,023.25	5,260.21
QALY lost due to injury	Male	19,139.78	20,515.18	19,588.24	24,571.50
	Female	5,972.41	8,370.39	9,322.45	8,507.21
	<b>Total</b>	<b>25,112.19</b>	<b>28,885.57</b>	<b>28,910.69</b>	<b>33,078.71</b>
QALY lost due to fatalities	Male	84,160.60	107,410.12	111,287.52	118,901.11
	Female	18,845.58	18,970.40	23,393.56	23,559.58
	<b>Total</b>	<b>103,006.2</b>	<b>126,380.5</b>	<b>134,681.1</b>	<b>142,460.7</b>
Economic Cost (Injuries, USD)	Male	72,624,172.6	86,497,128	98,396,627	129,251,250
	Female	22,661,772.2	35,291,657	46,828,997	44,749,711.1
	<b>Total</b>	<b>95,285,944.8</b>	<b>121,788,785</b>	<b>145,225,624</b>	<b>174,000,961.1</b>
Economic Cost (Fatalities, USD)	Male	319,339,822	452,867,918	559,025,035	625,444,808
	Female	71,507,857.2	79,983,949	117,511,700	123,928,338
	<b>Total</b>	<b>390,847,679</b>	<b>532,851,867</b>	<b>676,536,735</b>	<b>749,373,146</b>
<b>Total Economic Cost (USD)</b>		<b>486,133,623.8</b>	<b>654,640,652</b>	<b>821,762,359</b>	<b>923,374,107.1</b>
<b>% Economic Cost (Injuries)</b>		<b>19.60%</b>	<b>18.60%</b>	<b>17.67%</b>	<b>18.84%</b>
<b>% Economic Cost (Fatalities)</b>		<b>80.40%</b>	<b>81.40%</b>	<b>82.33%</b>	<b>81.16%</b>

Source: Author's calculations

The financial impact follows a similar trend. The total economic cost of traffic incidents surged from \$486 million in 2020 to \$923 million in 2023, nearly doubling over four years. Fatalities accounted for over 80% of these costs, underscoring

their significant burden on the economy. Despite a rise in GDP per capita from \$3,794 in 2020 to \$5,260 in 2023, the economic losses remain substantial.

While injury-related costs showed moderate growth, fatality-related costs escalated rapidly, exceeding \$749 million in 2023. This highlights the urgent need for improved road safety policies, stricter enforcement, and investment in preventive measures to mitigate human and economic losses. Addressing these issues through targeted interventions can reduce both QALY losses and financial strain, ultimately enhancing public health and economic sustainability.

## 5. Discussion

The findings of this study underscore the significant burden of traffic injuries and fatalities on both public health and the economy in Algeria. The increasing QALY losses over the years reflect persistent road safety challenges, particularly among vulnerable age groups such as young adults and children. The economic cost associated with these losses continues to rise, highlighting the need for urgent policy interventions.

The analysis of QALY losses due to injuries reveals a steady increase, particularly among males, who consistently account for the majority of the burden. Young adults aged 15–24 experience the highest losses, likely due to riskier driving behaviors, higher mobility, and increased exposure to traffic hazards. Additionally, children aged 5–9 have shown a concerning rise in QALY losses, emphasizing their vulnerability as pedestrians or passengers. Older adults ( $\geq 50$ ) also exhibit substantial losses, likely due to longer recovery times and a higher risk of permanent disability.

Traffic fatalities impose an even greater burden, with total QALY losses increasing from 103,006.2 in 2020 to 142,460.7 in

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2023. Males continue to experience significantly higher losses than females, reflecting greater exposure to high-risk driving behaviors and road conditions. The most affected age group is 20–29, with losses exceeding 17,000 QALYs annually, emphasizing the impact of fatalities on the economically productive population.

The economic cost of QALY losses due to traffic incidents nearly doubled between 2020 and 2023, reaching \$923 million. Fatalities accounted for over 80% of these costs, underscoring their devastating financial impact. Despite an increase in GDP per capita, the rising economic burden suggests that traffic injuries and fatalities remain a major challenge. The sharp increase in fatality-related costs, surpassing \$749 million in 2023, highlights the need for effective preventive measures to reduce mortality rates.

Addressing these challenges requires a comprehensive approach. Stricter traffic law enforcement, improved road infrastructure, and enhanced pedestrian safety measures are essential to reducing traffic incidents. Special attention should be given to high-risk groups, particularly young drivers and children, through awareness campaigns and targeted education programs. Additionally, strengthening emergency response systems and expanding rehabilitation services can help mitigate the long-term impact of injuries.

The increasing QALY losses and economic costs associated with traffic incidents in Algeria highlight the urgent need for intervention. Implementing effective road safety strategies can significantly reduce the human and financial burden, contributing to a safer and more sustainable transport system.

## 6. CONCLUSION

This study illuminates the profound toll of road accidents in Algeria, revealing a staggering rise in Quality-Adjusted Life Years (QALYs) losses and economic costs from 2020 to 2023. Total QALY losses escalated from 128,118 in 2020 to 175,539 in 2023, with fatalities driving over 80% of the burden, peaking at 142,461 QALYs in the final year. Males bore the brunt, with losses surging from 103,300 to 143,473 annually, reflecting their heightened exposure to traffic risks. Young adults aged 20–29 faced the greatest fatality-related losses, exceeding 17,000 QALYs yearly, while the 15–24 age group dominated injury-related losses at over 3,000 QALYs for males. Children aged 5–9 and older adults ( $\geq 50$ ) also emerged as vulnerable, with rising QALY losses signaling broader safety gaps. Economically, the burden nearly doubled, soaring from \$486 million to \$923 million, with fatality costs alone reaching \$749 million in 2023, despite a rising GDP per capita.

These findings underscore persistent road safety challenges in Algeria, amplifying the need for urgent action. The steady climb in QALY losses, particularly among young adults and males, points to risky behaviors and inadequate protections, while the vulnerability of children and seniors highlights deficiencies in pedestrian safety and recovery support. The economic strain, predominantly from fatalities, stresses the ripple effects on productivity and healthcare systems, far outpacing national income growth. Addressing this crisis demands a multifaceted strategy: stricter enforcement of traffic laws, upgraded road infrastructure, and robust public awareness campaigns targeting high-risk groups like young drivers. Enhanced emergency services and rehabilitation programs could curb the long-term health impacts of injuries, particularly for older adults.

Ultimately, this research bridges health and economic perspectives, offering a clear mandate for intervention. Reducing QALY losses and their \$923 million cost in 2023 is not just feasible but essential for Algeria's public health and sustainability. Implementing these evidence-based measures promises safer roads, healthier lives, and a stronger economy, turning data into a catalyst for transformative change.

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