

Mortality in Paraguayan adolescents: retrospective study (2018-2022)

Mortalidad en adolescentes paraguayos: estudio retrospectivo (2018-2022)

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ABSTRACT

Introduction: Adolescence carries health risks with long-term consequences. In Paraguay, suicide, road traffic injuries, and complications of adolescent pregnancy are among the leading causes of death, with regional inequalities and limited knowledge of these patterns. **Objective:** To describe the causes and trends of mortality in Paraguayan adolescents from 2018-2022, analyzing differences by age, sex, and region. **Methodology:** Observational, descriptive, cross-sectional, population-based study. Official death records of adolescents aged 10 to 18 years (2018-2022) from the General Directorate of Strategic Health Information were analyzed. Variables were cause of death (ICD-10), age, and sex. Rates were calculated by year, age, sex, and cause, and trends were assessed using linear regression. **Results:** A total of 2,766 deaths were recorded (rate: 44.87 per 100,000; 95% CI: 43.21-46.57). Leading causes were road traffic injuries (n=605; 9.81), suicide (n=446; 7.23), and infectious causes (n=384; 6.23), 51.9% of the total. Rates were higher in males and at 15-18 years. No temporal trend was significant (p>0.05). Road traffic injuries were highest in the Southern region and suicide in the Chaco. **Conclusion:** Adolescent mortality in Paraguay shows persistent patterns of premature death from external injuries, mental health problems, and infections, with differences by sex and region. Comprehensive policies are needed on road safety, suicide prevention, mental health, sexual and reproductive health, and health services, especially in the most affected regions.

KEYWORDS

Adolescent mortality Paraguay Traffic accidents Suicide Cause of death Epidemiology Public health

RESUMEN

Introducción: La adolescencia conlleva riesgos para la salud con consecuencias a largo plazo. En Paraguay, el suicidio, los accidentes de tránsito y las complicaciones del embarazo adolescente figuran entre las principales causas de muerte, con desigualdades regionales y conocimiento limitado de estos patrones. **Objetivo:** Describir las causas y tendencias de mortalidad en adolescentes paraguayos durante 2018-2022, analizando diferencias por edad, sexo y región. **Metodología:** Estudio observacional, descriptivo y transversal de base poblacional. Se analizaron registros oficiales de defunciones de adolescentes de 10 a 18 años (2018-2022) de la Dirección General de Información Estratégica en Salud. Las variables fueron causa de muerte (CIE-10), edad y sexo. Se calcularon tasas por año, edad, sexo y causa, y se evaluaron tendencias mediante regresión lineal. **Resultados:** Se registraron 2.766 muertes (tasa: 44,87 por 100.000; IC 95 %: 43,21-46,57). Las principales causas fueron accidentes de tránsito (n=605; 9,81), suicidio (n=446; 7,23) y causas infecciosas (n=384; 6,23), el 51,9 % del total. Las tasas fueron mayores en varones y a los 15-18 años. Ninguna tendencia temporal fue significativa (p>0,05). La mayor carga de accidentes correspondió a la región Sur y la de suicidio al Chaco. **Conclusión:** La mortalidad adolescente en Paraguay muestra patrones persistentes de muerte prematura por lesiones externas, problemas de salud mental e infecciones, con diferencias por sexo y región. Se requieren políticas integrales en seguridad vial, prevención del suicidio, salud mental, salud sexual y reproductiva y servicios de salud, sobre todo en las regiones más afectadas.

PALABRAS CLAVE

Mortalidad adolescente Paraguay Accidentes de tráfico Suicidio Causas de muerte Epidemiología Salud pública

Introduction

Adolescence is a critical phase of human development characterized by significant physical, psychological and social changes (1,2). During this period, individuals face a number of health risks that can result in long-term and even fatal consequences (3,4). Globally, the leading causes of adolescent mortality include road traffic injuries, suicide, interpersonal violence, and communicable and non-communicable diseases (5,6). These patterns vary significantly across regions and countries, reflecting differences in the social determinants of health, health systems and public policy (7,8).

In Paraguay, adolescent mortality represents a major public health challenge. Previous research has identified suicide, traffic accidents and complications of adolescent pregnancy as significant causes of death in this age group (9,10). Studies show an increase in suicide rates among children and adolescents, with hanging, strangulation or asphyxiation being the most common methods (11,12). In addition, HIV-infected children and adolescents in Paraguay face high mortality rates, with anemia as a significant predictor. Added to these are the sexual and reproductive health challenges and the high rate of adolescent pregnancy, reflecting broader problems of maternal mortality, poverty and inequality (13,14).

Inequalities in mortality rates between departments in Paraguay suggest the need for targeted interventions that address the specific barriers faced by adolescents in rural and less developed areas (10). These disparities reflect differences in access to health services and education. We recognize that the current understanding of adolescent mortality patterns in Paraguay is limited and requires constant updating to reflect changing trends and emerging public health challenges.

In this study, we set out to determine the specific causes and patterns of mortality in adolescents aged 10-18 years in Paraguay during the period 2018-2022. We sought to generate updated evidence to guide the formulation of public health policies and interventions aimed at reducing premature mortality in this crucial population group. We consider this analysis fundamental to identify priority areas for intervention, improve resource allocation, and develop effective strategies that address the specific health needs of Paraguayan adolescents.

Methodology

We conducted a descriptive, cross-sectional observational study with an epidemiological approach. Our objective was to analyze mortality in adolescents in Paraguay over a 5-year period, using official data from death certificates.

We included in our study all adolescents aged 10 to 18 years who died in Paraguay between January 1, 2018, and December 31, 2022. We identified these cases through death certificates registered at the Direccion General de Informacion Estratégica en Salud (DIGIES) of the Ministry of Public Health and Social Welfare of Paraguay. We excluded cases that were not properly registered or with incomplete or discordant information. The variables we considered were cause of death (according to ICD-10 record of the database), age and sex (Table 1).

TABLE 1. CLASSIFICATION OF CAUSE-OF-DEATH CATEGORIES AND CORRESPONDING ICD-10 CODES, PARAGUAY ADOLESCENT MORTALITY STUDY (2018-2022)

#	Category	ICD-10 codes included	Representative codes (most frequent in dataset)	n (2018-2022)
1	Road traffic injuries	V20-V29, V30-V39, V40-V49, V50-V59, V60-V69, V70-V79, V80-V89	V29 (motorcycle, n=114), V23 (n=111), V28 (n=57), V24 (n=55), V22 (n=53)	605
2	Suicide	X60-X84, Y87.0	X70 - Intentional self-harm by hanging (n=404), X74 (n=4), X64 (n=2), X80 (n=1)	446
3	Infectious causes	A00-B99, J09-J18, U07.1 (COVID-19)	J18 - Pneumonia (n=83), R99 (n=42), U07 - COVID-19 (n=28), A09 (n=18), A41 (n=13)	384
4	Other external causes	W00-W99, X00-X59 (excl. X60-X84), Y10-Y34, Y85-Y86	W69 - Drowning (n=73), X95 - Firearms assault (n=68), X59 (n=3), Y86 (n=1)	310
5	Cancer and other tumors	C00-D48	C91 - Lymphoid leukemia (n=52), C92 (n=17), C71 - Brain (n=17), C41 (n=15), C49 (n=10)	240
6	Homicide	X85-Y09, Y87.1	X95 - Assault by firearms (dominant), X99 - Assault by sharp object	139
7	Cerebral palsy and sequelae	G80, G09, Y86, Y89	G80 - Cerebral palsy (n=75), G09 - Sequelae of inflammatory CNS diseases (n=5)	101
8	Cardiovascular diseases	I00-I99, Q20-Q28 (congenital heart)	I21 - Acute myocardial infarction (n=11), Q21 - Congenital cardiac septal defect (n=7)	68
9	Rare diseases	E70-E88 (metabolic/storage), G10-G13, D55-D59, Q87-Q89, selected G/N/K codes	N18-N19 - Chronic kidney disease (n=12), E75 - Sphingolipidosis (n=5), E76 (n=4)	53
10	Maternal death	O00-O99	O99 - Other maternal conditions (n=10), O15 - Eclampsia (n=6), O72 - PPH (n=5)	37

Note: Classification was performed by the research team based on cause-of-death text and ICD-10 codes recorded in DIGIES/MSPBS death certificates. Cases with code R99 (ill-defined cause) were excluded from cause-specific analyses. Homicide category was identified via external cause codes X85-Y09 combined with intent flag in the database. COVID-19 (U07.1) was included under Infectious causes. n = total deaths in category over the 5-year study period (2018-2022).

We applied descriptive statistical methods to analyze the distribution of causes of mortality by age and sex. We stratified each cause of mortality by demographic variables and year of occurrence. We calculated overall mortality rates in adolescents and specific rates by age, sex, and cause of death. We analyzed mortality trends over time, performing a comparative analysis by sex and age.

For our analysis, we used STATA version 16 software and designed the tables and graphs with Microsoft® Excel for Mac version 16.66.1. We anonymized the information to protect the identity of the subjects and restricted access to the complete data to authorized personnel and the research team only. We store data on security systems and use them exclusively for the purposes of this study. Our use of these data is covered by regulations that allow their analysis for public health and epidemiology purposes, and we have the appropriate access permissions. The project was approved by the Research Ethics Committee of the National Institute of Health by opinion no. 023/2023.

Results

Over the five-year study period, we identified 2,766 deaths among adolescents aged 10 to 18 years in Paraguay, corresponding to an overall mortality rate of 44.87 per 100,000 adolescents (95% CI: 43.21-46.57). Annual mortality fluctuated notably across the period (Table 2).

We recorded the highest number of deaths in 2019 (n=595; rate: 48.40; 95% CI: 44.59-52.45), followed by a marked decrease in 2020 (n=499; rate: 40.49; 95% CI: 37.01-44.20), a year in which pandemic-related mobility restrictions were most stringent.

Mortality then recovered toward pre-pandemic levels in 2021 (n=567; rate: 45.87; 95% CI: 42.17-49.80) and remained stable in 2022 (n=563; rate: 45.39; 95% CI: 41.72-49.30).

TABLE 2. ANNUAL ADOLESCENT MORTALITY RATE BY CAUSE, PARAGUAY (2018-2022)																		
Años Cause of death	2018			2019			2020			2021			2022			Total 2018-2022		
	n	Rate*	95% CI	n	Rate*	95% CI	n	Rate*	95% CI	n	Rate*	95% CI	n	Rate*	95% CI	n	Rate*	95% CI
All causes	542	44.19	40.55-48.07	595	48.40	44.59-52.45	499	40.49	37.01-44.20	567	45.87	42.17-49.80	563	45.39	41.72-49.30	2766	44.87	43.21-46.57
Road traffic injuries	123	10.03	8.33-11.97	136	11.06	9.28-13.09	89	7.22	5.80-8.89	140	11.32	9.53-13.36	117	9.43	7.80-11.31	605	9.81	9.05-10.63
Suicide	78	6.36	5.03-7.94	90	7.32	5.89-9.00	86	6.98	5.58-8.62	105	8.49	6.95-10.28	87	7.01	5.62-8.65	446	7.23	6.58-7.94
Infectious causes	76	6.20	4.88-7.76	76	6.18	4.87-7.74	57	4.62	3.50-5.99	82	6.63	5.28-8.23	93	7.50	6.05-9.19	384	6.23	5.62-6.88
Other external causes	66	5.38	4.16-6.85	63	5.12	3.94-6.56	64	5.19	4.00-6.63	63	5.10	3.92-6.52	54	4.35	3.27-5.68	310	5.03	4.48-5.62
Cancer and other tumors	42	3.42	2.47-4.63	58	4.72	3.58-6.10	44	3.57	2.59-4.79	43	3.48	2.52-4.69	53	4.27	3.20-5.59	240	3.89	3.42-4.42
Homicide	33	2.69	1.85-3.78	25	2.03	1.32-3.00	38	3.08	2.18-4.23	35	2.83	1.97-3.94	8	0.64	0.28-1.27	139	2.25	1.90-2.66
Cerebral palsy and sequelae	17	1.39	0.81-2.22	40	3.25	2.32-4.43	10	0.81	0.39-1.49	17	1.38	0.80-2.20	17	1.37	0.80-2.19	101	1.64	1.33-1.99
Cardiovascular diseases	13	1.06	0.56-1.81	21	1.71	1.06-2.61	11	0.89	0.45-1.60	8	0.65	0.28-1.28	15	1.21	0.68-1.99	68	1.10	0.86-1.40
Rare diseases	11	0.90	0.45-1.60	4	0.33	0.09-0.83	12	0.97	0.50-1.70	5	0.40	0.13-0.94	21	1.69	1.05-2.59	53	0.86	0.64-1.12
Maternal death	14	1.14	0.62-1.92	6	0.49	0.18-1.06	7	0.57	0.23-1.17	7	0.57	0.23-1.17	3	0.24	0.05-0.71	37	0.60	0.42-0.83
Estimated population	1,226,476	-	-	1,229,282	-	-	1,232,536	-	-	1,236,222	-	-	1,240,332	-	-	6,164,848	-	-

* Rate per 100,000 adolescents aged 10-18 years. Maternal death: per 100,000 total adolescents (for 5-year column) and same denominator annually. 95% CI: exact Poisson method. Population: annual projections from DGEEC Paraguay (2012 census). STATA v16 used for analysis.

Road traffic injuries constituted the leading cause of adolescent death throughout the study period, accounting for 605 deaths (rate: 9.81 per 100,000; 95% CI: 9.05-10.63). Suicide ranked second (n=446; rate: 7.23; 95% CI: 6.58-7.94), followed by infectious causes (n=384; rate: 6.23; 95% CI: 5.62-6.88). Together, these three categories accounted for 51.9% of all adolescent deaths recorded in the period.

Other external causes (n=310; rate: 5.03), cancer and other tumors (n=240; rate: 3.89), and homicide (n=139; rate: 2.25) comprised the intermediate causes. Cerebral palsy and sequelae (n=101), cardiovascular diseases (n=68), rare diseases (n=53), and maternal death (n=37), were less frequent but persisted consistently across all five years. Figure 1 illustrates the proportional distribution of these causes annually.

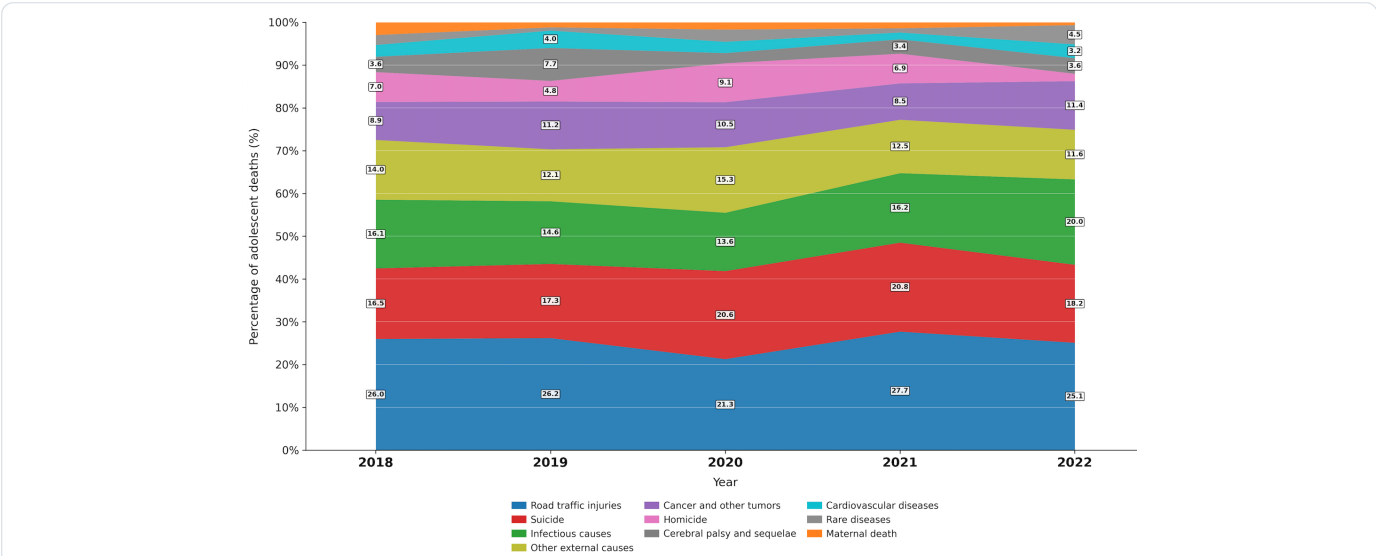


FIGURE 1 Adolescent mortality in Paraguay (2018-2022) by Groups of causes

We found pronounced differences in mortality patterns between sexes (Table 3). In male adolescents, road traffic injuries were the dominant cause of death (rate: 15.68 per 100,000; 95% CI: 14.32-17.13), a figure 4.2 times higher than the rate recorded in females (3.74; 95% CI: 3.08-4.50). Other external causes showed a similarly wide gap (males: 7.90; females: 2.05 per 100,000). Suicide rates were higher in males (8.25; 95% CI: 7.28-9.32) than in females (6.19; 95% CI: 5.33-7.14), as were homicide rates (3.35 vs. 0.83 per 100,000).

By contrast, infectious causes and cancer showed a narrower sex disparity (infectious: 7.04 vs. 5.40; cancer: 4.30 vs. 3.48), and maternal death, recorded exclusively in females, reached a rate of 1.22 per 100,000 female adolescents over the study period.

Age group differences were equally striking. Adolescents aged 15-18 years experienced an overall mortality rate 2.7 times higher than the 10-14 age group (59.21 vs. 22.26 per 100,000). This contrast was particularly pronounced for road traffic injuries (18.56 vs. 2.95) and suicide (12.54 vs. 3.07), and for homicide, which was almost entirely concentrated in the older group (3.91 vs. 0.69 per 100,000). Infectious causes and cancer, however, were distributed more evenly across age groups (infectious: 6.90 vs. 5.70; cancer: 4.28 vs. 3.59).

TABLE 3. ADOLESCENT MORTALITY BY CAUSE, SEX, AND AGE GROUP, PARAGUAY (2018-2022)

Cause of death	Male			Female			10-14 years			15-18 years			Total		
	n	Rate*	95% CI	n	Rate*	95% CI	n	Rate*	95% CI	n	Rate*	95% CI			
Road traffic injuries	492	15.68	14.32-17.13	113	3.74	3.08-4.50	102	2.95	2.41-3.58	503	18.56	16.97-20.25	605	9.81	9.05-10.63
Suicide	259	8.25	7.28-9.32	187	6.19	5.33-7.14	106	3.07	2.51-3.71	340	12.54	11.25-13.95	446	7.23	6.58-7.94
Infectious causes	221	7.04	6.14-8.03	163	5.40	4.60-6.29	197	5.70	4.93-6.56	187	6.90	5.95-7.96	384	6.23	5.62-6.88
Other external causes	248	7.90	6.95-8.95	62	2.05	1.57-2.63	108	3.13	2.56-3.77	202	7.45	6.46-8.55	310	5.03	4.48-5.62
Cancer and other tumors	135	4.30	3.61-5.09	105	3.48	2.84-4.21	124	3.59	2.99-4.28	116	4.28	3.54-5.13	240	3.89	3.42-4.42
Homicide	105	3.35	2.74-4.05	25	0.83	0.54-1.22	24	0.69	0.45-1.03	106	3.91	3.20-4.73	130	2.11	1.76-2.50
Cerebral palsy and sequelae	55	1.75	1.32-2.28	46	1.52	1.11-2.03	46	1.33	0.97-1.78	55	2.03	1.53-2.64	101	1.64	1.33-1.99
Cardiovascular diseases	38	1.21	0.86-1.66	30	0.99	0.67-1.42	36	1.04	0.73-1.44	32	1.18	0.81-1.67	68	1.10	0.86-1.40
Rare diseases	34	1.08	0.75-1.51	19	0.63	0.38-0.98	21	0.61	0.38-0.93	32	1.18	0.81-1.67	53	0.86	0.64-1.12
Maternal death	0	0.00	0.00-0.12	37	1.22	0.86-1.69	5	0.14	0.05-0.34	32	1.18	0.81-1.67	37	0.60	0.42-0.83
Total	1587	50.57	48.12-53.12	787	26.05	24.26-27.94	769	22.26	20.72-23.89	1605	59.21	56.35-62.18	2374	38.51	36.98-40.09

* Rate per 100,000 adolescents over the 5-year period (2018-2022). Maternal death rate calculated per 100,000 female adolescents. 95% CI: exact Poisson method. Population denominators: DGECC Paraguay projections (2012 census). Male = 3,138,025; Female = 3,020,826; 10-14 yrs = 3,454,176; 15-18 yrs = 2,710,672; Total = 6,164,848.

No cause of death showed a statistically significant trend over the five-year period (all $p > 0.05$; Table 4).

Road traffic injuries showed a non-significant descending direction (slope: -0.093 per year; 95% CI: $-1.991, 1.805$; $R^2 = 0.008$; $p = 0.886$), while suicide followed a non-significant ascending direction (slope: 0.216 ; 95% CI: $-0.626, 1.058$; $R^2 = 0.182$; $p = 0.474$). Infectious causes similarly showed a non-significant ascending direction (slope: 0.305 ; $R^2 = 0.214$; $p = 0.432$), consistent with the increase observed in 2021-2022. Among descending trends, other external causes showed the strongest regression fit ($R^2 = 0.700$; $p = 0.077$) and maternal death also showed a descending direction with notable $R^2 = 0.685$; $p = 0.084$, though neither reached statistical significance. The wide confidence intervals across all estimates reflect the limited statistical power inherent to a five-point temporal series (Figure 2).

TABLE 4. TEMPORAL TRENDS IN CAUSES OF ADOLESCENT MORTALITY, PARAGUAY (2018-2022)

Cause of death	Mean rate*	Trend	Slope	95% CI (slope)	R ²	p-value
Road traffic injuries	9.81	Descending	-0.093	(-1.991, 1.805)	0.008	0.886
Suicide	7.20	Ascending	0.216	(-0.626, 1.058)	0.182	0.474
Infectious causes	6.23	Ascending	0.305	(-0.769, 1.380)	0.214	0.432
Other external causes	5.03	Descending	-0.208	(-0.459, 0.042)	0.700	0.077
Cancer and other tumors	3.89	Ascending	0.046	(-0.617, 0.708)	0.016	0.840
Homicide	2.26	Descending	-0.329	(-1.295, 0.637)	0.282	0.357
Cerebral palsy and sequelae	1.64	Descending	-0.191	(-1.220, 0.838)	0.104	0.596
Cardiovascular diseases	1.10	Descending	-0.076	(-0.516, 0.364)	0.092	0.620
Rare diseases	0.86	Ascending	0.167	(-0.391, 0.725)	0.233	0.411
Maternal death†	1.23	Descending	-0.352	(-0.790, 0.087)	0.685	0.084

* Rate per 100,000 adolescents (10-18 yrs). † Maternal death: per 100,000 female adolescents. OLS regression; year centered on 2020; $df = 3$. No trend was statistically significant (all $p > 0.05$). Ascending/Descending = direction of slope (not statistical significance). Denominators: DGECC/Paraguay population projections (Census 2012).

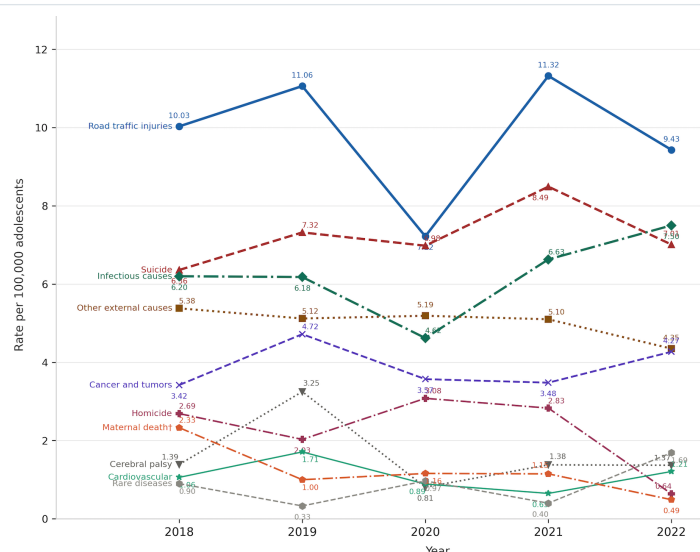


FIGURE 2

Adolescent Mortality trends by cause - Paraguay (2018-2022)

Rate per 100,000 adolescents aged 10-18 years. † Maternal death: per 100,000 female adolescents. No trend was statistically significant (all $p>0.05$). Source: DIGIES/MSPBS. Denominators: DGEEC/Paraguay (Census 2012).

Analysis by health region revealed substantial geographic heterogeneity in adolescent mortality across Paraguay (Figure 3). The Southern region (Itapúa, Misiones, Ñeembucú) showed the highest rates for road traffic injuries (24.93 per 100,000), infectious causes (21.92), and cancer (21.64), each exceeding the national average by more than 2.5-fold for road traffic injuries and 3.5-fold for infectious causes. In the Chaco region (Pte. Hayes, Boquerón, Alto Paraguay), suicide was the leading cause of death at a rate of 17.41 per 100,000, 2.4 times the national average. The Norte region (Concepción, San Pedro, Amambay) also showed the highest suicide as its leading cause (7.48 per 100,000), while the Centro Occidental region (Cordillera, Paraguari, Central, Asunción) recorded the highest cancer rate among the five geographic axes (5.75 per 100,000) alongside the lowest road traffic injury rate in the country (2.63 per 100,000). These findings indicate that the burden of adolescent mortality is not uniformly distributed across Paraguayan territory and may reflect differences in road infrastructure, access to health services, and underlying social determinants.

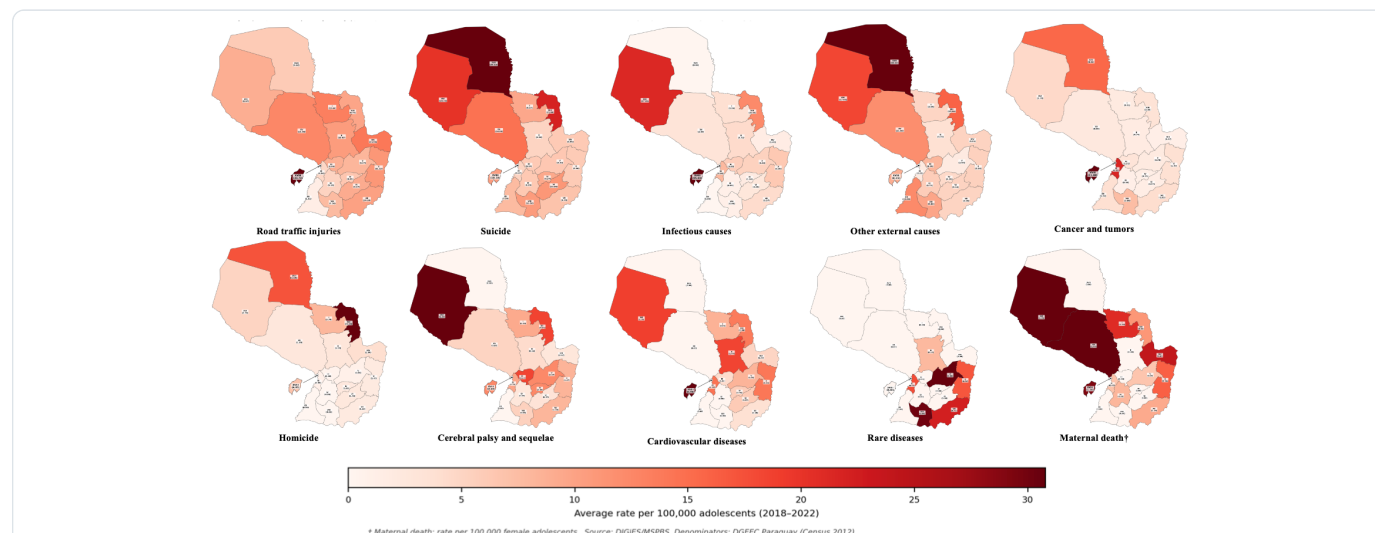


FIGURE 3

Average adolescent mortality rate by cause and Health Region, Paraguay (2018-2022)

Discussion

The results of our study provide a comprehensive view of the causes of mortality in Paraguayan adolescents between 2018 and 2022. The mortality rates we observed show significant variations, both over time and between different regions and age groups. We find that these fluctuations are consistent with changes in social dynamics, public health policies, and external events, such as the COVID-19 pandemic, which influenced mobility and access to health services.

We identified that traffic accidents remained the leading cause of mortality among adolescents, reflecting a global trend observed in similar studies (15). This finding leads us to highlight the urgent need to reinforce road safety policies aimed at this age group, specifically in terms of education on safe driving and control of risky behaviors associated with mobility. In agreement with previous studies, we found that the high rate of traffic accidents in adolescent males is worrisome, and we highlight the importance of preventive interventions focused on this subgroup, including awareness campaigns and improvements in road infrastructure to reduce the accident rate (7).

We note that suicide, positioned as the second most prevalent cause of death, reveals an alarming pattern that demands an immediate focus on mental health. The differences we found in suicide rates between male and female adolescents highlight the need to implement gender-sensitive interventions (11). We note that male adolescents have higher rates of suicide, which could be related to factors such as social pressure to adhere to norms of masculinity, stigmatization of emotional vulnerability, and more limited access to psychological support services. For female adolescents, although the rate is lower, we still consider it alarming, and reinforce the urgency of addressing psychosocial factors that may be contributing to these behaviors (16). We believe that public health policies should prioritize suicide prevention through the expansion of accessible and quality mental health services, as well as the implementation of emotional and resilience education programs in schools (17).

As for infectious causes, we note that they experienced an increase towards the end of the study period, which we believe could be influenced by the COVID-19 pandemic, which likely exacerbated adolescents' vulnerability to infections due to disruptions in health services and barriers in access to health care (8). These findings are consistent with global studies that show the impact of the pandemic on youth mortality and highlight the importance of strengthening the health system's capacity to manage health emergencies without compromising care for other medical conditions (13). This increase in infectious disease rates also leads us to highlight the need to improve prevention interventions, such as vaccination campaigns and promotion of healthy habits in the adolescent population (10).

As for maternal mortality, although we found it to be less frequent in the study group, its persistence reflects deficiencies in reproductive health services for adolescents. The low rate of maternal deaths that we observed in comparison with other contexts may be indicative of improvements in access to prenatal care, but we note that inequalities persist that must be addressed (18). We believe that the implementation of sexual and reproductive health policies that provide education and access to quality services is critical to prevent adolescent pregnancies and their complications, which contribute to maternal mortality in this group (14).

Finally, the regional differences we observed in mortality rates highlight inequalities in access to health and education services. We believe that rural and less developed areas of the country require specific interventions that address the geographic and socioeconomic barriers faced by adolescents (19). Our geographic analysis of mortality rates provides us with crucial evidence to guide public health policies toward a more equitable distribution of resources, prioritizing areas of greatest need (20).

Regarding adolescent mortality in Paraguay between 2018 and 2022, we highlight the persistence of distinct mortality patterns in this age group, with road traffic injuries and suicide as the leading causes of death.

Our findings underscore the need to strengthen road safety and mental health policies focused on reducing crashes and providing adequate psychological support to adolescents.

We observed differences in mortality rates between males and females that indicate the importance of adopting a gender-sensitive approach in the implementation of interventions, considering the different mortality patterns and vulnerabilities of each sex.

Likewise, although we found that maternal mortality is less frequent, we evidenced the need to improve sexual and reproductive health services to prevent complications during adolescent pregnancy.

We noted an increase in infectious causes towards the end of the period, possibly influenced by the COVID-19 pandemic, which leads us to reflect on the importance of a robust health system that is capable of dealing with both health emergencies and the care of medical conditions in a sustained manner.

Finally, we identified regional disparities in mortality rates that highlight the need to focus resources in more vulnerable areas and to reduce inequalities in access to health and education services to meet the Sustainable Development Goals related to adolescent health in the country.

We consider that our study provides a solid basis for the formulation of public policies aimed at improving health and reducing adolescent mortality in Paraguay, emphasizing the importance of multisectoral interventions that address both external risk factors and mental and reproductive health problems.

Editorial note

The opinions expressed in this article, as well as the methodological approach and results presented, are the sole responsibility of the authors. This work was reviewed and approved by external reviewers as part of the editorial process, but does not necessarily reflect the official position of the journal, its editorial committee, or its editor-in-chief.

Data availability

Data are available upon request to the corresponding author. Carlos Miguel Rios-González. Email: carlosrios.ins@gmail.com

Reviewer Comments

The comments and recommendations issued during the peer review process are available at the following link: [Dictamen 777](#)

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