# ORIGINAL ARTICLE

# Self-injurious behavior and related mortality in children under 10 years of age: a retrospective health record study in Brazil

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**Objective:** To describe and analyze data on self-injurious behavior (SIB) and related mortality in children under 10 years old in Brazil.

**Methods:** A descriptive study was performed using secondary public health care data extracted from the Hospital Information System (Sistema de Informações Hospitalares, SIH) and Mortality Information System (Sistema de Informações sobre Mortalidade, SIM) in Brazil. The databases are available for online access at http://datasus.saude.gov.br/.

**Results:** In Brazil, according to SIH data, 11,312 hospitalizations of patients under 10 years of age were recorded from 1998 to 2018 as resulting from SIB (ICD-10 X60-X84 codes). Of these, 65 resulted in death. According to the SIM, from 1996 to 2016, 91 deaths related to SIB were recorded, 81 (89%) in children aged 5 to 9 years, nine (9.9%) in children aged 1 to 4 years, and one (1.1%) in a child below 1 year of age.

**Conclusion:** These results highlight the relevance of creating measures to better understand SIB and related mortality in this age group. They also reveal the vulnerability of children in Brazil and warrant further studies to address these issues.

**Keywords:** Suicide; suicide attempt; children; self-harm; self-injurious behavior; suicidal behavior

## Introduction

Self-injurious behavior (SIB) is a broad phenomenon that involves nonsuicidal self-injury (NSSI), suicide attempts (SA), and suicide, with the latter two characterizing suicidal behavior (SB).[1] Although NSSI does not involve intention to die or high lethality, it has been consistently associated with SB.[2] In this sense, a review study concluded that the link between NSSI and SB was maintained after statistically controlling for age, gender, ethnicity, and socioeconomic status.[1] In fact, according to data from the literature, the presence of NSSI has been associated with a 26.7 fold increase in the risk of suicide.[3]

SB is complex, varies in severity, and encompasses several actions performed by a person that could lead to the person's own death, including suicidal ideation (SI) (thoughts about death and a desire to be dead), suicide plans (thoughts about self-harm that could result in death), communications or threats about suicide (transmitting or expressing thoughts about the explicit or implicit intent of suicide), SA (self-inflicted behavior with the aim of dying with a nonfatal outcome), and suicide.[4,5] Suicide involves a deliberate act of self-directed violence, the outcome of which is death.[6]

Suicide is a major cause of death worldwide, with approximately 1 million deaths per year[7]; it corresponds to more than half of all violent deaths in the world, and is currently the second leading cause of death in the 15- to 29-year-old age group.[8] Nevertheless, suicide is found in all age groups, with a growing tendency noted among adolescents,[9] making it a relevant public health problem.

The available information about SB often lacks standardization, due to cultural, legal, and bureaucratic issues that vary widely across different regions of the world and affect research in all age groups. In an attempt to improve research in this area, the Centers for Disease Control and Prevention (CDC) proposed a standardization of terms related to self-directed violence, defining suicide as

"death caused by self-directed detrimental behavior with any intention to die as a result of behavior."[10] In children, however, questions remain on how to characterize and evaluate SB.

There is no consensus in the literature regarding an age threshold for SB. Some scholars believe that children are too cognitively immature to express suicidal desires, and consequently they would be unable to engage in SB.[11] As stated by this perspective, SB would only appear in early adolescence, when individuals acquire a full understanding of death.[12,13] In this sense, the difficulty in characterizing childhood SB may be partially attributed to the effort of investigating and understanding death from the perspective of developmental stages as proposed by Jean Piaget.[12]

According to Piaget, cognition develops in four successive stages, characterized by progressively sophisticated and abstract processes. In the motor sensory stage (0 to 2 years), the child's cognitive activity is generated through physical interaction with his or her immediate environment. In the preoperational stage (18-24 months to 7 years), the acquisition of language marks the beginning of symbolic activity. Maturation of memory and imagination occur, however complex concepts, such as time or cause and effect, are not yet present. In the initial phase of the preoperational stage (approximately 2 years of age), there is an emergence of the understanding of death as a temporary and reversible phenomenon. In the last phase of the preoperational stage (approximately 7 years of age), there is an incipient recognition of death as a definitive and permanent process.[14,15]

In the operational stage (7 to 11 years), children and preadolescents demonstrate logical and concrete reasoning because they are already organized in time and space. They are better able to distinguish animate beings from inanimate ones and understand the opposition between life and death, thereby becoming aware of death as a definitive and permanent process. Nevertheless, they still cannot adequately explain causes of death. In the last stage, which concerns formal operations (starting at the age of 11), abstraction emerges, including the ability to postulate hypotheses and consider possibilities. They understand death as inevitable, universal, irreversible, and personal. From this perspective, a child would have a full understanding of death around the age of 11 years.[14,15] Concurrent with these theories, most of the SB literature in childhood has been targeted at older children, with few participants younger than 10 years of age.

However, more recent studies have investigated the complexity of developing an understanding of death during childhood through an analysis of specific sub-components of the biological domain of the concept of death, assuming that children develop intuitive or a common understanding about death through personal experiences and environmental influences and can attain satisfactory maturity even at an early age, approximately by 4 years old.[16,17] These studies show that children in this age range can understand aspects such as causality, inevitability (the understanding that every human being dies one day), universality (death occurs for every living being), irreversibility (death occurs and the person cannot be revived), and cessation of mental and bodily functions as a result of death.[18]

Studies developed in several countries, such as Argentina[19] and the United States,[20] have used SIB records to study mortality in children under 10 years of age. In these studies, mortality in this group was interpreted as SA and, consequently, suicide. In Brazil, these data have only been analyzed for children over 10 years old.[21]

Thus, our aim was to present and discuss SIB data in children under 10 years of age who were registered in hospital and mortality systems in Brazil from 1996 to 2018.

## Methods

This is an ecological and descriptive study that used secondary data extracted from the databases of the Sistema de Informações Hospitalares (SIH, Hospital Information System) and Sistema de Informações sobre Mortalidade (SIM, Mortality Information System) of the Departamento de Informática do Sistema Único de Saúde (DATASUS, Unified Health System Database) in Brazil. These data are available for online access at http://datasus.saude.gov.br/.[22] The systems are regularly updated and represent nationwide data.

The Brazilian Unified Health System (Sistema Único de Saúde [SUS]) was implemented following the approval of a new constitution in 1988, when a standardized death certificate, an official and mandatory instrument used nationally for collection of mortality data was adopted. All causes of death are recorded including those resulting from SIB.

Data related to conditions associated with codes X60 to X84 of the ICD-10, which correspond to SIB, were collected from DATASUS, focusing specifically on individuals under the age of 10 years. Two information systems were reviewed, In both, data were collected for the available age range and divided into three age groups: < 1 year; 1 to 4 years; and 5 to 9 years of age. The following were collected:

1) Data on hospital admissions (SIH database) categorized by the selected ICD-10 codes for the period from 1998 to 2018, including information on number of hospitalizations, gender, region, length of stay, and associated hospital deaths.
2) Data on deaths (SIM database) caused by SIB for the period from 1996 to 2016 (latest period available). The SIM includes childhood deaths outside the health care system (clinics and hospitals), for example deaths that occur at home, public highways, or other places. In the SIM, we accessed age, gender, race, and place of death.

## Results

In Brazil, from 1998 to 2018, 11,312 hospitalizations of children under 10 years of age were registered in the public health care system (SIH) resulting from SIB (intentional self-harm – ICD-10 X60-X84). Of these, 65 died, for a mortality rate of 0.56. The group of deaths included 42 males, 28 aged from 1 to 4 years, 21 from 5 to 9 years old,

and 16 under 1 year of age. Unfortunately, the SIH does not include additional clinical and sociodemographic information about these patients.

Hospital admissions were more frequent in the 1 to 4 years age group, with 6,028 cases (53.3%), and were less frequent among children under 1 year of age, with 911 cases (8.1%). In all age groups, boys were predominant (Table 1).

Of the five Brazilian regions, the Southeast had the largest number of hospitalizations, with 4,967 cases (43.9%). The lowest number was recorded in the Midwest, with 961 cases (8.5%). The highest proportion of hospitalizations was caused by poisoning with medical substances, with 4,310 cases (38.1%); of these, 2,007 (46.6%) occurred in the Southeast region. Nonmedical substance poisoning accounted for 3,136 cases (27.7%), of which 1,556 (49.6%) were in the Southeast. The lowest number of nonmedical substance poisoning was recorded in the North region, with 176 cases (5.6%). Cutting/piercing with objects accounted for 1,005 cases (8.9%), ranging from 68 cases (6.8%) in the Midwest to 511 cases (50.8%) in the Southeast. In 1,791 (15.8%) admissions, the self-harm method was not specified; of these, 765 (42.7%) were recorded in the Northern region (Table 2).

From 1996 to 2016, 91 deaths resulting from SIB in children under 10 years of age were recorded in the SIM. Of these, 81 (89%) referred to children between 5 and 9 years, nine (9.9%) referred to children between 1 to 4 years of age, and one (1.1%) referred to a child younger than 1 year of age. Most cases involved boys, totaling

74 cases (81.3%) (Table 3). The Northeast region had the highest number of incidents, with 34 cases (37.4%), and the Midwest had the lowest number, seven cases (7.7%). According to SIM, 74 children were male, and of these most had brown skin color (n=39) and 28 were white. In relation to place of death, 37 died at home, 32 in the hospital, one in another health clinic, and 21 of them were found in alternative areas (public highways and other areas).

## Discussion

This study describes the frequency of SIB and related deaths in children under 10 years of age in Brazil according to the official DATASUS database. We found that from 1998 to 2018, 11,312 hospitalizations were recorded

**Table 3** Deaths secondary to self-injurious behavior in children under 10 years of age, Brazil, 1996 to 2016

| Age (years) | < 1 | 1-4 | 5 -9 | Total |
|---|---|---|---|---|
| Gender | | | | |
| Male | 1 (1.1) | 3 (3.3) | 70 (77.9) | 74 |
| Female | 0 (0.0) | 6 (6.6) | 11 (12.1) | 17 |
| Total | 1 (1.1) | 9 (9.9) | 81 (89.0) | 91 |

Data presented as n (%).
Source: Ministério da Saúde/Secretaria de Vigilância em Saúde/Coordenação-Geral de Informações e Análises Epidemiológicas (MS/SVS/CGIAE), Sistema de Informações sobre Mortalidade (SIM).[22]

**Table 1** Clinical and sociodemographic characteristics of children under 10 years of age who were hospitalized for self-injurious behavior, Brazil, 1998 to 2018

| Age (years) | < 1 | 1-4 | 5-9 | Total |
|---|---|---|---|---|
| Number of hospitalizations | 911 (8.1) | 6,028 (53.3) | 4,373 (38.7) | 11,312 |
| Gender | | | | |
| Male | 507 (7.7) | 3,335 (50.7) | 2,730 (41.5) | 6,572 |
| Female | 404 (8.5) | 2,693 (56.8) | 1,643 (34.7) | 4,740 |
| Death | 16 (24.6) | 28 (43.1) | 21 (32.3) | 65 |
| Mortality rate (%) | 1.76 | 0.45 | 0.47 | 0.56 |
| Mean of length of stay (days) | 3.85 | 3.2 | 3.1 | 3.2 |

Data presented as n (%), unless otherwise specified.
Source: Sistema de Informações Hospitalares (SIH).[22] Status of the national database on February 16, 2019. Data from January 1998 to December 2018.

**Table 2** Number of admissions for self-injurious behavior in children under 10 years of age by region and method, Brazil, 1998 to 2018

| Causes | North | Northeast | Southeast | South | Midwest | Total |
|---|---|---|---|---|---|---|
| X60 to X64 (poisoning by medical substances) | 217 (5.0) | 1,275 (29.6) | 2,007 (46.6) | 572 (13.3) | 239 (5.5) | 4,310 |
| X65 to X69 (poisoning by nonmedical substances) | 176 (5.6) | 617 (19.7) | 1,556 (49.6) | 343 (10.9) | 444 (14.2) | 3,136 |
| X70 to X71 (hanging/drowning) | 6 (10.3) | 7 (12.1) | 30 (51.7) | 5 (8.6) | 10 (17.2) | 58 |
| X72 to X77 (weapons/fire/burn) | 152 (20.0) | 159 (20.9) | 242 (31.8) | 116 (15.3) | 91 (12.0) | 760 |
| X78 to 79 (cutting/piercing with objects) | 165 (16.4) | 138 (13.7) | 511 (50.8) | 123 (12.2) | 68 (6.8) | 1,005 |
| X80 to X81 (jumping from high place or objects) | 25 (14.0) | 60 (33.7) | 57 (32.0) | 22 (12.4) | 14 (7.9) | 178 |
| X82 (crash with a motor vehicle) | 14 (18.9) | 17 (23.0) | 18 (24.3) | 21 (28.4) | 4 (5.4) | 74 |
| X83 to X84 (other means specified and not otherwise specified) | 765 (42.7) | 203 (11.3) | 546 (30.5) | 186 (10.4) | 91 (5.1) | 1,791 |
| Total | 1,520 (13.4) | 2,476 (21.9) | 4,967 (43.9) | 1,388 (12.3) | 961 (8.5) | 11,312 |

Data presented as n (%).
Source: Sistema de Informações Hospitalares (SIH).[22] Status of the national database on February 16, 2019. Data from January 1998 to December 2018 subject to rectification.

in the SIH as a result of SIB, of which 65 patients died. From 1996 to 2016, 91 deaths were recorded in the SIM as a result of SIB (independently of hospitalization status). In this sense, the present study describes that SIB is sufficiently serious to result in immediate death or hospital admissions that can be followed by death. SIB is a concerning phenomenon in children under 10 years old and, to the best of our knowledge, this is the first study to report data on this young age group in Brazil.

In our study, more than 11,000 children under 10 years of age were hospitalized for SIB over 20 years of collected data. Most hospitalizations resulted from poisoning with medical and nonmedical substances, followed by the use of perforating objects. Since SIB is recognized as a public health problem, having reached an epidemic level, with extreme relevance when practiced by such small children, the numbers reported herein are remarkable. In the literature, we found only one retrospective study in Australia that analyzed children aged ⩽ 16 years who were hospitalized due to SIB over a 10-year period (July 2002 to June 2012). It is interesting to note that the study included a group of 124 children with age ranging from 6-10 years. The authors reported that 75.6% (n=90) were male and 52.5% (n=65) resided in urban areas. The majority of these children were hospitalized due poisoning (59.7%, n=74), and the place of poisoning was the home (59.9%, n=74). In our study, we also found that the majority of the children aged 5-9 years were male and were hospitalized as a result of poisoning. However, the Australian study differed from ours, since it did not consider the 55 hospitalizations of children aged ⩽ 5 years found in the database in their analysis. These results reinforce the contribution of the present study to the literature.[23]

Even though these data emphasize the vulnerability of Brazilian children, the real meaning of this information still needs to be clarified. The results show the need to better describe and understand the true meaning of SIB: is it the result of negligence or does it reflect an intentional action on the part of parents and caregivers? Or can these data also reflect SB in this age group? At what age is the child capable of understanding the meaning of death and desire it? Some hypotheses may be raised – an adult may deliberately report a wrong the reason for hospitalization or death. In this sense, neglect or infanticide would be concealed. Another hypothesis would be the actual occurrence of NSSI or even SB.

Children need supervision. The younger the age, the greater the care and attention needed by the child. Many childhood injuries result from caregiver negligence. For example, not keeping chemicals, medicines, firearms, and perforating objects out of the reach of children may lead to death. In this sense, a lack of full knowledge of domestic hazards may be the cause of this dangerous behavior, such as ingesting a product or substance without being aware of the possible toxicity.

Some studies show that in children, causes of hospitalization and death include accidents and caregiver negligence.[24,25] Children are curious about the smell and taste of objects and manipulate them because they are not aware of danger. Therefore, in many products, the packaging shows a warning to "keep out of reach of children."

In these cases, the family and the support network are especially important, and should allow efficient supervision of children with high-risk behaviors regarding the preservation of their lives.

Conversely, in young children, data on domestic violence might not be reported, or on the contrary relatives may overreport accidents or SIB. Therefore, the reasons for hospitalization or the causes of death may not be adequately recorded. In fact, the literature has shown that sometimes unintentional firearm deaths are reported as accidents.[25] It is sometimes not possible to confirm whether the reported cause of death or injury is actually the one reported in medical records or on the death certificate.[25] Therefore, considering the SB hypothesis, health professionals should investigate potential environmental or genetic variables and family history. Some articles show that in children under 14 years old, family conflicts, school-related problems, bullying, impulsivity, and depression are associated with childhood suicide.[26]

Historically, childhood is considered a period of great joy, without problems or suffering. However, studies indicate that children may exhibit serious mental disorders, such as depression[27] and bipolar disorder.[28] In a recent study in Brazil, children in the High-Risk Cohort Study for Development of Childhood Psychiatry Disorders (HRC) and their mothers were assessed using structured interviews. The HRC reported the prevalence rates of deliberate self-harm (or SIB) in children between the ages of 6 and 9 years (n=1,172); the rates were 1.8% for lifetime and 0.6% for the previous month. Moreover, in that study, the authors showed that diagnoses of depression, attention deficit hyperactivity disorder, and oppositional defiant disorder were associated with SIB, as well as having a mother with an anxiety disorder.[29] Another recent problem in children involves media use and screen time. There is a body of literature linking these habits with risk-taking behaviors, mental health, SB, NSSI, and cyberbullying.[30]

Despite the fact that most studies in the literature focus on suicide or SA rates for the age range between 10 and 15 years,[31-36] other studies have described the rates interpreted as SA in the age group of 5 to 10 years.[3,19,37,38] Again, it should be noted that the discrepancy exists because there is no consensus regarding the minimum acceptable age to classify the event as SA or suicide in children. Traditionally, scholars who adhere to Piaget's theory argue that children under the age of 7 are incapable of understanding death or presenting intentionality of dying. However, new studies have shown the relevance of biological and environmental factors in the understanding of death. These more recent studies indicate that children may understand key aspects of death, irreversibility, and cessation of mental and physical processes as early as 4 or 5 years. Thus, as they become older, their explanations of inevitability, universality, and causality becomes increasingly biological.[18] In this sense, our study might support the idea of intention to die and SB in early childhood.

Another important problem is the inconsistency in the recording of SB in children, perhaps due to underreporting, especially by relatives and the coroners themselves.

Failure to recognize SB as a motive may lead to incorrect classification of SA and suicide as accidental or undetermined SIB.[39] This misunderstanding may result from stigma and social shame surrounding SB, which leads to the belief that children are incapable of suicidal acts.[2]

In our understanding, the data on children in Brazil may reflect the lack of standardization of criteria to classify events of this nature in this age group, thus creating the need for specific studies in this area. In fact, we have not yet found precise measures that identify SB. Despite this, an alarming number of SIB events have been recorded in Brazil. In a previous study, a Brazilian group analyzed data on children above 10 years of age and showed a decreasing trend in hospitalization rate due to SIB, with the highest rates observed in the male population. They point out that there is a need for further analyses of SIB data in children.[21] Therefore, professional training in the collection and interpretation of SIB data is necessary. In addition to correct identification and public registration of SA in children, further studies need to evaluate the risk factors for this behavior in Brazil.

Regardless of any factor, the literature on child suicide recognizes that suicide cognitions are predictors of future SA. Also, the magnitude of the influence exerted by psychopathology and family history of SA is different in childhood vs. preadolescence.[40] There is also evidence that the development of suicidal thoughts in children is associated with specific cognitive vulnerabilities, such as a negative inferential style, a tendency toward rumination, emotional regulation issues, and the occurrence of traumas in childhood with ineffective coping resources.[41]

Although this study reveals important data about SIB rates and mortality as a consequence of SIB in children under 10 years of age in Brazil for the first time, some limitations need to be noted: the study is retrospective, and the data were extracted from the official databases in Brazil. No information was available on the child's health history or aspects such as sexual abuse, neglect by parents and caregivers, or other risk factors for NSSI or SB. There is also a possibility of underreporting and classification errors in terms of the main or secondary diagnoses or they relationship to SIB.

In conclusion, we identified SIB in young Brazilian children, which supports the need for further studies to explain this complex phenomenon. In addition, this work highlights the relevance of developing measures to improve clinical approaches. The study also reveals the need to clarify the differences between NSSI and SB, especially in this age group.

## Disclosure

The authors report no conflicts of interest.

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