



REVIEW ARTICLE

Abusive head trauma in children: a literature review☆☆☆☆

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KEYWORDS

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Child maltreatment;
Physical violence

Abstract

Objective: To review the scientific literature on pediatric abusive head trauma as a form of physical abuse against infants and young children, highlighting the prevalence, signs and symptoms, consequences, risk factors for its occurrence, and prevention strategies.

Data source: The MEDLINE, SciELO, LILACS, and Web of Science databases from 2001 to 2012 were reviewed, using the terms "shaken baby syndrome" and "abusive head trauma" in English, Spanish, and Portuguese.

Data synthesis: Pediatric abusive head trauma is defined as injury to the skull or intracranial contents of a infant or child younger than 5 years due to intentional abrupt impact and/or violent shaking. It occurs mainly in infants and children under 1 year of age, and may result in severe consequences, from physical or mental disabilities to death. Although there are specific signs for this form of abuse, they can be mistaken for common illnesses in children or accidental head injury; thus, clinical training of professionals involved in the assessment of cases to attain the correct diagnosis is crucial. Prevention strategies should include early identification of cases, as well as parental education on child development, especially on the infant's crying pattern.

Conclusions: Considering the severity of abusive head trauma in children, it is critical that prevention strategies be implemented and evaluated in the Brazilian context. It is suggested that its incidence indicators be assessed at the national level.

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PALAVRAS-CHAVE

Trauma craniano violento;
Síndrome do bebê sacudido;
Maus-tratos infantis;
Violência física

Trauma craniano violento pediátrico: uma revisão da literatura**Resumo**

Objetivo: Fornecer uma revisão de literatura científica sobre trauma craniano violento pediátrico enquanto forma de maus-tratos físicos contra bebês e crianças, ressaltando prevalência, sinais e sintomas, consequências, fatores de risco para sua ocorrência e, principalmente, estratégias de prevenção.

Fontes dos dados: Revisão nas bases de dados MEDLINE, SciELO, LILACS e Web of Science no período de 2001 a 2012 utilizando os termos “síndrome do bebê sacudido” e “trauma craniano violento” em inglês, espanhol e português.

Síntese dos dados: O trauma craniano violento é definido como a lesão ao crânio ou ao conteúdo intracraniano de um bebê ou criança menor de cinco anos devido a um impacto brusco intencional e/ou a uma sacudida violenta. Ocorre principalmente com bebês e crianças menores de um ano de idade, e pode resultar em consequências graves, desde deficiências físicas ou mentais até a morte. Apesar de haver sinais específicos para esta forma de maus-tratos, eles podem se confundir com doenças comuns em crianças ou traumas cranianos acidentais, sendo imprescindível o preparo clínico dos profissionais envolvidos na avaliação dos casos para o diagnóstico correto. As estratégias de prevenção devem incluir tanto a identificação precoce dos casos, como a educação parental sobre o desenvolvimento infantil, especialmente sobre o padrão de choro do bebê.

Conclusões: Considerando a gravidade do trauma craniano violento pediátrico, é fundamental que estratégias de prevenção sejam implementadas e avaliadas no contexto brasileiro. Sugere-se que indicadores de sua incidência sejam pesquisados nacionalmente.

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Introduction

Violence against children is a frequent and severe problem. Data from the World Health Organization (WHO) and from the International Society for Prevention of Child Abuse and Neglect (ISPCAN) demonstrate that in 2002, over 53,000 children younger than 15 years of age died across the world due to situations of abuse.¹ Among the forms of child abuse, it is worth mentioning pediatric abusive head trauma, due to its severity. In the year 2002, it is estimated that 1,400 children died from maltreatment in the United States,² and pediatric abusive head trauma accounts for 80% of these deaths, the leading cause of death for children victims of maltreatment.³ According to Lazoritz and Palusci, it is estimated that over 250 children die each year in the United States after being subjected to violent shaking.³⁻⁵

Despite this reality, pediatric abusive head trauma, hereinafter referred to only by abusive head trauma (AHT), can be prevented, and the pediatrician has a crucial role in these actions.⁶⁻⁸ Pediatricians are often present at stressful and challenging times for the family, especially those related to childcare. Furthermore, these professionals have contact with community resources that can help the family cope with their difficulties, which puts them in a unique position to prevent abuse and promote the future welfare of the child.⁶

In this sense, it is important that pediatricians understand situations that commonly lead to AHT, identifying risk factors in the family and providing adequate support to overcome these difficulties.^{8,9} This article aims to provide an overview of AHT, emphasizing its prevalence, signs,

consequences, risk factors, and possible prevention strategies, in order to assist pediatricians in their clinical practice.

Method

A review of the MEDLINE, SciELO, LILACS, and Web of Science databases was conducted from 2001 to December of 2012, using the terms “shaken baby syndrome” and “abusive head trauma” and their correlates in Portuguese and Spanish. A total of 238 scientific articles, book chapters, and books were found containing these key words. Of these, 173 articles were selected, as 65 were disregarded because they were related to another subject, were written in a language other than English, Spanish and Portuguese, or were not available as full text.

AHT

According to the Centers for Disease Control and Prevention of the United States (CDC), AHT can be defined as an injury to the skull or intracranial contents of a baby or child younger than 5 years due to intentional abrupt impact and/or violent shaking. Unintentional injuries resulting from negligent supervision, gunshot, and stabbing or penetrating trauma wounds are excluded from this definition.¹⁰

The use of the term AHT is recent and will be used in this article in accordance with the recommendation made in April 2012 by the CDC. However, it should be noted that other terms can be found in the literature to describe the same condition, such as shaken baby syndrome, violent

head trauma, non-accidental head trauma, or inflicted head trauma.

Case et al. observe that the way of shaking a baby that results in significant brain injury involves holding the child by the thorax or an extremity and violently shaking it back and forth, causing the head to whip with repeated accelerations and decelerations in each direction.¹¹ However, it is important to emphasize that there is no consensus in the literature regarding whether only shaking the baby can cause the observed brain lesions, or whether the impact of the child's head on some kind of surface is necessary,¹²⁻¹⁴ and what force would be necessary to inflict the injuries on the baby.^{14,15}

When AHT occurs as a result of violent shaking, a characteristic pattern of injury can be observed, which can include retinal hemorrhage, fractures, especially in the ribs and the extremity of long bones, and recognized patterns of brain injury.^{13,16-19} In accordance with the Joint Statement on Shaken Baby Syndrome,¹⁶ whenever there is the impact of the baby's head against some object, there may be additional injuries such as bruises, lacerations, and fractures.¹⁶ It should be noted that even in the case where there is impact, the signs of damage may not be visible, as the shock can occur against soft objects such as a mattress or a pillow.¹⁶

According to Frasier, the mean age at which children are usually shaken varies approximately from ages 4 to 6 months;¹² children who suffered head injuries due to accidents are, on average, 10 months older.² These data are in agreement with the literature indicating that children under 1 year of age are more likely to suffer brain injuries due to child abuse than accidents.^{20,21}

This increased susceptibility may be related to the fact that, when compared with older children, babies are more often alone with their caregivers, need constant care, and cannot provide reports on their history.¹² Furthermore, babies are particularly susceptible to AHT due to the fact their heads are relatively bigger and their brain is relatively heavier for their body, and because their neck muscles are not yet fully developed and strengthened, since the ability to sustain the head upright develops around 2 to 4 months of life.¹⁶

Incidence of AHT

In recent studies carried out in Scotland, United States, New Zealand and Switzerland, the incidence of AHT has been demonstrated to range from 14.7 to 38.5 cases per 100,000 children, with greater incidence in children younger than 1 year.²²⁻²⁸ It is noteworthy that, in the last survey conducted by the CDC, the incidence in the country was 0.76 fatal cases of AHT per 100,000 children under 4 years of age, increasing to 2.14 when considering only children younger than 1 year.²¹ In Brazil, there have been no studies that evaluated the incidence of AHT.

It must be emphasized that these rates may be underestimated, since many cases are not recognized as having been caused by violence, or do not even come to the attention of health services in order to be identified.^{12,27} In the United States, it is estimated that 85% of deaths resulting from child maltreatment are attributed to other causes on

death certificates, such as internal bleeding, which are not recorded as caused by violence.³ In addition, another difficulty concerns the lack of consensus in the field about the definition of AHT, as well as the codes of the International Classification of Diseases (ICD) to be used for its characterization.^{10,21,27,29,30} These facts indicate that the actual number of cases of AHT may be even higher, emphasizing the importance of more up-to-date studies on this subject.

Another strategy to investigate the incidence of AHT in a given region is a survey of the main approaches used by parents or other caregivers to discipline or calm their babies.¹² In a study by Theodore and Runyan in North and South Carolina, 2.6% of parents of children younger than two years reported that they had shaken their children as a way to discipline them.³¹ In Brazil, 10% of mothers interviewed in a study conducted in Embu, state of São Paulo, reported having shaken their children younger than two years of age in the last year.³²

In another study with 142 professionals from Family Health Units of a small city in the state of Pernambuco, 60.8% of the respondents reported having shaken a child or a baby; 50.5% of them declared that they had shaken the child to make him/her go to sleep and 25.7% to make him/her stop crying.³³ Consequently, despite the lack of studies investigating the prevalence of in Brazil, these studies point to the frequent occurrence of this form of maltreatment in the Brazilian context.

Signs of AHT

The triad of signs depicting AHT is characterized by subdural hematoma, brain edema, and retinal hemorrhage.^{12,18,19,34} Although not always caused by situations of violence, AHT appears to be the main cause of subdural hematomas in younger children.³⁵ Furthermore, this injury appears to be the main sign found in victims of AHT,^{2,18} and is described in 83% to 90% of diagnosed cases.⁹ These data point to the importance of suspecting maltreatment in the presence of subdural hematoma diagnosis in babies.

Another sign that has been strongly associated with AHT is retinal hemorrhage.^{18,19} Although the presence of this lesion is not exclusive for this diagnosis, a recent review of the literature indicated the occurrence of retinal hemorrhage in 74% of cases of AHT and in 82% of fatal cases.³⁵ According to Frasier, if there is no major history of accidental pediatric head trauma, such as car accident or fall from a significant height, retinal hemorrhage should be a warning sign of AHT in children.¹² Reinforcing this idea, the study by Keenan et al. found that 80% of child victims of AHT had eye injuries, a much higher percentage than in children who had suffered accidental pediatric head trauma, which ranged from 6% to 8%.³⁶ Moreover, when retinal hemorrhage occurs as a result of accidents, it is more moderate than when it occurs in situations of violence.¹² These findings emphasize the importance of ophthalmic assessment to identify cases of maltreatment in infants. Such practice would help to reduce the number of diagnostic failures and, therefore, prevent the recurrence of AHT.

It is noteworthy, however, that not all victims will present this triad, and that there are other characteristics that could

indicate the occurrence of AHT. Among them are upper respiratory infection, uncontrollable vomiting, diarrhea, decreased appetite, irritability, lethargy, apnea, seizures, and history of minor trauma.³⁷

Furthermore, according to the National Center on Shaken Baby Syndrome (NCSBS), the child may show signs of decreased muscle tone, poor sucking and swallowing reflexes, stiff posture, breathing difficulties, larger than normal head or forehead, incapacity to raise the head, inability of the eyes to focus or to follow movements, unequal size of pupils, and absence of smiles or vocalizations.¹⁷

After a literature review, Sieswerda-Hoogendoorn et al. observed that the main neurological manifestations resulting from AHT are: altered state of consciousness (77%), seizures (43-50%), vomiting (15%), and developmental delay (12%).⁹ According to the NCSBS, physical signs of strong pressure on the arms or chest are rare.¹⁷

The signs of AHT are often not recognized in less severe cases, so that it cannot be properly diagnosed.¹⁷ Hennes et al. highlight that some of the signs of AHT can mimic other diseases common in children, such as viral infections, colic, or food intolerance.³⁷ These data indicate the need for a proper assessment of the child so that this form of abuse can be identified early and treated appropriately.⁹ According to the Joint Statement on Shaken Baby Syndrome, the more severe the child's neurological injury, the more severe the signs and the shorter the period between the shaking and the onset of signs.¹⁶

Consequences of AHT

According to Case et al., head injuries correspond to 80% of fatal injuries resulting from child maltreatment in younger children.¹¹ According to the CDC, 25% to 30% of children victims of AHT die, and only 15% survive without any sequelae.³⁸

In a study performed in Switzerland, only 28.8% of the victims recovered completely from AHT, whereas 53.3% had moderate or severe disability as a result of this form of abuse.²⁸ It should be noted that the clinical characteristics presented by the victim at the time of injury appear to influence their future development. For instance, in the study by Greiner et al., AHT victims who presented with seizures at the time of hospital admission exhibited lower scores in the follow-up on a scale to evaluate motor, visual, and language development, when compared to victims without a history of seizures.³⁹

Among the immediate consequences of this form of abuse are: respiratory arrest or impairment, irritability, seizures, stiff posture, decreased level of consciousness, vomiting, decreased appetite, inability to suck or swallow, cardiac arrest, or death.¹⁷ The long-term consequences include learning difficulties, vision problems (including blindness), hearing and physical disabilities, cerebral palsy, speech problems, seizures, cognitive impairment, and death.^{16,17} Canadian data indicate that babies who appear to be well when discharged from the hospital can subsequently show evidence of cognitive and learning impairment, possibly at school age.¹⁶ It is disturbing to speculate on the frequency of learning disabilities found in several Brazilian schools

and the possible etiological association with maltreatment, which may occur from infancy.

Risk factors for AHT

Hennes et al. indicate the existence of different situations that increase the probability of occurrence of AHT, i.e., the risk factors for its occurrence. Among them, the authors mention single-parent families, mothers younger than 18, mothers with low education, mothers who did not have prenatal care, and families with low socioeconomic status.³⁷ Furthermore, the authors point out that there are some characteristics of the child that appear to increase the probability of AHT, such as child's age younger than 1 year, male gender, and premature birth or low birth weight.³⁷

More recently, Stephens et al. proposed a three-component model to explain the etiology of AHT. In their model, factors related to the baby, situational factors, and factors related to caregiver interact and lead to the occurrence of AHT.⁴⁰ The factors related to the baby refer to child development characteristics, such as crying pattern and separation anxiety. Situational factors refer to stressful situations such as natural disasters, social status, difficulties during pregnancy, and family isolation. Finally, the caregiver's factors may involve lack of knowledge about the baby's normal pattern of crying and the risks of shaking, frustration tolerance, lack of experience as a caregiver of other children, psychopathological factors, and jealousy of the relationship between the baby and other caregivers.⁴¹ Among these factors, the baby's crying pattern has been reported in the literature as the main trigger for the occurrence of AHT.^{11,37,41,42}

Baby's crying pattern

Crying is an important means of communication for babies, especially for newborns.⁴³⁻⁴⁵ At this stage, when babies are almost entirely dependent on their caregivers, crying plays an important role in ensuring the survival, health, and development of the child.^{43,44} Despite its importance, many studies have indicated specific crying properties that contribute to the feeling of frustration that many caregivers experience during the first months of the baby's life.^{46,47} These specific properties establish a crying pattern, first described by Brazelton. In his study, Brazelton asked 80 mothers to keep a daily record of their babies' crying pattern during their first 12 weeks of life. By analyzing the obtained information, the author obtained an "n-shaped" curve, where the vertical axis refers to the number of hours that the baby cries over a day and the horizontal axis refers to the age of baby in weeks.⁴⁸

The crying pattern found by Brazelton is characterized by an increase in the mean daily duration of crying in the first weeks of a baby's life, reaching a peak in the second month (sixth week) and a decrease in mean daily crying after the peak.⁴⁸ After the fourth month of life, there is a decrease in periods of inconsolable crying; the crying becomes more intentional and more related to environmental events.⁴⁹

This same pattern was observed in reproductions of the study by Brazelton in a similar population, i.e., Western human infants⁵⁰⁻⁵⁴ and in different populations, such as in

studies with babies born in a hunter society from northwest Botswana (Kung San!) with preterm human infants and non-primate mammal infants,^{55–58} suggesting that this pattern is robust and universal. Moreover, the fact that the Brazelton study has been replicated in different eras is further evidence that this pattern of crying is universal, persisting over time. It is noteworthy that, although there are individual differences in the amount of time during which each baby cries a day, there is an increase in this average daily crying for all babies, with a peak and subsequent decrease.

The crying pattern also includes episodes of prolonged inconsolable and unpredictable crying, which typically occur in the late afternoon or early evening and are accompanied by facial expressions of pain and increased muscle tone.^{59,60} These characteristics of crying were usually associated with the occurrence of colic in babies. However, according to Barr et al., although these episodes occur more frequently in infants who have frequent colic, they are not unique to this population. Moreover, according to these authors, these episodes are specific to the first months of the baby's life, and do not commonly occur after this period.⁴⁶

Although crying is normal for this period of the baby's life, it can cause frustration and stress for the family, factors that appear to contribute to the occurrence of AHT.^{59,60} Barr et al. and Lee et al. investigated whether the curve of incidence of AHT cases according to the victim's age matched the curve of the mean duration of crying according to the baby's age; the only difference between the studies was that in the former, the investigated AHT cases were recorded in California hospitals,⁵⁹ whereas the second study investigated cases of AHT published by the media.⁶⁰ The results of both studies indicated that the curves of crying and occurrence of AHT were quite similar, which provides empirical evidence for the assumption that crying is a precipitating factor for the occurrence of this form of maltreatment.^{59,60}

According to Lee et al, confirmation of this assumption also offers further significant evidence for the importance of prevention programs for AHT that must occur at least until the second month of the baby's life in order to be effective.⁶⁰ In addition, the authors emphasize that prevention programs should combine the understanding of specific properties of crying in the first months of the baby's life, the potential that crying has to frustrate caregivers, the limited time for the occurrence of inconsolable crying episodes during the baby's development, and the understanding that the only negative and severe consequence of crying in the first months is the occurrence of AHT and other forms of child abuse. Russell also emphasizes the need to teach parents how to deal with negative feelings generated by the baby's crying, stressing the importance of emotional self-regulation of caregivers to prevent cases of AHT.⁶¹

Prevention of AHT

Some peculiarities of AHT place it in a special position regarding prevention actions, compared with other forms of maltreatment in children. Firstly, AHT has an evident risk behavior (shaking) and an antecedent stimulus strongly associated with its occurrence (crying), enabling preventive actions to be more objective and targeted.⁶² Another important feature of this form of maltreatment refers to

the empirical evidence of the effectiveness of brief parent educational programs to prevent AHT.^{25,63}

Moreover, given the importance of its consequences, AHT is usually associated with significant economic costs for the government.⁶² In a study by Friedman et al. in New Zealand, the total costs during the life of each child victim of AHT is approximately NZ\$ 1,008,344.00, equivalent to US\$ 796,591.76.⁶⁴ In contrast, the costs for the implementation of parental education programs range from US\$ 4.50⁶³ to US\$ 10.00²⁵ per child. The difference between the costs associated with victims of AHT and those associated with prevention makes the economic advantage of implementing primary prevention programs evident. It is also noteworthy that the mentioned surveys do not consider the social and emotional impact for families of children victims of AHT, which will often persist throughout life.

The reviewed literature presented eight studies that described prevention programs for AHT.^{25,63,65–70} All programs described involved educational actions aimed at parents of newborns before discharge from hospital. This intervention, which is mainly carried out by nurses,^{25,60,65–68,70} was performed by medical residents in only one study.⁶⁷ The main materials used included videos and pamphlets disclosing the risks of shaking a baby, the baby's pattern of crying in the first months of life, and the strategies that parents can use when they feel angry or frustrated with the crying baby.^{25,63,65–67,69,70} Other materials include posters,^{25,69} cards,⁶⁸ and fridge magnets.^{67,70} It is noteworthy that five studies requested the parents to sign a statement of commitment worded "I know that shaking a baby is dangerous and agree to share this knowledge with others."^{25,63,66,70} According to Stewart et al., the use of this term is important, as it establishes a "social contract" between the community and parents, increasing the active participation of caregivers in the prevention of AHT.⁶⁵

All programs described in the literature showed positive outcomes in their assessments; however, it should be noted that only three of them used empirical measures to assess change in behavior or knowledge of caregivers.^{25,63,70} Deyo et al. used a questionnaire to assess the participants' knowledge of AHT before and after the intervention, and observed a significant increase in knowledge of the pattern of crying in the baby's first months of life.⁷⁰ Dias et al. and Altman et al. investigated whether the implementation of the program would reduce the number of cases of AHT, and found reductions of 47% and 75%, respectively.^{25,63} It is noteworthy that these results were compared with those from other regions that had not implemented actions to prevent AHT during that period; it was observed that the reduction in the number of cases occurred only in the areas covered by the program.^{25,63}

The remaining studies used subjective measures to assess their programs, such as asking participants whether they believed that the intervention had been helpful, whether they would recommend the materials to another person, or whether they recalled having participated in the intervention after a few months.^{65–69} Although these results indicate good adherence to these programs by parents and caregivers, they do not demonstrate efficacy in changing behavior or knowledge.

In addition to parental education in the maternity ward, the literature indicates the need for professional training

in several areas, so that they may be involved in prevention, by implementing prevention programs in the workplace and/or identifying and notifying cases of AHT, as well as preventing the occurrence of this form of maltreatment by professionals who are responsible for the care of infants or small children.^{33,66,71,72} Training and ongoing education of health professionals are extremely relevant, as professionals trained to recognize early signs of possible AHT can help to prevent new episodes, often more severe, from occurring.¹²

In Brazil, there have been no studies that described or evaluated strategies to prevent AHT. However, a partnership between The Children's Hospital at Westmead in Sydney, Australia, with the Laboratory for Analysis and Prevention of Violence (Laprev) of Universidade Federal de São Carlos, the Center for Integrated Studies of Childhood and Adolescence Health (Centro de Estudos Integrados Infância, Adolescência e Saúde - CEIIAS) of Rio de Janeiro, the Instituto Zero a Seis in São Paulo, and the Special Interest Group in Child and Adolescent Health of the Telemedicine University Network resulted in the translation and adaptation of the video "responding to a crying baby" into three languages (Spanish, Portuguese [Portugal], and Portuguese [Brazil]) and a media campaign to publicize AHT, launched on November 19, 2009.

The video, originally developed by the prevention program team of the Shaken Baby Prevention Project (Shaken Baby Syndrome Prevention Project - SBSPP) from the Children's Hospital in Westmead, Australia, shows two caregivers trying to deal with a crying baby. During the animation, information on the pattern of crying during the baby's first months of life, as well as some strategies to used in these situations, is given.⁶⁹ This video is the first Brazilian material to be used in the prevention of AHT, and is freely available online at the following address: <http://www.youtube.com/watch?v=o0vASBX8CQ0>.

Final considerations

AHT is a specific form of infant maltreatment usually victimizing children younger than 1 year of age, which results in severe consequences for the development of the victims, as well as for society. The fact that there often is a history of abuse prior to the injury that causes the child to need the health services makes the identification of potential cases of pediatric AHT crucial.^{16,36,73} In this sense, it is necessary that health professionals watch for the signs and symptoms the child has and determine whether the lesions correspond with the story told by parents or other caregivers. If the story appears to be controversial, dubious, or false, the abuse should become the main suspicion for professionals involved with the case.⁷³

In addition, the American Association of Pediatrics (AAP) states that physicians, especially pediatricians, should obtain a careful history of the child being treated, seeking to identify risk and protective factors in the family and to inform parents that frustration and anger are often feelings that accompany parenting, offering guidance about which stages of child development are more likely to generate these feelings, and what strategies can be used to address these situations in a healthy manner.^{6,74} The AAP also recommends that pediatricians talk to parents about infant crying,

explaining the pattern of crying in the early months and offering resources for caregivers to cope with this situation, as well as disciplinary practices that they can use with their children, encouraging the use of alternative strategies to corporal punishment.⁶

Even more important than the early identification of cases are the primary and secondary prevention actions, which aim to reduce the first occurrence of AHT. Given the scarcity of studies and strategies for prevention of this form of child maltreatment in Brazil, it is extremely important that preventive measures, such as those described in the article, are implemented and evaluated empirically in the national context. The need to create mechanisms to control the national prevalence of AHT is particularly emphasized, so that the magnitude of this matter can be verified in Brazil, as well as the need for an index to facilitate the success of preventive strategies.

Finally, although specific actions aimed at the prevention of AHT are important, the focus on prevention of other forms of abuse and neglect against children must not be disregarded. This is because AHT lies at the end of a spectrum of conditions that include other non-brain injuries, neglect, and emotional abuse.¹² Thus, the knowledge of pediatricians for the prevention of these forms of maltreatment may indirectly contribute to the prevention of AHT, and vice versa.

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Conflicts of interest

The authors declare no conflicts of interest.

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