

# Children injured: abuse or accident? Diagnosis through indicators

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## Abstract

**Introduction.** Objective: to establish indicators to help physicians accurately diagnose physical abuse in children.

**Material and methods.** A case and control study was conducted in children with injuries due to physical abuse (n=150) or accidents (n=150), respectively. The statistical analysis included the chi square test and simple logistic regression analysis. Bayes theorem was used to validate the diagnostic criteria.

**Results.** The variables child related were: clinical, radiological or gammagraphic discrepancies between the 2 groups were found odds ratio of 29.42 (15.84-54.81); presence of old lesions and scars 4.92 (3.00-8.07); the sense of the child being unwanted or non-accepted 18.95 (9.36-38.34); inadequate personal hygiene 5.61 (3.34-9.43); short height 7.94 (3.80-16.60); undernutrition 7.01 (3.10-15.89), low performance at school 8.56 (2.73-26.84); and incomplete vaccinations 3.71 (1.58-8.69). The family related: delays in seeking medical attention in 228.6 (72.6-720.5), alcoholism and/or drug abuse by parents in 3.40 (2.10-5.52), living with stepfather or stepmother in 31.66 (8.68-115.5); history of child abuse in either parents in 48.0 (13.21-174.5); physical abuse in another family member 14.1 (5.65-35.2); and medical attention was sought by another family member 5.75 (3.24-10.2).

**Conclusions.** Several combined indicators lead to the suspicion of physical child abuse with high degree certainty.

**Key words.** Child abuse; physical abuse; indicators.

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## Introduction

The clinical diagnosis of child abuse (ChA) may be a very simple or difficult task and generally depends on diverse factors such as: the way the patient reaches the hospital or the medical office, the attitude of family members, the ability and/or experience of the physician or the health professional seeing the child to suspect and possibly diagnose ChA, and others.<sup>1,4</sup>

With relative frequency and in spite of the fact that the personnel may have considered this problem, the injuries or the behavior of the child do not necessarily reflect the usual situation. Customarily, health professionals do not dig further or ask questions about injuries lacking a logical and convincing explanation, or are unaware of the correct management of the situation; hence, they tend to limit their action to resolving the acute problem on hand.<sup>5-9</sup>

Because of the above, there is a need to set forth specific clinical and social criteria that may aid the physician and/or paramedical personnel

in taking into account the possibility that a child with certain types of injuries may be a victim of ChA. Aware of this situation, the multidisciplinary group at the Clinic for the Integral Care of the Abused Child of the National Institute of Pediatrics (CAINM-INP) has carefully analyzed the most frequent clinical and social manifestations in 150 children diagnosed as having been battered. As well as developed an easy and practical procedure that allows for accurately diagnosing this nosologic possibility. In order to validate the information collected, the same data were studied in children whose physical injuries were clearly accidental. In this way, we intend on establishing accurate criteria for characterizing first, second or third order frequencies, and develop an association among them to establish a diagnostic accuracy equal to or greater than 90% in these cases.

## Material and methods

A case-control study was carried out in which the clinical charts of 150 battered children seen at

**Table 1. Types of injuries**

Type of injury	In physically abused children (n=150) %	In accidentally injured children (n=150) %
Fractures	25.3	47.3
Contusions	62	38
Wounds	4	3.3
Burns	6.6	10.6
Others*	2	0.6
Total	100	100

\*Asphyxia and poisoning

CAINM-INP were retrospectively reviewed. Patients with diseases causing bone fragility, hematologic changes or dermatologic conditions that at some time could be considered to be related to those of physical ChA victims were excluded. The

control group was constituted by 150 children of similar ages and sex as the index cases, with secondary accidental injuries. These children were seen at the Emergency Ward of a second-level children's hospital close to INP (Coyoacan Children's Hospital).

**Table 2. Frequencies observed in physical abuse and accidental injuries children. Odds ratios and 95% confidence interval values**

Variable	Frequencies %		Odds ratios 95% confidence intervals		
	Abuse	Accidental		Low	high
Rx or gammagraphic discrepancies	85	15	29.4	15.84	54.81
Sense of the child being unwanted or non-accepted	59	7	18.95	9.36	38.34
Low performance at school	17	2	8.56	2.73	26.84
Short height	35	6	7.94	3.80	16.60
Undernutrition	27	5	7.01	3.10	15.89
Inadequate personal hygiene	57	19	5.61	3.34	9.43
Presence of old lesions and scars	59	7	4.92	3.00	8.07
Incomplete vaccinations	16	4.5	3.71	1.58	8.69
Delays in seeking medical attention	85	2	228.60	72.56	720.50
History of child abuse in either parents	45	1	48.02	13.21	174.53
Living with stepfather or stepmother	35	1	31.66	8.68	115.49
Physical abuse in another family member	35	3	14.10	5.65	35.20
Medical attention was sought by another family member	46	12.5	5.75	3.24	10.20
Alcoholism and/or drug abuse by parents	55	26	3.40	2.10	5.52

First eight variables belong to the child and the six rest belongs to family

The study was carried out from February to October 1999. The diagnosis of physical ChA was reached using the criteria accepted at CAINM-INP. These criteria were based on the participation of pediatricians, health care personnel, social workers and the staff at the legal affairs department.<sup>10,11</sup>

X-rays were reviewed by pediatric radiologists from both institutions, intentionally looking for physical signs of physical ChA. Children accidentally injured were seen by a physician at CAINM-INP.

The most frequently observed clinical and family data were selected from the medical records. The variables studied concerning the children were the type the injuries, the clinical radiological and gammagraphic to expression the injuries, old injuries and scars, nutritional state, height, state of hygiene, vaccinations, school performance, and whether the child was wanted or accepted by his/her parents.

Concerning the family, we were interested in studying the time it had taken them to seek medical care for the child, who requested for the help, living conditions and relationship with the stepfather, stepmother or the person living with one of the parents, previous history of ChA of one of the parents, a history of abuse of another family member, alcoholism and/or use of other illegal substances by any of the parents.

#### *Definition of the operational variables*

A child was considered to have been accidentally injured when the story told by the child and/or the adult coincided with the existing lesion, and when the majority of the cases had occurred within the previous 24 hours.

To pinpoint whether there were clinical, radiological and/or gammagraphic discrepancies, the information obtained was compared to the type of lesion and/or fracture, as well as their multiplicity and time passed since they had occurred. The

child was considered to be "dirty" if the child's clothes and/or body contrasted with that of the adult's that accompanied the child.

The lack of an official document that substantiates the child's vaccinations (vaccination certificate), incomplete information or a lack of correlation showing that the vaccines administered did not coincide with the child's age, we regarded the immunization variable as incomplete.

A low school performance was related to whether the child was behind a year or did not go to school at all.

*Old injuries and scars injuries on the skin and/or old changeable fractures.* Non-desired or non-accepted child. The first is when the child that is born without the intention to be conceived by the parents and the non-accepted child are when present one malformation, chronic illness or incapacity and for the same is rejecting.

*Short stature.* The stature is less than two standard deviation from the middle in the curves of the growth.

*Undernutrition.* The weight wanted for the stature is less than two standard deviation from the middle in the curves of the growth.

*Delay in seeking medical care.* The medical attention was asked 24 hours later than the aggression.

*Alcoholism and/or drug addiction by the parents.* Living with stepfather or stepmother. The minor lives with the persons just mentioned.

*History of physical abuse in either parent.* History from phenomenon during the questionings of the childhood.

*History of physical abuse in another family member.* Any adult or minor from the family is attacked.

*Seeking medical care by a non-family member.* In action that is carried out by a familiar, close relative, neighbor, professor, etc.

*Statistical data analysis*

The analysis of data was carried out in four levels: a first level of the analysis consisted on obtaining numeric representations (percentage of frequencies observed between cases and control study, either positive or negatively in variables of the study).

A second analysis level was characterized in the calculation of odds ratios and 95% confidence intervals by simple logistic regression,<sup>12</sup> to show that in physical ChA exist a high risk of possessing adverse conditions in nutritional condition,

hygiene, incomplete immunization, low school performance, etc.

The third level of execution of data analysis consisted on the calculation of nosologic sensitivity and specificity by means of Bayes' Theorem,<sup>13</sup> for each one of the variable considered in the study. By means of the percentage of nosologic sensitivity one will be able to stratify the variables in first, second and third order.

The fourth level of the analysis was applied multivariate Bayes' theorem<sup>14</sup> and it consisted the

**Table 3. Percentages of nosologic sensitivity and specificity values**

<b>Variable</b>	<b>Sensitivity %</b>	<b>Specificity %</b>	<b>Prediction %</b>
Rx or gammagraphic discrepancies	85	85	85
Sense of the child being unwanted or non-accepted	90	69	93
Low performance at school	89	54	98
Short height	85	59	94
Undernutrition	85	57	95
Inadequate personal hygiene	75	65	81
Presence of old lesions and scars	72	67	75
Incomplete vaccinations	77	53	95
Delays in seeking medical attention	98	86	98
History of child abuse in either parents	97	64	99
Living with stepfather or stepmother	91	60	99
Physical abuse in another family member	91	60	97
Medical attention was sought by another family member	78	62	87
Alcoholism and/or drug abuse by parents	68	62	74

**Table 4. Summary of nosologic sensitivity and specificity obtained for percentages of sensitivity demarcations in multivariate Bayes theorem**

Percentage sensitivity	Number cases included	Number controls included	Sensitivity	Specificity	I-Specificity
91-100	115	1	0.77	0.993	0.007
81-90	20	1	0.90	0.986	0.014
71-80	9	0	0.96	0.986	0.014
61-70	2	0	0.97	0.986	0.014
51-60	1	2	0.98	0.973	0.027
41-50	1	3	0.99	0.953	0.047
31-40	0	2	0.99	0.940	0.060
21-30	0	1	0.99	0.933	0.067
11-20	1	9	0.99	0.873	0.127
0-10	1	131	1.00	0.000	1.000
Total	150	150			

evaluation of child by child either case or control to obtain a nosologic sensitivity expressed in percentage. To carry out this process a computer-system was used (PAQUEST V1.0).<sup>15</sup>

## Results

In the population the ChA studied, there were a greater number of skin injuries without fractures (Table 1).

In table 2, it is showed the odds ratios and 95% confidence intervals of the 14 variables. It can be seen that the first eight variables belong to the child and the rest to the family respectively. In both they are distributed in order to significant value. In this sense the most significant child's variable are radiographic or gammagraphic discrepancies. It is to say, in this variable in ChA has an odds ratio of 29.42:1 with respect the child that was suffered an accidental injury. The lowest significant variable is the incomplete vaccination. On the other hand, variables that belong to the family the delays in seeking medical attention, history of ChA in either parents or

living with stepfather or stepmother were extraordinarily significant because the group of ChA has odds ratios of 228.6, 48.02 and 31.66 respectively. Unexpectedly the variable alcoholism and/or drug showed the lowest odds ratio.

In table 3, it can be observed the values of nosologic sensitivity and specificity obtained on independent manner. These variables were classified as indicators according to their high odds ratios and nosologic sensitivity values.

In table 4 shows the summary of outcome of nosologic sensitivity and specificity in relation to demarcations of nosologic sensitivity percentages obtained by multivariate Bayes theorem, when all variables participate to give a specific diagnosis. It is necessary to say that there is slight contribution in the nosologic percentage for participation of any isolated variable in multivariate Bayes analysis. Even though it can be seen high nosologic percentages values on independent analysis.

In this table it can be observed that on high percentage values of sensitivity calculated on

Multivariate analysis corresponds at physical ChA and when the sensitivity values is zero or close to it belongs to accidental child injury diagnosis. In this way, it can be seen that only two controls were erroneously included as a physical ChA. On the other hand, also, two of cases were classified as an accident when they were really physical ChA. Other six cases showed low nosologic percentage values. For this reason, the study showed 0.77 or 77% of nosologic sensitivity but very high specificity.

The degree of sensitivity and specificity for each of the variables and their association, justifies the following classification:

1. The existence of two criteria of the first order, two of second order and two of third order indicates 90-100% diagnostic certainty.

2. The presence of two criteria of first order, one of second and another of third sum 80-89%.

3. A first order criteria, one of second and two of third order represent a diagnostic certainty of 70-79% (Table 5).

### Discussion

The availability of a series of indicators whose sum to provide a high percentage of diagnostic certainty constitutes a tool of enormous usefulness for physicians, paramedics or health professionals working with physically abused victims.

According to these findings battered children are characterized by data from the child or from the family. All of them were classified in first,

**Table 5. Diagnostic criteria for physical child abuse**

<b>First order</b>	<b>Second order</b>	<b>Third order</b>
<b>In the child</b>	<b>In the child</b>	<b>In the child</b>
Clinical, radiological and gammagraphic discrepancies	Short height Low school performance Non-desired or non-accepted child	Old injuries and scars Undernutrition Incomplete vaccination inadequate personal hygiene
<b>In the family</b>	<b>In the family</b>	<b>In the family</b>
Delay in seeking medical attention	History of child abuse in either parents Living with stepfather or stepmother	Alcoholism and use of illegal substances by the parents History of physical abuse of another family member  Medical attention by a non-family member
Foot notes: the existence of two criteria of first order, two of second order and two of third order indicates 90-100% of diagnostic certainty The presence of two criteria of first order, one of second and another of third sum 80-89% A criteria of first order, one of second and two of third order represent 70-79%		

second or third order according their nosologic sensitivity and specificity.

### *Indicators in the child*

#### *The first grade*

The first variable is the concerning clinical, radiological and/or gammagraphic discrepance, it is necessary to point to the importance of conducting a special search of this indicator in children with physical injuries suspected of having been physically abused. Therefore, in these cases we must take into consideration the story told by the adult and compare it with the type and location of the lesions,<sup>1-3,16-21</sup> or the presence, in the gammagraphic and/or bone X rays screening, the old fractures and/or unusual fracture sites.<sup>22-32</sup>

However, it must be emphasized that when faced with these findings, a differential diagnosis must be made taking into consideration the child's age and sex, as well as family history, since there are diverse pathologies capable of causing similar injuries to those observed in abused children and therefore, assign a fair and adequate value to this criteria.<sup>1,2,4,18,33</sup>

#### *The second grade*

a) Short stature. In cases of physical abuse or emotional deprivation, are conditions that affecting the secretion or use of the growth hormone has been considered as a conditioning factor of the clinical manifestation, in the absence of another pathology.<sup>34,35</sup>

b) The importance of accurately interrogating the planned, desired and/or accepted child could be explained when this condition is not met and can be detected in a number of risk situations for physical abuse. For example, the physical damage a conceived child may suffer when mistreated by the future mother and/or its surrounding environment if the mother tries to abort.<sup>34</sup> The birth of a child with malformations, of a different sex than that expected, at a time when the family is in crisis, or with a chronic disease, etc., makes this population susceptible to physical abuse.<sup>3,36,37</sup>

c) Low performance at school. When the child is surrounded by adequate conditions to possibly go to school and his/her school level is below that expected by the child's chronological age, this may be due to physical abuse that is one consequence to the damage generated by the aggression. However, this situation may also be a consequence of other intrinsic or social factors in which the child is found immersed. In general, this criterion should be carefully handled in order to not misinterpret its etiology.<sup>3,4</sup>

#### *The third grade*

a) When the child presents diverse skin injuries of variable locations and age. These indicators serve as a guide for suspecting the diagnosis of physical ChA. In this manner, in all children with these types of injuries it is necessary to adequately and precisely define their characteristics, including an explanation for their presence.<sup>2,4,18,19</sup> However, other etiologies should be considered in order not to make a mistake.<sup>2,4</sup>

b) Undernutrition. When there is an obvious state of malnutrition clearly expressed by low weight or other data, one must suspect, among other pathologies, the possibility of physical abuse in any variety or form, when there are data suggestive of the phenomenon.<sup>38,39</sup>

c) Incomplete vaccines. When the vaccines provided at the time of the medical checkup have not been recorded on the vaccination card and do not correlate with the child's age or were not specified by the parent or tutor, this merits concern and further investigation on why this action has not been taken. This may support the idea that there is negligence on behalf of the adult with respect to his/her obligations to the child, when not providing enough attention concerning this aspect of preventive medicine and one of his/her rights as an individual.<sup>4,38</sup> On the other hand, it must also be kept in mind that the delay in vaccinating the child can explain why the child has been in an acute or chronic disease state. This condition should be carefully studied.<sup>40,41</sup>



d) The presence of data related to poor hygiene such as long dirty finger nails, uncombed hair, poor bodily hygiene and unpleasant odors can be in important contrast to the hygienic conditions of parents or tutors. Correctly analyzing this finding, this indicator may be considered as an alert to the physician caring for the child during a first visit.<sup>4,38,42</sup>

#### *Indicators in the family*

Family aspects are very important in assessing the injuries of a possibly abused child. These are analyzed below.

#### *The first grade*

The delay in seeking medical care as a family indicator was considered as the most outstanding among them all. Several authors have used these criteria in different ways: for example, the frequency observed in physically abused children seen at the CAINM-INP confirmed this finding since 1984. At the time it was not given a fair value.<sup>3</sup> Usually the child is taken to a clinic to get medical attention 48-72 or more hours later after having being exposed to the aggression and on certain occasions independent of its severity and at about midnight or in the middle of the night.<sup>43-49</sup> It is essential to know where the child was previously medically cared for or hospitalized in order to adequately assess this indicator.

#### *The second grade*

a) Living with a stepfather or stepmother or the mother's boyfriend or father's girlfriend. Due to the high frequency of these living conditions in the study population, this variable constitutes a second order indicator. In some cases, where this condition exists but no other elements exist leading to suspect this syndrome, special care should be taken of the child when at any time there are lesions with no clear explanation.<sup>50</sup>

b) It is a well-known fact that when one of the parents was a victim of child abuse during his/her

childhood, the phenomenon usually repeats itself. The parent now becomes the aggressor.<sup>3,51-53</sup> Current studies allow supposing that the aggressors state of depression favors the development of this behavior.<sup>50</sup>

#### *The third grade*

a) The use of alcohol and/or illegal substances is closely associated with violent phenomena. The existence of this problem within the family nucleus can generate aberrant behavior among adults that may range from severe depression to aggression directed at several family members with important repercussions to family dynamics and especially in relation to the children.<sup>50-56</sup>

b) A history of violence against another family member should be intentionally searched for when a child is suspected of being physically abused. Similarly, when an adult has been a victim of aggression, the physician should make sure the child does not suffer from the same problem.<sup>56-59</sup>

c) When a person not belonging to the immediate family nucleus takes a child with several injuries for medical care, suspicion of physical abuse should arise and there should be a search for answers.<sup>2,3,5</sup>

#### *Conclusions*

We are sure that through the correct use of these indicators, both by the physicians as well as by allied health professionals working with children, it may be easier to establish a diagnosis of suspicion and later of certainty in a very high percentage. This will provide a greater level of care for the child, to his family and even in certain cases to the aggressor since when faced with this situation it is easier to set forth diverse programs for action to be taken.

Finally, we must not lose sight of the fact that in a minority of cases the following events may exist:

That the child may pinpoint the possible aggressor.

That the aggressor may accept his/her guilt.

That there may be reliable witnesses to these events.

In this case, the existence of this information will reinforce the criteria analyzed in this study. In their absence, the value of the criteria will maintain high specificity.

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## EL NIÑO LESIONADO: ¿ACCIDENTE O MALTRATO? EL DIAGNÓSTICO A TRAVÉS DE INDICADORES

*Introducción.* Objetivo: proporcionar indicadores clínicos que permitan al médico precisar el diagnóstico de maltrato físico en niños.

*Material y métodos.* Se realizó un estudio de casos y controles, empleando niños con lesiones secundarias a maltrato físico (n =150) y por accidentes (n =150) respectivamente. El análisis estadístico incluyó la prueba de chi cuadrada y el análisis de regresión logística simple. Con la finalidad de establecer la validez de los criterios diagnósticos se utilizó el teorema de Bayes.

*Resultados.* Relacionados al menor con maltrato físico fueron: discordancia clínico-radiológica o gammagráfica de las lesiones, se obtuvo una razón de momios de 29.4 (15.84-54.8); lesiones y cicatrices antiguas 4.92 (3.0-8.07); ser un producto no deseado o aceptado 18.95 (15.8-54.8); higiene personal inadecuada 5.61 (3.34-9.43); talla baja 7.94 (3.8-16.6); desnutrición 7.01 (3.1-15.89); bajo rendimiento escolar 8.56 (2.73-26.84) e inmunizaciones incompletas 3.71 (1.58-8.69). De la familia: retardo en la solicitud de atención médica 228 (72.6-720.5); alcoholismo y/o consumo de sustancias en los padres 3.40 (2.10-5.52); convivencia con padrastro o madrastra 31.66 (8.68-115.5); antecedente de maltrato en los padres 48.0 (13.21-174.5); maltrato en algún otro familiar 14.1 (5.65-35.2); y solicitud de atención médica por un familiar ajeno 5.75 (3.24-10.2).

*Conclusiones.* Las diversas combinaciones de los indicadores permiten establecer el diagnóstico de maltrato físico con un alto grado de certeza.

**Palabras clave.** Síndrome del niño maltratado; indicadores; abuso físico.

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