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Trends and Burden of Mortality from External Causes in Paraguay: A Nationwide Study, 2015-2019

Tendencias y carga de mortalidad por causas externas en Paraguay: un estudio nacional, 2015-2019

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ABSTRACT

Background: External causes of death—including transport injuries, suicides, and homicides—represent a growing public health challenge in low- and middle-income countries. In Paraguay, systematic analyses of mortality from these causes remain limited. This study aimed to describe national trends and sociodemographic patterns of mortality from external causes between 2015 and 2019.

Methods: A retrospective, longitudinal, observational study was conducted using secondary data from the Vital Statistics Information Subsystem of the Ministry of Public Health and Social Welfare. All deaths attributed to external causes (ICD-10 codes V01–Y98) were included. Age- and sex-specific mortality rates were calculated per 100,000 inhabitants, standardized using the WHO World Standard Population (2000-2025). Potential Years of Life Lost (PYLL) were estimated for ages 0–70 years. Temporal trends were analyzed using Poisson regression models with robust standard errors (p≤0.05).

Results: Between 2015 and 2019, 16,218 deaths from external causes were registered, corresponding to a mean mortality rate of 46.6 per 100,000. Males accounted for 78.9% of deaths (73.0 per 100,000), and the 18–29 age group was the most affected (28.5%). Leading causes included land transport accidents (36.4%), homicides (17%), and suicides (12.1%). Motorcycle crashes showed a 16% increase (rate ratio 1.2; p = 0.0389), while suicides rose 22% (rate ratio 1.2; p=0.0431). Amambay recorded the highest departmental rate (126.2 per 100,000). Total PYLL reached 538,441, predominantly among men.

Conclusions: Mortality from external causes in Paraguay remains high and unevenly distributed, disproportionately affecting young urban males. Transport injuries, suicides, and homicides are the primary contributors. Strengthening road safety policies, violence prevention strategies, and mental health services—together with improved mortality surveillance—is essential to mitigate premature deaths and reduce preventable loss of life.

Keywords: external causes; suicide; life expectancy; accidents, traffic; homicide.

RESUMEN

Introducción: Las causas externas de muerte —incluidos los accidentes de transporte, los suicidios y los homicidios— constituyen un creciente desafío de salud pública en los países de ingresos bajos y medianos. En Paraguay, los análisis sistemáticos de la mortalidad por estas causas son escasos. El objetivo de este estudio fue describir las tendencias nacionales y los patrones sociodemográficos de la mortalidad por causas externas entre 2015 y 2019.

Métodos: Se realizó un estudio observacional, longitudinal y retrospectivo utilizando datos secundarios del Subsistema de Información de Estadísticas Vitales del Ministerio de Salud Pública y Bienestar Social. Se incluyeron todas las defunciones atribuidas a causas externas (CIE-10: V01–Y98). Se calcularon tasas de mortalidad específicas por edad y sexo por cada 100.000 habitantes, estandarizadas mediante la población mundial de referencia de la OMS (2000-2025). Los Años Potenciales de Vida Perdidos (APVP) se estimaron para el rango de 0 a 70 años. Las tendencias temporales se analizaron mediante modelos de regresión de Poisson con errores estándar robustos (p≤0,05).

Resultados: Entre 2015 y 2019 se registraron 16.218 muertes por causas externas, con una tasa media de 46,6 por 100.000 habitantes. Los hombres concentraron el 78,9% de los fallecimientos (73,0 por 100.000) y el grupo de 18 a 29 años fue el más afectado (28,5%). Las principales causas fueron los accidentes de transporte terrestre (36,4%), los homicidios (17%) y los suicidios (12,1%). Los accidentes de motocicleta aumentaron 16% (razón de tasas 1,2; p=0,0389) y los suicidios 22% (razón de tasas 1,2; p=0,0431). Amambay presentó la tasa más alta (126,2 por 100.000). Los APVP totales ascendieron a 538.441, principalmente en hombres.

Conclusiones: La mortalidad por causas externas en Paraguay se mantiene elevada y distribuida de forma desigual, afectando de manera desproporcionada a los hombres jóvenes de áreas urbanas. Los accidentes de tránsito, los suicidios y los homicidios son los principales contribuyentes. Es necesario fortalecer las políticas de seguridad vial, prevención de la violencia y salud mental, junto con sistemas de vigilancia más sólidos, para reducir las muertes prematuras y evitar pérdidas prevenibles de vida.

Palabras claves: causas externas; suicidios; años potenciales de vida perdidos; accidentes de tránsito; homicidio.

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INTRODUCTION

The World Health Organization (WHO) defines trauma and injury as acute exposure to physical agents—such as mechanical energy, heat, electricity, chemicals, or ionizing radiation—that exceed the threshold of human tolerance. In certain cases, injuries result from the abrupt absence of essential elements, including oxygen or warmth, as seen in events like drowning or frostbite. For analytical and intervention purposes, trauma is commonly categorized based on intentionality and the nature of the perpetrator. The standard classifications include unintentional (accidental); intentional (deliberate); interpersonal (e.g., assaults and homicides); self-inflicted (e.g., substance misuse, self-harm, and suicide); legal intervention (e.g., police or state actions); conflict-related (e.g., war, civil unrest); undetermined intent; and other specified external causes (1).

Injuries due to external causes account for over 5 million deaths annually and represent approximately 9% of global mortality (2). They constitute a major public health burden, contributing to elevated rates of hospital admissions, emergency consultations, and long-term disability (3). Despite being largely predictable and preventable, these events have historically received limited attention on global health agendas (4). The development of evidence-based injury prevention strategies, grounded in reliable data, is essential to mitigating the societal and economic consequences for both governments and communities (5–7).

According to the WHO, approximately 1.19 million people die each year from road traffic accidents, with an additional 20 to 50 million sustaining non-fatal injuries, many resulting in permanent disability. The economic toll of road traffic injuries is profound, encompassing direct healthcare costs, productivity losses from fatalities and disabilities, and caregiving demands on affected families. These incidents are estimated to cost countries around 3% of their Gross Domestic Product (GDP) (8).

In Paraguay, non-communicable diseases (NCDs) remain the leading cause of mortality. In 2020, the mortality rate for communicable diseases was 34.3 per 100,000 population, while mortality from circulatory system diseases reached 125.1 per 100,000—2.4 times higher than that for communicable conditions. In comparison, mortality from external causes was 45.5 per 100,000, with road traffic incidents, suicides, and homicides representing the predominant contributors (9). The multifactorial nature of these deaths—intertwining social, behavioral, and structural determinants—poses a significant challenge in terms of mortality, morbidity, and economic burden. Without coordinated intersectoral interventions, this burden is likely to rise (10).

In the past decade, exacerbated by the COVID-19 pandemic, there has been a marked escalation in domestic violence against children and women, including lethal outcomes classified in many countries as femicides (11). Violent deaths, particularly assaults and homicides, are closely associated with alcohol abuse, the proliferation of organized crime, increased civilian firearm possession, and deteriorating mental health—particularly among adolescents and young adults in lower-income settings (12).

This study addresses a critical evidence gap by comprehensively examining all deaths attributed to external causes. Such holistic analyses are rarely undertaken, as existing literature tends to focus on non-communicable conditions, particularly cardiovascular diseases—and their associated risk factors such as obesity and hypertension—given their dominant share in overall mortality. In contrast, this research emphasizes the public health relevance of external causes, including premature mortality, aligning with one of the key indicators of the Sustainable Development Goals (SDGs)(13).

Mortality surveillance is a cornerstone of public health planning. Analyzing the frequency and trends of deaths due to external causes provides insights into the most pressing and unexpected threats to population health, guiding policy formulation and targeted interventions.

Therefore, this study aims to analyze national trends and the burden of mortality due to external causes in Paraguay between 2015 and 2019, focusing on sociodemographic characteristics, geographical distribution, and causes of death.

MATERIAL AND METHODS

A retrospective, longitudinal, observational study with a descriptive design was conducted using secondary data extracted from the Vital Statistics Information Subsystem, based on death certificates compiled by the General Directorate of Strategic Health Information of the Ministry of Public Health and Social Welfare (MSP y BS) of Paraguay. The analysis included all deaths attributed to external causes occurring in Paraguay between 2015 and 2019, excluding those potentially unrecorded due to underreporting. According to national health indicators, underreporting in mortality statistics is currently estimated at 20–30%.

Causes of death were coded using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), specifically categories V01 to Y98, which correspond to external causes. The study utilized information from death certificates, collecting the following variables: age, sex, cause of death, department of residence, area of occurrence, year of death, and classification of the external cause. External causes were categorized as follows:

- *Land transport accidents (V01–V99)*: including pedestrians (V01–V09), cyclists (V10–V19), motorcyclists (V20–V29), vehicle occupants (V30–V79), and other land transport incidents (V80–V89);
- *Water transport accidents (V90–V94) and air transport accidents (V95–V97)*;
- *Accidental trauma (W00–X59)*: including falls (W00–W19), drowning (W65–W74), exposure to electric current (W85–W99), and exposure to fire, smoke, and flames (X00–X09);

- *Intentional injuries*: including suicides (X60–X84), homicides/assaults (X85–Y09);
- *Complications of medical care (Y40–Y84)*;
- *Sequelae of external causes of morbidity and mortality (Y85–Y98)*.

Population estimates were sourced from the General Directorate of Statistics, Surveys, and Censuses. Between 2006 and 2014, estimates were based on the 2002 national census; from 2015 onward, projections were based on the 2012 census, both disaggregated by sex and age group for the period 2000–2050. These projections served as denominators for calculating mortality rates.

For the computation of Potential Years of Life Lost (PYLL), a lower age limit of 0 years and an upper limit of 70 years were applied. An upper age limit of 70 years was selected based on WHO recommendations for measuring premature mortality in middle-income settings, representing the productive years of life in most Latin American contexts (14).

Data were grouped by year, sex, age group, and department of residence. Mortality trends from external causes were assessed by calculating age- and sex-specific mortality rates per 100,000 inhabitants, using the respective annual population as denominators. Age-standardized mortality rates were calculated using the World Health Organization World Standard Population (2000-2025) as the reference population.

To calculate the rate of change, the mortality rate in the first year of the study period was subtracted from that in the last year and divided by the rate in the last year. The ratio of change was calculated by dividing the rate in the last year by that in the first year. Statistical significance of temporal trends was assessed using Poisson regression models with robust standard errors, comparing mortality rates between 2015 and 2019 by cause category. A significance level of $p \leq 0.05$ was applied, and no adjustments for multiple comparisons were made.

PYLL was calculated for both sexes within the 0-70-year age range and expressed per 1,000 population. To illustrate temporal and categorical trends, two types of graphs were created. A horizontal bar chart with 95% confidence intervals was developed to represent the percentage change in age-standardized mortality rates by type of cause. In addition, a combined bar-and-line chart was constructed to show annual fluctuations in both the proportion of deaths from external causes and the corresponding mortality rates. Data analysis was performed using Microsoft Excel® 2021 and Epi-Info7 version 7.2.1.1.

data were anonymized and derived from publicly available secondary sources. Ethical principles outlined in the Declaration of Helsinki were adhered to throughout the study. Data were obtained from the Vital Statistics Information Subsystem, specifically from death certificates issued by the General Directorate of Strategic Health Information (MSPBS).

Analyzing mortality data due to external causes provides critical insight into the country's health profile, as it enables the assessment of the magnitude and temporal evolution of this public health issue and supports the design and implementation of evidence-based health interventions and policy planning.

RESULTS

Between 2015 and 2019, Paraguay registered a total of 16,218 deaths attributed to external causes, corresponding to an average mortality rate of 46.6 per 100,000 inhabitants. Of these, 78.9% occurred among men and 21.1% among women, yielding a male-to-female mortality ratio of approximately 3.7:1 **(Table 1)**.

By age group, mortality was highest among young adults aged 18–29 years (28.5%), followed by those aged 30–39 years (15.2%) and ≥70 years (13.6%). The age-specific mortality rate increased sharply among older adults, reaching 160.6 per 100,000 in individuals aged 70 years or older. In contrast, children under 9 years accounted for only 3.9% of all deaths. Overall, 46.2% of deaths occurred within the premature mortality range (30-70 years).

Regarding the area of residence, 80.5% of deaths were concentrated in urban areas (61.6 per 100,000), while 19.5% occurred in rural settings (22.3 per 100,000), indicating a predominance of external-cause mortality in more densely populated zones.

In terms of cause, land transport accidents were the leading contributor, representing 36.4% of all external deaths, followed by homicides/assaults (17%) and suicides (12.1%). Within land transport accidents, motorcycle crashes accounted for more than half (53.5%), while pedestrian incidents (21.9%), vehicle occupants (16.5%), and cyclist accidents (0.6%) made up smaller proportions. Other notable categories included accidental trauma (12.1%), health care complications (4.1%), and sequelae of external causes (2.4%).

Figure 1 illustrates the temporal evolution of deaths from external causes in Paraguay between 2015 and 2019. Although the total number of deaths and the corresponding mortality rate per 100,000 inhabitants showed moderate year-to-year fluctuations, a slight overall increase was observed at the end of the period. The rate rose from 47.0 in 2015 to 50.2 in 2019, with a temporary decline in 2017 (41.1 per 100,000). The proportion of deaths due to external causes also increased, from 19.5% to 22.1%. However, the low coefficient of determination (R^2=0.0206) indicates that these variations do not follow a clear linear trend, suggesting that annual changes may reflect contextual or episodic factors rather than a steady temporal progression.

The analysis by department of residence **(Table 2)** revealed marked geographic variation in mortality rates from external causes in Paraguay between 2015 and 2019. The highest rates were recorded in Amambay (126.2 per 100,000 inhabitants), more than three times the national average (46.6 per 100,000). Elevated rates were also observed in Alto Paraguay (84.8), Boquerón (64.8),

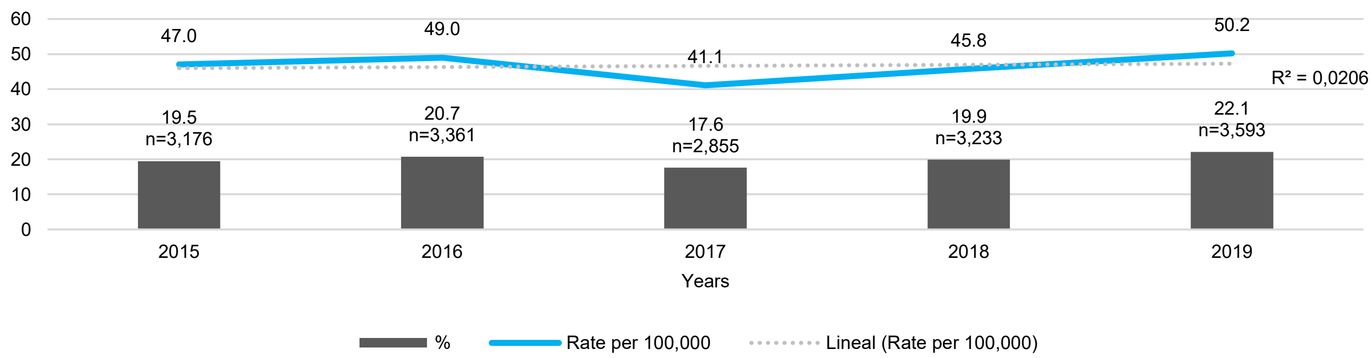
Concepción (67.3), and Presidente Hayes (61.1)—departments characterized by low population density and limited access to emergency services. In contrast, the lowest rates were found in Caaguazú (35.3), Central (36.1), and Itapúa (39.8), although these departments, together with Asunción, accounted for the largest absolute number of deaths, reflecting their higher population concentrations. Overall, the spatial distribution of external-cause mortality indicates a north-to-south gradient, with higher relative risk in border and semi-rural departments—particularly in the Chaco and northern regions—compared with the more urbanized central and southern areas of the country.

Table 1. Analysis of the sociodemographic characteristics of deaths resulting from external causes in Paraguay between 2015 and 2019

Category	n	%	95% CI	Rate per 100,000
Sex				
Men	12,797	78.9	78.2–79.5	73.0
Women	3,421	21.1	20.4–21.8	19.8
Age group				
<9 years	629	3.9	3.6–4.2	9.0
10–17 years	1,199	7.4	7.1–7.8	22.0
18–29 years	4,593	28.5	27.8–29.2	60.5
30–39 years	2,449	15.2	14.6–15.7	48.7
40–49 years	1,891	11.7	11.2–12.2	51.4
50–59 years	1,873	11.6	11.1–12.1	66.7
60–69 years	1,280	7.9	7.5–8.3	69.1
≥70 years	2,199	13.6	13.1–14.1	160.6
Age unknown	305	1.9	1.6-2.4	-
Area of residence				
Rural	3,105	19.5	18.8–20.2	22.3
Urban	12,857	80.5	79.8–81.2	61.6
Area not specified	256	1.6	1.4-1.8	-
Type of cause				
Land transport accidents	5,903	36.4	32.4–40.8	17.0
* Cyclists	36	0.6	0.4–0.8	0.1
* Motorcyclists	3,160	53.5	52.3–54.7	9.1
* Vehicle occupants	975	16.5	15.6–17.4	2.8
* Pedestrians	1,292	21.9	20.8–23.0	3.7
* Other land transport	440	7.5	6.9–8.1	1.3
Water transport accidents	9	0.1	0.03–0.13	0.03
Air transport accidents	15	0.1	0.07–0.18	0.04
Accidental trauma	1,964	12.1	10.7–13.8	5.6
• Falls	435	22.1	20.9-24.4	1.3
• Drowning	744	37.8	35.0-39.8	2.1
• Exposure to electric current	548	27.9	26.6-29.3	1.6
• Exposure to fire, smoke and flames	237	12.1	10.5-15.9	0.7
Suicides	1,970	12.1	10.9–13.0	5.7
Assaults/Homicides	2,758	17.0	15.5–18.8	7.9
Health care complications	667	4.1	3.8–4.4	1.9
Sequelae of external causes	385	2.4	2.5–3.1	1.1

Percentages and confidence intervals (95% CI) were calculated using the total number of deaths (n = 16,218) as the denominator unless otherwise indicated.
** Percentage within land transport accidents.*
• Percentage within accidental trauma.
Totals may not sum exactly to 100% due to rounding and missing data.

Figure 1. Temporal trends in mortality rates and proportion of deaths from external causes, Paraguay, 2015-2019



The analysis of mortality trends from external causes in Paraguay between 2015 and 2019 revealed heterogeneous variations across population groups and categories of cause **(Table 3)**. Overall mortality from external causes increased by 7% (95% CI: −25% to +39%), rising from 47.0 to 50.2 per 100,000 inhabitants. Males continued to account for the vast majority of deaths, with rates nearly four times higher than those among females (79.1 vs. 20.9 per 100,000; $p<0.0001$), corresponding to a male-to-female ratio of 3.7:1. By age

group, individuals aged 18–29 years showed a statistically significant 8% increase (95% CI: +1% to +15%; p=0.0256), whereas those under 17 years experienced a 9% decline (95% CI: −32% to +14%).

Regarding the area of residence, urban mortality increased by 12% (95% CI: −14% to +38%), while rural mortality declined significantly by 17% (95% CI: −23% to −11%; p<0.0001), indicating a progressive concentration of external-cause deaths in urban areas. Land transport accidents remained the leading cause, representing 36% of all external deaths. Within this group, motorcycle crashes showed a statistically significant 16% increase (95% CI: +1% to +31%; p=0.0389), whereas cyclist fatalities declined by 37% (95% CI: −64% to +9%). Notable upward trends were also observed for sequelae of external causes (+120%; 95% CI: +20% to +220%; p=0.0173) and health care complications (+82%; 95% CI: +5% to +159%; p=0.0355). Suicide mortality increased by 22% (95% CI: +1% to +43%; p=0.0431). Conversely, electrocution deaths decreased by 30% (95% CI: −58% to −8%), while other unintentional injuries such as drowning and fire-related deaths showed minor, non-significant changes (**Figure 2**).

Table 2. Mortality rate from external causes by department of residence in Paraguay between 2015 and 2019.

Department	n (2015–2019)	%	Rate per 100,000
Concepción	822	5.1	67.3
San Pedro	866	5.3	41.3
Cordillera	786	4.8	52.5
Guairá	434	2.7	39.3
Caaguazú	964	5.9	35.3
Caazapá	345	2.1	37.4
Itapúa	1,179	7.3	39.8
Misiones	360	2.2	58.3
Paraguarí	659	4.1	51.7
Alto Paraná	1,997	12.3	50.1
Central	3,744	23.1	36.1
Ñeembucú	201	1.2	45.3
Amambay	1,038	6.4	126.2
Canindeyú	565	3.5	51.0
Presidente Hayes	370	2.3	61.1
Boquerón	204	1.3	64.8
Alto Paraguay	73	0.5	84.8
Asunción (Capital)	1,230	7.6	46.9
Foreigners	381	2.3	—
Total / Country	**16,218**	**100.0**	**46.6**

Rates per 100,000 inhabitants, using departmental population estimates.

Table 3. Percentage variation in mortality rates due to external causes in Paraguay, 2015-2019.

Category	n (2015)	% (2015)	n (2019)	% (2019)	Rate 2015	Rate 2019	% Change (95% CI)	Rate ratio	*p-value*
Total	3,176	100.0	3,593	100.0	47.0	50.2	+7% (−25% to +39%)	1.1	0.6618
Men	2,510	79.0	2,851	79.3	73.6	79.1	+7% (+5% to +9%)	1.1	<0.0001
Women	666	21.0	742	20.7	19.9	20.9	+5% (−18% to +28%)	1.1	0.6464
Age group									
<9 years	120	3.8	126	3.5	8.6	9.0	+4% (−20% to +28%)	1.0	0.7237
10–17 years	265	8.4	243	6.8	24.3	22.2	−9% (−32% to +14%)	0.9	0.6831
18–29 years	926	29.3	1,032	28.7	62.0	67.1	+8% (+1% to +15%)	1.1	0.0256
30–39 years	477	15.1	577	16.1	50.6	54.0	+7% (−16% to +30%)	1.1	0.5717
40–49 years	393	12.4	401	11.2	55.5	52.4	−6% (−29% to +17%)	0.9	0.5931
50–59 years	336	10.6	385	10.7	62.6	65.5	+5% (−18% to +28%)	1.0	0.6116
60–69 years	251	8.0	325	9.1	73.8	81.1	+10% (−12% to +32%)	1.1	0.3493
≥70 years	390	12.4	497	13.9	152.4	169.4	+11% (−2% to +24%)	1.1	0.1028
Area of residence									
Rural	732	23.0	619	17.2	27.4	22.9	−17% (−23% to −11%)	0.8	<0.0001
Urban	2,444	76.9	2,974	82.8	59.8	66.9	+12% (−14% to +38%)	1.1	0.3623
Type of cause									
Land transport accidents	1,165	36.7	1,295	36.0	17.2	18.1	+5% (−28% to +38%)	1.0	0.8084
• Cyclists	12	0.4	8	0.2	0.2	0.1	−37% (−64% to +9%)	0.6	0.3173
• Motorcyclists	579	18.2	712	19.8	8.6	10.0	+16% (+1% to +31%)	1.2	0.0389
• Vehicle occupants	187	5.9	208	5.8	2.8	2.9	+5% (−33% to +43%)	1.1	>0.9999
• Pedestrians	273	8.6	275	7.7	4.0	3.8	−5% (−32% to +22%)	1.0	>0.9999
• Other land transport	106	3.3	89	2.5	1.6	1.2	−21% (−50% to +8%)	0.8	0.4795
Accidental trauma	420	13.2	407	11.3	6.2	5.7	−8% (−33% to +17%)	0.9	0.5931
• Falls	85	2.7	99	2.8	1.3	1.4	+10% (−16% to +36%)	1.1	0.3173
• Drowning	149	4.7	156	4.3	2.2	2.2	−1% (−25% to +23%)	1.0	>0.9999
• Electrocution	151	4.8	112	3.1	2.2	1.6	−30% (−58% to −8%)	0.7	0.4765
• Fire/smoke/flames	35	1.1	40	1.1	0.5	0.6	+8% (−19% to +35%)	1.1	0.6547
Suicides	382	12.0	493	13.7	5.7	6.9	+22% (+1% to +43%)	1.2	0.0431
Assaults/Homicides	565	17.8	588	16.4	8.4	8.2	−2% (−25% to +21%)	1.0	>0.9999
Health care complications	110	3.5	212	5.9	1.6	3.0	+82% (+5% to +159%)	1.8	0.0355
Sequelae of external causes	46	1.4	107	3.0	0.7	1.5	+120% (+20% to +220%)	2.2	0.0173

% Change calculated as ((Rate2019 / Rate2015) – 1) × 100.
95% confidence intervals derived from rate ratio estimates using Poisson regression models.

During the study period, deaths from external causes resulted in a total of 538,441 Potential Years of Life Lost (PYLL). Land transport accidents were the main contributor, accounting for 200,515 PYLL (6 per 1,000 population), followed by homicides/assaults (2.8 per 1,000), accidental trauma (2.5 per 1,000), and suicides (2.0 per 1,000). Across all categories, men accounted for the majority of PYLL, particularly in transport-related and violent causes (**Table 4**).

Figure 2. Horizontal bar chart with 95% confidence intervals for percentage change in mortality rates by external cause, Paraguay, 2015-2019

Type of cause
Sequelae of external causes 120
Health care complications 82
Assaults/Homicides -2
Suicides 22
• Fire/smoke/flames 8
• Electrocution -30
• Drowning -1
• Falls 10
Accidental trauma -8
* Other land transport -21
* Pedestrians -5
* Vehicle occupants 5
* Motorcyclists 16
* Cyclists -37
Land transport accidents 5
-100 -50 0 50 100 150
% Change (2015-2019)

Asterisks (*) indicate subgroups within the "Land transport accidents" category, while dots (•) correspond to subgroups of "Accidental trauma."

Table 4. Potential years of life lost (PYLL) due to external causes by sex and cause group in Paraguay from 2015 to 2019

Types of causes	Land transportation accidents			Accidental trauma			Intentionally self-inflicted injuries/Suicides			Assaults/Homicides			Health Care Complications		
Sex	n	n PYLL	Rate*	n	n PYLL	Rate*	n	n PYLL	Rate*	n	n PYLL	Rate*	n	n PYLL	Rate*
Men	4,758	168,725	9.98	1,890	68,44	4.05	1,385	49,592	2.93	2,378	83,3	4.93	196	3,575	0.21
Women	854	31,79	1.97	391	16,872	1.05	458	18,2	1.13	287	10,377	0.64	125	2,252	0.14
Total	5,612	200,515	6.00	2,281	85,312	2.55	1,843	67,792	2.03	2,665	93,677	2.80	321	5,827	0.17

**Rates expressed per 1,000 population.*

DISCUSSION

This study provides the first national overview of mortality from external causes in Paraguay prior to the COVID-19 pandemic, revealing a steady upward trend between 2015 and 2019. Three findings stand out: (a) the predominance of male deaths, particularly among young adults; (b) the growing weight of motorcycle-related crashes, suicides, and homicides; and (c) the marked geographic concentration of external-cause mortality in border departments such as Amambay. Collectively, these results underscore persistent vulnerabilities in road safety, mental health, and violence prevention policies.

The pattern observed in Paraguay aligns with trends reported across Latin America, where external causes have become an increasingly relevant source of premature mortality (14–17). In Brazil, Colombia, and Mexico, male-dominated mortality profiles and rising motorcycle fatalities mirror those identified here (18–20). However, Paraguay's increase in medical complications and sequelae suggests possible differences in coding practices or post-injury care quality, highlighting the need to strengthen death certification and surveillance systems (17,21). The consistency of these findings with regional data reinforces that external-cause mortality is both preventable and socially determined.

Motorcycle crashes emerged as the leading external cause of death, reflecting broader transformations in the country's mobility landscape. The rapid expansion of the vehicle fleet—36% motorcycles in 2022—stems from increased affordability following the establishment of local assembly plants in 2006 (22-26). Motorcycles have become essential to informal employment, including delivery services and mototaxis, where long working hours and piece-rate pay encourage risk-taking. Enforcement of helmet and licensing regulations remains limited, and public road-safety education campaigns are sporadic. A

2017 national study reported that 63.3% of motorcyclists did not use helmets and over half engaged in distracting behaviors while driving (24,25,27). Cultural norms valorizing speed, risk, and masculine competitiveness—documented in studies from Brazil (18,20)—likely operate similarly in Paraguay, amplifying young men's exposure to fatal injuries.

Homicides, the second most frequent cause, reflect the convergence of structural inequality, organized crime, and weak governance. The territorial concentration of lethal violence in Amambay, where mortality rates exceed 120 per 100,000 inhabitants, is linked to its strategic role in the transnational drug trade. The department functions as both a cultivation zone for marijuana and a corridor for cocaine trafficking from Bolivia and Peru toward Brazil and Europe (28,29). High homicide rates in border areas such as Concepción and Alto Paraguay may also reflect spillover violence, competition for trafficking routes, and socio-economic marginalization. Addressing these dynamics requires policies that combine law enforcement with social and economic inclusion strategies, rather than punitive approaches alone.

Self-inflicted injuries ranked third among external causes, increasing by 22% during the period. This rise likely reflects both underdiagnosed depression and worsening social stressors. Between 2015 and 2019, Paraguay experienced economic stagnation, youth unemployment, and persistent gender inequality—factors associated with mental distress. Access to mental-health services remains highly centralized in Asunción, with limited coverage in rural areas. Stigma surrounding suicide continues to hinder help-seeking and accurate death reporting (30,31). Strengthening primary-care detection, integrating psychosocial support, and developing community-based prevention programs are urgent priorities.

Nearly half (46.5%) of deaths from external causes occurred before age 70, primarily among economically active males. The loss of individuals in their most productive years translates into diminished workforce participation, reduced household income, and social destabilization. With 64.9% of the national population aged 15–64 years (32), premature external-cause mortality directly affects Paraguay's human capital formation and long-term economic growth. Investments in injury prevention, violence reduction, and mental-health promotion thus have both public-health and macroeconomic relevance.

The study faces limitations typical of analyses based on secondary data. Underreporting of 20–30% and misclassification of causes—especially those of "undetermined intent"—may underestimate homicide and suicide mortality more than accidents (17). As the data end in 2019, the analysis does not capture post-pandemic shifts. Nonetheless, the pre-COVID baseline allows comparison with subsequent years. Although limited in behavioral variables, these results provide a foundation for future analytic research exploring socioeconomic, cultural, and environmental determinants of external-cause mortality in Paraguay and similar middle-income contexts in Latin America.

Notably, this study concludes before the COVID-19 pandemic. Evidence from other countries suggests that confinement and mobility restrictions temporarily reduced traffic fatalities but increased domestic violence and self-inflicted deaths. Mental-health deterioration and economic hardship have also been linked to higher suicide rates post-2020 (33–35). Continuous surveillance will be essential to determine whether pre-pandemic trends persist or have shifted in the aftermath.

Preventing deaths from external causes requires coordinated, multisectoral action.

Road safety: Implement continuous education programs, strengthen enforcement of helmet and licensing laws, and promote safe infrastructure for vulnerable road users. Violence prevention: Expand research on territorial dynamics of organized crime and develop community-based approaches addressing poverty and youth exclusion. Suicide prevention: Increase access to mental-health care, integrate psychological first aid into primary health services, and reduce stigma through public campaigns. Surveillance: Modernize mortality information systems and enhance real-time reporting to monitor post-2019 trends.

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