Perinatal Factors Associated with Infant Maltreatment

Takeo Fujiwara[1,2,3], Makiko Okuyama[2], Haley Tsui[3] and Karestan C. Koenen[4]

[1]Department of Health Promotion and Research, National Institute of Public Health, Saitama, Japan. [2]Department of Psychosocial Medicine, National Center of Child Health and Development, Tokyo, Japan. [3]Centre for Community Child Health Research, Child Family Research Institute, University of British Columbia. [4]Department of Society, Human Development, and Health, Harvard School of Public Health, MA, U.S.A.

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

Correspondence: Takeo Fujiwara, M.D., Ph.D., MPH, Section of Behavioral Science, Department of Health Promotion and Research, National Institute of Public Health, 2-3-6, Minami, Wako-shi, Saitama, 351-0197, Japan. Tel: 048-458-6193; Fax: 048-469-3716; Email: tfujiwara@niph.go.jp

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 multidisciplinary 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).

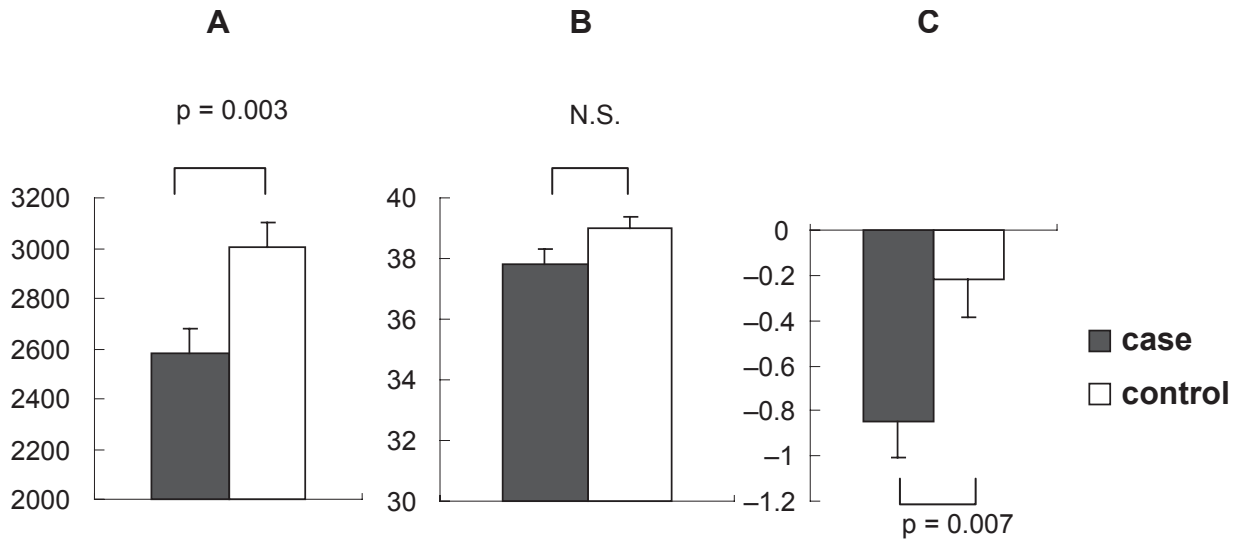

Figure 1. Comparison of perinatal variable averages for infant maltreatment cases and controls and the results of t-test analyses. **A**: birth weight (g), **B**: gestational age (weeks), and **C**: z-score of birth weight for gestational age and maternal experience of delivery.

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)
Child factors			
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	
Parental factors			
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)	
Household factors			
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.

Acknowledgements

This research is supported by Ministry of Health, Labor, and Welfare in Japan.

TF is supported by Fostering Young Researchers A: Grant for Studying Abroad from Pfizer Health Research Foundation. KCK is supported by 1K08MH070627-01.

Disclosure

The authors report no conflicts of interest.

References

[1] Ministry of Health Labor and Welfare in Japan. National Congress of Director in Child Protection Center 2005 Fiscal Year. Tokyo: Ministry of Health, Labor, and Welfare in Japan; 2005.

[2] Kobayashi, N. National Survey of Child Maltreatment 1. Incidence of Child Maltreatment and Management. In: Ministry of Health Labor and Welfare in Japan, editor. FY. 2001 Health Science Research: Report of Survey of Child Maltreatment and its Measures. Tokyo: Ministry of Health Labor and Welfare in Japan; 2002.

[3] National Clearinghouse on Child Abuse and Neglect Information, Child Maltreatment 2003: Summary of Key Findings. In: Administration for Children and Families, U.S. Depertment of Health and Human Services; 2005.

[4] National Clearinghouse on Child Abuse and Neglect Information, Child Abuse and Neglect Fatalities: Statistics and Interventions. In: Administration for Children and Families, U.S. Department of Health and Human Services; 2004.

[5] Sidebotham, P. and Golding, J. 2001. Child maltreatment in the "children of the nineties" a longitudinal study of parental risk factors. *Child Abuse Negl.*, 25(9):1177–200.

[6] Stier, D.M., Leventhal, J.M., Berg, A.T., Johnson, L. and Mezger, J. 1993. Are children born to young mothers at increased risk of maltreatment? *Pediatrics*, 91(3):642–8.

[7] Brown, J., Cohen, P., Johnson, J.G. and Salzinger, S. 1998. 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.*, 22(11):1065–78.

[8] Chaffin, M., Kelleher, K. and Hollenberg, J. 1996. Onset of physical abuse and neglect: psychiatric, substance abuse, and social risk factors from prospective community data. *Child Abuse Negl.*, 20(3):191–203.

[9] Dinwiddie, S.H. and Bucholz, K.K. 1993. Psychiatric diagnoses of self-reported child abusers. *Child Abuse Negl.*, 17(4):465–76.

[10] Kotch, J.B., Browne, D.C., Dufort, V. and Winsor, J. 1999. Predicting child maltreatment in the first 4 years of life from characteristics assessed in the neonatal period. *Child Abuse Negl.*, 23(4):305–19.

[11] Windham, A.M., Rosenberg, L., Fuddy, L., McFarlane, E., Sia, C. and Duggan, A.K. 2004. Risk of mother-reported child abuse in the first 3 years of life. *Child Abuse Negl.*, 28(6):645–67.

[12] Kelleher, K., Chaffin, M., Hollenberg, J. and Fischer, E. 1994. Alcohol and drug disorders among physically abusive and neglectful parents in a community-based sample. *Am. J. Public Health*, 84(10):1586–90.

[13] Rumm, P.D., Cummings, P., Krauss, M.R., Bell, M.A. and Rivara, F.P. 2000. Identified spouse abuse as a risk factor for child abuse. *Child Abuse Negl.*, 24(11):1375–81.

[14] Tajima, E.A. 2000. The relative importance of wife abuse as a risk factor for violence against children. *Child Abuse Negl.*, 24(11):1383–98.

[15] Cappelleri, J.C., Eckenrode, J. and Powers, J.L. 1993. The epidemiology of child abuse: findings from the Second National Incidence and Prevalence Study of Child Abuse and Neglect. *Am. J. Public Health*, 83(11):1622–4.

[16] Wu, S.S., Ma, C.X., Carter, R.L., Ariet, M., Feaver, E.A., Resnick, M.B. et al. 2004. Risk factors for infant maltreatment: a population-based study. *Child Abuse Negl.*, 28(12):1253–64.

[17] Sidebotham, P., Heron, J. and Golding, J. 2002. Child maltreatment in the "Children of the Nineties:" deprivation, class, and social networks in a U.K. sample. *Child Abuse Negl.*, 26(12):1243–59.

[18] Benedict, M.I. and White, R.B. 1985. Selected perinatal factors and child abuse. *Am. J. Public Health*, 75(7):780–1.

[19] Sidebotham, P. and Heron, J. 2003. Child maltreatment in the "children of the nineties:" the role of the child. *Child Abuse Negl.*, 27(3):337–52.

[20] Famularo, R., Fenton, T. and Kinscherff, R. 1992. Medical and developmental histories of maltreated children. *Clin. Pediatr* (*Phila*), 31(9):536–41.

[21] Zelenko, M., Lock, J., Kraemer, H.C. and Steiner, H. 2000. Perinatal complications and child abuse in a poverty sample. *Child Abuse Negl.*, 24(7):939–50.

[22] Tanimura, M., Matsui, I. and Kobayashi, N. 1995. Analysis of child abuse cases admitted in pediatric service in Japan. I. Two types of abusive process in low birth-weight infants. *Acta. Paediatr. Jpn.*, 37(2):248–54.

[23] Leventhal, J.M., Berg, A. and Egerter, S.A. 1987. Is intrauterine growth retardation a risk factor for child abuse? *Pediatrics*, 79(4):515–9.

[24] Leventhal, J.M., Egerter, S.A. and Murphy, J.M. 1984. Reassessment of the relationship of perinatal risk factors and child abuse. *Am. J. Dis. Child*, 138(11):1034–9.
[25] Starbuck, G.W., Krantzler, N., Forbes, K. and Barnes, V. 1984. Child abuse and neglect on Oahu, Hawaii: description and analysis of four purported risk factors. *J. Dev. Behav. Pediatr.*, 5(2):55–9.
[26] Shearman, J.K., Evans, C.E., Boyle, M.H., Cuddy, L.J. and Norman, G.R. 1983. Maternal and infant characteristics in abuse: a case control study. *J. Fam. Pract.*, 16(2):289–93.
[27] Egeland, B. and Sroufe, L.A. 1981. Attachment and early maltreatment. *Child Dev.*, 52(1):44–52.
[28] Carlson, E.A. 1998. A prospective longitudinal study of attachment disorganization/disorientation. *Child Dev.*, 69(4):1107–28.
[29] Takimoto, H., Yokoyama, T., Yoshiike, N. and Fukuoka, H. 2005. Increase in low-birth-weight infants in Japan and associated risk factors, 1980–2000. *J. Obstet. Gynaecol. Res.*, 31(4):314–22.
[30] Gluckman, P.D., Seng, C.Y., Fukuoka, H., Beedle, A.S. and Hanson, M.A. 2007. Low birthweight and subsequent obesity in Japan. *Lancet*, 369(9567):1081–2.
[31] Halpern, L.F., Brand, K.L. and Malone, A.F. 2001. Parenting stress in mothers of very-low-birth-weight (VLBW) and full-term infants: a function of infant behavioral characteristics and child-rearing attitudes. *J. Pediatr. Psychol.*, 26(2):93–104.
[32] Hack, M., Taylor, H.G., Drotar, D., Schluchter, M., Cartar, L., Wilson-Costello, D. et al. 2005. Poor predictive validity of the Bayley Scales of Infant Development for cognitive function of extremely low birth weight children at school age. *Pediatrics*, 116(2):333–41.
[33] Mikkola, K., Ritari, N., Tommiska, V., Salokorpi, T., Lehtonen, L., Tammela, O. et al. 2005. Neurodevelopmental outcome at 5 years of age of a national cohort of extremely low birth weight infants who were born in 1996–1997. *Pediatrics*, 116(6):1391–400.
[34] National Center for Child Health and Development, Introduction. In: National Center for Child Health and Development; 2005.
[35] Hayes, N.C. 2003. Hospital SCAN. (Suspected Child Abuse and Neglect) Team Models. In: Pererson MS, Durfee M, editors. Child Abuse and Neglect: Guidelines for Identification, Assessment, and Case Management. Volcano CA: Volcano Press 239–48.
[36] Fujiwara, T., Okuyama, M. and Ishii, T. 2006. Development of Child Maltreatment Database for Hospitals. *The Journal of the Japan Pediatric Society*, 110(7):926–33.
[37] Okuyama, M. 2003. Prevention of Child Abuse. *Japan Medical Association Journal*, 46(2):80–5.
[38] Nishida, H., Sakaue, M., Kurachi, K., Asada, A., Kubo, S. and Funakawa, H. 1884. Fetal Growth Curve of Japanese. *Acta Neonatologica Japonica*, 20(1):90–7.
[39] SAS. Version 8.0. Cary, NC: SAS Institute, Inc; 1999.
[40] Peng, Y., Huang, B., Biro, F., Feng, L., Guo, Z. and Slap, G. 2005. Outcome of low birthweight in China: a 16-year longitudinal study. *Acta. Paediatr.*, 94(7):843–9.
[41] Shenkin, S.D., Starr, J.M., Pattie, A., Rush, M.A., Whalley, L.J. and Deary, I.J. 2001. Birth weight and cognitive function at age 11 years: the Scottish Mental Survey 1932. *Arch. Dis. Child*, 85(3):189–96.
[42] Martinussen, M., Fischl, B., Larsson, H.B., Skranes, J., Kulseng, S., Vangberg, T.R. et al. 2005. Cerebral cortex thickness in 15-year-old adolescents with low birth weight measured by an automated MRI-based method. *Brain*, 128(Pt 11):2588–96.
[43] Zeskind, P.S. and Lester, B.M. 1981. Analysis of cry features in newborns with differential fetal growth. *Child Dev.*, 52(1):207–12.
[44] Als, H., Tronick, E., Adamson, L. and Brazelton, T.B. 1976. The behavior of the full-term but underweight newborn infant. *Dev. Med. Child Neurol.*, 18(5):590–602.
[45] Silverman, J.G., Decker, M.R., Reed, E. and Raj, A. 2006. Intimate partner violence victimization prior to and during pregnancy among women residing in 26 U.S. states: associations with maternal and neonatal health. *Am. J. Obstet. Gynecol.*, 195(1):140–8.
[46] Hazen, A.L., Connelly, C.D., Kelleher, K., Landsverk, J. and Barth, R. 2004. Intimate partner violence among female caregivers of children reported for child maltreatment. *Child Abuse Negl.*, 28(3):301–19.
[47] Olds, D.L., Eckenrode, J., Henderson, CRJr, Kitzman, H., Powers, J., Cole, R. et al. 1997. Long-term effects of home visitation on maternal life course and child abuse and neglect. Fifteen-year follow-up of a randomized trial. *JAMA*, 278(8):637–43.
[48] Fujiwara, T. 2007. Population Strategy to Address Child Maltreatment in Japan. *Public Health*, 121:485–6.
[49] Ricciotti, H.A., Chen, K.T. and Sachs, B.P. 1995. The role of obstetrical medical technology in preventing low birth weight. *Future Child*, 5(1):71–86.
[50] Alexander, G.R. and Korenbrot, C.C. 1995. The role of prenatal care in preventing low birth weight. *Future Child*, 5(1):103–20.
[51] Chomitz, V.R., Cheung, L.W. and Lieberman, E. 1995. The role of lifestyle in preventing low birth weight. *Future Child*, 5(1):121–38.