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ORIGINAL ARTICLE

Characterization of mortalitypreschool and schoolin San Cristobal

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ABSTRACT

Introduction: the health of children and adolescents in Cuba is a priority for the State, the Ministry of Public Health, and local governments. This approach has led to outstanding results in mortality indicators for these population groups.
Aim: analyze the epidemiological characteristics of preschool and school mortality.
Methods: a study was carried outdescriptive and longitudinal, thatanalyzed pediatric mortality in San Cristóbal, Artemisa, from 2013 to 2022. Document review provided the information needed to determine the variables studied. Statistical analysis included mortality rates and trend analysis using semi-averages and exponential smoothing for predictions.
Results: thirty-eight deaths were included in children aged one-14 years, differentiating between preschool and school-aged children. Mortality showed an irregular pattern with an upward trend. In preschool children, congenital anomalies and malignant tumors prevailed, while in school-aged children, malignant tumors and accidents predominated. A reduction in preschool mortality and an increase in school-aged mortality were identified, reflecting opposite patterns in both age groups..
Conclusions: infant mortality in San Cristóbal presents contrasting dynamics. In preschoolers, the main causes are congenital anomalies and tumors, with a predicted decline according to exponential smoothing. In schoolchildren, accidents and tumors predominate, reflecting a growing trend that demands preventive strategies and better access to medical care.

Keywords: Infant Mortality; Child, Preschoo; Prognosis.

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INTRODUCTION

Pediatric mortality, a fundamental indicator of a country's socioeconomic and health development, has steadily decreased in recent decades thanks to strategies promoted by international organizations and joint efforts of governments, donors, and communities. Since 2000, this global rate has declined by 52 %, saving millions of children's lives. However, in 2023, 4,8 million children under five years old died, mainly from preventable causes. Ensuring access to healthcare services and vaccinations, along with political and financial commitment, is essential to eliminate these deaths and secure a better future for children.[1,2]

In Cuba, maternal and child care has become a priority within the national health system, reflecting organized societal efforts actively involving families and communities. These actions aim to ensure a higher quality of life for women and children. However, the mother and child's health conditions are determined by physical and social environmental factors. Special importance is given to social factors such as working, family, and community conditions, which directly influence quality of life.[3]

Globally, the main causes of child and adolescent mortality include accidents, interpersonal violence, and infectious diseases, primarily in areas with limited access to basic services. Reducing these figures requires preventive and educational initiatives to create safer and more equitable environments for children. In Cuba, the main causes of mortality in children under 19 years old include accidents, congenital malformations, malignant tumors, self-inflicted injuries, and chronic diseases. These require policies prioritizing prevention, mental health care, and access to advanced treatments.[4,5,6,7]

This context raises the question: What are the epidemiological characteristics and determining factors of preschool and school-aged mortality in children under 15 years old in San Cristobal, and how can they be addressed to reduce their impact? This study aims to analyze the epidemiological characteristics of preschool and school-aged mortality in San Cristobal, identifying patterns and associated factors to contribute to planning prevention strategies and improving the quality of life for this vulnerable group.

METHODS

A descriptive and longitudinal investigation was conducted in the municipality of San Cristobal, province of Artemisa, during the period 2013-2022. Information was obtained from the mortality database of the statistics department. The study universe consisted of 38 deaths of children aged one to 14 years, 11 months, and 29 days, including all cases due to the small universe size, coinciding with the sample.

For this study, childhood was divided into two stages: a) Preschool: from one year to four years, 11 months, and 29 days, and b) School-aged: from five years to 14 years, 11 months, and 29 days. Each stage saw 19 deaths during the analyzed period.

The following rates and indicators were defined for the analysis of infant mortality: 1) Preschool Mortality Rate = (Number of deaths from one to four years / Population from one to four years) x 1000; 2) Preschool mortality by causes: Mortality rate = (Number of deaths by cause / Total number of preschool deaths) x 1000; 3) School-aged Mortality Rate = (Number of school-aged deaths / School-aged population) x 1000; 4) Specific cause school-aged mortality rate =

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(Number of deaths by specific cause / Total number of enrolled students) x Factor; and 5) Causes of death for both groups: described according to the basic cause recorded in the San Cristobal death system.

An analysis of infant mortality was carried out, considering key health indicators: preschool and school-aged mortality. Trends, causes of death, and a quantitative mortality forecast were examined.

The semi-average method, using data from the period 2013-2022, was employed to evaluate data evolution. This method involves dividing the time series into two equal-duration segments and calculating the average for each. These values are then positioned at the midpoint of each interval on the time axis. A straight line connecting the semi-averages is drawn to visualize the trajectory of infant mortality, identifying general trends and possible variations in the analyzed variable's behavior. This approach provides a preliminary trend estimate without resorting to more complex predictive models.

Additionally, exponential smoothing, a forecasting technique that assigns greater weight to more recent observations to capture the temporal dynamics of infant mortality, was applied. This method uses a smoothing factor (α) ranging between zero and one, allowing model sensitivity adjustment to series fluctuations. A high α value emphasizes recent data, reflecting abrupt changes, while a low value provides greater forecast stability by considering longer trends. With this model, preschool and school-aged mortality was projected, providing a more accurate estimation of its future evolution.

Statistical Processing
Descriptive measures, such as rates and percentages, were used for statistical processing based on the variables analyzed. Data analysis was conducted using the statistical packages SPSS version 11.5 for Windows, Statistic version 6.0, and EconometricViews version 4.0, the latter specifically employed for mortality forecasting using the exponential smoothing model.

Ethical Considerations
Authorization was obtained from the health management team of Artemisa province and San Cristóbal municipality to use the infant mortality database for research purposes, acknowledging the importance of the results for the development of the maternal and child care program.

RESULTS

The time series of preschool mortality during the period 2013-2022 is represented in Figure 1, showing cases every year except 2015. The mortality rate exhibits highly irregular behavior, with significant fluctuations and a secular trend towards increase. The years with the highest number of deaths were 2016, 2019, and 2021, recording rates above 9,3 per 1,000 live births.

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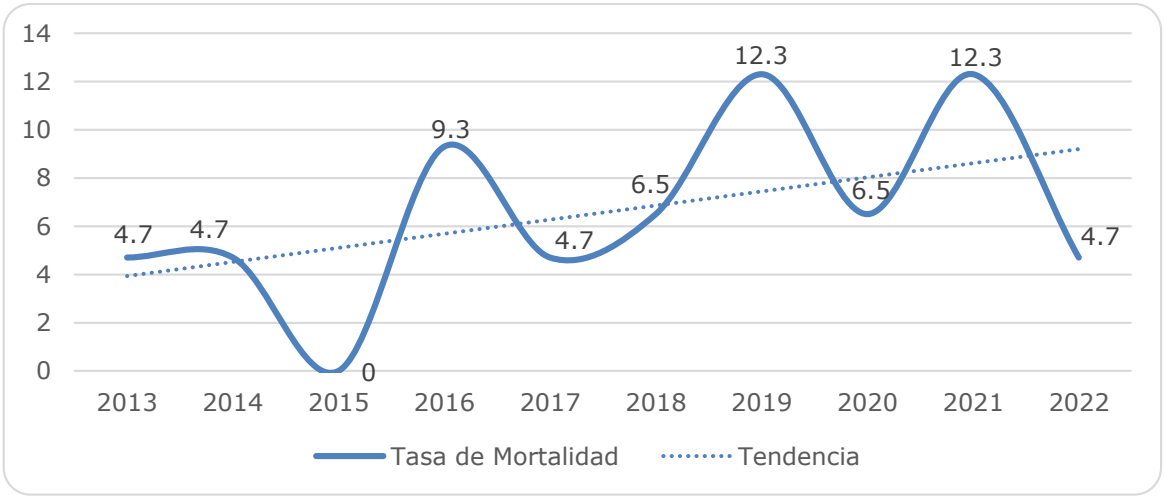

Fig. 1 Time series of mortality in preschool children.

Figure 2 shows mortality by causes in preschoolers, highlighting that congenital anomalies and tumors are the primary causes, each with five cases, followed by infectious diseases, which report four cases. Other causes of death report three cases, while accidents and heart diseases present two cases each.

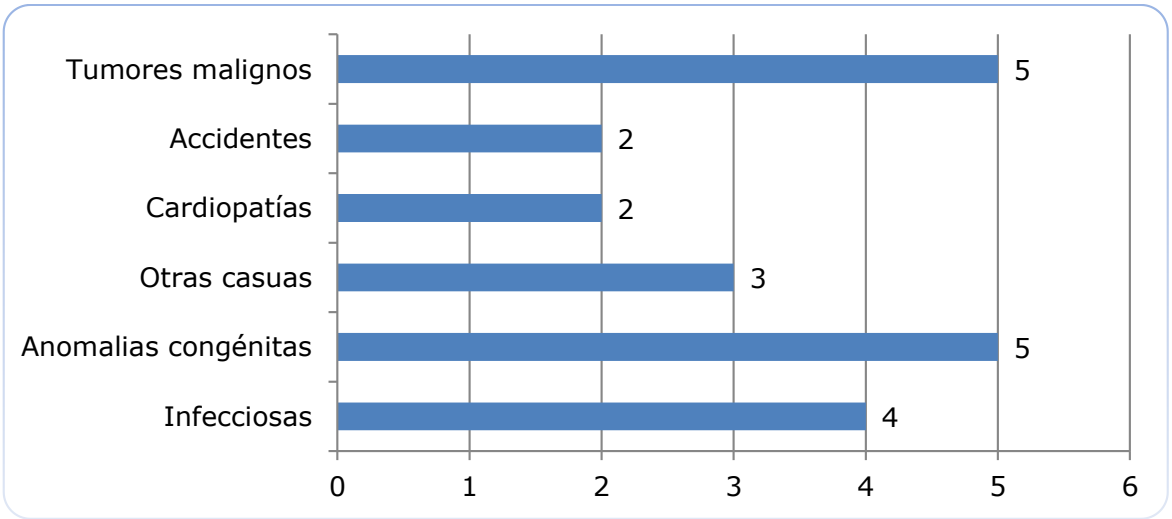

Fig. 2 Causes of mortality in preschoolers.

Figure 3 presents the forecast of preschool mortality in the municipality of San Cristóbal, based on a two-parameter exponential smoothing model. The results indicate a decreasing trend in the preschool mortality rate, with an expected value of 1.9 per 1,000 live births in 2024 [Mean Squared Error (MSE) = 2.4].

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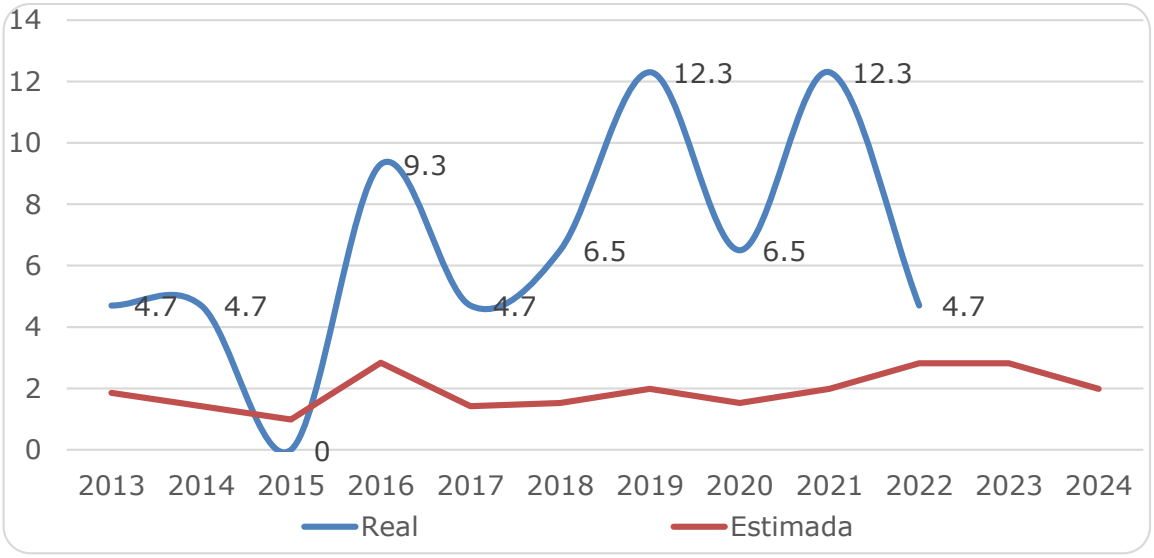

Fig. 3 Preschool mortality, actual and estimated rates.

Figure 4 shows school-aged mortality, characterized by highly irregular behavior with large fluctuations over time. Deaths are recorded every year, and the secular trend shows a sustained increase.

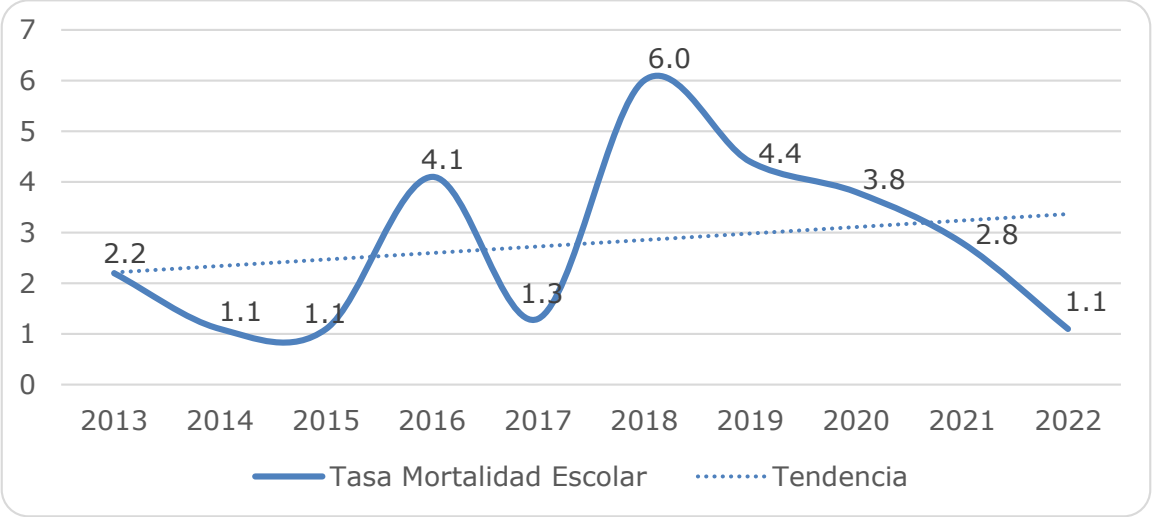

Fig. 4 Time series of school-aged mortality.

Figure 5 represents mortality by its causes, highlighting that malignant tumors, with eight cases (38,1 %), constitute the main cause of death, followed by accidents, with six cases (28,6 %). Other causes report three cases (14,3 %), while heart diseases and infectious diseases present two cases each (9,5 %).

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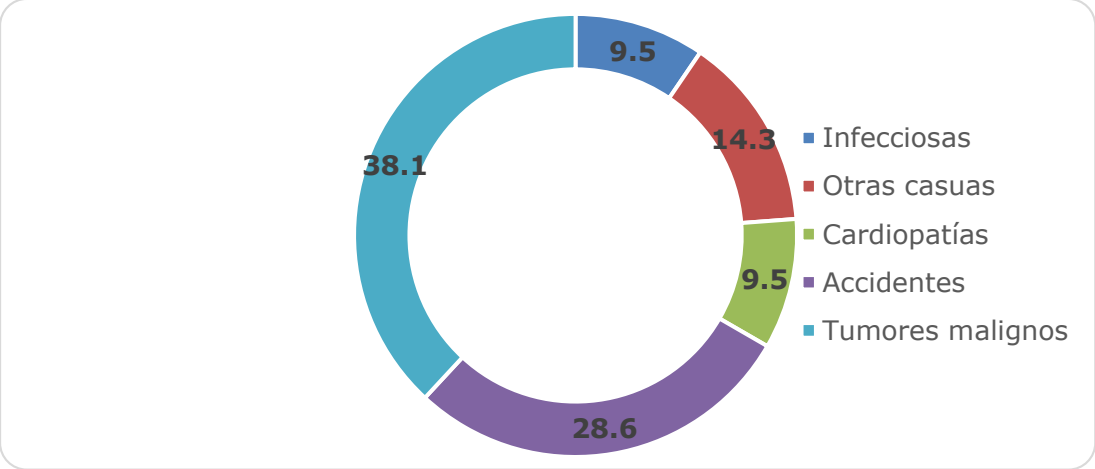

Fig. 5 Causes of mortality in school-aged children.

Figure 6 presents the forecast of school-aged mortality in the municipality of San Cristóbal, based on a two-parameter exponential smoothing model. The results indicate an increasing trend in the mortality rate for this age group, with an expected value of 5.19 per 1,000 inhabitants in 2024 (MSE = 2.4).

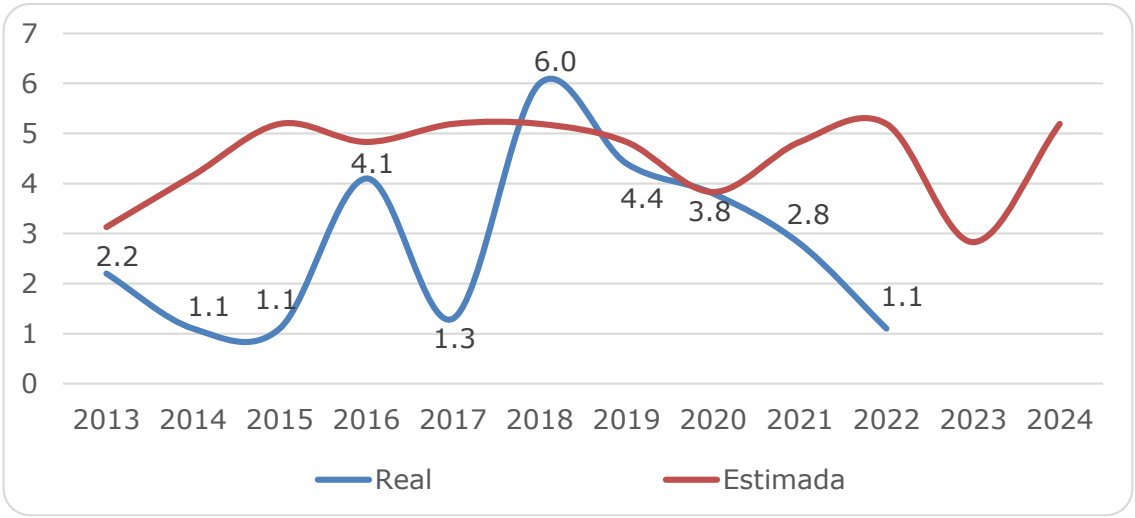

Fig. 6 School-aged mortality, actual and estimated rates.

DISCUSSION

This series of cases in preschoolers shows irregular fluctuations, with significant increases recorded in the years 2016, 2019, and 2021, reaching rates of 9.3, 12.3, and 12.2 per 1,000 inhabitants, respectively. In 2019, it was estimated that approximately 5.2 million deaths occurred worldwide in children under five years old, with sub-Saharan Africa accounting for about 55%, i.e., around 2,8 million deaths in this age group.[8] In their study, Dlamini et al.,[9] determined that the median mortality in children under five years old was 82 in Kenya, 117 in Rwanda, 113 in Uganda, and 97 in Tanzania.

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The under-five mortality rate in the Region of the Americas showed a significant decrease, dropping from 26,4 deaths per 1,000 live births in 2000 to 12,9 deaths per 1,000 in 2021. If this trend continues, it is likely that the projected goal for 2025 will be reached.[10] In Cuba, the under-five mortality rate dropped to 7,1 per 1,000 live births in 2023.[7]

The irregular behavior of preschool mortality in this series contrasts with the decreasing trend observed in Cuba and the Region of the Americas. While globally, infant mortality remains a challenge, especially in sub-Saharan Africa, these findings highlight local variations that require a deeper analysis of the factors influencing these increases.

As observed, congenital anomalies and malignant tumors continue to be the main causes of death in this series. In 2019, 5,3 million deaths were recorded globally in children under five years old related to preterm birth (17,7 %), respiratory infections (13,9 %), perinatal events (11,6 %), and diarrhea (9,1 %). Infectious causes accounted for 49,2 %, while 21,7 % were preventable through vaccination. Since 2000, infant mortality has notably decreased, particularly due to the reduction in infectious diseases. However, regional differences persist in trends and specific causes.[11]

The study by Bassat et al.,[12] analyzed 632 post-neonatal deaths in seven high-mortality regions in Africa and Asia. Through various diagnostic methods, they identified malnutrition, HIV, malaria, congenital defects, respiratory infections, and diarrheal diseases as the main causes. In 86,9 % of cases, there was an infection in the causal chain, and 82,3 % of deaths were considered potentially preventable. In the Americas, the main causes of mortality in one- to four-year-old children include congenital anomalies, perinatal complications, lower respiratory tract infections, suffocation, birth trauma, neonatal infections, colitis, malnutrition, traffic accidents, sudden infant death syndrome, and drowning.[13]

In Cuba, infant mortality in this age group is associated with congenital anomalies, infectious diseases, accidents, and respiratory conditions, which continue to pose a challenge to public health despite medical and preventive advances.[7]

The differences observed in the causes of infant mortality reflect variations in socioeconomic determinants, access to medical care, implementation of preventive measures, and the burden of specific diseases within each region.

In the preschool mortality forecasting model for the municipality, significant fluctuations are observed. Therefore, it is essential to maintain and even strengthen maternal and child health program actions to achieve a more stable and sustained decline. Mathematical models applied to health problems present inherent variations due to their use in human populations. Therefore, it is crucial to identify the biological, socio-environmental, and healthcare factors that influence mortality in this age group.[14]

The variability in child mortality forecasting models highlights the need for adaptive interventions that integrate biological, socio-environmental, and healthcare factors to achieve sustained reductions.

During the analyzed period, unfavorable indicators are observed in the five to 14-year-old group, with rates of 6,0 and 4,4 per 1,000 inhabitants in 2018 and 2019, respectively. However, these figures show a downward trend in subsequent years. Internationally, the main causes of mortality in school-aged children are accidents, respiratory and diarrheal diseases, malnutrition, and cardiovascular conditions. The incidence of these conditions varies by region and access to health services, highlighting inequalities in prevention and medical care.[15] In the Americas, the

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most frequent factors of school-aged mortality include traffic accidents, malignant tumors, congenital malformations, respiratory diseases, and self-inflicted injuries, reflecting disparities in access to medical care and preventive strategies.[16]

In Cuba, the main causes of death in school-aged children are accidents, malignant tumors, respiratory diseases, congenital malformations, and infectious diseases, highlighting persistent challenges in public health and the need to strengthen preventive strategies.[7] Within this age group, recognizing the differences in interests and priorities between children aged five to nine is essential. At this stage, they attend school, play in parks and streets, participate in group excursions, and maintain great curiosity; however, their perception of danger and risks is still limited, contributing to a high frequency of accidents.[17]

The study by León et al.,[18] in Havana, highlights the high proportion of deaths among adolescents attributed to tumors and malignant diseases, representing almost half of the cases (48,7 %). Additionally, unintentional injuries constitute a significant cause (19,7 %), emphasizing the importance of preventive strategies and improving access to specialized care to reduce these risks.

The differences in school-aged mortality reflect the influence of structural, economic, and social factors in each region. Although there is a tendency towards reduction, inequalities persist that require comprehensive strategies to improve prevention and access to medical care. The mortality forecast in this age group indicates an upward trend, requiring a strategic response from municipal health managers. It is crucial to strengthen the analysis and supervision mechanisms within the maternal and child health program to identify risk factors, optimize resources, and improve the implementation of preventive measures. Timely anticipation and adjustment of strategies could significantly contribute to reducing these indicators and protecting the vulnerable child population.

CONCLUSIONS

Preschool and school-aged mortality in San Cristóbal reveal patterns of variability and trends that require attention in public health. In the case of preschool mortality, irregular behavior with significant fluctuations over time is observed. The main causes include congenital anomalies and tumors. Despite this variability, the forecast based on an exponential smoothing model suggests a possible decline in the coming years, which could reflect advances in prevention and pediatric care. On the other hand, school-aged mortality shows an increasing trend, with recorded deaths every year and a sustained rise in cases. Predominant causes include malignant tumors and accidents. Predictive analysis indicates that this increase could continue, highlighting the need to strengthen preventive strategies and improve access to timely medical interventions. Implementing health policies adapted to the epidemiological realities of each age group will be key to countering these challenges.

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Conflict of interest
The authors declare no conflict of interest.

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Author contributions
DRDR: participated in data collection, conceptualization, research, drafting-original draft, drafting-review and editing.
JRSP: participated in data collection, conceptualization, research, drafting-original draft, drafting-review and editing.
BVT: participated in data collection, conceptualization, research, drafting-original draft, drafting-review and editing.
YSR: participated in data collection, conceptualization, research, drafting-original draft, drafting-review and editing.
LSC: participated in data collection, conceptualization, research, drafting-original draft, drafting-review and editing.
GECA: participated in data collection, conceptualization, research, drafting-original draft, drafting-review and editing.
CEPB: participated in conceptualization, drafting-original draft, drafting-review and editing.

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