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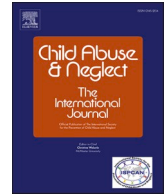
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Physical abuse of young children during the COVID-19 pandemic: Alarming increase in the relative frequency of hospitalizations during the lockdown period

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ABSTRACT

Background: In France, the COVID-19 pandemic led to a general lockdown from mid-March to mid-May 2020, forcing families to remain confined. We hypothesized that children may have been victims of more physical abuse during the lockdown, involving an increase in the relative frequency of hospitalization.

Methods: Using the national administrative database on all admissions to public and private hospitals (PMSI), we selected all children aged 0–5 years hospitalized and identified physically abused children based on ICD-10 codes. We included 844,227 children hospitalized in March–April 2017–2020, of whom 476 (0.056%) were admitted for physical abuse. Relative frequency of hospitalization for physical abuse observed in March to April 2020 were compared with those from the same months in the three previous years (2017–2019).

Findings: Even if absolute number of children exposed to physical abuse did not fluctuate significantly, we found a significant increase in the relative frequency of young children hospitalized for physical abuse from 2017 (0.053%) to 2020 (0.073%). Compared with the 2017–2019 period, and considering the observed decrease in the number of overall hospital admissions during the first lockdown, the number of children exposed to physical violence was 40% superior to what would be expected.

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Interpretation: The sharp increase in the relative frequency of hospitalizations for physical abuse in children aged 0–5 years in France is alarming. As only the most severe cases were brought to the hospital for treatment during the lockdown, our figures probably only represent the tip of the iceberg of a general increase of violence against young children.

1. Background

The new Coronavirus 19 (SARS-CoV-2) was identified for the first time in Wuhan Province, China, on December 31, 2019. Since that date, the virus has spread rapidly around the world and governments have imposed various restrictive measures including general population lockdowns to control the spread of the epidemic. In France, a first lockdown was ordered between March 17 and May 11, 2020. During this period, people were forced to stay at home. Exits from the apartment were tolerated, only 1 h a day within 1 km around home, but without contact to anyone not belonging to the same household. Although necessary to decrease the spread of the Coronavirus 19, this lockdown had a considerable impact on the lifestyle and daily routines of most of the population (Lambert et al., 2020). Families lived in physical isolation and without access to childcare since day-care centers, schools and welfare services were temporarily closed. These institutions also play a crucial role in identifying violence and protecting children, especially from physical abuse against children (Martinkevich et al., 2020).

Several studies conducted around the world have raised the alarm about a dramatic increase in family violence and child maltreatment during the COVID-19 lockdown (Bérubé et al., 2020; Boserup et al., 2020; Campbell, 2020; Caron et al., 2020; Green, 2020; Lee et al., 2021; Martinkevich et al., 2020). All of them found that the lockdown created a convergence of several of the risk factors that can lead to an increase in child maltreatment, for example: self-contained living and related factors such as psychological distress increase in alcohol consumption or economic problems. These issues were also associated with non-available or restricted access to external support (such as medical or social services, schools or nurseries), which is important for the diagnosis of child abuse, especially physical abuse. While these data ascertain a major public health problem relative to the increase in child maltreatment during the lockdown, none of these studies quantify this phenomenon. Physical violence against children tends to be repeated, causing serious injuries and even death, and physically abused children regularly require hospitalization because of their injuries. In older children and adolescents, physical abuse is more difficult to identify than in younger children. Trauma is generally less specific. They are also less severe, which may avoid the need for hospital care. In addition, the motor skills of young children make it easier to identify situations where the child is not able to fight back to injure themselves. For this reason, we conducted our study with young children, aged 0 to 5 years. We hypothesized that children may have been victims of more physical abuse during the lockdown in France and, given the seriousness of this violence, hospitalization for physical abuse may have increased. We therefore conducted a nationwide study in order to address this question.

2. Methods

2.1. Study design and participants

This retrospective observational study was conducted using the national *Programme de Médicalisation des Systèmes d'Information* (PMSI) database, which collects discharge abstracts for all patients admitted to public and private hospitals in France. In 2020, this database contains the information of approximately 2000 hospitals.

We included all children aged 0 (from birth) to 5 years hospitalized between March and April of each year from 2017 to 2020 and identified all codes (primary or secondary diagnoses) for documenting physical abuse of the International Classification of Diseases, 10th revision (ICD-10) used in the PMSI. All children who had at least one hospitalization with a diagnosis at discharge that included one of these codes were considered victims of abuse. (Gilard-Pioc et al., 2019) (Supplementary Table 1).

The relative frequency of hospitalization for physical child abuse observed in March and April 2020 in France were compared with the relative frequencies from the same months in 2017, 2018 and 2019.

These relative frequencies were defined as the number of physically abused children divided by the total number of hospitalized children during the same period.

We additionally retrieved information on gender, hospital death at discharge, and hospital stays for COVID-19 identified as primary diagnoses (PD), related diagnoses (RD) or associated diagnoses (AD) in relation to their date of admission by ICD-10 codes U0710, U0711, U0712, U0714 or U0715.

2.2. Statistical analysis

Nominal variables are presented as frequencies (percentage); interval- or ratio-scaled variables were presented as means \pm standard deviation and medians (interquartile range Q1-Q3). The different variables analysed in the cohort of patients hospitalized for child maltreatment were compared between the two periods (March–April months of 2017/2018/2019 versus March–April 2020) using Chi-2 or Fisher's exact test (for nominal variables) and the Student's *t*-test or Mann–Whitney test (for interval- or ratio-scaled variables).

The variation in admission was analysed using the Cochran-Armitage test. We also estimated the ratio of the number of observed

physical abuses in 2020 to the number of expected physical abuses compared to the relative frequencies of previous years. The statistical significance threshold was set at <0.05 . All analyses were performed using SAS (SAS Institute Inc., Version 9.4, Cary, NC).

This study was carried out by a multidisciplinary team including epidemiologists with expertise in the PMSI database, forensic physicians, psychologists and psychiatrists. The work was approved by the Ethics and Scientific Committee for Research, Studies and Evaluation in Health (CESREES, *Comité Ethique et Scientifique pour les recherches, les études et les évaluations dans le domaine de la santé*, June 9, 2020) and the French Institute of Health Data (INDS, *Institut National des Données de Santé*, registration number 1611357, June 15, 2020) and authorized by the French Data Protection Authority (CNIL, *Commission Nationale de l'Informatique et des Libertés*, registration number DR-2020-250, July 3, 2020). Written consent was not needed for this retrospective study as there was no impact on patient care and all data were anonymous.

3. Results

We included 844,227 young children representing 943,325 hospital stays in France, in March and April 2017–2020. Analyses were both performed using hospital stays and children as the unit of analysis. We observed a decrease in hospital stays from a mean of 257,716 hospital stays in March and April 2017–2019 (with annual figures quite constant across time) to 170,177 hospital stays in March and April 2020. The same decrease was observed for children from a mean of 230,366 children in March and April 2017–2019 (with annual figures also quite constant across time) to 153,129 children in March and April 2020.

Among the total hospital stays, 520 (0.055%) included a report of physical abuse and there was a significant increase ($p < 0.01$) from 2017 to 2020 (0.053% in 2017, 0.046% in 2018, 0.054% in 2019, and 0.073% in 2020; Fig. 1). When considering the whole 2017–2019 period, we also found a significant difference compared to 2020 (0.051% in 2017–2019 vs. 0.073% in 2020, $p < 0.01$), with 1.5 more hospitalizations related to physical abuse in 2020.

Among the 844,227 children hospitalized in March and April 2017–2020, 476 (0.056%) were admitted for physical abuse at least once. We found a significant increase ($p < 0.01$) between 2017 and 2020 (0.053% in 2017 and 0.073% in 2020; Fig. 2), the relative frequencies for 2017, 2018 and 2019 being stable (about 0.05%). There was also a significant increase in 2020 compared to the 2017–2019 period (0.053% in 2017–2019 vs. 0.073% in 2020, $p = 0.01$). Considering the relative frequency of the 2017–2019 period, the number of physically abused children observed in 2020 was 1.4 times higher than what would be expected if the probability of physical abuses was the same as in previous years (Fig. 3).

Boys were hospitalized more often (Table 1), both in the group of physically abused and non-abused children (56.34% and 55.45% respectively during the 2017–2020 period). However, although the proportion of boys was stable from 2017 to 2019 (around 57% of physically abused children and less than 56% of non-abused children), we found that fewer boys (and by consequence more girls) were hospitalized during lockdown and they made up a comparatively smaller proportion of physically abused children. Among the physically abused children, the percentage of boys decreased from 57.14% in the 2017–2019 period to 53.57% in 2020, although this difference was not significant.

Hospital deaths also increased between 2017 and 2019 and 2020. While this increase was not significant for physically abused children (1.65% for 2017–2019 vs. 1.79% for 2020), it was significant in non-abused children (0.57% vs. 0.76%, $p < 0.01$). In addition, we found almost three times more deaths among physically abused children than in non-abused children, stable between 2017 and 2019 and 2020.

We also assessed our population for COVID-19 infection. None of the physically abused children was diagnosed with COVID-19, and there were very few cases of COVID-19 (0.34%) in the group of children who were not physically abused.

4. Discussion

To our knowledge, this is the first national study to investigate children aged 0 to 5 years old hospitalized for physical abuse during

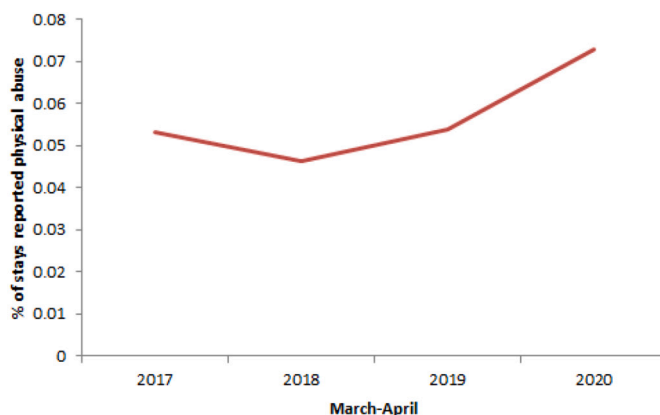


Fig. 1. Percentage of hospital stays reporting physical abuse for children aged 0 to 5 years old in March and April during the 2017–2020 period.

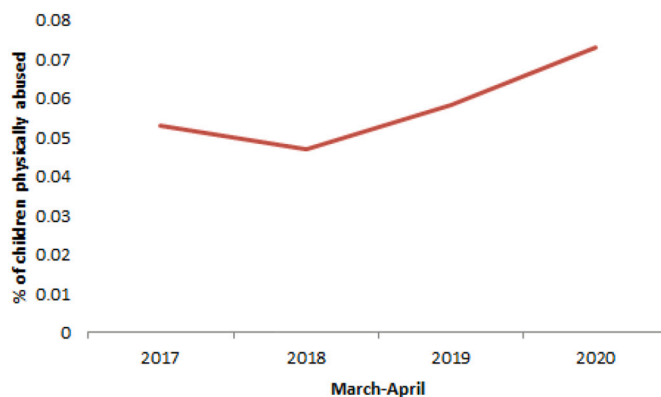


Fig. 2. Percentage of hospitalized children aged 0 to 5 years old physically abused in March and April during the 2017–2020 period.

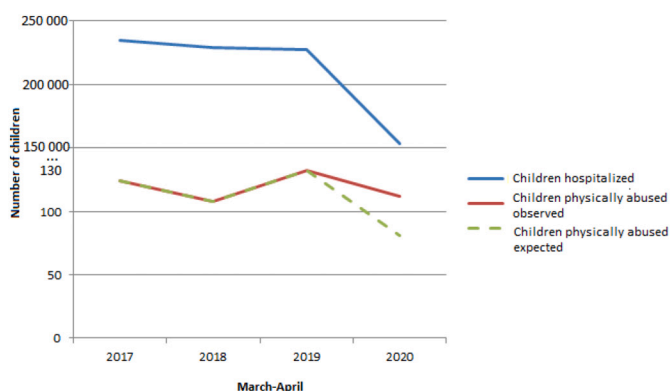


Fig. 3. Number of children hospitalized and physically abused.

the COVID-19 lockdown. Between March and April 2020, compared with the same periods in the last three previous years (2017–19) our study showed a decrease in the number of overall hospital admissions. During this period, compared with the 2017–2019 period, and considering the observed decrease in the number of overall hospital admissions during the first lockdown, the number of children exposed to physical violence was 40% superior to what would be expected if the admissions of physically abused children had decreased at the same rate as overall admissions. Hospital deaths of children in the age group also increased in March and April 2020 compared to previous years in general, but not in the group of physically abused children. Surprisingly, we did not observe the usual over-prevalence of boys among physically abused children (Davies et al., 2015; Salem et al., 2020) during the lockdown, and almost as many girls as boys were hospitalized in relation to physical abuse.

In the context of the COVID-19 lockdown, even if absolute number of children exposed to physical abuse did not fluctuate significantly, the 50% increase in the relative frequency of children hospitalized for physical abuse may have several explanations. Firstly, as observed during previous epidemics (Gu et al., 2015), the risk of being contaminated by the virus or transmitting it to one's entourage generated fear and anxiety in the general population (Wang, Pan, Wan, Tan, et al., 2020; Wang, Pan, Wan, et al., 2020). In addition, several studies from around the world have shown a negative impact of the lockdown on mental health, with an increase in anxiety and depression (Gualano et al., 2020; Wang, Pan, Wan, Tan, et al., 2020; Wang, Pan, Wan, et al., 2020), as well as an increase in alcohol consumption (Martinkevich et al., 2020). All of these latter factors have been associated with an increased risk of physical child abuse (Braham et al., 2018; Laslett et al., 2012; Sidebotham, 2008).

Furthermore, the lockdown created a sudden and lasting disruption in the daily routines of French families (Thierry et al., 2021). Work was suspended or done from home. Children usually spending time in day-care or schools also remained at home, and many parents were forced to assume the role of full-time educators combined with their work from home, further increasing parental burden and stress, and therefore compounding the risk of physical abuse. Having no access to peers and no social contacts outside of the household, no respite from family care, has also likely increased parental stress. Children, too, have surely missed their peers and time on playgrounds adding to a potential level of distress and, in turn, to their caregivers' level of distress. Finally, children were more vulnerable to abuse following the closing of social service facilities, since abuse could not be detected by social workers or educators who usually play a key role at this level (Martinkevich et al., 2020). Some residential care facilities were closed temporarily, and children were re-united with their family homes and re-exposed to physical abuse. This may have led to more repeated and severe physical abuse requiring more hospital care. In the same way, school seems to lead to abuse early reporting. Is it possible that

Table 1
 Characteristics of children 0 to 5 years old hospitalized in March or April 2017 to 2020.

March–April	2017		2018		2019		2020		2017–2019	
	Physically abused	Not abused	Physically abused	Not abused	Physically abused	Not abused	Physically abused	Not abused	Physically abused	Not abused
Boys, n (%)	124 71 (57.26%)	234,666 131,352 (55.97%)	108 61 (56.48%)	229,104 127,836 (55.80%)	132 76 (57.58%)	226,964 126,600 (55.78%)	112 60 (53.57%)	153,017 81,156 (53.04%)	364 208 (57.14%)	690,734 454,951 (55.45%)
Hospital death at discharge, n (%)	2 (1.61%)	1370 (0.58%)	2 (1.85%)	1313 (0.54%)	2 (1.52%)	1237 (0.55%)	2 (1.79%)	1169 (0.76%)	6 (1.65%)	3920 (0.57%)
COVID-19, n (%)							0 (0%)	517 (0.34%)		

lockdown, and thus the closure of schools, causes a delay in this reporting and that therefore more victims require hospitalization.

In view of these results, the null hypothesis is that the number of physical abused young children requiring hospitalization during the lockdown period remained constant. However, we cannot rule out that the phenomenon of physical abuse increased during this period. In fact, we note that children, whatever their condition, were less hospitalized during the months of March and April 2020. It is therefore difficult to understand why this phenomenon would not also affect abused children, especially since their parents, who may be the perpetrators of violence, are often reluctant to take their children to the hospital. In addition, in France, during the most critical period of the epidemic, radiology units were reserved in priority for patients suffering from COVID-19 (Meyer et al., 2021), resulting in a delay in diagnosis for other patients, including physically abused children. Some children arrived at the emergency room and were redirected as outpatients for additional examinations (typically in the case of fractures), thus delaying diagnosis and reducing the likelihood that the physical abuse would be discovered. Abused children may have been hospitalized, certainly in the most severe cases, which is confirmed in our work by the 8% increase in the relative frequency of mortality during the lockdown period compared to the previous 3 years. Less severe cases may have been less often referred to hospital or less often hospitalized after referral to the emergency room. This will have to be confirmed by further research on the difficulties accessing the hospital when many units were reserved for patients affected by COVID-19. In this context, it seems obvious that stays for abuse for 0–5 year old should have decreased, which is absolutely not the case in our study. Therefore, it seems very unlikely that physically abused children were hospitalized equally likely during the 2020 lockdown period as during the non-confined periods in previous years. However, as shown in Fig. 3, the number of cases of physical abuse recorded during the lockdown was 30% higher than expected.

Finally, our results are consistent with the findings of the French 119 helpline for endangered children that reported a sharp increase in their activity during lockdown (in comparison with the equivalent period in 2019). During the lockdown they recorded a 56% increase in calls and a 30% increase in information sent to the departmental child protection services “concerning minors in danger or at risk of being in danger”. Direct use of police services or emergency services (SAMU) increased by 113% and the demand for emergency response by departments increased by 87% (GIP *enfance en danger*, 2020), confirming once again the fact that violence increased during this period.

The relative frequency of death for children admitted to hospitals has increased during the lockdown independently from physical abuse. Percentages rose from 1.65% in 2017–19 to 1.79% in 2020 in abused children, and from 0.57% to 0.76% in non-physically abused children. Again, there are several potential epidemic-related explanations for these increases. People were scared to go to the hospital, which was no longer seen as being safe (Lantelme et al., 2020; Zhao et al., 2021). Therefore, hospitalization was voluntarily limited to the most severe or life-threatening cases, either by the family or the hospital staff, whose resources were stretched thin. This argument is supported by the fact that total deaths have not increased across the years under scrutiny. Rather the percentage of deaths in relation to the lowered relative frequency of hospital admissions (as confirmed by our results) has risen. While the increased percentage could also have been COVID-19-related, none of the hospitalized abused children were found to be infected by the virus, which is not surprising as young children are less severely affected and therefore rarely hospitalized or tested for COVID-19 (Oualha et al., 2020; Piroth et al., 2020; Shen K et al., 2020). However, there might have been an underestimation in the number of physically abused children with COVID-19 as children hospitalized with COVID-19 were either severe or complicated cases, (Oualha et al., 2020; Piroth et al., 2020; Shen K et al., 2020) and so the physical abuse might not have been detected or coded by physicians. Nevertheless, the relative frequency of mortality among children hospitalized for physical abuse was almost three times higher than among children hospitalized without a code for physical abuse. This rate, which remained unchanged during the lockdown, is consistent with data from previous studies (Davies et al., 2015; Sabotta & Davis, 1992).

During the 2017–2019 period, boys were more often hospitalized for physical abuse than girls (a constant rate of approximately 57%). These findings are consistent with the literature, which shows that there is a higher risk of physical abuse in male children, (Davies et al., 2015; Salem et al., 2020) while psychological and sexual abuse is more often documented in females (Starling & Holden, 2020). Though many studies have reported similar findings for child physical abuse (Davies et al., 2015; Salem et al., 2020) few have provided hypothesis about the observed gender ratio. One explanation could be that the children are seen differently by the perpetrator depending on their gender (Rey Salmon & Adamsbaum, 2018). It is a popular belief that a boy should learn to be tough, which may lead to more violent parenting (Fontaine, 1991). On the contrary, girls may appear more fragile, leading to less physically violent behaviours. For example, Barr (2012) suggested that “*some male caretakers believe that it is okay for infant girls to cry, but not infant boys, despite their age*”. Health professionals are, however, not exempt from stereotypical attitudes on gender roles. An increased rate of reported psychological violence against girls might be due to a bias in health professionals to more readily document this type of violence in girls. Biased attitudes on gender roles and physical abuse might also have affected its documentation by professionals. We did not find the usual over-prevalence of boys among physically abused children during the French lockdown period. This surprising result needs to be interpreted in the particular context of the nationwide lockdown. Recent studies have shown that women (Santé Publique France, 2020; Wang, Pan, Wan, Tan, et al., 2020; Wang, Pan, Wan, et al., 2020), especially those living with children under the age of 5 years (Pierce et al., 2020), were particularly affected by the lockdown, experiencing more severe deterioration in mental health than the rest of the population. Parental mental health impairment and psychiatric disorders have been identified as factors associated with child physical abuse, which might have resulted in an increase in female perpetrators during the lockdown. This may have had an influence on the gender ratio of perpetrators, considering that previous studies have shown that male perpetrators are responsible for 60–70% of child physical abuse cases (Edwards et al., 2020; Starling & Holden, 2020). While the increased frequency of female perpetrators might potentially be associated with an altered gender ratio of physically abused children, the finding remains rather puzzling.

Our work has several strengths. The main strength of our study is that it is based on comprehensive nationwide PMSI data. The fact that these national data are used for the allocation of hospital budgets encourages improvement in data quality in terms of coherence,

accuracy and exhaustiveness and justifies its use in several domains including perinatal and COVID-19 (Clesse et al., 2020; Iacobelli et al., 2017; Piroth et al., 2020; Quantin et al., 2021; Revert et al., 2018). It provides data on child physical abuse, a major public health problem which, paradoxically, remains poorly documented (Jud et al., 2013). We analysed data for all hospital stays from every public and private hospital at a national level using the French national database (PMSI). Our team previously developed the algorithm used here to identify physical abuse in children from the same database in order to estimate the frequency of physical abuse in children aged 0 to 5 years old hospitalized in France (Gilard-Pioc et al., 2019). This algorithm is currently being validated by the French agency for Public Health, and the first results have shown a positive predictive value of 0.83.

We are nonetheless aware that our work has some limitations. First, we chose to only look at physical abuse as it was not feasible to reliably identify psychological and emotional abuse or neglect. Secondly, we limited our study to hospitalized cases even though a potentially non-negligible portion of physically abused children are not seen at hospitals. However, it is difficult to identify and assess these cases, and hospitalization is rare for the first instance of physical abuse. In addition, some children are only seen in the emergency department and some may die outside the hospital without ever having been admitted to the hospital for maltreatment; these children are not found in our database (Gilard-Pioc et al., 2019). Thirdly, although the lockdown took place between March 17, 2020 and May 11, 2020, we used data from March and April 2020 and did not access data from May 2020. However, the data we considered on the first days of March may be counter balanced by those we could not take into account in May. As experienced, we may also hypothesize that the last 15 days of the lockdown were more unbearable than the first 15 days leading to an underestimation of child abuse hospitalizations. Fourthly, we know that the codes for child physical abuse may be under-used by physicians, leading to an underestimation in the French national database. However, physicians are not likely to fail to code for child abuse in a discharge abstract when they observe a traumatic injury that has led to a severe medical condition and trends have to be considered, the possible underestimation could be no differential in lockdown period compared to control periods. Overall, we were not surprised, therefore, to obtain a low prevalence compared to the literature (Diaz & Petersen, 2014; Joseph et al., 2015). For example, in 2009, Gilbert et al. (2009) found that about 10% of children in high-income countries were neglected or abused. However, they considered all abused children and all types of abuse, while our study focused on children hospitalized for physical abuse.

It is also possible that, due to the difficulties encountered by hospitals during the epidemic, physicians were less careful with their coding. In this case, we would expect to see a decrease in the frequency of hospitalizations for physical abuse. So, although an underestimation was plausible, our work showed a significant increase in the relative frequency of physically abused children aged 0–5, compared to the same period over the previous 3 years (2017–19).

5. Conclusion

The medical community and policy makers should be drastically alarmed about the observed increase in the proportion of hospitalizations for physical abuse among children aged 0–5 years old during the general lockdown in France, especially considering that our results likely only show the tip of the iceberg. It is possible that the COVID-19 epidemic has initiated long-term changes in family dynamics and in the functioning of social institutions. Moreover, ongoing economic pressure in relation to the pandemic have led to increased burden on family incomes due to job losses or lowered wages, at the vulnerable populations' expense. To ensure that these changes are not to the detriment of children at-risk, the authorities should take into account children safety risks, by balancing the benefits while pronouncing a lockdown decision. There is a need for increased resources allocated to the protection of young children, who are particularly vulnerable to abuse, which abuse is particularly difficult to diagnose, and whom may develop short and long-term dramatic consequences.

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