

Perinatal Factors Associated with Infant Maltreatment

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Abstract

Background: The association between birth outcomes and child maltreatment remains controversial. The purpose of this study is to test whether infants without congenital or chronic disease who are low birth weight (LBW), preterm, or small for gestational age (SGA) are at an increased risk of being maltreated.

Methods: A hospital-based case-control study of infants without congenital or chronic diseases who visited the National Center for Child Health and Development, Tokyo, between April 1, 2002 and March 31, 2005 was conducted. Cases (N = 35) and controls (N = 29) were compared on mean birth weight, gestational age, and z-score of birth weight.

Results: SGA was significantly associated with infant maltreatment after adjusting for other risk factors (adjusted odds ratio: 4.45, 95% CI: 1.29–15.3). LBW and preterm births were not associated with infant maltreatment.

Conclusion: Infants born as SGA are 4.5 times more at risk of maltreatment, even if they do not have a congenital or chronic disease. This may be because SGA infants tend to have poorer neurological development which leads them to be hard-to-soothe and places them at risk for maltreatment.

Abbreviations: SCAN, Suspected Child Abuse and Neglect; LBW, low birth weight; ZBW, z-score of birth weight adjusted for gestational age, sex, and parity; SGA, small for gestational age; SD, standard deviation; OR, odds ratio; aOR, adjusted odds ratio; CI, confidence interval; IPV, intimate partner violence.

Keywords: child abuse, birth weight, preterm, small for gestational age

In 2004, the number of child maltreatment cases reported to the Child Guidance Center in Japan (similar to Child Protection Services in the U.S. or U.K.) amounted to 33,000, which is 30 times the prevalence in 1990 (a child is defined as aged 0–17 years old) (1). Although the incidence rate of child maltreatment (1.5 per 1000 in 2002 (2)) is still much lower than in the U.S. (12.4 per 1000 in 2003 (3)), it is possible that many child abuse cases are not identified or recognized by the Child Guidance Center. Infants less than one year of age make up the largest proportion (44%) of child maltreatment deaths in Japan (1). A similar trend was found in the U.S.: 41% of child maltreatment fatalities are of infants less than one year of age (4).

Aside from the age of the child, a number of other risk factors for child maltreatment have been identified. These include: parental factors (e.g. young motherhood (5–7), parental maltreatment history (5), parental psychiatric disorders (7–11), parental drug abuse (8, 9, 12), intimate partner violence (IPV) (11, 13, 14)), household factors (e.g. poverty (7, 10, 15, 16), having other siblings (10, 16), poor social support (10, 17), and child factors (e.g. low birth weight (LBW) (11, 16, 18, 19), childhood medical disorders and developmental delays (19–21)).

Research-based evidence for LBW as a risk factor for child maltreatment is particularly inconsistent in the medical literature. In a nation-wide child maltreatment population study in Japan, it was reported that the percentage of maltreated children who were born as LBW was 43%, which is much higher than in the general population (5.7%) (22). In contrast, case-control studies in the U.S. using data from

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children born in the 1970's showed no association between LBW and child maltreatment (21, 23–26). Moreover, some have argued that the association between LBW and maltreatment can be explained by the fact that LBW infants tend to have congenital or chronic diseases, which require special care from mothers and may hinder or prevent the development of maternal attachment to the child (20, 22, 27, 28). Little is known about whether LBW infants without congenital or chronic diseases are at risk of maltreatment.

On the other hand, it has been reported that mean birth weight in Japan is gradually decreasing (29). The factors contributing to the trend of LBW are still unknown; however, it is speculated that physicians' recommendations to avoid eating salty foods in order to avoid pre-eclampsia was over emphasized for pregnant mothers and resulted in a lack of maternal nutrition (30). Whatever the reason may be, there is a simultaneous trend of both increased child maltreatment and LBW; therefore, it is worthwhile to pursue this association between them in Japan.

Few case-control studies examining LBW as a risk factor for child maltreatment have been conducted using data from children born in the 21st century. Furthermore, no such study has been implemented in Japan, where child maltreatment is a growing public health concern. Thus, we propose examining the association between perinatal risk factors (LBW, preterm birth, and SGA) and child maltreatment in a case-control study of children born after 2001. We hypothesize that LBW infants would be at increased risk of maltreatment even if they do not have any congenital or chronic disease. Recent studies showed that pre-mature infants tend to increase maternal stress (31) and have behavior problems or poor cognitive development (32, 33). Thus we conducted a case-control study of the association between LBW and maltreatment in Japanese infants less than one year of age without congenital or chronic disease.

Method

Study design and setting

This is a hospital-based case-control study of children who visited the National Center for Child Health and Development, Tokyo, Japan from April 1 2002 to March 31 2005. The National Center for Child Health and Development is one

of the five national centers and the only national center which is dedicated to pediatrics and maternal health (34). In this hospital, the function of the Suspect Child Abuse and Neglect (SCAN) team involves evaluating the suspicion of suspected cases from medical evidence similar to what is done in the U.S.(35). The SCAN team is a multi-disciplinary review team composed of psychiatric pediatricians, general pediatricians, emergency-medicine pediatricians, radiologists, ophthalmologists, gynecologists, nurses, and medical social workers, who have thorough experience dealing with child maltreatment. In this hospital, if physicians, nurses, or other hospital staff suspect child maltreatment, they are meant to report the cases to the SCAN team. Next, this team reviews the suspected child maltreatment cases and communicates with relevant sectors for the child, such as the Child Guidance Center or Health Centers based on their evaluation of suspicion.

From April 1 2002 to March 31 2005, 177 suspected cases were consulted among 95,424 outpatients to the SCAN team (36). These cases were divided into three categories according to their susceptibility of child maltreatment (definite, probable, or not maltreated) based on medical records and information related to social welfare. The criteria for the inclusion of definite or probable child maltreatment cases are the following: 1) assault, 2) unexplained severe injury, 3) possible inadequate supervision, 4) possible malnutrition or delay in seeking medical care, 5) suspected sexual assault, 6) suspected psychological trauma, 7) witness of IPV, 8) suspected Munchausen Syndrome by Proxy, 9) other suspicious findings (e.g. fall without witnesses). This criteria is based on the broader definition of child maltreatment as "a serious violation for the rights of children" (37) applied from Law Concerning Prevention of Child Abuse in Japan. Based on the likelihood of the criteria, definite or probable cases were differentiated.

Procedures for identification and selection of cases and controls

Cases include all infants (age <1 year old) who were registered as definite or probable suspected child maltreatment reviewed by the SCAN team in the hospital, excluding those who have congenital or chronic disease. As this study focuses on the association between perinatal factors and child maltreatment, we excluded cases lacking a

record of birth weight, gestational age, or sex of the child. Controls were randomly selected among children who visited the emergency room at the hospital who met the same age criteria. The SCAN team also reviewed the controls and confirmed them not to be maltreated.

Independent variables

Child, parental, and household risk factors of child maltreatment were retrospectively compiled from medical records and social welfare records into the SCAN database for both cases and controls (36). Factors used in this study are the following: 1) child factors: gender, birth weight (g), gestational age (week), plurality (single pregnancy, twin or more), 2) parental factors: mother's age at birth, marital status, the mother's history of psychiatric disease, the mother's history of maltreatment as a child, IPV, and 3) household factors: the number of siblings excluding the child, public aid eligibility, and housing type (apartment type or detached house).

Perinatal factors of the child were further analyzed by employing the Japanese fetal growth curve (38) and Z-scores of birth weight adjusted for gestational age, sex, and parity (ZBW), were calculated. LBW is defined as <2500 g, preterm is defined as <37 weeks, and SGA is defined as ZBW is <-1.0. Plurality of the infants was also coded from medical records.

Parental factors were coded by doctors who observed the cases. If the information was insufficient, we referred to social welfare records which list information from medical social worker's interviews or communication with a health center or child protection services. The mother's psychiatric history was coded based on the history of visits to a mental clinic or a prescription of psychiatric medicine which was obtained from the interview by the doctor of the infants. Information pertaining to the mother's own history of maltreatment as a child and IPV was collected from the mother's interview conducted by psychiatric pediatricians.

With regard to household factors, having other siblings was coded from medical records. In this study, having other siblings means that the infants are the youngest sibling if cases or controls are not twins, as we selected cases and controls that were <1 year old. Public aid eligibility was coded from the information of medical insurance. Housing types were categorized as either apartment

or detached house, based on the address of infants. If the address included an apartment number or indication of living in a dormitory, it was categorized as an apartment, and others were categorized as detached houses.

Statistical analysis

To observe the difference of perinatal factors as a numerical variable by cases and controls, the average birth weight, gestational age, and ZBW of cases and controls were compared by t-test. We also assessed the distribution of categorical variables of the child, parent, and household risk factors for both cases and controls. Crude odds ratios (ORs) and 95% confidence intervals (CIs) were calculated by using logistic regression. Furthermore, multivariate logistic regression was performed by the following models (each model was adjusted for significant factors in crude OR other than perinatal factors): Model 1: birth weight (numerical variable), Model 2: ZBW (numerical variable), Model 3: LBW (categorical variable), and Model 4: SGA (categorical variable). All statistical analyses were performed by using SAS Version 8.0 (39).

Ethical issues

This study was done by using secondary data. The Institutional Review Board at the National Center for Child Health and Development approved this study.

Results

Of the 177 children reported to the SCAN team from 2002 to 2005, we identified 35 cases in which infants, without congenital or chronic disease, and with records of birth weight, gestational age, and sex. As controls, 29 children were randomly selected from the patients who were confirmed non-maltreated cases and who fit the same inclusion criteria for this study.

The averages of perinatal factors were significantly different for birth weight and ZBW, but not for gestational age (Fig. 1). The average birth weight among cases was 2584 g, whereas for controls, it was 3006 g (difference: 522 g, $p = 0.003$). The average ZBW among cases was -0.85, whereas with the controls, it was -0.22 (difference: 0.63, $p = 0.007$). On the contrary, the average gestational age was not statistically different (38 weeks for cases, 39 weeks for controls).

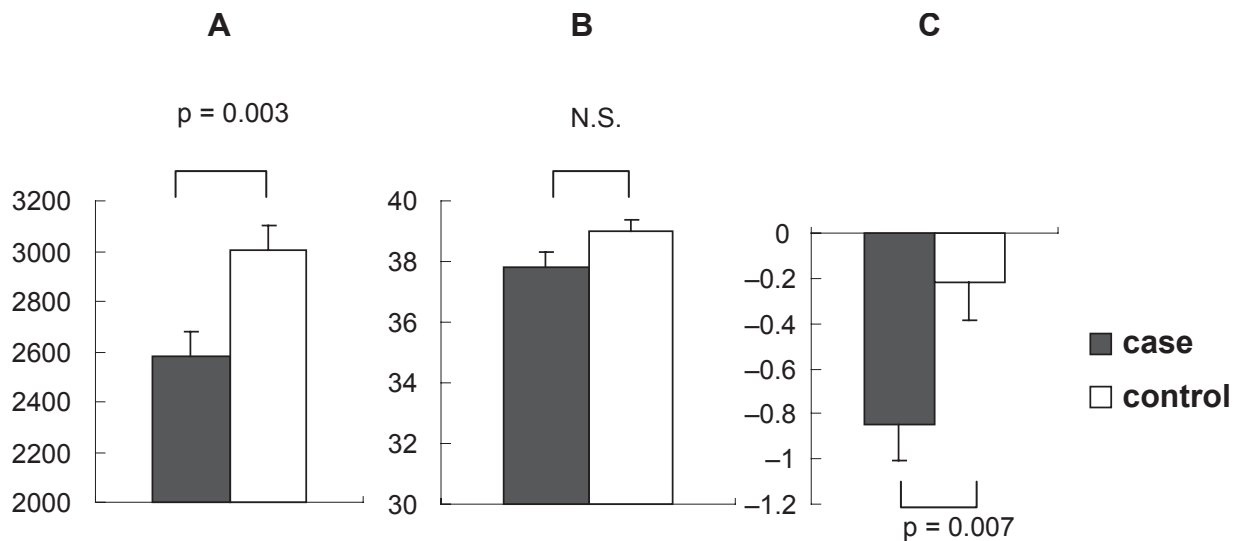


Figure 1. Comparison of perinatal variable averages for infant maltreatment cases and controls and the results of t-test analyses. **A:** birth weight (g), **B:** gestational age (weeks), and **C:** z-score of birth weight for gestational age and maternal experience of delivery.

The distribution of cases demonstrated that the majority of the infants were male (54%), non-low birth weight (63%), non-preterm (77%), and born as a singleton (88%). Older mothers, age 30 years or more, and having other siblings were factors that were present in the majority of the cases (68%, 53% respectively). Among categorical variables of the perinatal factors, statistically significant factors were LBW (OR: 3.69, CI: 1.05–13.0) and SGA (OR: 3.62, CI: 1.19–11.1), whereas preterm and plurality were not significant. Among parental factors, it was found that older mothers (age 30 and more years old) tend to maltreat their children more than younger mothers (<30 years old), although this was not statistically significant. Being a single mother, having a psychiatric disease history, a history of maltreatment when the mother was a child and IPV were factors that were more prevalent among cases, although these were not statistically significant. Having other siblings was significantly associated with infant maltreatment (OR: 3.94, CI: 1.27–12.2). Differences in patterns of public aid eligibility were not statistically significant (Table 1).

In a multivariate logistic regression model, birth weight, ZBW, and SGA were significantly associated with infant maltreatment after adjusting for other significant risk factors, i.e. having other siblings. According to model 1, a 100 gram increase of birth weight reduces the risk of infant maltreatment by 19%, holding constant the existence of other siblings. Similarly, model 2 showed 1.0 unit

of ZBW decreases the risk of infant maltreatment by 69%, holding constant having other siblings. Infants born SGA were 4.5 times more at risk of infant maltreatment adjusted for having siblings (aOR: 4.45, CI: 1.29–15.3). However, LBW was not statistically significantly associated with infant maltreatment after adjusting for other significant factors (Table 2).

Discussion

In this hospital-based case-control study, we found that infants born as SGA without congenital or chronic disease are 4.5 times more likely to be maltreated than infants who were not born SGA. LBW and preterm factors were not directly associated with infant maltreatment, although birth weight was inversely associated with the risk of being maltreated.

Our findings, which used an SGA measure, provide a more detailed analysis of the relationship between LBW and infant maltreatment. This novel perspective is different from previous case-control studies which did not examine SGA and showed no association between LBW and child maltreatment (23–26). Consistent with previous studies which found no association between child abuse and LBW (<2500 g), (24, 25), we found no association between LBW and infant maltreatment after controlling for other significant risk factors. Furthermore, we also confirmed no association between gestational age and infant maltreatment, which is consistent with previous studies (24, 26). However,

Table 1. Distribution of child, parental, and household factors for infant maltreatment cases and controls and odds ratios.

Factors	Cases (N = 35), n (%)	Controls (N = 29), n (%)	OR (95% CI)
<i>Child factors</i>			
Sex			
Male	19 (54)	12 (41)	1.68 (0.62–4.55)
Female	16 (46)	17 (59)	Reference
Low Birth Weight			
<2500 g	13 (37)	4 (14)	3.69 (1.05–13.0)
2500 g +	22 (63)	25 (86)	Reference
Preterm			
<37 weeks	8 (23)	3 (10)	2.57 (0.61–10.8)
37 weeks +	27 (77)	26 (90)	Reference
Small for Gestational Age			
<-1.0 SD	17 (49)	6 (21)	3.62 (1.19–11.1)
-1.0 SD +	18 (51)	23 (79)	Reference
Plurality			
Twin	4 (12)	2 (7)	1.67 (0.28–9.87)
Single	30 (88)	25 (93)	Reference
Missing	1	2	
<i>Parental factors</i>			
Mother's Age at birth			
<30 years old	10 (32)	9 (36)	Reference
30 years old +	21 (68)	16 (64)	1.18 (0.39–3.59)
Missing	4	4	
Single mother			
Yes	1 (3)	0 (0)	N/A
No	34 (97)	29 (100)	
Maternal mental disorder			
Yes	4 (11)	1 (3)	3.61 (0.38–34.3)
No	31 (89)	28 (97)	Reference
Maltreated history when mother was child			
Yes	2 (6)	0 (0)	N/A
No	33 (94)	29 (100)	
Intimate partner violence			
Yes	2 (6)	0 (0)	N/A
No	33 (94)	29 (100)	
<i>Household factors</i>			
Number of Siblings			
1+	18 (53)	6 (22)	3.94 (1.27–12.2)
0	16 (47)	21 (78)	
Missing	1	2	
Public aid eligibility			
Yes	2 (6)	0 (0)	N/A
No	33 (94)	29 (100)	

OR, odds ratio; CI, confidence interval.

Table 2. Multivariate logistic regression results for the association between perinatal factors of child and infant maltreatment.

Factors	aOR (95% CI)
Model 1	
Birth Weight (unit: 100 g)	0.81 (0.70–0.94)
Having other siblings	4.34 (1.21–15.6)
Model 2	
Z score of birth weight for parity, sex, and gestational age (unit: 1SD)	0.31 (0.14–0.69)
Having other siblings	5.08 (1.39–18.6)
Model 3	
Low Birth Weight (<2500 g)	3.10 (0.83–11.6)
Having other siblings	3.56 (1.12–11.3)
Model 4	
Small for Gestational Age (<–1.0 SD)	4.45 (1.29–15.3)
Having other siblings	3.99 (1.21–13.1)

aOR, adjusted odds ratio; CI, confidence interval.

in contrast with one previous study showing no association between SGA and physical abuse (23), SGA was associated with infant maltreatment in our study. The definition of SGA in the previous study (23) was birth weight less than tenth percentile for gestational age, which is equal to -1.3 SD of z-score of birth weight for gestational age (38). Thus, the inconsistency might be due to different definitions of SGA.

Birth weight adjusted for gestational age, parity, and sex (i.e. Z-score) may represent incongruent neurological or cognitive development, which are directly connected to behavioral problems during infancy. It is well known that extremely low birth weight is related to delayed neurological development (32, 33). However, relationships between birth weight and neurological development were not limited to extremely low birth weight (40, 41). Part of this association may be explained by the fact that SGA infants tend to have head trauma during pregnancy (42). However, there might be a direct linear relationship between neurological development and Z-score. Poorly grown infants in the uterus may have deficient neurological development, and as a result, their behaviors may become difficult for parenting or soothing (e.g. higher pitch cry (43)). It has been shown that infants with SGA had greater difficulty in modulating their state as compared with healthy infants (44).

Another possible interpretation is IPV during pregnancy. Previous research showed that IPV is associated with poorer pregnancy outcomes, including low birth weight (45). In addition, IPV is associated with child maltreatment (46). In this study, although we collected information on IPV, and found that the presence of IPV was higher in those cases of child maltreatment, this was not statistically significant. However, the existence of IPV might be underreported and we did not examine IPV during the pregnancy. IPV during pregnancy might be a confounder for the association between SGA and infant maltreatment.

A limitation of this study is the small number of cases and controls. We did not pair each case and control based on demographic variables such as age, gender, or household status. However, our maltreatment cases and controls were matched in age (infants < 1 year old), sex and household status. We did not have information on the trigger or process of infant maltreatment, which is crucial information for an intervention during the parenting of infants. Further research using focus group interviews for mothers with SGA infants would help to provide this information.

Our findings have important implications for the prevention of infant maltreatment. First, at-risk infants can be identified at the moment of delivery by using records of birth weight and gestational age collectively. Obstetricians and pediatricians

should monitor SGA infants carefully, not only on their physical or neurological development, but also on maternal stress involved in taking care of the infants. Second, a home visitation program should be provided for families with SGA infants. Usually, home visitation programs aimed at preventing child maltreatment focuses on parents or household risk factors (e.g. low income, single mother) (47) as a high-risk strategy (48). Certain perinatal factors should also be considered significant risk factors for infant maltreatment. Third, interventions to decrease the prevalence of SGA infants might reduce child maltreatment. There are several strategies to help prevent SGA including obstetrical technology (49), prenatal care (50), or lifestyle changes such as drug use, nutrition, physical activity, and social support (51). Further studies are needed to evaluate the effectiveness of these interventions to reduce the rate of SGA and infant maltreatment.

In conclusion, children who were born as SGA are 4.5 times more likely to be maltreated when they are 1 year old or less, even if they do not have congenital or chronic disease. It is speculated that infants born SGA tend to have poor neurological development which may lead them to become hard-to-soothe infants, and consequently, may lead to an increased risk of maltreatment. Further research is needed to elucidate the association between SGA, neurological development, and subsequent parental responses.

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Disclosure

The authors report no conflicts of interest.

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