

**Potential years of life lost by external causes among children from one to nine years of age from 2000 to 2018 in a brazilian state**

**Anos potenciais de vida perdidos por causas externas entre crianças de um a nove anos de idade no período de 2000 a 2018 em um estado brasileiro**

**Años de vida potenciales perdidos por causas externas entre niños de uno a nueve años en el periodo 2000 a 2018 en un estado brasileño**

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**Abstract**

Introduction: Injuries or any other health problems with sudden onset, generated by violence or other exogenous cause, are called external causes (EC). The indicator Potential Years of Life Lost - PYLL expresses the impact of early deaths in relation to the life expectancy for a given population. ECs were the major causes of death in children aged 1 to 9 years with 1,037 deaths (19.38%). Objective: To determine PYLL by EC among children aged 1 to 9 years in the state of Piauí, Brazil. Methods: This is a retrospective, longitudinal study with a quantitative approach. Its scenario is the State of Piauí. The population and sample were

composed of deaths from EC registered in the Mortality Information System - MIS from Brazil, which occurred in children in the intended age group. For data analysis, the method that establishes a limit age for the calculation of PYLL was used, based on the average life of the population. Results: In Piauí between January 2000 and December 2018, there were 1,037 deaths (11.67%). The highest number of PYLL was found among male children, aged 5 to 9 years. Deaths caused by drowning were predominant, with 258 deaths (24.9%), being responsible for 16,857 PYLL, followed by accidents with pedestrians, with 184 deaths (17.8%), adding up to 11,911.5 years. Conclusion: Accidental drowning and submersion and pedestrian accidents predominate as the main EC. It can be estimated that 67,581 years of life for children aged 1 to 9 years were lost by EC in Piauí.

**Keywords:** Potential years of life lost; Childhood mortality; External causes.

### **Resumo**

**Introdução:** Lesões ou quaisquer outros agravos à saúde com início súbito, geradas pela violência ou outra causa exógena, são chamadas causas externas (CE). O indicador Anos Potenciais de Vida Perdidos - APVP expressa o impacto das mortes precoces em relação à duração de vida esperada para uma determinada população. As CE foram a maior causa de morte em crianças de 1 a 9 anos com 1.037 óbitos (19,38%). **Objetivo:** Determinar os APVP por CE entre crianças de 1 a 9 anos do Estado do Piauí, Brasil. **Métodos:** Trata-se de um estudo retrospectivo, longitudinal, de abordagem quantitativa. Tem como cenário o Estado do Piauí. A população e a amostra foram compostas pelos óbitos por CE registrados no Sistema de Informações sobre Mortalidade - SIM do Brasil, ocorridos em crianças na faixa etária pretendida. Utilizou-se para análise de dados o método que estabelece uma idade limite para o cálculo dos APVP, com base na vida média da população. **Resultados:** No Piauí, entre janeiro de 2000 e dezembro de 2018, houve 1.037 óbitos (11,67%). O maior número de APVP foi verificado entre crianças do sexo masculino, na faixa etária de 5 a 9 anos. Predominaram os óbitos por afogamento, com 258 óbitos (24,9%), sendo responsável por 16.857 APVP, seguido por acidentes com pedestres, com 184 óbitos (17,8%), somando mais 11.911,5 anos. **Conclusão:** Predominam como principais CE afogamentos e submersões acidentais e acidentes em pedestres. Constata-se que 67.581 anos de vida de crianças de 1 a 9 anos foram perdidos por CE no Piauí.

**Palavras-chave:** Anos potenciais de vida perdidos; Mortalidade na infância; Causas externas.

## Resumen

**Introducción:** Las lesiones o cualquier otro problema de salud de aparición repentina causado por la violencia u otras causas exógenas se denominan causas externas (CE). El indicador de posibles años de vida perdidos - LPA expresa el impacto de las muertes tempranas en relación con la duración de vida prevista para una población determinada. La AE fue la principal causa de muerte en niños de 1 a 9 años con 1.037 muertes (19,38%). **Objetivo:** Determinar los VAPA por AE entre los niños de 1 a 9 años en el Estado de Piauí, Brasil. **Métodos:** Este es un estudio retrospectivo, longitudinal, de enfoque cuantitativo. El escenario es el Estado de Piauí. La población y la muestra estaban compuestas por las muertes por AE registradas en el Sistema Brasileño de Información sobre Mortalidad - SIM, que se produjeron en niños del grupo de edad previsto. Utilizamos para el análisis de los datos el método que establece un límite de edad para el cálculo del APVP, basado en la vida media de la población. **Resultados:** En Piauí, entre enero de 2000 y diciembre de 2018, hubo 1.037 muertes (11,67%). El mayor número de APVP se encontró entre los niños varones de entre 5 y 9 años de edad. El ahogamiento fue la causa predominante de muerte, con 258 muertes (24,9%), siendo responsable de 16.857 APVP, seguido de los accidentes de peatones, con 184 muertes (17,8%), añadiendo otros 11.911,5 años. **Conclusión:** Los principales EC son ahogamientos y sumersiones accidentales y accidentes en peatones. Se puede ver que 67.581 años de vida de los niños de 1 a 9 años se perdieron por la AE en Piauí.

**Palabras clave:** Años potenciales de vida perdidos; Mortalidad en la infancia; Causas externas.

## 1. Introduction

Mortality from external causes is one of the biggest public health problems worldwide, causing thousands of deaths and hospitalizations. Injuries or other health problems with sudden onset, which are generated by violence or other exogenous causes, are classified as external causes, and may be intentional or not. In addition, they affect practically all age groups (Marques et al., 2017).

They play a prominent role, in a negative way, on the age groups of mortality rates. In this sense, the monitoring of causal factors, associated with the increase in childhood mortality rates, represents an opportunity for the development of preventive strategies. These should be aimed at reducing the risk of death in the child population, through public policies related to children's health (France et al., 2014).

Brazil recorded 2,648,918 deaths from external causes, in the period from 2000 to 2018, and the State of Piauí, for example, recorded 37,811 deaths in the same period. Of these, 1,037 deaths occurred in children aged 1 to 9 years, which corresponds to 19.38%, and being the major cause of deaths in the State, followed by neoplasms, with 767 deaths (14.3%) (BRASIL, 2018).

The State of Piauí has a life expectancy of 71.2 years of age for the general population, according to the most recent official data. Although it has grown in recent years, it is among the worst expectations among the States of the Federation. This is mainly due to the socioeconomic vulnerability of its population. Phenomenon that can be explained considering the magnitude of external causes in the scenario of mortality in children aged 1 to 9 years of age and the peculiar sociodemographic characteristics (IBGE, 2018).

It is worth mentioning that studying mortality in children aged 1 to 9 years can contribute to assess the quality of healthcare and to identify the points that require changes in the organization to improve care. Achieving a better understanding of the reasons and factors related to premature deaths, involves identifying the profiles of mortality from external causes in children.

Therefore, knowledge of the mortality profile, the situational and epidemiological diagnosis of the population is essential for the assessment and planning of health actions (Ishitani et al., 2017). Regarding the sheltered population, data collection and analysis procedures, the concentration of infant deaths due to external causes and related socioeconomic and geographic factors, allows for a comparative investigation, directly contributing to health decision making. Therefore, census data strongly interfere in the decline of preventable deaths, throughout the Brazilian territory (Caldas, 2017).

In Brazil, important sources of data and information for this diagnosis are the Mortality Information System - MIS and the potential years of life lost - PYLL. This establishes different significance for each cause, and translates a social value (Ishitani et al., 2017), that one, presents data from national registries, according to causes, population segments and other intended search characteristics.

PYLL expresses the impact of deaths that occurred early in relation to the expected life for a given population. It is a predictive indicator of premature deaths. Life expectancy is inversely proportional (Garcia et al., 2017a). Therefore, we aimed to determine the PYLL for external causes among children aged 1 to 9 years old in the State of Piauí, Brazil. Since this state is below the national average, which today is 76 years of expectation, and is the second

with the worst hope for living in the country, behind only its neighbor, Maranhão (IBGE, 2018).

## 2. Methodology

This is a retrospective study, with a longitudinal approach referring to the years 2000 to 2018, with a quantitative approach. Its scenario is the State of Piauí. This State is located in the Northeastern Region of Brazil, is limited to the States of Maranhão, Ceará, Pernambuco, Bahia and Tocantins, in addition to being bathed by the Atlantic Ocean. Its territorial extension is 251,576.644 Km<sup>2</sup>, divided into 224 municipalities. It is the third largest in the Northeast, being inferior only to the States of Bahia and Maranhão. In the last demographic census, it had a population of 3,118,360 inhabitants (IBGE, 2010).

The population of Piauí has low life expectancy, making it necessary to know the trends in mortality for decision-making and specifically for external causes. Since, mainly, these are the ones that directly interfere in the PYLL, regarding the age of 1 to 9 years.

Both the population and the sample of this study were composed of the number of deaths from external causes that occurred in children aged 1 to 9 years in the State of Piauí, registered in MIS from Brazil. All records of deaths from external causes were included, referring to the large group of this category in the system, present in the International Classification of Diseases and Related Health Problems in its tenth review, ICD-10.

According to ICD-11, which will take effect in January 2022, the reasons for deaths from external causes are subdivided into categories, which are: unintentional (therefore, accidental), intentional (therefore, deliberate), interpersonal (assaults and homicides), self-harm (drug abuse, alcoholism, suicide, self-harm), legal interventions (for example, police actions), wars, civil uprisings and disturbances (violent demonstrations, for example) and undetermined intent (WHO, 2019).

Data extraction took place during the month of September 2020. All public information related to death certificates was made available on the universal access website of the Department of Informatics of the Unified Health System (DATASUS). The collection of data of interest was carried out via *webpage* the MIS, using the internet of the researchers' own technological resources.

The data for analysis were arranged in spreadsheets *Excel for Windows*, version 2013, fed by double entry (typing), in order to avoid failures in the database. The results were presented, according to the descriptive statistics.

The method described by Romeder and McWhinnie (1977) was used for data analysis. The procedure is simple and easy to understand, allowing its use in a systematic way in health planning. The technique establishes an age limit for the calculation of PYLL, based on the average life of the population. In Piauí, the average life expectancy in the last 5 years was 70.5 years of age for the general population.

Knowing this average, life expectancy at birth of 70 years of age was considered for calculation purposes. This value is multiplied by the number of deaths that occurred at each age and the number of years remaining to reach that limit (the expectation). Each of the subtotals are added up and thus, the causes of death, which tend to be concentrated in the younger age groups, will present a higher PYLL in relation to those more advanced, the last years of life.

The following expression summarizes the PYLL calculation mathematically:

$$\sum_{i=1}^{69} a_i d_i = \sum_{i=1}^{69} (m - i - 0,5) d_i$$

$a_i$  = number of years left to complete the considered life expectancy (70 years in this case) when death occurs between ages  $i$  and  $i + 1$  years;

$d_i$  = number of deaths between ages  $i$  and  $i + 1$  years.

Once this research includes secondary data from the public domain, it did not require appreciation by the Research Ethics Committee (CEP) with human beings. Since it prevents the breach of confidentiality and anonymity of personal information of the subjects. However, the guidelines of Resolution No. 506/2016 of the National Commission for Ethics in Research (CONEP) of the National Health Council (CNS) were followed, corresponding to the confidentiality of information that explains the ethical principles of research involving human beings (Brazil, 2016).

### 3. Results and Discussion

External causes were responsible for a total of 37,811 deaths in the period from January 2000 to December 2018 in Piauí. This represents 11.7% of the total deaths in the State, in the same period, and is second only to diseases related to the circulatory system with 102,305 deaths for neoplasms, which caused 40,025 deaths, respectively.

Among the total number of deaths, in the age group from 1 to 9 years old, Piauí registered 5,352 child deaths. The observation of the causes of death of children indicates that the main group that causes deaths in Piauí are external causes, with 1,037 deaths, followed by neoplasms, with 767 deaths and infectious and parasitic diseases with 673 deaths.

In all groups of deaths from external causes, male deaths predominate. Table 1 shows the distribution of these deaths, according to the sociodemographic characteristics of sex, race and color. In this table, some aspects stand out, such as the predominance of males and, in the variable race/skin color, the highest number of deaths among browns.

**Table 1.** Distribution of deaths from external causes in children aged 1 to 9 years in the State of Piauí, from 2000 to 2018, according to sociodemographic characteristics. Floriano - Piauí, 2020.

VARIABLES	FROM 1 TO 4 YEARS		FROM 5 TO 9 YEARS	
	<i>n</i>	<i>% deaths</i>	<i>n</i>	<i>% deaths</i>
Gender				
Male	280	27.0	342	33.0
Female	220	21.2	195	18.8
Race / Skin color				
White	98	9.4	86	8.3
Black	32	3.1	32	3.1
Yellow	3	0.3	1	0.1
Brown	311	30.0	377	36.3
Indigenous	-	-	1	0.1
Skinned	56	5.4	40	3.9
<b>TOTAL</b>	<b>500</b>	<b>48.2</b>	<b>537</b>	<b>51.8</b>

Source: Authors.

For males, the occurrence of about 622 deaths corresponds to 60% of the records and with a greater number in the age group of 5 to 9 years. Of the ratio of deaths related to color/race due to external causes shown in table 1, of the 1,037 deaths due to external causes registered for the studied period, 66.35% (688) were verified among children declared to be brown, also standing out in the age group of 5 to 9 years. Then, mortality among the declared white women reached 184 deaths (17.7%) of the total of them.



The proportion of deaths due to major external causes in males is also confirmed in similar studies such as Corassa et al. (2017) and Marques et al. (2017). They state that the Brazilian population with a higher risk of death related to external causes are brown male individuals, admitting the existence of ignored variables when filling out death certificates.

According to Romero, Rezende and Martins (2016), when analyzing mortality profiles through multiple correspondence, deaths predominate in white children, aged between 5 and 9 years, living in more urbanized municipalities. In this perspective, therefore, the relationship between age, race/color and risk of death related to external causes is significant. It is a fact that there is a representative number of ignored data in death certificates.

Such data are related to race/color, sex, education and medical assistance. The absence of adequate registration of data related to the individual's characteristics reflects errors in the secondary data available in mortality systems and significantly affects public health policies (Melo & Valongueiro, 2015).

The results in Table 1 agree with recent studies carried out in the same period. Although the inadequate registration of the variables present in the death certificates should be considered, it must be admitted that there are other epidemiological strategies currently used to control and detail infant mortality.

The data obtained reveal that brown children aged 5 to 9 years are more vulnerable to death from external causes. Complementary to this phenomenon profile, table 2 shows the distribution of the number of annual deaths due to external causes, from 2000 to 2018, in each age group studied.

**Table 2.** Distribution of deaths from external causes in the state of Piauí, by age group and year of occurrence. Floriano - Piauí, 2020.

YEAR OF DEATH	FROM 1 TO 4		FROM 5 TO 9		TOTAL
	YEARS		YEARS		
	<i>n</i>	<i>% deaths</i>	<i>n</i>	<i>% deaths</i>	
2000	26	50.9	25	49.0	51
2001	32	57.1	24	42.8	56
2002	27	42.8	36	57.1	63
2003	25	51.0	24	48.9	49
2004	29	45.3	35	54.6	64

2005	23	51.1	22	48.8	45
2006	30	40.0	45	60.0	75
2007	33	43.4	43	56.5	76
2008	36	48.0	39	52.0	75
2009	28	48.3	30	51.7	58
2010	21	39.6	32	60.4	53
2011	34	61.8	21	38.2	55
2012	26	53.0	23	47.0	49
2013	28	57.1	21	42.9	49
2014	21	35.6	38	64.4	59
2015	13	37.1	22	62.9	35
2016	27	57.5	20	42.5	47
2017	19	44.2	24	55.8	43
2018	22	62.9	13	37.1	35
<b>TOTAL</b>	<b>500</b>	-	<b>537</b>	-	<b>1,037</b>

Source: Authors.

The highest occurrence of deaths from external causes was in 2007, with 76 deaths (Table 2), being children from 5 to 9 years old most affected. This year is followed by 2006 and 2008 with 75 deaths each, with an annual average of approximately 55 deaths. While, 2015 and 2018 were the years with the lowest records in the number of deaths from external causes among children.

When analyzing mortality over the years, there is a decrease in the number of deaths for the age groups of one to four years of age and, from five to nine years, especially in the last 10 years. Even with some annual variations, in 2008, 75 deaths were registered and, in 2018, 35 deaths from external causes.

The reduction in the number of deaths in Piauí, shown in table 2, may be associated with government measures, such as, for example, the National Policy for the Reduction of Accident and Violence Morbimortality (PNRMAV), approved in 2001 throughout the Brazilian territory. This objective is to act in the face of accidents and violence in Brazil,

emphasizing the importance of sectors and health professionals in the fight (Matos & Martins, 2013).

There is a significant decline in infant mortality rates in the federal units, in children between 1 and 5 years of age, highlighting the marked participation of external causes, accidents and violence, as the reason for death. The Northeast region of the country showed the greatest reduction in mortality levels, between the years 1990 and 2015, when compared to the others (France et al., 2017).

Although national laws, such as the "*Lei seca*" (dry law) and the "*Lei da cadeirinha*" (chair seat law), have been sanctioned and their results are positive, studies such as the one by Preis et al. (2018) disagree with the results obtained here and reveal a progressive national increase in the number of deaths from external causes. They show the divergence in mortality between the female and male sexes, attributing it to biological, cultural and social aspects.

It is believed that the decrease in the number of deaths from external causes is partly related to health promotion and prevention measures implemented in Piauí territory during the reference period of this study. It should also be pointed out the greatest technological advance in the last ten years, as a contributing factor to the reduction of mortality. Since technology can assist in the dissemination of knowledge about prevention and care, and also, the improvement in health care through laws and programs such as "Mais Médicos".

Regarding the distribution of deaths from external causes, Table 3 and 4 show the number of deaths from 1 to 9 years of age, in the period from 2000 to 2018, according to the large group of external causes and their respective PYLL. There were a total of 946 accidents, including drowning, being run over and falling, which represents 91.2% of the causes of death.

**Table 3.** PYLL for detailed external causes, in children aged 1 to 4 years, between 2000 and 2018, according to the large ICD10 group. Floriano - Piauí, 2020.

<b>Group of external causes</b>	<b>1 to 4 years</b>	<b>PYLL</b>
Accidents	454	30,645
Pedestrian	71	4,792.5
Cyclist	5	337.5
Motorcyclist	20	1,350
Automobile	22	1,485
Other automobiles	43	2,902.5
Falls	27	1,822.5
Exposure to mechanical forces	21	1,417.5
Accidental drowning and submersion	134	9,045
Other accidental breathing risks	15	1,012.5
Exp. To Electric current and high temperatures	54	3,645
Exposure to smoke, fire and the flames	16	1,080
Contact with animals and poisonous plants	9	607.5
Exposure to natural forces	-	-
Accidental poisoning	13	877.5
Other causes and unspecified	4	270
Intentionally self-inflicted injuries	-	-
Assaults	25	1,687.5
Events of undetermined intent	16	1,080
Mmedical and surgical care complications	4	270
Sequelae of external causes	1	67.5
<b>Total</b>	<b>500</b>	<b>33,750</b>
<b>Total of PYLL</b>		<b>1,381</b>

Source: Authors.

**Table 4.** PYLL for detailed external causes, in children aged 5 to 9 years, between 2000 and 2018, according to the large ICD10 group. Floriano - Piauí, 2020.

<b>Group of external causes</b>	<b>5 to 9 years</b>	<b>PYLL</b>
Accidents	492	30,996
Pedestrian	113	7,119
Cyclist	19	1,197
Motorcyclist	16	1,008
Automobile	32	2,016
Other automobiles	64	4,032
Falls	27	1,701
Exposure to mechanical forces	35	2,205
Accidental drowning and submersion	124	7,812
Other accidental risks to breathing	12	756
Exp. To Electric current and high temperatures	19	1,197
Exposure to smoke, fire and the flames	13	819
Contact With animals and poisonous plants	4	252
Exposure to natural forces	3	189
Accidental poisoning	4	252
Other causes and unspecified	7	441
Intentionally self-inflicted injuries	3	189
Assaults	27	1,701
Events of undetermined intent	14	882
Medical and surgical care complications	-	-
Sequelae of external causes	1	63
<b>Total</b>	<b>537</b>	<b>33,831</b>
<b>Total of PYLL</b>		<b>1,385</b>

Source: Authors.

In view of the data presented, it is observed that accidents represent 946 deaths (91.2%) from external causes, aged 1 to 9 years old. Although automobile accidents are among the main causes of death in Brazil, among the 405 (39.0%) of transport accidents,

those involving only motorcycles did not stand out, when comparing the segments 5 to 9 years and 1 to 4 years old.

The main cause of death in children for the period studied was drowning and accidental submersion, with 258 deaths, corresponding to 24.9% of deaths and, being the main responsible for lost lives with 16,857 years of life, followed by accidents. pedestrian traffic (pedestrians) with 17.8% deaths (184), resulting in a further 11,911.5 PYLL. Third, exposure to electric current and high temperatures stands out with 7.0% of deaths (73) and 4,842 years of lives lost.

Between 2010 and 2014, in individuals aged from 0 to 4 years, there are 14.0% more deaths from traffic accidents, 18.0% more from homicides and three times more drownings for males. For children aged five to nine years, there are 80.0% more deaths from traffic accidents, 90.0% more deaths from homicides and three times more drownings for males (Agranonik, Furstenau & Bandeira, 2017).

A survey of the profile of mortality from external causes conducted by Romero, Rezende and Martins (2016) points out that drowning is one of the main causes of death in children aged 1 to 4 years, living in less urbanized cities. Children aged between 5 and 9 years, the deaths are the result, mostly, of traffic accidents.

PYLL, adding the two age groups shown in tables 3 and 4, reach 67,581 years of life lost in children victims of external causes in Piauí. Total of PYLL was 2,766 for every 100 thousand inhabitants.

Although the proportion of deaths increases significantly, according to age, for both sexes, among male children under five years of age, there are 44.0% more deaths among boys. (Agranonik, Furstenau & Bandeira, 2017). That said, the greatest potential for lost years was in the male population, with 60.0%, and in the age group of 5 to 9 years.

It is recognized, therefore, that a study limiting the use of secondary data from MIS for the presentation of information, incurs risks when using only data from this source. Therefore, there is a possibility of information bias, due to possible insufficient notifications or variations in the specificity of the data, which affects the quality of the studies. Although, in view of these limitations, the findings shown here serve to guide existing and upcoming preventive measures and policies.

#### 4. Conclusion

From the results, it was observed that the majority of deaths in the period from 2000 to 2018, in children from one to nine years old due to external causes, are concentrated between five and nine years, predominating in males and in brown color individuals. The rate of PYLL is higher in males than in females for all groups of external causes throughout the study period. Assessing the studied period, a significant reduction in the mortality profile was observed. Accidental drowning and submersion and pedestrian accidents predominate as the main external causes of death.

It was found that 67,581 years of life for children aged 1 to 9 years were lost due to external causes in Piauí. The largest PYLL was in males 40,446, the age group of 5 to 9 years with 33,831 years of life lost. It is observed that 91.2% of the external causes were accidents totaling 60,645 PYLL, and we have drowning as the accident that most registered deaths reaching 16,857 PYLL.

The explanation of PYLL in children in the state of Piauí in recent decades was approached as a novelty. Based on that, measures must be taken so that it is possible to avoid them and seek to understand what factors are associated with these deaths. For it is known that this scenario also stems from social and behavioral factors. Through this, it is noted that there are spaces to foster future studies on the theme, which allow continued investigations like this. In addition, it is suggested that other works be carried out by expanding the search bases.

It is possible that, with new theoretical and practical foundations in relation to the studied field and scenario, the attention of public agents, managers and health professionals of the state is drawn to the serious public health problem installed, mainly due to accidents. Fostering the formulation of joint and effective coping strategies, aimed mainly at preventing these deaths, is necessary. Efforts are needed to maintain improvements.

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