DANISH MEDICAL JOURNAL

Original Article

Dan Med J 2023;70(8):A10220657

Skin lesions in 397 children referred for forensic medical examination on suspicion of physical abuse

Lise Frost, Line Qvist Borreschmidt & Dorthe Arenholt Bindslev

Department of Forensic Medicine, Aarhus University, Denmark

Dan Med J 2023;70(8):A10220657

ABSTRACT

INTRODUCTION. Physical child abuse is a well-known global health problem. Considerable efforts have been devoted to identifying predictors of physical abuse.

METHODS. This study included all 397 cases in the cohort of children aged 0-18 years referred to the Department of Forensic Medicine, Aarhus University, Denmark, between 2000 and 2020 on suspicion of exposure to physical abuse. The number, character and location of skin lesions were described. Bone fractures were recorded. A total of 59 cases involving weapons and sharp force violence related to attack or fighting between young people were assessed as a separate group.

RESULTS. The annual number of cases referred increased. The male-to-female ratio in the cohort was 6:4. Bruising was the most common skin manifestation in the blunt force violence (BFV) group; 72.2% of the individuals had skin lesions on the head and neck, thus visible on a normally dressed child. Lesions on the hands and arms were present in 69.8% of the BFV cases and may partially reflect defensive reactions. One or more bone fractures were recorded in 19.5% of the BFV group. Occult fractures were observed in 40% of the children in the BFV group ≤ 2 years of age.

CONCLUSIONS. More than 70% of the children in the BFV group had lesions on the head and neck visible on a normally dressed child. Skin lesions on hands and arms, which are visible on a lightly dressed child, were just as frequent. Persons with close relation to children should be aware of this opportunity to spot non-accidental skin injuries.

FUNDING. none.

TRAIL REGISTRATION. not relevant.

Reports on the prevalence of child abuse reflect multifactorial social and cultural differences between countries [1, 2]. Difficulties in recognising child abuse have been suggested as a reason for underestimation of the number of victims of physical child abuse and fatal cases [2-4]. Unfortunately, consequences of physical abuse are often identified late in the process [5, 6]. Abusive injuries may appear as non-specific or discrete and thus be missed as they do not raise suspicion of physical abuse [5-7]. Knowledge about non-incidental injuries is therefore important for the first suspicion of physical child abuse to be raised among family, caregivers and schoolteachers, etc. [8]. The initial suspicion is essential for further appropriate measures to be taken by professionals. It was reported that physicians have failed to recognise signs of physical abuse preceding more severe abusive trauma or even fatalities [5, 6, 9, 10]. In recent years, efforts among researchers and paediatricians have focused on identifying characteristics of injuries of physically abused children to raise awareness of such findings among health professionals and caregivers alike [11, 12]. Specific lesion patterns

have been suggested as predictors in the evaluation of potential physical abuse of injured children [6, 12, 13]. In past years, a number of screening tools for identifying children exposed to physical abuse have been developed, and clinical application of such tools has shown potential to improve the recognition of physical abuse [12]. However, systematic reviews have concluded that: "... there is no gold standard for identifying child abuse" [13]. Furthermore, the need for further knowledge and improved awareness was emphasized [1, 6, 7, 9-11, 13].

In Denmark, questionnaire surveys of Danish school children revealed that about 5% reported a history of physical abuse [14, 15]. Until now, no systematic investigation has been published on the lesion patterns in Danish children referred for forensic examination as suspected victims of violence. The aim of the present study was to characterise skin lesions and their localisation in the entire cohort of children referred for forensic medical examination at the Department of Forensic Medicine, Aarhus University, Denmark, during a 21-year period.

METHODS

The study included all 0-18-year-old children who due to suspicion of physical abusive trauma were referred by the police for forensic medical examination at the Department of Forensic Medicine, Aarhus University, Denmark, between 2000 and 2020.

All records, reports and further documentation were reviewed and evaluated by the authors. For each case, the following data were collected: age and gender, type of lesion, localisation and number of skin lesions. All skin lesions were recorded irrespective of abusive or non-abusive character. Individual diagnoses of occult bone fractures were recorded. A total of 59 cases involving attack with a sharp weapon in relation to assault and/or fighting were grouped separately as sharp force violence (SFV). The remaining 338 cases were grouped as blunt force violence (BFV).

Trial registraton: not relevant.

RESULTS

The number of children examined annually increased during the observation period (**Figure 1**). The BFV category comprised 338 children; 143 females, 195 males with a mean age of 7.4 years; (**Table 1** and **Figure 2**). Infants and toddlers dominated. The SFV category counted 59 children; 15 females, 44 males with a mean age of 16.0 years (**Figure 3**).

FIGURE 1 Number of annual cases referred for forensic medical examination at Aarhus University on suspicion of physical child abuse (N = 397).

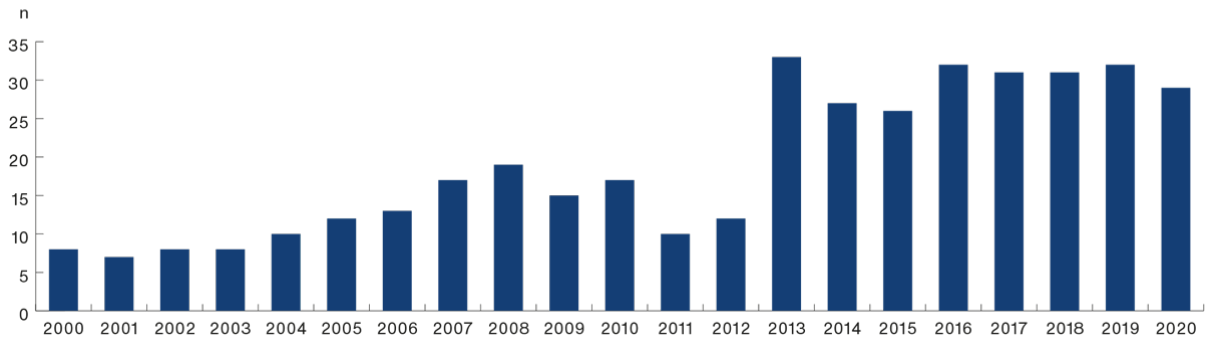


TABLE 1 Number, location and character of skin lesions documented in reports from forensic medical examination of 338 children aged 0-18 years on request by the police due to suspicion of physical abuse: blunt force violence category.

	Total	Skin lesions	Cases
	N	n (%)	with ≥ 1 lesion in the region, n (%)
Cases	338		
Skin lesions	3,975		
Localisation of skin lesions			
Head		825 (20.8)	244 (72.2)
Intraoral		42 (1.1)	42 (12.4)
Neck		213 (5.4)	105 (31.1)
Truncus		653 (16.4)	201 (59.5)
Hands/arms		1,147 (28.9)	236 (69.8)
Feet/legs		989 (24.9)	126 (37.3)
Nates/genitals		106 (2.7)	58 (17.2)
Character of skin lesions			
Bruises		1,872 (47.1)	
Skin abrasions		1,037 (26.1)	
Scars		698 (17.6)	
Stab wounds		29 (0.7)	
Burns, bites, swellings		288 (7.2)	
Combinations or other		51 (1.3)	

FIGURE 2 Age and gender distribution of children examined on suspicion of physical abuse: blunt force violence category (N = 338).

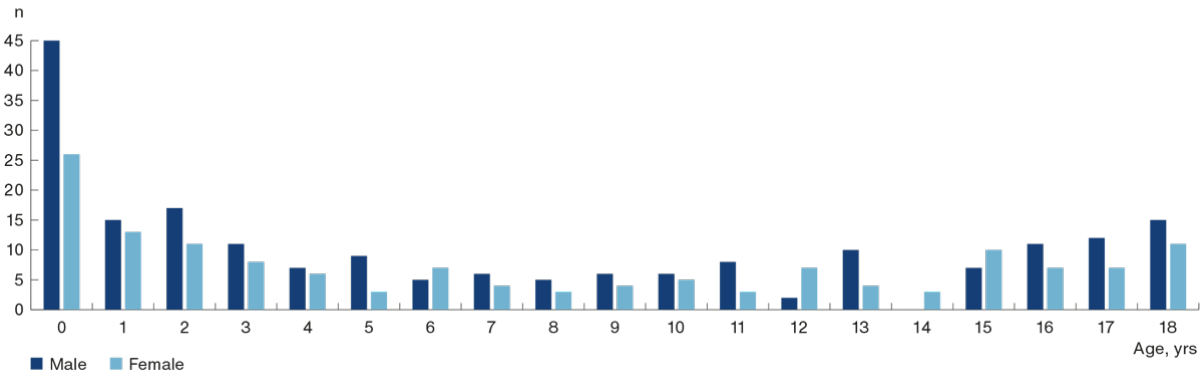
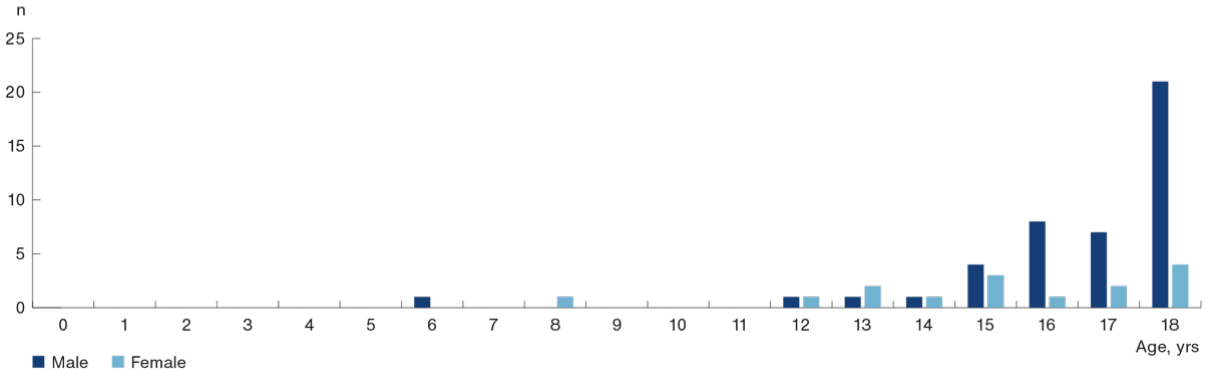


FIGURE 3 Age and gender distribution of children examined on suspicion of physical abuse: sharp force violence category (N = 59).



In the BFV group, skin lesions were most frequently recorded on the hands/arms (28.9%), feet/legs (24.9%) and the head (20.8%). At the individual level, one or more lesions on the head, hands and arms were present in a considerable number of individuals (72.2% and 69.8%, respectively), followed by truncus (59.5%) and feet/legs (37.3%) (Table 1). The mean number of lesions per individual was 11.8 (range: 1-63). A total of 19.5% of the BFV individuals had one or more fractures. Moreover, 82% of the fractures were found in children ≤ 2 years old, meaning that 42.1% of the examined children ≤ the age of two years had occult fractures.

Bruises were the most prevalent type of lesion in the BFV group (Table 1).

Stab wounds dominated the SFV group and were seen in 50% of the group. Bruises were observed in 17%; skin abrasions in 22%; scars in 2%. The mean number of lesions per individual was 6.9 (range: 1-32). The most prevalent lesion locations were the truncus (66% of the group), hands and arms (64%). The prevalence of individuals with one or more lesions in the head was 46%; neck 29%; feet and legs 36%; nates/genitals 11.8%. Three individuals (5%) had bone fractures; two of these were restricted to nose fractures.

DISCUSSION

The present study includes the cohort of children referred for forensic medical examination at our institute during a 21-year period. The referral area of the Department covers approximately 40% of the Danish population. The investigation of the entire cohort during such a long time period is unique and allows for documentation of a wide array of diagnostic and causative factors related to the medical assessment of children who are suspected victims of physical child abuse. This initial presentation of our study focuses mainly on skin lesions.

Young children dominated the BFV category, which includes battered child cases. In the group of children aged ≤ 2 years (37.2% of the cohort), we found that in addition to skin lesions and other lesions, 42.2% of this group had occult fractures. Eismann et al. [6] reported comparable findings: between 14% and 25% of children with occult fractures among 378 infants presented with visible injuries to a paediatric emergency department.

The study shows that 72.2% of the children in the BFV group had skin lesions in the head, which could be observed on a normally dressed child (face, ears and scalp) and were thus visible to any person who came into close contact with the child (family, caregivers and schoolteachers, etc.). A high prevalence of lesions on the head is in accordance with previous studies [6, 12]. Pierce et al. [12] compared abusive and non-abusive injuries in young children and found that the strongest differentiator of bruising characteristics between abusive and non-abusive lesions was bruised body region [12]. Non-abusive injuries were most commonly seen in regions

overlying bony prominences. Ear, neck, fleshy part of the cheeks and angle of the jaw were regions more frequently affected in abused children than in non-abused children [12]. In the present study hands, arms, feet and legs were almost equally affected, which is of importance for caregivers, doctors and other professionals who see the child partially or totally undressed. The fact that hands and arms were affected in 69.8% of the BFV cases may, at least partially, reflect defensive reactions but may also include non-abusive trauma common in skin regions overlaying bony prominences in these regions.

Abusive physical trauma may involve multiple impacts inflicted over a period of time, resulting in a picture of both fresh and fading bruises and skin abrasions [6, 12], which were the predominant skin lesions in the BFV category. Scars were observed in 17.6% of the BFV group and may reflect longer-lasting exposure to physical abuse, contrary to the SFV group representing cases of more spontaneous single events.

The SVF group differed significantly from the rest of the cohort by the fact that physical trauma were related to attack, assault or fighting with sharp weapons, primarily knifes. The pattern and character of injuries differed from the remaining cohort and the circumstances of the cases as described in the reports appeared to be spontaneous single events (data not shown).

To arrive at the suspicion of physical abuse, assessment of the overall lesion pattern and distribution of lesions is important [3, 5-8, 11-13]. This is highlighted in recently suggested decision rules for improved recognition of physical abuse [12]. A validated screening tool has shown promising potential for distinguishing between abusive and non-abusive trauma in children [12]. Our finding of a high prevalence of skin lesions in the head and neck area and the pattern of bruising on the truncus is in accordance with the lesion pattern observed in physically abused children that may be identified by using the clinical decision rule screening tool on bruising [12]. Our study underlines the importance of increased awareness when skin lesions, even discrete or fading ones, are observed in non-prominent areas that are at low risk of accidental trauma, particularly in the head, neck and truncus region.

The additional finding that more than 40% of the 0-2-year-old children and 19.5% of the total BFV group had one or more occult bone fractures not recognised during the clinical examination underpins the importance that the medical examiner identifies hidden inflicted lesions in young children. Our results thus emphasise the importance of following the American Academy of Pediatrics (AAP) recommendation that a full body X-ray examination should always be performed in children under the age of two years who are suspected for physical child abuse [16]. Supplementary X-ray examination may also be a relevant consideration in selected cases of older children. Recent decision models are available [8].

Our study is limited to the group of suspected physically abused children undergoing police investigation and forensic medical examination. An estimated approx. 3-4% of the children undergoing evaluation in the Danish “Børnehuse” (Child Protection Houses) are referred for forensic medical examination [15]. Our study thus covers a minor part of the children who are suspected to be physically abused and represents a selection of cases that have attracted special attention. For this reason, our results cannot be directly extrapolated to broader groups of children. However, for both caregivers and health professionals, our results underline the importance of noticing even subtle signs of recent or fading skin lesions, not least in the head and neck area, especially in locations that are not obviously at risk of being exposed to accidental trauma (not overlaying bony prominences).

During our study period, an increasing number of children were referred for forensic medical examination. Our data do not allow for interpretation of the cause or causes explaining this. In recent decades, new Danish legislation and regulations have been adopted to improve the rights of children who are at risk of maltreatment, which may have had an impact on the number of cases initiated [17].

CONCLUSIONS

In this long-term full cohort of children being referred for forensic medical examination on suspicion of physical child abuse, approx. 70% of the children in the BFV group had one or more lesions in the head region and on hands and arms in locations that are often visible on a normally dressed child. Caregivers and professionals should be aware of this. If lesions are observed in areas that are less likely to be exposed to non-abusive trauma, careful attention should be given to the cause of the lesions. For medical professionals, our study underlines the importance of following the guidelines for radiological examination of traumatised children since more that 40% of the examined children aged ≤ 2 years had occult fractures. Among the entire BFV group, almost 20% of the examined children had fractures.

If health professionals overlook the often obvious, but discrete, signs of inflicted violence, they may fail to suspect child abuse, leaving the child without the help it needs and potentially putting the child's life at risk [3-5, 8-11].

Correspondence *Lise Frost.* E-mail: lif@forens.au.dk

Accepted 24 May 2023

Conflicts of interest none. Disclosure forms provided by the authors are available with the article at ugeskriftet.dk/dmj

References can be found with the article at ugeskriftet.dk/dmj

Cite this as Dan Med J 2023;70(8):A10220657

REFERENCES

1. Stoltenborgh M, Bakermans-Kranenburg MJ, van Ijzendoom MH, et al. Cultural-geographical differences in the occurrence of child physical abuse? A meta-analysis of global prevalence. Int J Psychol. 2013;48(2):81-94.
2. Sethi D, Bellis M, Hughes K, et al. European Report on preventing child maltreatment. Copenhagen: World Health Organization. Regional Office for Europe, 2013.
3. Merrild CH, Frost L. Identifying signs of child neglect and abuse in general practice. Dan Med J. 2021;68(2):A05200396.
4. Flugt A, Frost L, Søndergaard C, Milidou I. Lethal abusive head trauma in infancy in Denmark from 2000 to 2011. Dan Med J. 2021;68(4):A08200604.
5. Thorpe EL, Zuckerbraun NS, Wolford JE Berger RP. Missed opportunities to diagnose child physical abuse. Pediatr Emerg Care. 2014;30(11):771-6.
6. Eismann EA, Shapiro RA, Makoroff KL, et al. Identifying predictors of physical abuse evaluation of injured infants. Opportunities to improve recognition. Pediatr Emerg Care. 2021;37(12):e1503-e1509.
7. Bennett CE, Christian CW. Clinical evaluation and management of children with suspected physical abuse. Pediatr Radiol. 2021;51(6):853-60.
8. Martinkevich P, Larsen LL, Græsholt-Knudsen T et al. Physical child abuse demands increased awareness during health and socioeconomic crises like COVID-19. Acta Orthop. 2020;91(5):527-33.
9. Jenny C, Hymel KP, Ritzen A et al. Analysis of missed cases of abusive head trauma JAMA. 1999;281(7):621-6.
10. King WK, Kiesel EL, Simon HK. Child abuse fatalities: are we missing opportunities for intervention? Pediatr Emerg Care. 2006;22(4):211-4.
11. Hoedeman F, Pulman PJ, Smits AW et al. Recognition of child maltreatment in emergency departments in Europe: should we do better? PLoS One. 2021;16(2):e0246361.
12. Pierce MC, Kaczor K, Lorenz DJ et al. Validation of a clinical decision rule to predict abuse in young children based on bruising characteristics. JAMA. 2021;4(4):e215832.
13. McTavish JR, Gonzalez A, Santesso N et al. Identifying children exposed to maltreatment: a systematic review update. BMC

Pediatr. 2020;20(1):113.

14. Ottosen MH, Henze-Pedersen S. Fysisk vold og seksuelle overgreb mod børn. 2021. Copenhagen: VIVE, 2021. www.vive.dk/da/udgivelser/fysisk-vold-og-seksuelle-overgreb-mod-boern-16645/ (May 2023).
15. Social- og Boligstyrelsen. Årsstatistik om overgreb mod børn 2020. Social- og Boligstyrelsen, 2020. https://sbst.dk/nyheder/2020/aarsstatistik-om-overgreb-mod-boern (May 2023).
16. Section of Radiology, American Academy of Pediatrics. Diagnostic imaging of child abuse. Pe*diatrics.* 2009; 123(5):1430-5.
17. Social- og Boligstyrelsen. Årsstatistik om de danske børnehuse 2020. Social- og Boligstyrelsen, 2022. https://sbst.dk/udgivelser/2022/aarsstatistik-om-de-danske-boernehuse-2020 (May 2023).