Maternal, prenatal and postnatal risk factors for early child physical abuse: a French nationwide cohort study

Flora Blangis,[a,b,c,d,*] Jérôme Drouin,[a] Elise Launay,[b,c,e] Sara Miranda,[a] Mahmoud Zureik,[a,f] Jérémie F. Cohen,[b,d] Alain Weill,[a] Rosemary Dray-Spira,[a] and Martin Chalumeau[b,d]

[a]EPI-PHARE Scientific Interest Group, French National Agency for Medicines and Health Products Safety (ANSM), French National Health Insurance (CNAM), F-93200, Saint-Denis, France
[b]Obstetrical, Perinatal and Pediatric Epidemiology Research Team, Centre of Research in Epidemiology and StatisticS, Université Paris Cité, INSERM, F-75014, Paris, France
[c]Inserm CIC 1413, Nantes University Hospital, F-44000, Nantes, France
[d]Child Protection Unit - Department of General Pediatrics and Pediatric Infectious Diseases, AP-HP, Necker-Enfants Malades Hospital, Université Paris Cité, F-75015, Paris, France
[e]Department of Pediatric Emergency Care, Nantes University Hospital, F-44000, Nantes, France
[f]Université Versailles Saint-Quentin-en-Yvelines, F-78180, Montigny-le-Bretonneux, France

The Lancet Regional Health - Europe 2024;42: 100921

Published Online 14 May 2024
https://doi.org/10.1016/j.lanepe.2024.100921

Summary

Background Identifying risk factors for early child physical abuse (CPA) is crucial for understanding its mechanisms and defining effective preventive interventions. We aimed to identify maternal, prenatal and postnatal factors associated with early CPA.

Methods This cohort study was based on comprehensive data from the Mother-Child EPI-MERES nationwide register and included all infants born alive in France between 2010 and 2019. Factors associated with early CPA (before age 1) were identified with a multilevel Cox regression model with random intercepts at the regional level.

Findings Among the 6,897,384 included infants, 2994 (40/100,000) had a diagnosis of early CPA, at a median age of 4 months. Independent factors most strongly associated with early CPA were maternal low financial resources (adjusted hazard ratio [aHR] 1.91; 95% confidence interval [95% CI] 1.67–2.18), maternal age <20 years versus 35–40 years (aHR 7.06; 95% CI 6.00–8.31), maternal alcohol use disorder (aHR 1.85; 95% CI 1.48–2.31), opioid use disorder (aHR 1.90; 95% CI 1.41–2.56), intimate partner violence (aHR 3.33; 95% CI 2.76–4.01), diagnosis of a chronic mental disorder (aHR 1.50; 95% CI 1.14–1.97) or somatic disorder (aHR 1.55; 95% CI 1.32–1.83), hospitalisation for a mental disorder (aHR 1.88; 95% CI 1.49–2.36), very preterm birth (aHR 2.15; 95% CI 1.68–2.75), and diagnosis of a chronic severe neurocognitive disorder in the infant (aHR 14.37; 95% CI 11.85–17.44).

Interpretation Independent risk factors of early CPA identified at the national level in France may help in understanding CPA mechanisms and developing effective prevention programs including risk-stratification tools to optimise the allocation of parenting interventions to parents who could most benefit from them.

Funding Ile-de-France regional council, L'Oréal-UNESCO For Women In Science France Young Talent Award, French National Observatory for Child Protection [ONPE], French Association of Ambulatory Paediatrics [AFPA], HUGO university hospitals network, Mustela Foundation and Sauver la Vie prizes.

Keywords: Early child physical abuse; Maternal, prenatal and postnatal factors; Nationwide cohort; EPI-MERES register; French national health data system

Introduction

Child physical abuse (CPA) is defined as the intentional use of physical force against a child, including hitting, beating, kicking, shaking, biting, strangling, scalding, burning, poisoning, and suffocating.[1] Early CPA is associated with significant morbidity and mortality. The peak incidence of early CPA occurs at 1–7 months of age,[2,3] and the estimated incidence of severe physical

*Corresponding author. Obstetrical, Perinatal and Pediatric Epidemiology Research Team, Centre of Research in Epidemiology and StatisticS, Université Paris Cité, INSERM, Maternité de Port-Royal, 53 Avenue de l'Observatoire, F-75014, Paris, France.
E-mail address: flora.blangis@inserm.fr (F. Blangis).

Research in context

Evidence before this study

Identifying risk factors for early child physical abuse is crucial for understanding its mechanisms and defining effective preventive interventions. We searched MEDLINE via PubMed for articles published from inception to January 11, 2024, using the terms "physical abuse" or "maltreatment" and "infant" and "risk factor" and "maternal" or "perinatal" or "prenatal" or "neonatal" or "postnatal" with no language restriction. Only two large population-based studies examined early child physical abuse, overcoming many of the limitations found in other studies. However, these studies focused primarily on maternal or postnatal factors.

Added value of this study

This nationwide cohort study, based on data from the EPI-MERES register in France, used a validated algorithm to identify a substantial cohort of physically abused infants. It allowed for examining numerous risk factors, including rare ones, associated with early child physical abuse and confirming the findings of other studies in the area. In addition, it enabled the simultaneous study of a wide range of socio-economic and medical maternal, prenatal and postnatal factors.

Implications of all the available evidence

The identification of numerous risk factors for early child physical abuse at the population level will allow for a risk assessment that includes a broader range of independent factors than those used in current interventions. The development of risk-stratification tools based on these identified factors could help health professionals in maternity wards decide whether to allocate parenting interventions to parents who could most benefit from them. The association between early CPA and maternal mental disorders was also confirmed. However, further research is needed to explore the potential role of psychotropic drugs on postnatal behaviour.

abuse during the first year of life in high-income countries varies from 16 to 62 per 100,000 infants depending on the type of injury studied and the design and setting of the study.[3–10] The main lesions of early CPA (i.e., before age 1) are skin injuries, skeletal injuries, and intracranial injuries.[11] Among survivors, early CPA is responsible for long-term consequences that include neuro-developmental impairment,[12] mental disorders,[13] and somatic diseases.[14] In this context, early CPA is a target of various primary preventive interventions based on universal campaigns promoting parental education on the harmful effects of violence on children or home visits for at-risk populations.[15,16] Studies evaluating the impact of these interventions have shown moderate to no efficacy.[15,17,18] The identification of early CPA risk factors may help in understanding its mechanisms and defining effective preventive interventions.

Identified risk factors for early CPA can be classified into three main categories.[19,20] First, although early CPA can occur in any social environment, several risk factors are related to economic and socio-geographical inequities: low maternal education level[21,22]; social deprivation[21]; means-tested benefits[8,21]; social housing[21]; and parental unemployment.[21,23] Second, risk factors are also related to parental vulnerability: young maternal age[4,19,21,22]; single parenthood[21,22]; parental history of early CPA and foster care during childhood[24]; intimate partner violence[25]; large number of siblings[21]; maternal mental disorder[19,21,22]; alcohol and drug abuse[21,26]; unintended pregnancy[26]; short birth interval[27,28]; multiple pregnancies[29]; maternal smoking during pregnancy[21]; limited prenatal care[27]; and abuse among siblings.[30,31] Third, some factors are related to parent-infant bonding and infant characteristics: obstetric complications at birth[22]; low birth weight[24]; prematurity[8,32]; male sex[4,8]; and chronic disease or disability.[33,34] However, our knowledge of the risk factors of early CPA is limited because it is based on old,[22,24,26–28,32] retrospective,[25,27,29,32,34] single-centre hospital-based studies[21,25,27,32] or studies based on small samples,[22,29] also including older children aged <4 years[4,32] to <18 years[22] or evaluating a specific risk factor[28,29,32–34] or specific population (e.g., children with a chronic disease or disability,[33,34] siblings[30,31]) or a specific type of abuse (e.g., abusive head trauma[4,25,27]) or using only univariate analyses.[22,27,29] To our knowledge, only two large population-based studies investigated early CPA risk factors, one focusing on maternal factors and the other on postnatal factors.[8,19]

We aimed to identify independent maternal, prenatal and postnatal factors associated with early CPA by using a population-based cohort study based on a nationwide register in France.

Methods

Data sources

This nationwide cohort study was based on comprehensive data from the Mother-Child EPI-MERES register,[35–37] which includes all pregnancies ending in 2010 onward identified in the French National Health Data System (Système national de données de santé [SNDS]).[38] For 94% of pregnancies that result in a delivery, the mother's information is linked to their offspring.

The SNDS covers 98.8% of the French population. Since 2006, the SNDS has included socio-demographic and medical information on all outpatient services reimbursed by the national health insurance, including reimbursement claims for dispensed drugs and health

expenditures for "long-term disease" (LTD). LTD is an administrative status that enables 100% reimbursement for severe or costly chronic diseases. It is requested mostly by primary care practitioners and is validated by the physician of the beneficiary's health insurance scheme. The diagnosis justifying LTD status is recorded in the SNDS in 30 main categories according to the International Classification of Diseases, 10th revision [ICD-10].[39,40] The SNDS also contains inpatient information, including hospital discharge diagnoses according to the ICD-10.

Each adult is identified by a unique and anonymous number. Patients and public were not involved in this research. Given that data are anonymous, no informed consent to participate or publish was required. The EPI-PHARE Scientific Interest Group in Epidemiology of Health Products has permanent regulatory access to the SNDS database via its constitutive bodies, the French National Agency for the Safety of Medicines and Health Products and the French National Health Insurance (French Decree no. 2016–1871, December 26, 2016), thus the present work did not require approval from the French Data Protection Authority (CNIL). The study was registered at EPI-PHARE (no. T-2023-02-402). We followed the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) adequate guidelines to report this study (Appendix 1).[41]

Cohort constitution and inclusion criteria

The cohort for this study included all infants in the EPI-MERES register who were born alive between January 1, 2010, and December 31, 2019. We excluded same-sex twins or higher-order multiples (who are indistinguishable in the EPI-MERES register because of insufficient quality for analysis), infants who died during hospitalisation at birth (because they are at very low risk of early CPA), and infants without any reimbursement of care found in the first year of life (considered as living abroad).

Outcome

Early CPA was defined using a previously validated algorithm that identified ICD-10 discharge codes for physical abuse or maltreatment (T74.1, T74.9, W50, Y07), assault (Y08, Y09, X91-95, X97-99, Y00-04, Y87.1, Z65.4), or injuries (Z04.5, T71) recorded during the first year of life for any inpatient stay.[42] The index date for the diagnosis of early CPA was the first hospitalisation with one or more of these codes.

Maternal, prenatal and postnatal factors

Among the numerous variables directly available in the EPI-MERES register or that can be constructed from the SNDS, the factors studied were selected from the literature and our previous knowledge, and all were included in the three categories identified.[4,21,22,24–29,32] First, they were related to economic and socio-geographical inequities: mother's administrative region of residence; social deprivation index indicating the socio-economic level of the mother's municipality of residence[43]; and level of financial resources defined by the Complementary Universal Health Insurance (CMU-C) status (free access to health care for people with low income) at the start of pregnancy and allowances received by salaried employees during maternity leave. Second, they were related to maternal vulnerability: young maternal age at the beginning of pregnancy; hospitalisation for intimate partner violence from the year before pregnancy to the first postnatal year based on ICD-10 codes; indicators of chronic tobacco consumption and alcohol or opioid use disorder[38] in the 5 years before childbirth; grand multiparity (≥4 live births); short birth interval (<18 months)[44]; multiple pregnancy (twins or higher-order multiples); hospitalisations during pregnancy in medical, surgical, or obstetric wards (excluding obstetric hospitalisation in the week preceding childbirth); diagnosis of a chronic mental disorder (based on the LTD status claim initiated or ongoing) from the year before pregnancy to the first postnatal year; hospitalisation for a mental disorder from the year before pregnancy to the first postnatal year (before censoring by stopping follow-up at the time of early CPA diagnosis); and diagnosis of a chronic somatic disorder (based on the LTD status claim initiated or ongoing) from the year before pregnancy to the first postnatal year. Third, we also assessed variables related to parent–infant bonding and infant characteristics: assisted reproduction; mode of delivery; term birth; birth weight standardised on sex and gestational age[45]; neonatal hospitalisation at birth; infant sex; and diagnosis of a severe chronic neurocognitive or non-neurocognitive disorder in the infant (based on LTD status claim) during the first year of life (before censoring by stopping follow-up at the time of early CPA diagnosis) (Appendix 2).

Statistical analyses

The unit of analysis was the infant: all infants of a woman during the study period were included in the analysis, and women who had several infants were included as many times as they had infants. Characteristics of the infants were described. For each factor studied, we calculated crude and adjusted hazard ratios (aHRs) and their 95% confidence intervals (95% CIs) using a Cox regression model. All models accounted for censoring by stopping follow-up at the time of early CPA diagnosis, at the time of death for infants who died before age 1, or at the end of follow-up at age 1. In the multivariable analysis, we used a multilevel Cox regression model appropriate for hierarchical data structures. More specifically, we used a frailty model in which we included random effects for the different regions to adjust for geographic clustering.[46] It included all 21 of the above-mentioned variables. Infants (level 1) were nested within the mother's administrative region of residence (level 2) by using a random intercept for each region. We

graphically assessed the proportional hazards assumption for each covariable included in the model based on scaled Schoenfeld residuals and confirmed its validity for each covariable.[47] We conducted two sensitivity analyses. We kept maternal age, term of birth, and birth weight as continuous variables with restricted cubic spline transformations if the model assumption of linearity was violated. We fitted four models according to the time of exposure (year before pregnancy, during pregnancy, at birth, and first postnatal year). The data were analysed using SAS 9.4 (SAS Institute, Cary NC, USA).

Ethics committee approval

The EPI-PHARE scientific group has regulatory permanent access to the SNDS database (French Decree no. 2016–1871, December 26, 2016).

Role of the funding source

FB, EL and MC received external funding for this study (Ile-de-France regional council; L'Oréal-UNESCO For Women in Science France Young Talent Award; French National Observatory for Child Protection [ONPE]; French Association of Ambulatory Paediatrics [AFPA]; HUGO university hospitals network; Mustela Foundation and Sauver la Vie prizes). The authors had no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years and no other relationships or activities that could appear to have influenced the submitted work. The funders had no role in the design and conduct of the study; the analysis and interpretation of the data; preparation; the review, or approval of the manuscript.

Results

Participants

We identified 7,157,638 infants in the EPI-MERES register who were born alive between January 1, 2010, and December 31, 2019. The study population included 6,897,384 infants (96.4% of the infants identified), of whom 2994 (40/100,000) had a diagnosis of early CPA (Fig. 1). The ICD-10 codes used (n = 3456 occurrences) indicated physical abuse or maltreatment (n = 3124; 90.4%), injuries (n = 249; 7.2%), or assault (n = 83; 2.4%) (Appendix 3). The median age at the diagnosis of early CPA was 4 months (interquartile range 2–6) (Fig. 2). Among the other infants included, 2721 (0.04%) died before age 1, with a median age of 3 months (interquartile range 1–6), and the 6,891,669 infants without a diagnosis of CPA and who did not die were censored at age 1.

Factors associated with early CPA

Economic and socio-geographical inequities

The incidence of early CPA varied according to the mother's administrative region of residence, ranging from <10/100,000 (French overseas territories) to 70/100,000 infants (Centre-Val de Loire) (Table 1). We found no independent association between social deprivation index and early CPA. Early CPA was associated with mothers who had low versus high financial resources (aHR 1.91; 95% CI 1.67–2.18).

Maternal vulnerability factors

Early CPA was associated with age 12–20 and 20–25 years versus 35–40 years (aHR 7.06; 95% CI 6.00–8.31 and 3.17; 95% CI 2.74–3.68, respectively) (Table 1 and Appendix 4), hospitalisation for intimate partner violence between the year before pregnancy and the first postnatal year (aHR 3.33; 95% CI 2.76–4.01), and chronic tobacco consumption (aHR 1.28; 95% CI 1.15–1.42), alcohol use disorder (aHR 1.85; 95% CI 1.48–2.31), and opioid use disorder (aHR 1.90; 95% CI 1.41–2.56). Early CPA was not associated with grand multiparity (aHR 1.11; 95% CI 0.91–1.35). Early CPA was associated with a short birth interval (aHR 1.48; 95% CI 1.27–1.72), multiple pregnancy (aHR 1.39; 95% CI 1.07–1.81), and ≥1 hospitalisation during pregnancy (aHR 1.34; 95% CI 1.23–1.45). Early CPA was also associated with diagnosis of a chronic mental disorder or hospitalisation for a mental disorder between the year before pregnancy and the first postnatal year (aHR 1.50; 95% CI 1.14–1.97, and 1.88; 95% CI 1.49–2.36, respectively) and diagnosis of a chronic somatic disorder between the year before pregnancy and the first postnatal year (aHR 1.55; 95% CI 1.32–1.83).

Parent-infant bonding and infant characteristics

Early CPA was reduced in cases of assisted reproduction (aHR 0.64; 95% CI 0.47–0.87) (Table 1) but was increased for infants with emergency caesarean section versus a vaginal birth (aHR 1.19; 95% CI 1.08–1.31), with very preterm birth versus full-term birth (aHR 2.15; 95% CI 1.68–2.75), with very small for gestational age versus appropriate birth weight (aHR 1.34; 95% CI 1.17–1.54), and with neonatal intensive care unit hospitalisation versus remaining with the mother within 5 days of birth (aHR 1.38; 95% CI 1.18–1.62). Early CPA was associated with male sex (aHR, 1.41; 95% CI 1.31–1.51) and diagnosis of a severe chronic non-neurocognitive or neurocognitive disorder during the first year of life (1.43; 95% CI 1.01–2.02, and aHR 14.37; 95% CI 11.85–17.44, respectively).

Sensitivity analyses

Keeping in the model the variables maternal age, term of birth, and birth weight as continuous variables yielded similar results (Appendix 5). Associations varied according to the time of exposure. Early CPA was no longer associated with intimate partner violence in the year before pregnancy, assisted reproduction, short birth interval, hospitalisation for a mental health disorder in the first postnatal year, and diagnosis of a chronic somatic disorder (in the year before pregnancy, during pregnancy, and in the first postnatal year) (Appendix 6).

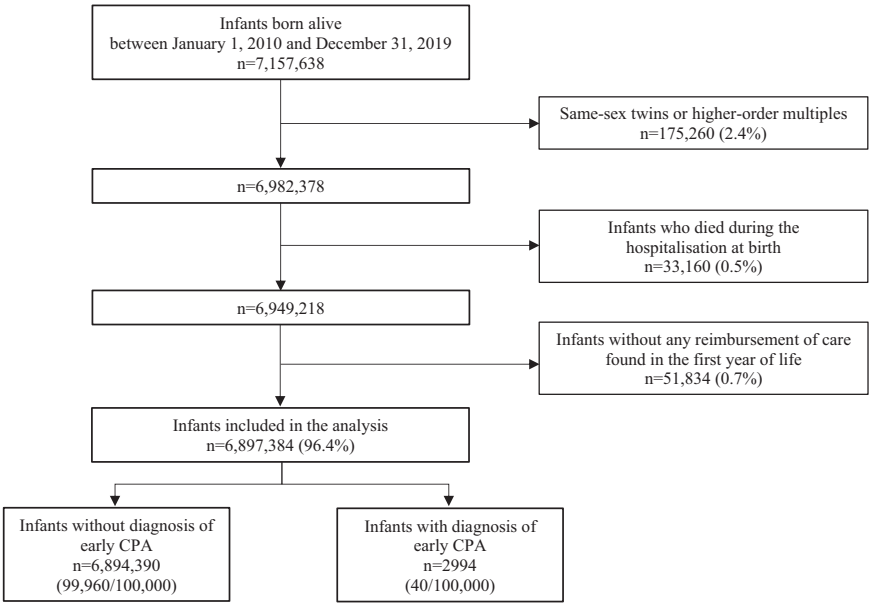

Fig. 1: **Study flow chart. CPA: child physical abuse.**

Discussion

In this study, we investigated the epidemiology of early CPA within a national birth cohort using a validated mother-child register. The incidence of early CPA in our study (40/100,000 infants) was close to that reported in several studies in the literature: from 16 to 62/100,000 infants <1 year old in high-income countries, depending on the type of injury studied and the design and setting of the study.[3–8,19]

Among the independent factors linked to economic and socio-geographical inequities associated with early CPA in our study, significant regional variations were observed within France. These variations could be explained by real variations in the incidence of early CPA linked to regional variations in housing type, socio-economic level, and childcare practices. They could also be explained by variations in the performance of detecting early CPA or reluctance to code CPA by childcare and healthcare professionals, notably linked to unequal training, lack of specialized child protection teams in some regions during the study period, or variable workloads in emergency departments. The association between low financial resources and early CPA could be explained by parental stress and pressure associated with financial distress.[48] Poor living conditions or reduced access to childcare can also lead to parental stress and fatigue.[48]

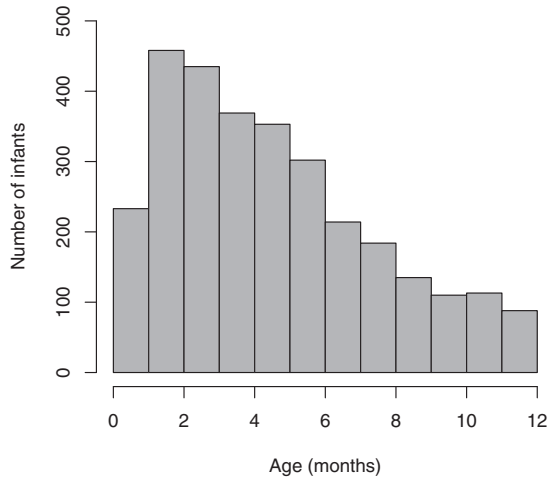

Fig. 2: **Age at first hospitalisation of infants with a diagnosis of early child physical abuse in France between January 1, 2010, and December 31, 2019 (n = 2994).**

The associations confirmed at the national level between maternal vulnerability and early CPA may indicate links between at-risk populations and family environments and CPA. Some mechanisms have been suggested in the literature that could partly explain these associations. A mother's young age may be associated with low socio-economic status, immaturity, impulsivity, or reflect isolation.[26] Hospitalisation for intimate partner violence is frequently associated with early CPA, often perpetrated by the intimate partner violence offender or, more rarely, the victim.[25,49] Sensitivity analyses confirmed this association during pregnancy and the first postnatal year. Chronic tobacco consumption, alcohol, and opioid use disorders during pregnancy can indicate psychosocial problems such as low adaptive functioning and health-risk behaviours.[21,50] Alcohol and opioid use disorders have been found to be associated

	Infants without a diagnosis of early CPA N = 6,894,390		Infants with a diagnosis of early CPA N = 2994		Crude HR (95% CI)	p[a]	Adjusted HR (95% CI)[b]	p
	n	%	n	%				
Economic and socio-geographical inequities								
Administrative region						<0.001		
Centre-Val de Loire	252,855	3.7	186	6.2	REF		–	
Hauts-de-France	658,569	9.6	417	13.9	0.86 [0.72–1.02]		–	
Grand Est	521,250	7.6	294	9.8	0.77 [0.64–0.92]		–	
La Réunion	124,964	1.8	65	2.2	0.71 [0.53–0.94]		–	
Nouvelle-Aquitaine	518,667	7.5	262	8.8	0.69 [0.57–0.83]		–	
Pays de la Loire	384,055	5.6	195	6.5	0.69 [0.57–0.84]		–	
Occitanie	546,146	7.9	259	8.7	0.65 [0.53–0.78]		–	
Bourgogne-Franche-Comté	255,461	3.7	118	3.9	0.63 [0.50–0.79]		–	
Normandie	328,009	4.8	143	4.8	0.59 [0.48–0.74]		–	
Guadeloupe	36,851	0.5	15	0.5	0.55 [0.33–0.94]		–	
Martinique	37,249	0.5	15	0.5	0.55 [0.32–0.93]		–	
Auvergne-Rhône-Alpes	823,827	12.0	283	9.5	0.47 [0.39–0.56]		–	
Provence-Alpes-Côte d'Azur	509,917	7.4	174	5.8	0.46 [0.38–0.57]		–	
Bretagne	311,472	4.5	97	3.2	0.42 [0.33–0.54]		–	
Ile-de-France	1,493,499	21.7	454	15.2	0.41 [0.35–0.49]		–	
Corse	24,297	0.4	<10	<0.10	0.34 [0.15–0.76]		–	
Guyane	34,485	0.5	<10	<0.10	0.32 [0.16–0.64]		–	
French overseas collectivities	13,222	0.2	<10	<0.10	0.21 [0.05–0.83]		–	
Missing	19,595	0.3	<10	<0.10	0.07 [0.01–0.50]			
Deprivation index quintile						<0.001		0.33
1 (less deprived)	1,303,111	18.9	408	13.6	REF		REF	
2	1,310,863	19.0	500	16.7	1.22 [1.07–1.39]		0.94 [0.82–1.08]	
3	1,289,970	18.7	550	18.4	1.36 [1.20–1.55]		0.92 [0.80–1.05]	
4	1,264,345	18.3	585	19.5	1.48 [1.30–1.68]		0.89 [0.78–1.02]	
5 (more deprived)	1,617,186	23.5	916	30.6	1.81 [1.61–2.03]		0.94 [0.82–1.07]	
No known place of residence	108,915	1.6	35	1.2	1.03 [0.73–1.45]		0.71 [0.50–1.00]	
Level of financial resources						<0.001		<0.001
No CMU-C and income[c] ≥2000€/month	1,782,245	25.9	412	13.8	REF		REF	
No CMU-C and income <2000€/month	1,904,978	27.6	714	23.9	1.62 [1.44–1.83]		1.11 [0.98–1.25]	
No CMU-C and unknown or no income[d]	2,444,090	35.5	1164	38.9	2.06 [1.84–2.31]		1.38 [1.23–1.55]	
CMU-C	763,077	11.1	704	23.5	3.99 [3.54–4.51]		1.91 [1.67–2.18]	
Maternal vulnerability								
Maternal age range at pregnancy start (years), median (interquartile range)	29 (26–33)		26 (21–30)			<0.001		–
[12–20]	211,056	3.1	476	15.9	9.39 [8.03–10.97]	<0.001	7.06 [6.00–8.31]	<0.001
[20–25]	1,056,821	15.3	853	28.5	3.36 [2.91–3.88]		3.17 [2.74–3.68]	
[25–30]	2,304,739	33.4	799	26.7	1.44 [1.25–1.67]		1.55 [1.34–1.80]	
[30–35]	2,133,538	31.0	567	18.9	1.11 [0.95–1.29]		1.20 [1.03–1.40]	
[35–40]	982,015	14.2	236	7.9	REF		REF	
[40–55]	206,221	3.0	63	2.1	1.27 [0.96–1.68]		1.10 [0.83–1.45]	
Intimate partner violence[e]	34,784	0.5	135	4.5	9.31 [7.83–11.06]	<0.001	3.33 [2.76–4.01]	<0.001
Indicator of chronic tobacco consumption[f]	524,058	7.6	427	14.3	2.02 [1.83–2.24]	<0.001	1.28 [1.15–1.42]	<0.001
Indicator of alcohol use disorder[f]	40,167	0.6	96	3.2	5.66 [4.62–6.93]	<0.001	1.85 [1.48–2.31]	<0.001
Indicator of opioid use disorder[f]	21,700	0.3	49	1.6	5.28 [3.99–7.01]	<0.001	1.90 [1.41–2.56]	<0.001
Grand multiparity	192,981	2.8	104	3.5	1.25 [1.03–1.52]	0.03	1.11 [0.91–1.35]	0.32
Short birth interval	220,352	3.2	185	6.2	2.00 [1.72–2.32]	<0.001	1.48 [1.27–1.72]	<0.001
Multiple pregnancy	79,885	1.2	61	2.0	1.78 [1.38–2.29]	<0.001	1.39 [1.07–1.81]	0.02
≥1 hospitalisation[g]	1,376,726	20.0	963	32.2	1.90 [1.76–2.05]	<0.001	1.34 [1.23–1.45]	<0.001
Diagnosis of chronic mental disorders[e]	50,796	0.7	103	3.4	4.81 [3.95–5.85]	<0.001	1.50 [1.14–1.97]	0.004
Hospitalisation for a mental disorder[e,h]	40,350	0.6	110	3.7	6.49 [5.36–7.85]	<0.001	1.88 [1.49–2.36]	<0.001
Diagnosis of chronic somatic disorders[e]	261,377	3.8	257	8.6	2.38 [2.10–2.71]	<0.001	1.55 [1.32–1.83]	<0.001

(Table 1 continues on next page)

	Infants without a diagnosis of early CPA N = 6,894,390		Infants with a diagnosis of early CPA N = 2994		Crude HR (95% CI)	p[a]	Adjusted HR (95% CI)[b]	p
	n	%	n	%				
(Continued from previous page)								
Parent-infant bonding and infant characteristics								
Assisted reproduction	189,193	2.7	42	1.4	0.50 [0.37–0.68]	<0.001	0.64 [0.47–0.87]	0.01
Mode of delivery						<0.001		0.002
Vaginal delivery	5,494,340	79.7	2255	75.3	REF		REF	
Scheduled caesarean section	470,821	6.8	185	6.2	0.96 [0.82–1.11]		1.11 [0.95–1.29]	
Emergency caesarean section	929,229	13.5	554	18.5	1.46 [1.33–1.60]		1.19 [1.08–1.31]	
Term of birth						<0.001		<0.001
Full-term birth ≥37 WG	6,483,181	94.0	2564	85.6	REF		REF	
Preterm birth 32–37 WG	361,001	5.2	330	11.0	2.31 [2.06–2.60]		1.42 [1.24–1.63]	
Very preterm birth <32 WG	50,208	0.7	100	3.3	5.06 [4.15–6.18]		2.15 [1.68–2.75]	
Birth weight[i]						<0.001		<0.001
Appropriate > P10	5,887,918	85.4	2369	79.1	REF		REF	
Small for gestational age P3–P10	515,794	7.5	303	10.1	1.46 [1.30–1.65]		1.20 [1.07–1.36]	
Very small for gestational age < P3	274,763	4.0	244	8.2	2.21 [1.94–2.52]		1.34 [1.17–1.54]	
Missing	215,915	3.1	78	2.6	0.90 [0.72–1.13]		0.91 [0.72–1.14]	
Infant sex						<0.001		<0.001
Female	3,365,411	48.8	1194	39.9	REF		REF	
Male	3,528,979	51.2	1800	60.1	1.44 [1.34–1.55]		1.41 [1.31–1.51]	
Neonatal hospitalisation at birth						<0.001		<0.001
Staying with the mother	5,797,230	84.1	2154	71.9	REF		REF	
Medical paediatrics unit	332,536	4.8	176	5.9	1.43 [1.22–1.66]		1.30 [1.11–1.52]	
Neonatal unit	500,915	7.3	349	11.7	1.88 [1.68–2.10]		1.24 [1.10–1.40]	
Neonatal intensive care unit	263,709	3.8	315	10.5	3.23 [2.87–3.64]		1.38 [1.18–1.62]	
Diagnosis of severe disorder in the infant[j]								
None	6,838,686	99.2	2845	95.0	REF	<0.001	REF	<0.001
Chronic non-neurocognitive disorder	42,447	0.6	33	1.1	1.91 [1.35–2.69]		1.43 [1.01–2.02]	
Chronic neurocognitive disorder	13,257	0.2	116	3.9	21.79 [18.10–26.23]		14.37 [11.85–17.44]	

CMU-C: Complementary Universal Health Insurance; HR: hazard ratio; 95% CI: 95% confidence interval; WG: weeks of gestation. Reference categories are indicated for variables with >2 categories. [a]Chi-squared test. [b]Adjusted on deprivation index, level of financial resources, maternal age, intimate partner violence, indicator of chronic tobacco consumption, indicator of alcohol use disorder, indicator of opioid use disorder, grand multiparity, short birth interval, multiple pregnancy, ≥1 hospitalisation, diagnosis of chronic mental disorders, hospitalisation for a mental disorder, diagnosis of chronic somatic disorders, assisted reproduction, mode of delivery, term of birth, birth weight, infant sex, neonatal hospitalisation at birth, diagnosis of severe disorder in the infant (level 1), and administrative region (level 2). [c]Maternity leave allowance. [d]Unemployed or information not provided by the health insurance scheme. [e]Pre-, per-, and post-pregnancy. [f]In the 5 years before childbirth. [g]In medical, surgical, or obstetric wards during pregnancy excluding obstetric hospitalisation a week before childbirth. [h]Before censoring. [i]For gestational age and sex (Z-score) in percentile (P). [j]In the first year of life, before censoring.

Table 1: **Associations between the factors studied and early child physical abuse (CPA) in infants.**

with disinhibition, leading to violent behaviour.[51,52] The independent associations between short birth intervals or multiple pregnancies and early CPA could be attributed to the fatigue experienced from caring for two or more infants, but short birth intervals were not associated with CPA when only birth-related variables were analysed.[27–29] Hospitalisations during pregnancy can lead to maternal anxiety and fatigue. We confirmed the association between early CPA and maternal mental disorders with the analysis of LTD status and hospitalisations for mental disorders.[21,22,27] However, we did not explore the potential role of psychotropic drugs on postpartum behaviour, including violence. These drugs might affect behaviour by removing inhibitions or anxiety linked to their use or withdrawal. Further research is needed to better understand the relation between psychotropic drug use and early CPA.

As in other studies,[53] we identified several potential disruptors of safe parent-infant bonding as independent risk factors of early CPA: emergency caesarean section, prematurity, low birth weight, and hospitalisation of the infant at birth. However, we found a protective effect of assisted reproduction, even after adjustment for maternal age, probably related to a "strong desire for children" that may help bonding. The absence of this association in the sensitivity analyses could be due to the potential influence of this variable on other birth-related factors that might contribute to the association studied.

The association between early CPA and prematurity could also be explained by differences in crying patterns between premature infants and term infants,[54] as well as the stress associated with prolonged hospitalisation and the complications of prematurity.[54,55] The independent association between male sex and early CPA might be partly attributed to the aversion male adults feel toward a male infant's crying, both in terms of sound and visual cues, for example.[56] Severe chronic non-neurocognitive or neurocognitive disorders in infants could be associated with parental stress, difficulties in bonding, then early CPA.[53,57] In our study, early CPA was highly associated with a diagnosis of a severe chronic neurocognitive disorder in the infant, in line with the well-established association between childhood disability and CPA.[33]

The associations we identified between early CPA and numerous factors linked to economic and socio-geographical inequities, maternal vulnerability, and poor parent-infant bonding reinforce the hypothesis that early CPA is multifactorial and requires multidimensional interventions based on socio-ecological models to address broader social factors.[19,21,26,58] Additionally, the identification of numerous risk factors implies a need for a more precise risk assessment that incorporates a broader range of independent factors than those used by current interventions. These identified factors could help in allocating existing resources, such as parenting interventions, to parents who could most benefit from them by refining risk-stratification tools already proposed in the literature for use during pregnancy and at birth.[59]

Our study has several strengths. The first strength is the coverage rate of the EPI-MERES register that allowed for analysing 2994 cases of CPA, substantially more than in previous studies,[4,8,21,22,24–27,32] thus ensuring enough statistical power and allowing for studying rare factors such as opioid use disorder or assisted reproduction (frequency <3%). Second, the national population-based design of the register and its very small attrition limited the selection bias found in non-population-based studies. Third, although some of the factors studied may reflect the consequences of early CPA, they were measured before the diagnosis of early CPA, which limited the classification bias found in retrospective studies. Fourth, the use of the Mother-Child EPI-MERES register enabled the study of a large number of socio-economic and medical maternal, prenatal and postnatal factors simultaneously. Finally, we used a validated algorithm to identify early CPA that has a positive predictive value of 92% for infants <1 year old.[60]

Our study also has several limitations. The first limitation is the residual confounding from unmeasured covariates, particularly those related to socio-economic status (e.g., educational attainment and occupation), to maternal vulnerability (e.g., late booking for antenatal care and concealment of pregnancy), and that paternal factors may occur, as in all observational studies. Paternal factors are poorly studied in the literature, although fathers are often involved in the perpetration of early CPA, directly or indirectly by their absence, which is also difficult to quantify. This absence could increase the likelihood of familial economic inequities.[61–63] Similarly, we were unable to study early CPA in siblings, nor were we able to examine birth order or birth interval between siblings. However, despite this limitation, our study allowed us to confirm associations that are valuable in the early detection and prevention of CPA. Second, the EPI-MERES register's limited data history may result in approximations for factors such as chronic tobacco consumption and inaccessible information such as a history of childhood abuse or substance use disorder since adolescence.[24] Third, CPA was defined using ICD-10 codes, which likely underestimated its incidence and precluded the examination of other forms of abuse such as emotional abuse and neglect. These forms of abuse may also influence the effects of CPA on later health outcomes.[64,65] Other variables were derived from ICD-10 codes, potentially influencing results. For example, defining intimate partner violence based on hospital discharge codes probably selected the most severe non-immediately-lethal cases and overestimated the association observed with CPA. Fourth, although we excluded same-sex twins due to technical constraints, this affected only 2.4% of the sample, and we were still able to confirm the association between multiple pregnancies and early CPA. Fifth, we treated mothers of twins and higher-order multiples (1.2% of the sample) as statistically independent by duplicating them at the infant level. Given the low proportion of such infants, a 3-level modelling was deemed unnecessary. Sixth, CPA risk factors available as continuous variables were studied in categories that may have led to a loss of statistical power. However, sensitivity analysis using these continuous variables without categorisation led to similar results. Seventh, as in any study of early CPA, some notorious risk factors or protective factors of CPA may have led to implicit bias during the evaluation of suspected early CPA by hospital teams, thereby falsely reinforcing or attenuating known associations. Finally, we were unable to consider the usually sustained process of CPA or determine whether the physical abuse was recurrent. We studied factors for only infants hospitalised for early CPA. The factors associated with CPA for infants who died without hospitalisation or who were not hospitalised are probably different. However, not hospitalising an infant <1 year old with suspected early CPA is rare in France.

Conclusions

The independent maternal, prenatal and postnatal risk factors of early CPA identified for the first time at the

population and national level in France may help in understanding CPA mechanisms and developing effective prevention programs including risk-stratification tools to optimise the allocation of parenting interventions to parents who could most benefit from them.

Contributors

Conception and design of study: Flora Blangis, Jérôme Drouin, Elise Launay, Sara Miranda, Mahmoud Zureik, Jérémie F. Cohen, Alain Weill, Rosemary Dray-Spira, Martin Chalumeau.

Data management: Flora Blangis, Jérôme Drouin, Sara Miranda.

Data analyses: Flora Blangis.

Drafting of the manuscript: Flora Blangis, Elise Launay, Sara Miranda, Mahmoud Zureik, Jérémie F. Cohen, Alain Weill, Rosemary Dray-Spira, Martin Chalumeau.

Revising of the manuscript: Jérôme Drouin.

Final approval of the version to be published: Flora Blangis, Jérôme Drouin, Elise Launay, Sara Miranda, Mahmoud Zureik, Jérémie F. Cohen, Alain Weill, Rosemary Dray-Spira, Martin Chalumeau.

Data sharing statement

The procedures carried out with the French data privacy authority (CNIL, Commission nationale de l'informatique et des libertés) do not provide for the transmission of the database. Consultation by the editorial board or interested researchers may nevertheless be considered, subject to prior determination of the terms and conditions of such consultation and in respect for compliance with the applicable regulations. All requests for access must be submitted to the Health data hub. Further information to do this request is available on these websites:

- https://www.snds.gouv.fr/SNDS/Processus-D-acces-aux-donnees
- https://documentation-snds.health-data-hub.fr/introduction/03-acces-snds.html#les-acces-sur-projet.

Declaration of interests

FB, EL and MC received external funding for this study (Ile-de-France regional council; L'Oréal-UNESCO For Women in Science France Young Talent Award; French National Observatory for Child Protection [ONPE], French Association of Ambulatory Paediatrics [AFPA], HUGO university hospitals network; Mustela Foundation and Sauver la Vie prizes). All authors have nothing to disclose, no patents, products in development, or marketed products to declare.

Acknowledgements

FB, EL and MC thank the funders for this study.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanepe.2024.100921.

References

1 World Health Organization. *Preventing child maltreatment: a guide to taking action and generating evidence/World Health Organization and International Society for prevention of child abuse and neglect*. Geneva: World Health Organization; 2006 [cited 2023 April]. Available from: https://apps.who.int/iris/handle/10665/43499.
2 Lee C, Barr RG, Catherine N, et al. Age-related incidence of publicly reported shaken baby syndrome cases: is crying a trigger for shaking? *J Dev Behav Pediatr*. 2007;28:288–293.
3 Leventhal JM, Martin KD, Asnes AG. Incidence of fractures attributable to abuse in young hospitalized children: results from analysis of a United States database. *Pediatrics*. 2008;122:599–604.
4 Keenan HT, Runyan DK, Marshall SW, et al. A population-based study of inflicted traumatic brain injury in young children. *JAMA*. 2003;290:621–626.
5 Niederkrotenthaler T, Xu L, Parks SE, et al. Descriptive factors of abusive head trauma in young children-United States, 2000-2009. *Child Abuse Negl*. 2013;37:446–455.
6 Leventhal JM, Martin KD, Gaither JR. Using US data to estimate the incidence of serious physical abuse in children. *Pediatrics*. 2012;129:458–464.
7 Leventhal JM, Gaither JR. Incidence of serious injuries due to physical abuse in the United States: 1997 to 2009. *Pediatrics*. 2012;130:e847–e852.
8 Loiseau M, Cottenet J, François-Purssell I, et al. Hospitalization for physical child abuse: associated medical factors and medical history since birth. *Child Abuse Negl*. 2023;146:106482.
9 Barlow KM, Minns RA. Annual incidence of shaken impact syndrome in young children. *Lancet*. 2000;356:1571–1572.
10 Fujiwara T, Okuyama M, Miyasaka M. Characteristics that distinguish abusive from nonabusive head trauma among young children who underwent head computed tomography in Japan. *Pediatrics*. 2008;122:e841–e847.
11 Dubowitz H, Bennett S. Physical abuse and neglect of children. *Lancet*. 2007;369:1891–1899.
12 Chevignard MP, Lind K. Long-term outcome of abusive head trauma. *Pediatr Radiol*. 2014;44(Suppl 4):S548–S558.
13 Sugaya L, Hasin DS, Olfson M, et al. Child physical abuse and adult mental health: a national study. *J Trauma Stress*. 2012;25:384–392.
14 Hughes K, Bellis MA, Hardcastle KA, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *Lancet Public Health*. 2017;2:e356–e366.
15 Macmillan HL, Wathen CN, Barlow J, et al. Interventions to prevent child maltreatment and associated impairment. *Lancet*. 2009;373:250–266.
16 Thomas D, Leicht C, Hughes C, et al. *Emerging practices: in the prevention of child abuse and neglect*. Washington, DC: US Department of Health and Human Services; 2004.
17 Viswanathan M, Fraser JG, Pan H, et al. Primary care interventions to prevent child maltreatment: updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2018;320:2129–2140.
18 Barlow J, Johnston I, Kendrick D, et al. Individual and group-based parenting programmes for the treatment of physical child abuse and neglect. *Cochrane Database Syst Rev*. 2006;3:Cd005463.
19 Smith JN, Guttmann A, Kopp A, et al. Association of maternal risk factors with infant maltreatment: an administrative data cohort study. *Arch Dis Child*. 2023;109:23.
20 Græsholt-Knudsen T, Stadelhofer MV, Edelbo MF, et al. Risk factors for first occurrence of documented severe physical child abuse: a systematic review. *Int J Child Maltreat*. 2023:1–57.
21 Baldwin H, Biehal N, Allgar V, et al. Antenatal risk factors for child maltreatment: linkage of data from a birth cohort study to child welfare records. *Child Abuse Negl*. 2020;107:104605.
22 Brown J, Cohen P, Johnson JG, et al. A longitudinal analysis of risk factors for child maltreatment: findings of a 17-year prospective study of officially recorded and self-reported child abuse and neglect. *Child Abuse Negl*. 1998;22:1065–1078.
23 Judd N, Hughes K, Bellis MA, et al. Is parental unemployment associated with increased risk of adverse childhood experiences? A systematic review and meta-analysis. *J Public Health*. 2023;45:829–839.
24 Sidebotham P, Heron J. Child maltreatment in the "children of the nineties": a cohort study of risk factors. *Child Abuse Negl*. 2006;30:497–522.
25 Notrica DM, Kirsch L, Misra S, et al. Evaluating abusive head trauma in children <5 years old: risk factors and the importance of the social history. *J Pediatr Surg*. 2021;56:390–396.
26 Sidebotham P, Golding J, Team AS. Child maltreatment in the "Children of the Nineties": a longitudinal study of parental risk factors. *Child Abuse Negl*. 2001;25:1177–1200.
27 Benedict MI, White RB, Cornely DA. Maternal perinatal risk factors and child abuse. *Child Abuse Negl*. 1985;9:217–224.
28 Crowne SS, Gonsalves K, Burrell L, et al. Relationship between birth spacing, child maltreatment, and child behavior and development outcomes among at-risk families. *Matern Child Health J*. 2012;16:1413–1420.
29 Lang CA, Cox MJ, Flores G. Maltreatment in multiple-birth children. *Child Abuse Negl*. 2013;37:1109–1113.
30 Kisely S, Strathearn L, Najman JM. Risk factors for maltreatment in siblings of abused children. *Pediatrics*. 2021;147.
31 Lindberg DM, Shapiro RA, Laskey AL, et al. Prevalence of abusive injuries in siblings and household contacts of physically abused children. *Pediatrics*. 2012;130:193–201.
32 DiScala C, Sege R, Li G, et al. Child abuse and unintentional injuries: a 10-year retrospective. *Arch Pediatr Adolesc Med*. 2000;154:16–22.

33 Sullivan PM, Knutson JF. Maltreatment and disabilities: a population-based epidemiological study. *Child Abuse Negl*. 2000;24:1257–1273.
34 Svensson B, Bornehag CG, Janson S. Chronic conditions in children increase the risk for physical abuse–but vary with socioeconomic circumstances. *Acta Paediatr*. 2011;100:407–412.
35 Lassalle M, Zureik M, Dray-Spira R. Proton pump inhibitor use and risk of serious infections in young children. *JAMA Pediatr*. 2023;177:1028–1038.
36 Tran A, Zureik M, Sibiude J, et al. Prevalence and associated factors of antibiotic exposure during pregnancy in a large French population-based study during the 2010-19 period. *J Antimicrob Chemother*. 2023;78:2535–2543.
37 Meyer A, Neumann A, Drouin J, et al. Benefits and risks associated with continuation of anti-tumor necrosis factor after 24 weeks of pregnancy in women with inflammatory bowel disease : a nationwide emulation trial. *Ann Intern Med*. 2022;175:1374–1382.
38 Miranda S, Drouin J, Le Tri T, et al. EPI-MERES, a nationwide mother-child register built from the French national health data system (SNDS) for pregnancy and paediatric pharmacoepidemiological research [Abstract]. The 39th International Conference on Pharmacoepidemiology and Therapeutic Risk Management (ICPE), Halifax, Canada, 25-27 August 2023. *Pharmacoepidemiol Drug Saf*. 2023;32:1–675.
39 World Health Organization. *International statistical classification of diseases and related health problems, 10th revision*. 5th ed.; 2015 [cited 2023 April]. Available from: https://apps.who.int/iris/handle/10665/246208.
40 Tuppin P, Rudant J, Constantinou P, et al. Value of a national administrative database to guide public decisions: From the système national d'information interrégimes de l'Assurance Maladie (SNIIRAM) to the système national des données de santé (SNDS) in France. *Rev Epidemiol Sante Publique*. 2017;65(Suppl 4):S149–S167.
41 Benchimol EI, Smeeth L, Guttmann A, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. *PLoS Med*. 2015;12:e1001885.
42 Gilard-Pioc S, Cottenet J, Mikaeloff Y, et al. Eight-year period prevalence of physical abuse in hospitalised infants and corresponding in-hospital mortality in France. *Child Abuse Rev*. 2019;28:353–365.
43 Rey G, Jougla E, Fouillet A, et al. Ecological association between a deprivation index and mortality in France over the period 1997–2001: variations with spatial scale, degree of urbanicity, age, gender and cause of death. *BMC Public Health*. 2009;9:1–12.
44 Gemmill A, Lindberg LD. Short interpregnancy intervals in the United States. *Obstet Gynecol*. 2013;122:64.
45 Ego A, Prunet C, Lebreton E, et al. Courbes de croissance in utero ajustées et non ajustées adaptées à la population française. I–Méthodes de construction. *J Gynecol Obstet Biol Reprod*. 2016;45:155–164.
46 Therneau TM, Grambsch PM, Therneau TM, et al. *The cox model*. New York: Springer; 2000.
47 Schoenfeld D. Partial residuals for the proportional hazards regression model. *Biometrika*. 1982;69:239–241.
48 Marcal KE. The impact of housing instability on child maltreatment: a causal investigation. *J Fam Soc Work*. 2018;21:331–347.
49 Casanueva CE, Martin SL. Intimate partner violence during pregnancy and mothers' child abuse potential. *J Interpers Violence*. 2007;22:603–622.
50 Pickett KE, Wilkinson RG, Wakschlag LS. The psychosocial context of pregnancy smoking and quitting in the Millennium Cohort Study. *J Epidemiol Community Health*. 2009;63:474–480.
51 Widom CS, Hiller-Sturmhöfel S. Alcohol abuse as a risk factor for and consequence of child abuse. *Alcohol Res Health*. 2001;25:52.
52 Freisthler B, Kepple NJ, Wolf JP, et al. Substance use behaviors by parents and the decision to substantiate child physical abuse and neglect by caseworkers. *Children Youth Serv Rev*. 2017;79:576–583.
53 Centers for Disease Control and Prevention. *Violence prevention*; 2022 [cited 2023 April]. Available from: https://www.cdc.gov/violenceprevention/childabuseandneglect/riskprotectivefactors.html.
54 Frodi AM, Lamb ME, Leavitt LA, et al. Fathers' and mothers' responses to the faces and cries of normal and premature infants. *Dev Psychol*. 1978;14:490.
55 Gray PH, Edwards DM, O'Callaghan MJ, et al. Parenting stress in mothers of very preterm infants—influence of development, temperament and maternal depression. *Early Hum Dev*. 2013;89:625–629.
56 Richey L, Li T, Rilling JK. Perception of male and female infant cry aversiveness by adult men. *J Reprod Infant Psychol*. 2022;40:76–90.
57 Goldberg S, Morris P, Simmons RJ, et al. Chronic illness in infancy and parenting stress: a comparison of three groups of parents. *J Pediatr Psychol*. 1990;15:347–358.
58 Belsky J. Etiology of child maltreatment: a developmental-ecological analysis. *Psychol Bull*. 1993;114:413.
59 van der Put CE, Bouwmeester-Landweer MBR, Landsmeer-Beker EA, et al. Screening for potential child maltreatment in parents of a newborn baby: the predictive validity of an Instrument for early identification of Parents at Risk for child Abuse and Neglect (IPARAN). *Child Abuse Negl*. 2017;70:160–168.
60 Loiseau M, Cottenet J, François-Purssell I, et al. Valeur prédictive positive d'un algorithme de repérage des enfants maltraités physiquement, âgés de 0 à 5 ans. *Bull Epidémiol Hebd*. 2022;11:202–210.
61 Edwards GA, Maguire SA, Gaither JR, et al. What do confessions reveal about abusive head trauma? A systematic review. *Child Abuse Rev*. 2020;29:253–268.
62 Dubowitz H. Where's Dad? A need to understand father's role in child maltreatment. *Child Abuse Negl*. 2006;30:461–465.
63 Lee SJ, Bellamy JL, Guterman NB. Fathers, physical child abuse, and neglect: advancing the knowledge base. *Child Maltreat*. 2009;14:227–231.
64 McKenzie K, Scott DA, Waller GS, et al. Reliability of routinely collected hospital data for child maltreatment surveillance. *BMC Public Health*. 2011;11:1–8.
65 González-Izquierdo A, Woodman J, Copley L, et al. Variation in recording of child maltreatment in administrative records of hospital admissions for injury in England, 1997-2009. *Arch Dis Child*. 2010;95:918–925.