Vol.1, No.3, 40-46 (2013)
http://dx.doi.org/10.4236/fmar.2013.13008

Forensic Medicine and Anatomy Research

Medicolegal autopsies in children: Experience of a department of Legal Medicine in Brazil

Manoel Eugenio dos Santos Modelli[1*], Marco Agassiz de Almeida Vasques[1], Riccardo Pratesi[2]

[1]Institute of Legal Medicine of Federal District, Brasília, Brazil; [*]Corresponding Author: manoelmodelli@gmail.com
[2]University of Brasilia, Brasilia, Brazil

Received 16 January 2013; revised 26 February 2013; accepted 10 March 2013

ABSTRACT

Purposes: The purpose of this study was to determine the pattern of mortality in children's Federal District. Knowledge of the epidemiology of injuries is essential for planning, implementation and evaluation of preventive measures. Methods: We analyzed the forensic examination documents of all children under 12 years sent to the IML-DF, during 2010. The data analyzed included age, gender, cause of death (*i.e.* natural or external), mechanism of death (traffic accident, asphyxia, firearm injuries, poisoning, heat injuries) and the medical cause of death. Results: A large number of children (n = 123 total; n = 71 males, n = 52 females) were examined in the IML-DF, Brasília, Brazil. Mean age was 37.96 months, with a median of 12 months, and 21% of children were younger than 1 month. There were 62 cases (33 males and 29 female) classified as natural deaths. The average age for natural deaths was 18.72 months. Most cases of natural death occurred in the first year of life (n = 50), being prevalent in the first month of life (n = 24). Among the 62 cases analyzed, six were stillborns, 13 suffered intrauterine fetal distress (e.g. placental insufficiency, prematurity and meconium aspiration), 36 had lung problems (e.g. Acute respiratory distress syndrome (ARDS), bronchopneumonia, pulmonary hemorrhage, interstitial pneumonitis and infant respiratory distress syndrome (IRDS)), five had neurological problems (e.g. hydrocephalus, hydranencephaly, convulsive seizures and meningitis) and two had undetermined cause of death. There were also isolated cases of heart disease, leukemia, diabetic ketoacidosis, peritonitis caused by acute appendicitis and amniotic band syndrome. There were 61 cases of deaths from external causes, as a consequence of the following: blunt instrument, firearm, physical agent (*i.e.* heat), physicochemical agent (*i.e.* asphyxia) and chemical agent (*i.e.* poisoning). Conclusions: The profile of deaths from external causes in this developing country follows a trend similar to trends reported in the literature for other developing countries. The majority of deaths are accidental, with traffic accidents being the most frequent cause, followed by asphyxia (*i.e.* aspiration of gastric contents and drownings). Sporadic cases of poisoning, injuries from firearms, accidents and fires also occur.

Keywords: Forensic Autopsies; Violent Deaths; Children Mortality; Developing Country; Patterns of Mortality

1. INTRODUCTION

Brasília (Federal District), the capital of Brazil, is located in the country's central region. In addition to its central area (Pilot Plan), it also has several satellite (peripheral) cities. In 2010, its population was estimated at 2,570,160 inhabitants, with a population density of 444.06 people/km^2. The child mortality rate in 2008 was 16.3/1000 births [1].

The Institute of Legal Medicine of the Federal District (IML-DF) is the institution responsible for reviewing deaths from external causes, in the Federal District; therefore, all child victims of violence or suspicious deaths are sent to the IML-DF. This study examined all children sent to the IML-DF during 2010. The epidemiological study was authorized by the director of IML-DF. A total of 123 deaths were analyzed, 62 were considered

deaths from natural causes. Regarding only deaths from external causes (n = 61), the mortality rate was 2.44/100,000 inhabitants, which is low compared to other undeveloped and developed countries.

Deaths from external causes are a public health problem worldwide, and are the leading causes of long-term disability and the most common type of death in children. The cost for treating these disabled children is significant in the budget of industrialized countries. Despite the improvements in education and prevention, these injuries are still the leading causes of death after the first year of life. Annually, external causes are responsible for the death of more than 5 million people, 875,000 of them are children accounting for 9% of global mortality. In 2005, there were 173,753 deaths from external causes in the USA, and 1856 of them were children [2]. In Brazil, 2003 data from SIM (Mortality Information System) reported external cause mortality rates of 17.7/100,000 inhabitants, in children under 5 years [3].

In Estonia, external cause mortality rates in children were 85.1/100,000 inhabitants in 2001-2005, which is almost seven times higher than the 12.8 European Union average [4]. High rates of infant mortality also occur in African countries (53.1/100,000) and Asia countries (21.8/100,000), followed by North America (14.4/100,000) and Europe (7.9/100,000). In Brazil, the main causes of mortality in children in 2006 were traffic accidents (29.3%), drowning (21.1%), asphyxia (15.4%), physical agression (7%), and falls (5.1%). External cause mortality rates in this population were 12.2/100,000 inhabitants [5].

2. METHODOLOGY

We analyzed the forensic examination documents of all children under 12 years sent to the IML-DF, during 2010. The data analyzed included age, gender, cause of death (*i.e.* natural or external), mechanism of death (e.g. traffic accident, asphyxia, firearm injuries, poisoning, heat injuries) and the medical cause of death. The study was authorized by the director of IML-DF.

3. RESULTS

During the study period, 123 children under 12 years were examined in the IML-DF, Brasília, Brazil (**Table 1**). Records for males (n = 71) and females (n = 52) were examined. The overall average age was 37.96, with a median of 12 months and 21% of children were younger than 1 month. The majority of cases involved were the 0 to 6 months age group (n = 62). All children examined were victims of accidental deaths. The age distribution is shown in **Figure 1**.

3.1. Deaths from Natural Causes

A total of 29 females and 33 males with an average age of 18.72 months were classified as natural deaths. The age distribution is shown in **Figure 2**.

Most cases of natural death occurred in the first year of life (n = 50), and several occurred in the first month of life (n = 24). Among the 62 cases analyzed, six were

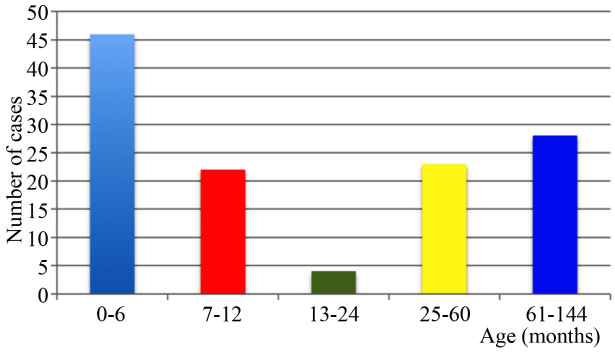

Figure 1. Age distribution of the number of cases examined.

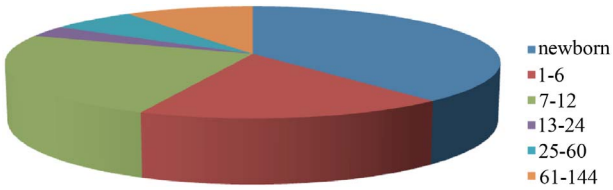

Figure 2. Age (months) distribution and number of cases occurring from natural death.

Table 1. Manner of death and number of cases.

Manner of death	Total case					
		Stillborns	Distress fetal	Neurologic problems	Lung problems	
Disease	60 (48.7%)	6 (4%)	13 (10%)	5 (4%)	36 (29.2%)	
NON-disease related cause	61 (49.5%)	Blunt trauma	Asphyxia	Heat-fire	Firearm	Poisoning
		31 (25.2%)	21 (17%)	6 (4%)	2 (1%)	1 (0.8%)
Unknown	2 (0.01%)					
Total	123 (100%)					

stillborns, 13 suffered intrauterine fetal distress (e.g. placental insufficiency, prematurity and meconium aspiration), 36 had lung problems (e.g. ARDS, bronchopneumonia, pulmonary hemorrhage, interstitial pneumonitis and infant respiratory distress syndrome (IRDS), five had neurological problems (e.g. hydrocephalus, hydranencephaly, convulsive seizures and meningitis) and two had undetermined cause of death. There were also isolated cases of heart disease (n = 2), leukemia (n = 1), diabetic ketoacidosis (n = 1), peritonitis caused by acute appendicitis (n = 1) and amniotic band syndrome (n = 1).

3.2. Deaths from External Causes

There were 61 cases of deaths from external causes, as a consequence of the following: blunt instrument (n = 31), firearm (n = 2), physical agent (*i.e.* heat, n = 6), physicochemical agent (*i.e.* asphyxia, n = 21) and chemical agent (*i.e.* poisoning, n = 1).

3.3. Deaths by Use of Blunt Instrument

A total of 31 children (13 females and 18 males) had death caused by a blunt instrument. The average age was 73.80 ± 45.93 months. These deaths can be categorized as follows: car accident (n = 8), motorcycle accident (n = 1), running over by truck (n = 1), motorcycle (n = 1) and car (n = 15). Four children were victims of falls (e.g. from a horse, gate, tree, and dropping a television on a child) and one child had no history of trauma. The medical cause of death was traumatic brain injury (n = 20), polytrauma (n = 9), meningitis (n = 1) and cardiac tamponade (n = 1). More than half of children (58%) died at the scene, while the rest (42%) were taken to the hospital, with an average hospital stay of 1.8 days, and maximum stay of 4 days before death occurred.

3.4. Deaths by Use of Physicochemical Action

Deaths by use of physicochemical action (e.g. asphyxia) totaled 21 cases, 14 males and seven females. The average age was 34.14 ± 38 months. These deaths occurred by aspiration of gastric contents (n = 9), drowning (n = 7), hanging (n = 1), direct suffocation with a plastic bag (n = 1), foreign body aspiration (*i.e.* banana, n = 1) and indirect suffocation by bed-sharing (n = 1), and garage door crushing (n = 1).

There were seven cases of drowning, involving five males and two females. The average age was 58.28 ± 41.81 months. Four deaths occurred in swimming pools, one in a river, one in a pond, and one in an irrigation tank.

Nine children (seven males and two females) had aspiration of gastric contents and sudden death. The children were found lifeless in their bed, some with signs of recent feeding. They were in treatment of gastroesophageal reflux disease and neuropathy. The average age was 18.8 ± 29.81 months.

3.5. Deaths by Use of Firearms

Two children, aged 8 and 12 years respectively, were victims of firearm projectiles. The 8-year-old was an accidental victim of a single projectile to the head, during a drug dealing gang confrontation in a public area. The 12-year-old was shot three times in the dorsal region, while being used as a shield during a drug dealing gang confrontation. The medical causes of death were traumatic brain injury and hypovolemic shock, respectively.

3.6. Deaths by Use of Physical Agent

Six children were victims of heat injuries, all from fire in homes. The average age was 42 ± 18.19 months. Three children were females and the other three were males. The percentage of burnt area ranged from 20% to 90% (57% average) and a body was found carbonized. Three children died at the scene, one survived for 24 h, one survived for 72 h and another for 32 days.

3.7. Deaths by Use of Chemical Agent

The only victim of chemical agent poisoning was a 12-month-old child, whose mother administered carbamate pellets for killing rats to him. The mother also took the poison in a suicide attempt. The child was hospitalized for 7 days before confirmation of brain death. The lungs were the most affected organs, resulting in respiratory depression and hypersecretion. The greatest number of deaths occurred in the more populous regions with lower socioeconomic index. In the central area (Pilot Plan), the number of cases was small (4/61). In our casuistry, there were no fatal cases of neglect, and physical or sexual abuse.

4. DISCUSSION

In 2010, 123 children underwent forensic examinations at the IML-DF. Of these, 61 were victims of deaths from external causes, most of them traffic accidents, followed by asphyxia, burns, firearms and poisoning. Considering the existing population in the Federal District, the mortality rate in this age group was low (2.4/100,000 inhabitants), compared to other developing and/or developed countries.

Knowledge of the epidemiology of injuries is essential for planning, implementation and evaluation of preventive measures. During 2002-2006, 186 children aged 0 to 14 years died from external causes in Scotland (4.3/100,000). The main cause of death was traffic accidents (*i.e.* mostly from being run over), while falls and drown-

ing represented 7% and 6% of fatal injuries, respectively [6].

In Estonia, an emerging country from Northern Europe, in the 2001-2005 period, 262 forensic autopsies were conducted in children under 14 years of age. Most deaths (81%) were attributed to external causes and 80% were considered unintentional. Unlike other countries, asphyxia was the cause of nearly half of all unintentional deaths, and foreign body aspiration was the most common cause of choking. Strangulation was linked to 5 death cases (e.g. toys, fence and pants). There were also cases of accidental airway obstruction and thoracic immobilization [7].

No evidence of death by abuse, be it physical, sexual, by delayed medical intervention or negligence was identified in the cases analyzed in this period. Mortality related to maltreatment remains a significant challenge due to the underestimation of official data. The risk factors more associated with maltreatment are: maternal drug use, emotional stress, single mothers, mother with more than one child, and children with special needs [8].

Neglect, mainly nutritional, is among the cases of abuse difficult to diagnose when it is not associated with physical violence. It can take many forms, such as improper hygiene, lack of medical care and food restriction. Piercecchi-Marti *et al*. (2006) reported a case of death in a 6 months child, who developed growth and weight gain retardation and internal injuries related to protein-calorie malnutrition (loss of muscle and fat, thymic atrophy, hepatic steatosis) [9]. In Hanover, three cases of fatal neglect were reported in a period of 5 months. Lack of prenatal care, low socioeconomic level or alcohol use, weight below the 3rd percentile, extreme dehydration, fatty liver degeneration, thymic atrophy and signs of aspiration were related to these cases [10].

In addition, Mateju *et al*. (2009) reported a fatal case of Rapunzel syndrome (extreme form of trichobezoar extending from the stomach to the duodenum) in a 3 years and 10 months child, which was related to parental neglect [11]. Costa *et al*. (2007) when analyzing forms of violence against children through data from 1293 cases recorded by Brazilian Tutelary Councils found that 78.1% of them occurred at home. The most frequent were: neglect (failure to provide basic care and abandonment), physical violence (beatings), psychological (intimidation) and sexual violence [12].

Although head injuries from physical abuse are among the most common causes of fatal injuries in children, these were not found in our study. Case (2007) reports that physical abuse is the leading cause of death in children, comprising 10% of all injuries to children under 2 years; cranial lesions correspond to 40% - 50% and 80% of them are fatal [13].

According to the International Statistical Classification of Diseases and Related Health Problems (ICD-10th revision), accidents and violence, such as injury and poisoning, have been linked to hospitalization in Brazil, where a quarter of the population are children between 0 and 14 years. A study conducted in Londrina (Brazil) showed that falls remain the primary cause for nonfatal hospitalizations (32.4%), followed by traffic accidents (19.5%). In this population, traffic accidents (44.4%), drowning (16.7%) and aspiration of gastric contents (11.1%) were the major causes of death from external causes [14].

In our casuistry, the leading cause of violent death in children was traffic accidents, mainly by running over. Bockholdt & Schneider (2003) reported that in Berlin, almost 50% of all fatalities in children aged 0 to 15 years were due to traffic accidents, and 40% involved the children as pedestrians. In 60% of cases, the main injury was traumatic brain injury. None of the patients survived more than 30 days [15].

In 2006, data on mortality of children indicated that the main causes of deaths were traffic accidents (29.3%), followed by drowning (21.1%), the aspiration of foreign bodies (15.4%), violence (7%) and falls (5.1%). In this population, the external cause mortality rates were 12.2/100,000 inhabitants [5]. In a study by Martins & Andrade (2005), traffic accidents (44.4%) and drowning (16.7%) were the leading external causes of deaths, and traumatic brain injury was the main lesion related to death (50%) [14].

According to our casuistry, traumatic brain injury was the leading medical cause of death in traffic accidents (64.5%), with a maximum hospital stay of 4 days. In the US, it is responsible for 95,000 hospital admissions and costs of 10 billion dollars per year. The presence of a fracture involves high possibility of intracranial lesions. The best diagnostic test is the tomography [16]. Lloyd *et al*. (2003) reported that X-ray tests alone were unable to detect 31% of the fractures identified by tomography [17].

Asphyxia was the second most frequent cause of death from external causes among patients examined in our department, with a predominance of aspiration of gastric content, followed by drowning. In a study involving 98 children in Estonia from 2001 to 2005, asphyxia by aspiration was the most common cause of accidental death (91.9%). Most children died, at home, during the first six months of life, and more than half of their mothers had only basic education [4].

Asphyxia is the leading cause of death among children under 5 years of age. In a study carried out in San Diego, USA, positional asphyxia was the most frequent cause of death. The authors reported one case of asphyxia from aspiration of a foreign body, one caused by a plastic bag and also emphasized the occurrence of drownings in the

1 to 4 years age group [2].

We had only one case of food aspiration. Ozdemir *et al.* (2005) reported 10 cases occurred in Istanbul in a period of 6 years. Eight children were younger than 2 years and all accidents occurred at home. Obstruction usually occurs between the pharynx and the trachea bifurcation. The increased intraluminal mucus secretion, bronchospasm, mucosal edema and inflammation may lead to secondary obstructions and asphyxia in partial blockages (beans and rice) [18].

7/21 (33.3%) of asphyxia cases were due to drowning, four cases in swimming pools and three in rivers. Usually, submersion accidents happen in recreational areas. Swimming pools contribute to the highest drowning mortality rates for children aged 1 to 3 years, who are left unattended. Most cases of submersion accidents in bathtubs occur with children, especially infants, left unsupervised at the time of the event [19].

The annual incidence in all children ranges from 1.5 to 4.4 per 100,000. When analyzing the records on medicolegal autopsies performed at the Sick Children Hospital over 20 years, 81 drowning cases were reported, 18 of which occurred in bathtubs and 28 in swimming pools. The average age was 17 months and most children were males. Accident in bathtubs occurred with younger children [20].

Two children were victims of firearms, one was an accidental case and the other was used as a shield during a confrontation between drug dealing gangs. Penetrating trauma was reported in 17.7% of all cases examined in Los Angeles, among children aged 0 to17 years [2]. A total of 77 cases were caused by use of firearms and eight cases by use of knives, being most prevalent with children aged 15 to17 years [21].

We had only one case of chemical intoxication (poisoning) carried out by a mother, who attempted suicide after administering carbamates to the child. Flanagan *et al*. (2005) examined death certificates of children under 10 years, killed from poisoning. They consider the accidents with fire (inhalation of combustion products) as poisoning [22]. These fire-related deaths are not Registered as poisoning in most countries, including Brazil, but as caused by use of physical agent.

We had six cases of death from burns, occurred in accidental home fires. Klys *et al.* (2008) reported a case of accidental fatal intoxication with ethanol in a 5-year-old child, which occurred at a party. The child was found dead in bed on the morning of the following day, with pulmonary edema, congestion of internal organs and macrovesicular steatosis of the liver [23]. The cases analyzed in our institute were classified as accidental deaths, with no evidence, in any case, that could raise suspicion of intentional killing or murder.

Baralic *et al*. (2010) examined incidence and other medicolegal characteristics of homicides carried out against children aged 0 to 14 years, in Belgrade, from 1991 to 2005. They reported 46 cases, 69.6% of which involving a parent as the perpetrator, most often the mother. Closed head trauma was the most common injury, followed by hypovolemic shock. The largest number of victims was in the 1 to 4 years age group [24].

According to the literature, some societies have reported a relatively high incidence of homicide in children. In the USA, homicides are the fourth cause of death in children aged 1 to 14 years [21,25]. A 1997 article comparing children homicides in the USA and in other 25 industrialized countries found that in the USA the rate was up to five times higher than in other countries [26]. Homicide by suffocation (mechanical obstruction or occlusion of the nose and mouth with hands or by other means) may leave no sings if the victim, such as an infant, is unable to react. In this case, the difference between sudden death and death by suffocation may be impossible to establish [27].

The homicide rate in 2003 in the USA, for children aged 0 to 4 years was 3/100,000 inhabitants when considering African Americans, the rate was 4.2/100,000. The vast majority of homicides occurred at home, by the use of weapons that included household objects. Most abusers were female, most often the mother, who showed certain risk characteristics: under 19 years of age, unmarried, poorly educated, having other children and late initiation of prenatal care. Children characteristics included low birth weight, low gestational age, low Apgar scores and they were often males. Firearms are used in only 5% of the homicides in this age group [28].

Homicides in children are the most difficult cases for forensic pathologists, because the events are not usually witnessed, accidental explanations are offered, often there is more than one responsible in contact with the child during that period and there are conflicting opinions among experts. Furthermore, the possibility that the lesions presented are derived from a natural disease should be considered, e.g., ecchymosis, subdural hemorrhages resulting from specific deficiencies of coagulation factors, platelet deficiencies or hereditary capillary fragility [29,30]. A case of fatal subarachnoid hemorrhage caused by ruptured vertebrobasilar artery aneurysm in a 3 and a half year old child, associated with giant cell arteritis, was reported by Corliss *et al.* (2011) [31].

Although deaths from maltreatment abound in the literature, we had no confirmed cases of deaths by physical aggression. As all suspicious deaths are referred to our institute, perhaps the explanation lies in the lack of diagnosis or absence of injuries serious enough to cause death. According to the US Department of Health and Human Service, 1460 children died from maltreatment in 2005. Children aged 0 to 3 months were 25%, children

aged 9 months or less were 50% and children aged 2 to 6 years were 19%. The craniofacial region was the most common lesion site. In the assessment of injuries in young children, the physician should evaluate the possibility of accidental trauma [32].

5. CONCLUSIONS

The death of any child is a tragedy, especially when associated with violence. Most cases of abused and neglected children do not evolve to death, but lethal developments may be an indication of what the nations should consider when addressing children's needs. The mortality patterns mirror what is happening in society and their analysis enables the implementation of more effective preventive measures.

The profile of deaths from external causes in our region, in a developing country, follows a trend reported in most articles published in the literature: the majority is accidental, and traffic accident is the most frequent cause, followed by asphyxia (aspiration of gastric contents and drownings), considering specific age groups. Sporadic cases of poisoning, injuries from firearms accidents and fires have also been found.

In addition to the knowledge of the epidemiologic profile of these deaths and the improvement in child protection services by the authorities, as well as doctors and teachers, the economic growth and improved health care have contributed to lower child mortality rates in developing countries.

REFERENCES

[1] www.portalbrasil.net/ http://www.portalbrasil.net/estados_df.htm

[2] Fraga, A.M.A., Fraga, G.P. and Stanley, C. (2010) Children at danger: Injury fatalities among children in San Diego County. *European Journal of Epidemiology*, **25**, 211-217. doi:10.1007/s10654-009-9420-1

[3] Gawryszewski, V.P. and Rodrigues, E.M.S. (2006) The Burden of injury in Brazil, 2003. *São Paulo Medical Journal*, **124**, 208-213. doi:10.1590/S1516-31802006000400007

[4] Lang, K., Parna, K. and Grjibovski, A.M. (2010) Deaths of infants subject to forensic autopsy in Estônia from 2001 to 2005: What can we learn from additional information? *Population Health Metrics*, **8**, 27. doi:10.1186/1478-7954-8-27

[5] Malta, D.C., Mascarenhas, M.D.M. and Silva, M.M.A. (2009) Perfil dos atendimentos de emergência por acidentes envolvendo crianças menores de dez anos-Brasil, 2006 a 2007. *Ciência e Saúde Coletiva*, **14**, 1699-1679. doi:10.1590/S1413-81232009000500008

[6] Pearson, J. and Stone, D.H. (2009) Pattern of injury mortality by age-group in children aged 0 - 14 years in Scotland, 2002-2006, and its implications for prevention. *BMC Pediatrics*, **9**, 26. doi:10.1186/1471-2431-9-26

[7] Vali, M., Lang, K. and Soonets, R. (2007) Childhood deaths from external causes in Estonia, 2001- 2005. *BMC Public Health*, **7**, 158. doi:10.1186/1471-2458-7-158

[8] Parrish, J.W. and Gessner, B.D. (2010) Infant maltreatment-related mortality in Alaska: Correcting the count and using birth certificates to predict mortality. *Child Abuse & Neglect*, **34**, 951-958. doi:10.1016/j.chiabu.2010.07.002

[9] Piercecchi-Marti, M.D., Louis-Borrione, L. and Bartoli, C. (2006) Malnutrition, a rare form of child abuse: Diagnostic criteria. *Journal of Forensic Sciences*, **51**, 670-673. doi:10.1111/j.1556-4029.2006.00130.x

[10] Fieguth, A., Gunther, D. and Kleemann, W. (2002) Lethal child neglect. *Forensic Science International*, **130**, 8-12. doi:10.1016/S0379-0738(02)00270-0

[11] Mateju, E., Duchanova, S. and Kovac, P. (2007) Fatal case of Rapunzel syndrome in neglected child. *Forensic Science International*, **190**, e5-e7. doi:10.1016/j.forsciint.2009.05.008

[12] Costa, M.C.O., Carvalho, R.C. and Santa Bárbara, J.F.R. (2007) O perfil da violência contra crianças e adolescentes, segundo registros de Conselhos Tutelares: Vítimas, agressores e manifestações de violência. *Ciências & Saúde Coletiva*, **12**, 1129-1141. doi:10.1590/S1413-81232007000500010

[13] Case, M.E. (2007) Abusive head injuries in infants and young children. *Legal Medicine*, **9**, 83-87. doi:10.1016/j.legalmed.2006.11.017

[14] Martins, C.B.G. and Andrade, S.M. (2005) Causas externas entre menores de 15 anos em cidade do Sul do Brasil: Atendimentos em pronto-socorro, internações e óbitos. *Revista Brasileira de Epidemiologia*, **8**, 194-204. doi:10.1590/S1415-790X2005000200012

[15] Bockholdt, B. and Schneider, V. (2003) The injury pattern to children involved in lethal traffic accidents in Berlin. *Legal Medicine*, **5**, S390-S392. doi:10.1016/S1344-6223(02)00139-6

[16] Mulroy, M.H., Loyd, A.M. and Frush, D.P. (2012) Evaluation of pediatric skull fracture imaging techniques. *Forensic Science International*, **214**, 167-172.

[17] Lloyd, D.A., Carty, H. and Patterson, M. (1997) Predictive value of skull radiography for intracranial injury in children with blunt head injury. *The Lancet*, **349**, 821-824. doi:10.1016/S0140-6736(96)09356-7

[18] Ozdemir, Ç., Uzun, I. and Sam, B. (2005) Childhood foreign body aspiration in Istanbul, Turkey. *Forensic Science International*, **153**, 136-141. doi:10.1016/j.forsciint.2004.08.014

[19] Rauchschwalbe, R., Brenner, R.A. and Gordon, S.S. (1997) The role of bathtub seats and rings in infant drowning deaths. *Pediatrics*, **100**, e1. doi:10.1542/peds.100.4.e1

[20] Somers, G.R., Chiasson, D.A. and Smith, C.R. (2006) Pediatric drowning. A 20-year Review of autopsied cases: III. Bathtub drownings. *The American Journal of Forensic Medicine and Pathology*, **27**, 113-116. doi:10.1097/01.paf.0000220981.54069.b8

[21] McGowan, A.K., Crosby, A.E. and Hasbrouck, L.M. (2006) Child and adolescent violent deaths: An epidemicologic investigation. *Journal of the National Medical Association*, **98**, 158-164.

[22] Flanagan, R.J., Rooney, C. and Griffiths, C. (2005) Fatal poisoning in childhood, England & Wales 1968-2000. *Forensic Science International*, **148**, 121-129. doi:10.1016/j.forsciint.2004.04.083

[23] Klys, M., Wozniak, K. and Rojek S. (2008) Ethanol related death of a child: An unusual case report. *Forensic Science International*, **179**, e1-e4. doi:10.1016/j.forsciint.2008.03.017

[24] Baralic, I., Savic, S. and Alempijevic, D.M. (2010) Child Homicide on the territory of Belgrade. *Child Abuse & Neglect*, **34**, 935-942. doi:10.1016/j.chiabu.2010.06.003

[25] Patton, S.B. (2003) Understanding the murder of children and intervening to reduce the risk. *Topics in Advanced Practice Nursing e-Journal*, **3**.

[26] The Centre for Disease Control and Prevention (1997) Rates of homicide, suicide, and firearm-related death among children—26 industrialized countries. *Journal of the American Medical Association*, **277**, 704-705. doi:10.1001/jama.1997.03540330028013

[27] Banaschaka, S., Schmidt, P. and Madea, B. (2003) Smothering of children older than 1 year of age—Diagnostic significance of morphological findings. *Forensic Science International*, **134**, 163-168. doi:10.1016/S0379-0738(03)00135-X

[28] Bennett, M.D., Hall, J. and Frazier, L. (2006) Homicide of children aged 0 - 4 years, 2003-04: Results from the National Violent Death Reporting System. *Injury Prevention*, **12**, ii39-ii43. doi:10.1136/ip.2006.012658

[29] Gehb, I., Rittner, C. and Puschel, K. (2009) Unassisted childbirth or homicide—different appraisals of severe inju- ries in a newborn. *Legal Medicine*, **11**, S174-S175. doi:10.1016/j.legalmed.2009.01.038

[30] Cordner, S.M., Burke, M.P. and Dodd, M.J. (2011) Issues in child homicides: 11 cases. *Legal Medicine*, **3**, 95-103. doi:10.1016/S1344-6223(01)00016-5

[31] Corliss, R.F., Zydowicz, S. and Slamat, S. (2011). Fatal Subarachnoid hemorrhage due to ruptured verte brobasilar aneurysm associated with giant cell arteritis in a child. *The American Journal of Forensic Medicine and Pathology*, **32**, 255-259. doi:10.1016/S1344-6223(01)00016-5

[32] Ross, A.H., Abel, S.M. and Radisch, D. (2009) Pattern of injury in child fatalities resulting from child abuse. *Forensic Science International*, **188**, 99-102. doi:10.1016/j.forsciint.2009.03.021