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Original Article / Оригинални рад

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Social, clinical and radiological characteristics of physical abuse of children up to 3 years of age hospitalized in a tertiary health institution

Социјалне, клиничке и радиолошке карактеристике физичког злостављања деце узраста до три године хоспитализоване у терцијарној здравственој установи

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Социјалне, клиничке и радиолошке карактеристике физичког злостављања деце узраста до три године хоспитализоване у терцијарној здравственој установи

SUMMARY

Introduction/Objective Child abuse is a significant public health problem in modern society. Many cases of violence against children remain undetected. Serbia has no official protocols for medical examination of abused children.

The aim of this study was to analyze the social, clinical and radiological characteristics of physical abuse of children aged up to three years that required hospital treatment.

Methods This retrospective study included 98 physically injured children admitted to the University Children's Hospital in period from 2013 to 2015, with suspected physical abuse. Beside the history of injuries, complete clinical examination and standard laboratory analysis were performed in all children as well as X-ray examination in children with apparent or suspected skeletal injury. Ultrasound examination and computerized tomography or magnetic resonance imaging were performed in selected patients. Final diagnosis of abuse was established by multi-disciplinary assessment team. Children are divided in two groups: with proven and with suspected abuse.

Results Most of 98 children who were suspected of being abused (92%) were from one or both unemployed parents, 68% were male, 60% the first-born and 44% younger than one year. Skeletal fractures had 92% of the children of whom 19% had two or more fractures. The commonest fracture was a linear skull fracture which was detected in 51% of cases. Abuse was confirmed in only 5 of 98 suspected cases.

Conclusion Among the known social risk factors for abuse of children, the low economic status of the family was the most frequent in our analyzed sample. The most common injury is a linear skull fracture.

Keywords: child abuse, children under 3 years, bone fractures

САЖЕТАК

Увод/Циљ Злостављање деце је значајан јавноздравствени проблем савременог света. Многи случајеви насиља над децом остају неоткривени. Србија нема званичне протоколе за медицинско испитивање злостављане деце.

Циљ рада је анализа социјалних, клиничких и радиолошких карактеристика физичког злостављања деце узраста до три године која су хоспитално лечена.

Методе У ретроспективну опсервациону студију укључено је 98 физички повређене деце са сумњом на физичко злостављање, хоспитализоване на Универзитетској дечјој клиници у периоду 2013–2015. године. Код све деце су урађени: анамнеза, клинички преглед, стандардне лабораторијске анализе, а радиографско испитивање код деце са очигледном или суспектном повредом скелета. Код поједине деце урађени су: ултразвучни преглед, КТ и МР. Завршну дијагнозу злостављања је постављао мултидисциплинарни тим. Деца су подељена у две групе: са доказаним и суспектним физичким злостављањем.

Резултати Већина деце (92%) су из породица са једним или оба незапослена родитеља. Мушког пола су 68%, прворођено је 60% и 44% је плаће од годину дана. Прелом костију је имало 92% деце, од чега 19% два и више прелома. Најчешћи прелом је био линеарна фрактура лобање и то код 51% деце. Злостављање је потврђено само код пет од 98 сумњивих случајева.

Закључак У анализираном узорку низак економски статус породице је био најчешћи социјални фактор ризика за злостављање деце. Најчешћа повреда је линеарна фрактура лобање.

Кључне речи: злостављање деце, деца узраста до три године, преломи костију

INTRODUCTION

Child abuse is a significant public health problem in modern society. Unfortunately many cases of violence against children remain undetected [1, 2]. Several risk factors are associated with child abuse: parents younger then 20 years, lower socioeconomic status, separated parents, history of mental illness, alcohol and drugs consumption. Abused children are more often male, who were unwanted, children with developmental delay or chronic disease [1–3].

Fractures are the second most frequent manifestation of physical abuse, preceded only by skin lesions (bruises, contusions) [4, 5]. Fractures are usually multiple and may occur in any bone in the skeleton [4]. The evident cases of abuse are those that have occurred in the presence of witnesses or if there has been a confession. All other cases that raise the suspicion of abuse (age younger than 18 months, signs of fracture healing, unknown or inconsistent history of injury mechanism and presence of other injuries) require material evidence specific to the identified injury [2, 4, 6–10].

Radiological investigations should include a high quality skeletal survey, while brain computed tomography (CT) and/or magnetic resonance imaging (MRI) are mandatory in children younger than 2 years and in older children with neurological signs/symptoms. The use of abdominal imaging, including ultrasonography (US), CT and/or MRI is debatable if the child has no symptoms [4, 6, 8–10].

In Serbia there are papers on forensic and psychiatric aspects of child abuse [11, 12], but with no mention of radiological investigations. Serbia does not have an official protocol that defines standards for performing skeletal surveys on children in whom physical abuse is suspected. The results of this study will highlight significant epidemiological factors associated with child abuse, and provide an overview of the radiological standards for diagnosis of child abuse in Serbia. Given the recent adoption across Europe of the Royal College of Radiology/Royal College of Pediatrics and Child Health (RCR/RCPCH) guidelines for investigating child abuse [13, 14], results will also act as a baseline comparator for future similar studies.

The aim of this study was to analyze the social, clinical and radiological characteristics of physical abuse of children aged up to three years that required hospital treatment.

METHODS

Data for this retrospective observational study were extracted from the medical records of 98 children younger than 3 years of age admitted to University Children's Hospital in Belgrade in period from 2013 to 2015 because of suspected physical abuse.

Table 1. Skeletal surveys performed according to RCR/RCPCH guidelines.

Radiographic Projection	Number of children (n =98)	
	Proven abuse	Suspected abuse
Skull (frontal and lateral)*	5	67
Thorax (AP)	5	38
Right and left oblique views of the chest	4	29
Abdomen (pelvis and hip) (AP)	0	2
Lumbosacral and cervical spine (lateral)	1	7
Both upper arms (AP)	0	7
Both forearms (AP)	1	14
Both femurs (AP)	1	11
Both lower legs (AP)	1	12
Hands (PA)	0	4
Feet (DP)	0	4
Follow–up survey	0	2

*Towne view: one child with proven abuse, four children with suspected abuse.

In addition to the history of injuries, complete clinical examination and standard laboratory analysis were performed in all children with suspected physical abuse as well as X-ray examination in children with apparent or suspected skeletal injury. Ultrasound (US) examination and computerized tomography (CT) or magnetic

Table 2. The frequency of use of additional diagnostic methods.

Additional examination	Abdomen	Brain	Other*
CT	2	42	7
MR imaging	0	19	1
Ultrasonography	47	61	11

*Other: CT of spine in 5 and upper leg in 2 cases, MRI of spine in one case, US of soft tissue in 7 and testicles in 4 cases.

resonance imaging (MRI) were performed in selected patients (Table 1 and 2). Final diagnosis of abuse was established by multidisciplinary assessment team. Children are divided in two groups: with proven and with suspected abuse. We defined the proven abuse cases with medical records agreed by the professionals involved, such as: the signs of previously medically untreated fractures, unknown or inconsistent history of mechanism of injury in the presence of unexplained fractures on skeletal survey, the presence of injuries other than the presenting injury, especially if injuries were those specific for abuse, plus presence of at least two of the following criteria: admission of assault, presence of witnesses, involvement of police or social services, and legal outcome. We defined the suspected abuse as cases with inconsistent history of mechanism of injury, discrepancies between the extent of an injury and the reported mechanism of injury, estimated by a physician. Also, presence of the risk factors in parents that rise suspicion for child abuse were taken into account, such as parents younger then 20 years, lower socioeconomic status, separated parents, history of mental illness, alcohol and drugs consumption.

Based on information provided by parents or the person who had brought the child to the hospital, we recorded: age, education, employment of parents or main occupation, marital status of parents, number of children and family, guardianship of children and mechanism of injury. In relation to findings from the physical examination, we recorded the presence of other visible non–skeletal injuries (bruises, lacerations, contusions, burns, abrasions, evidence of pinching) and presence of chronic disease or birth defect of children.

According to the radiographic signs of fracture, our patients were divided into three groups: patients with fractures described in the literature as highly specific for abuse (posterior and lateral rib fractures, metaphyseal fractures and long bone fractures in non-walking age, scapular fracture, spinous process fracture, multiple “eggshel” skull fractures, occipital impression fracture), patients with moderately specific fractures (multiple fractures, epiphyseal separation, vertebral body fracture, complex scull fracture) and patients with fractures of low specificity for abuse (clavicular fracture, oblique and spiral shaft fracture of long bones, linear skull fracture) [4].

Cases with skeletal dysplasia or other bone disease, as well as with traffic trauma were not included in this study.

RESULTS

Most of 98 children who were suspected of being abused (92%) were from one or both unemployed parents, 68% were male, 60% the first-born and 44% younger than one year. Education after secondary school had 7% of parents and up to 20 years old were 16% of them. Most parents

(96%) were married. There were 40 children aged up to 12 months, 28 children aged 12 to 24 months and 30 children aged 24 to 36 months. Skeletal fractures had 92% of the children of whom 19% had two or more fractures (Table 3 and 4). The commonest fracture was a linear skull fracture which was detected in 51% of cases. Additional injuries distant to the site of fracture were identified in 70% children. The physical abuse was undoubtedly proved in 5 (5%) out of all 98 suspected cases, one in age up to 12 months, one in age 12-24 months and three cases in 24-36 months age group, all of them with craniocerebral injuries. In these cases the perpetrator of the abuse was discovered, and all of these children were hospitalized at the Department of Neurosurgery. Figure 1 shows the X-ray appearance of skull fractures in one of them.

Table 3. Distribution of fractures.

Fracture type/site – Number of fractures (n=90)								
Skull			Long bone				Clavicle	Digit
Linear	Complex	Total	Diaphyseal	Metaphyseal	Epiphyseal	Total		
46 (51%)	5 (6%)	51 (57%)	34 (38%)	0	1 (1%)	35 (39%)	3 (3%)	1 (1%)

Table 4. Distribution of fractures by age.

Fracture type/site (n=90)	**Group of years**		
	0–12 months	**12–24 months**	**24–36 months**
Skull	27 (77%)	16 (57%)	8 (30%)
Long bone	5 (14%)	11 (39%)	19 (70%)
Clavicle	3 (9%)	0	0
Digit	0	1 (4%)	0
Total	35 (100%)	28 (100)	27 (100%)

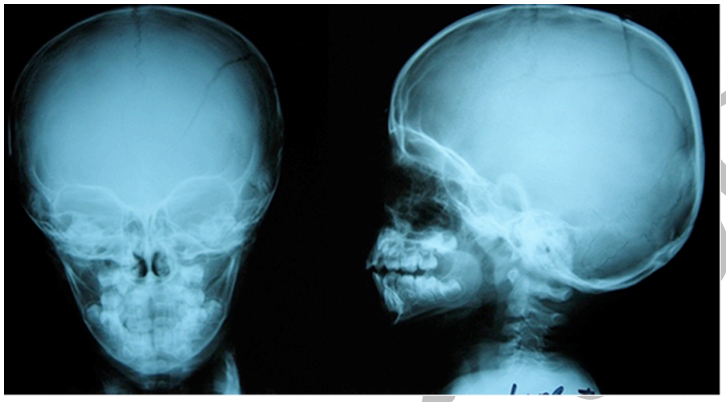

Figure 1. X-ray of the head of a boy 2 years and 2 month old injured with multilinear left fronto-parieto-occipital fracture.

DISCUSSION

Our results indicate that physical abuse of children younger than 3 years was undoubtedly confirmed only in 5% out of all 98 suspected cases. This is relatively low compared to other reports because there was no consistent approach to the investigation of these children [15-19].

According to our data, physical abuse is twofold more frequent in males. Numerous studies indicate that maltreatment of children most frequently occurs in families with lower economic status and education [1–3, 20], that was confirmed in our research. In our group of patients only 3% of parents are educated beyond secondary school and only 7% of them are both employed. While the majority of parents are married, they are aged in their early twenties. Although there are scarce data in the literature related to birth order and child abuse, most cases in our study were first-born. All of these suggest that parental immaturity, lack of experience and financial difficulties may be instrumental in the causation of abuse.

Unfortunately, we were unable to record data on the psychiatric disorders, confirmed use of alcohol and/or drugs or previous abuse in the families. This information should be included in future studies, since it will contribute to a more complete picture of the problem [20].

Large studies cite unknown or inconsistent history of mechanism of injury as a major indicator of abuse [1–3, 15–20]. In most of our cases, the mechanism of injury was either unknown or it was stated as self injury. Non–ambulant children are unable to self–inflict or independently sustain accidental injury. In older children, who walk and play independently, there is a greater probability of accidental injury, but they may also be abused and there is no single fracture that is absolutely certain diagnostic sign of abuse. Therefore, the diagnostic dilemma of differentiating intentionally inflicted from accidental injury is always present.

The third major indicator of child abuse is the presence of visible soft tissue injuries (bruises, abrasions, lacerations), especially if they are present in several regions of the body in non–ambulant children or over non–bony sites (i. e. cheeks, buttocks or thights), if they vary by date or have typical appearence suggestive for abuse (handprint, pinch and tramline bruises, cord or belt buckles marks, bites) [1–3, 5, 15–20]. Upper lip frenulum tear and ear contusons are highly suggestive for child abuse. Burns and scald injuries should draw attention if they have appearenece suggestive for intentional trauma (i. e. cigarette burns, immersion scald injuries with sharp demarcation and/or "stocking or glove" type distribution). Such lesions were observed in 70% of our patients with suspected and in all children with proven abuse.

Radiographs demonstrated at least one fracture in 92% of our patients. Unsuspected fractures were detected in 17%. This is slightly lower than in the study by Barber et al. who reported that previously unsuspected fractures were noted on skeletal survey in 21% of their cases [17]. However, it must be emphasized that their research referred only to infants and that they adhered to a standardized imaging protocol.

Almost 20% of our examined children had more than one fracture and that is an important clinical warning of possible physical abuse. This is similar to the findings of Karmazyn et al. who proved multiple fractures in 18% [18]. It is interesting that 91% patients had low–specific and the remainder moderate–specific fractures.

In Barber's study 14% had rib and 4.6% uncommon fractures, which can be considered highly–specific [17]. Our lack of identification of fractures of high specificity may be mostly due to the low numbers of full skeletal surveys performed. Also, only 2% had a follow–up skeletal survey. This is even lower than the 14% and 8.5% reported by Sonik et al. and Bennett et al. respectively [21, 22]. Clearly there is room for significant improvement in the quality of imaging performed in Serbia.

In this study, 57% of children had a skull fracture and 39% children had long bone fracture. Skull fractures were the most common in the two younger age groups, with a note that the number of long bone fractures increased with age, presumably associated with the more active lifestyles in older children. Other authors identified more long bone fractures then skull fractures in their researches.

Taitz et al. [15] verified the long bone fractures in 65% and skull fractures in 24% of cases, Carty and Pierce 62% and 27%, and Karmazyn et al. 21% and 7% of the [15, 18, 23].

Our study demonstrates that child abuse is a very serious problem that requires a multidisciplinary approach including police, court and social services, as well as the creation of a national guideline for investigating these children. Following medical care, a safe permanent residence is required in order to protect the child from potentially repeated violence [20].

CONCLUSION

Child abuse is a significant public health problem in Serbia that requires immediate creation of a national guideline for medical investigating these children and multidisciplinary approach for its solution. In most cases, the perpetrator of violence against children up to 3 years remains unknown. Among the known social risk factors for abuse of children, the low economic status of the family was the most frequent in the analyzed sample. More exposed to abuse in this age are males, firstborn and those originating from parents with medium and low levels of education. Injuries in physically abused children at this age are very different. The most common and most serious injury is a linear skull fracture. Health professionals of all profiles should be aware of suggestive signs for child abuse. Child abuse prevention and early recognition should be emphasized, especialy in suspected but not proven cases, in order to prevent further victim suffering.

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