

# Study on risk factors of children's behavioral problems during prenatal and neonatal period

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## Abstract

**Objective:** To understand the risk factors of children's behavioral problems during prenatal and neonatal period, so as to provide the scientific evidence for early prevention and intervention.

**Methods:** Totally 2257 children from 3 primary schools in Xiamen were surveyed by Achenbach Child Behavioral Checklist, and a multivariable logistic regression model was used to analyze the risk factors of children's behavioral problems.

**Results:** When children's gender, age, family socio-economic status and educational level of parents were considered, preterm birth ( $OR = 1.903, P = 0.014$ ), having history of being hospitalized during the neonatal period ( $OR = 1.783, P = 0.006$ ), maternal medication use during pregnancy ( $OR = 2.676, P < 0.001$ ) might be the main risk factors of children's behavioral problems during the prenatal and neonatal periods. Continuous breastfeeding for more than 6 months was the protective factor of children's behavioral problems ( $OR = 0.631, P = 0.027$ ). Maternal alcohol use in pregnancy might also increase the risk of children's behavioral problems ( $OR = 2.591, P = 0.058$ ).

**Conclusion:** Early interference and monitoring of the psychological and developmental behaviors of the pretermog, longer duration of breastfeeding, reducing harmful factors exposure during pregnancy (such as alcohol, medicine) will play an important role to prevent and reduce children's behavioral problems.

## Introduction

Children's behavioral problems not only directly affect their ability to learn and carry out daily life and social activities, but they may also have a negative impact on personality and behaviors when they are adults. In recent years, scholars have carried out a large number of related risk factors research in order to prevent and control children's behavior problems [1,2]. However, the current studies were focused on the risk factors that can be interfered with later in life such as family environment, parenting styles, and school education, etc. While systematically epidemiological studies on risk factors during prenatal and neonatal period were relatively few. This paper explores the risk factors of children's behavioral problems during prenatal and neonatal periods, so as to provide the scientific evidence for early prevention and intervention.

## Materials and methods

### Subjects

All students in grades 1 to 4 of three primary schools in Huli district of Xiamen City, Fujian Province were selected to participate in a questionnaire survey. A total of 2,443 questionnaires were handed out and 2,322 were returned (the respond rate was 95.04%), of which the valid questionnaires was 2,257 (the valid rate was 97.20%). Among 2,257 students, 1,217 (53.9%) were boys and 1,040 (46.1%) were girls; the age distribution is: 215 (9.5%) of 6 years old, 317 (14.0%) of 7 years old, 547 (24.2%) of 8 years old, 575 (25.5%) of 9 years old, 372 (16.5%) of 10 years, 231 (10.2%) of 11 years.

## Methods

Behavioral problems of the children were assessed by their parents using *the Chinese version of the Child Behavior Checklist* (CBCL). The CBCL is a questionnaire composed of 113 items rated on a three-step response scale ranging from 0 (absent) to 2 (very often present). The sum of individual item scores is converted to T-scores, in which higher scores indicate more severe problems. T-score  $\geq 41$  was considered as children with behavioral problem and T-score  $< 41$  was considered as normal children.

The possible risk factors of behavioral problems were collected through the General Status of Children Questionnaire which was self-designed. The contents of the questionnaire included: child and neonatal factors (gender, weight, height, birth weight, birth age and medical history, duration of breast-feeding, etc), parental factors (parent education background, parent's age when the child was born, alcohol and tobacco consumption, income, upbringing style, etc) and prenatal factors (X-ray exposure during pregnancy, maternal alcohol use and smoking in pregnancy, maternal medication use during pregnancy, delivery method, etc).

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**Statistical analysis**

The statistical analyses were performed with SPSS ver. 17.0. The Pearson  $\chi^2$  test was used for single factor analysis and the Logistic regression analysis method was used for multi-factors analysis.

**Results**

**The detection rate of children's behavioral problems**

Of the 2,257 children, 287 were detected with behavioral problems. The detection rate was 12.70%. For boys, the detection rate was 13.97%, and the detection rate of girls was 11.25% ( $\chi^2=3.735$ ,  $P = 0.053$ ). The detection rate of 6 years old was 12.09%, 7 years old was 12.62%, 8 years old was 14.07%, 9 years old was 12.00%, 10 years old was 12.03%, 11 years old was 13.10%, the differences of detection rates of various ages were not statistically significant ( $\chi^2 = 1.444$ ,  $P = 0.919$ ).

**The single factor analysis**

The results of the Pearson  $\chi^2$  test showed that the detection rates increased in the children with mother's education level  $\leq$  primary school, abusive parenting style, preterm birth, having history of being hospitalized during the neonatal period, maternal medication use during pregnancy, maternal alcohol use in pregnancy ( $P<0.05$ ) (Table 1).

**The multi-factors analysis**

The Logistic regression analysis was used to screen risk factors during prenatal and neonatal period of children's behavioral problems. Five independent variables (children's age, gender, family income, mother's education background, father's education background) were considered as control factors in the analysis model and 13 independent variables (Table 2) were analyzed by backward regression method with  $P<0.05$  as variable inclusion criteria  $P<0.10$  as variable exclusion criteria.

When children's gender, age, family's socio-economic status and educational level of parents were adjusted, preterm birth ( $OR = 1.903$ ,  $P = 0.014$ ), having history of being hospitalized during the neonatal period ( $OR = 1.783$ ,  $P = 0.006$ ), and maternal medication use during pregnancy ( $OR = 2.676$ ,  $P<0.001$ ) might be the main risk factors of children's behavioral problems during the prenatal and neonatal periods. Continuous breastfeeding for more than 6 months was the protective factor of children's behavioral problems ( $OR = 0.631$ ,  $P = 0.027$ ). Maternal alcohol use during pregnancy might also increase the risk of children's behavioral problems ( $OR = 2.591$ ,  $P = 0.058$ ).

**Discussion**

The development of children's behavior problems is the result of the combination of many factors such as biology, family environment and society. Studies have shown that exposure to harmful factors during pregnancy and neonatal diseases are the most important risk factors for children's behavioral problems [3].

Premature infants are prone to brain damage because they are born early as the nervous system is not yet mature. Hutchinson conducted a survey on children with a gestational age  $<28$  weeks when they were 8 years old and found that despite ongoing improvements

**Table 1.** The results of the single factor analysis.

Variable	Category	Rate (%)	$\chi^2$	P	Variable	Category	Rate (%)	$\chi^2$	P
Age(years)	6	12.1	1.400	0.924	Family income (Yuan/month)	<5000	17.2	7.550	0.110
	7	12.6				5000~	13.1		
	8	14.1				10000~	11.0		
	9	12.0				15000~	13.3		
	10	12.0				$\geq 20000$	10.4		
	11	13.1							
Gender	Boy	13.4	2.833	0.092	Overweight / obesity of child	Normal	12.5	0.394	0.821
	girl	11.1			Overweight	11.2			
Mother education background	$\leq$ Primary school	18.3	12.139	<b>0.016</b>	Mother education background	Obesity	12.1	8.269	0.082
	Middle school	12.3				$\leq$ Primary school	19.8		
	High school	10.8				Middle school	12.6		
	Technical school	12.3				High school	13.4		
	$\geq$ College/university	11.3				Technical school	10.5		
Parents upbringing style a	Education mainly	11.5	20.980	<b>&lt;0.001</b>	Age of maternity	$\geq$ College/university	11.3	0.723	0.395
	Blame mainly	24.0				<35 years old	12.4		
Vaginal delivery	Yes	12.4	0.082	0.775	Low birth weight	$\geq 35$ years old	9.0	0.261	0.610
	No	12.0				No	12.2		
Preterm birth	No	11.5	15.570	<b>&lt;0.001</b>	History of being hospitalized during the neonatal period	Yes	13.7	6.490	<b>0.011</b>
	Yes	21.2				No	11.7		
Breast-feeding	<6 months	16.4	7.169	<b>0.007</b>	History of poor pregnancy of mother	Yes	17.3	2.589	0.108
	$\geq 6$ months	11.8				No	11.9		
Passive smoking b	No	11.2	2.398	0.122	Maternal medication use during pregnancyd	Yes	15.4	10.779	<b>0.001</b>
	Yes	13.4				No	12.0		
Maternal smoking in pregnancy	No	12.8	0.394	0.530	Maternal alcohol use in pregnancy	Yes	20.0	14.564	<b>&lt;0.001</b>
	Yes	7.1				No	12.4		
X-ray exposure during pregnancy	No	12.2	0.350	0.554		Yes	37.0		
	Yes	13.4							

Note: a. No blaming the child or blaming the child  $\leq 1$  times every week identified as "education mainly", while blaming the child  $\geq 2$  times every week identified as "blame mainly". b. One or both parents smoke in the home. c. Identified according to Screening for overweight and obesity among school-age children and adolescents (WS/T586-2018). d. Including unprescribed or prescribed antiviral and antibiotic medicine.

**Table 2.** The values in the Logistic regression model.

Item	Variables	Values
Dependent variable	Behavioral problems	No = 0, Yes = 1
Control variables	Age(years)	6 years = 1, 7 years = 2, 8 years = 3, 9 years = 4, 10 years = 5, 11 years = 6
	Gender	Girl = 0, Boy = 1
	Mother education background	≤ Primary school = 1, Middle school = 2, High school = 3, Technical school = 4, ≥ College/university = 5
	Father education background	≤ Primary school = 1, Middle school = 2, High school = 3, Technical school = 4, ≥ College/university = 5
	Family income (Yuan/month)	5000 Yuan/month = 1, 5000 Yuan/month ~ = 2, 10000 Yuan/month ~ = 3, 15000 Yuan/month ~ = 4, 20000 Yuan/month ~ = 5
Independent variables	Parents upbringing style	Education mainly = 0, Blame mainly = 1
	Overweight / obesity of child	Normal = 0, Overweight = 1, Obesity = 2
	Age of maternity	<35 years old = 0, ≥ 35 years old = 1
	Vaginal delivery	Yes = 0, No = 1
	Low birth weight	No = 0, Yes = 1
	Preterm birth	No = 0, Yes = 1
	History of being hospitalized during the neonatal period	No = 0, Yes = 1
	History of poor pregnancy of mother	No = 0, Yes = 1
	Passive smoking	No = 0, Yes = 1
	Breast-feeding	<6 months = 0, ≥ 6 months = 1
	Maternal medication use during pregnancy	No = 0, Yes = 1
	Maternal smoking in pregnancy	No = 0, Yes = 1
	Maternal alcohol use in pregnancy	No = 0, Yes = 1
X-ray exposure during pregnancy	No = 0, Yes = 1	

**Table 3.** The results of the multiple factor analysis.

Variables	$\beta$	SE	Wald $\chi^2$	P	OR(95%CI)
Age	-0.048	0.057	0.693	0.405	0.953 (0.852~1.067)
Gender	0.467	0.167	7.804	<b>0.005</b>	1.595 (1.149~2.213)
Mother education background	-0.351	0.110	10.197	<b>0.001</b>	0.704 (0.568~0.873)
Father education background	-0.048	0.101	0.230	0.631	0.953 (0.783~1.074)
Family income	-0.073	0.074	0.980	0.322	0.929 (0.804~1.074)
Parents upbringing style	0.923	0.254	13.241	<b>&lt;0.001</b>	2.518 (1.531~4.140)
Preterm birth	0.643	0.262	6.010	<b>0.014</b>	1.903 (1.138~3.183)
History of being hospitalized during the neonatal period	0.579	0.211	7.550	<b>0.006</b>	1.783 (1.180~2.694)
Breast-feeding	0.460	0.207	4.912	<b>0.027</b>	0.631 (0.420~0.948)
Maternal medication use during pregnancy	0.946	0.215	19.312	<b>&lt;0.001</b>	2.576 (1.689~3.928)
Maternal alcohol use in pregnancy	0.952	0.502	3.607	0.058	2.592 (0.970~6.927)

in the management of Premature infants, the rate of neurobehavioral impairment at school-age remains too high relative to controls [4]. Polic selected 253 6-12-year-olds children who were born late preterm (34 week~36 week+6) and 131 full-term children and assessed their behavioral problems [5], and the results showed that children born late preterm had a greater risk for emotional and behavioral problems during childhood than their full-term born peers and they experienced serious health problems upon birth. In addition, Studies have shown that many neonatal diseases, such as neonatal asphyxia, intracranial hemorrhage, convulsions, and nuclear jaundice, can lead to brain damage in newborns, which can affect children's neurobehavioral development [3]. The neonatal health problems associated with prematurity present a negative impact on later child emotional and adapted behavior [6]. In this study, the results also revealed that children with preterm birth and having history of being hospitalized during the neonatal period were more likely to have behavioral problems. Therefore, for these children, it is necessary to plan the implementation of neuropsychological behavior development monitoring and early intervention to prevent and reduce long-term poor behavior problems.

The study by Grace found that breast feeding for ≥6 months was positively associated with improved motor development outcomes

at 10, 14 and 17 years of age ( $\beta = 1.38, P = 0.019$ ) when adjusted for child's sex, maternal age, alcohol intake, family income, hypertensive status, gestational stress and mode of delivery [7]. Ye et al., found that breastfeeding with longer duration and increased intensity could promote better development in children [8]. Recently, a systematic review was conducted by Poton and the result showed that children breastfed for at least three to four months had fewer total behavior and conduct disorders in childhood [9]. In our study, continuous breastfeeding for more than 6 months was the protective factor of children's behavioral problems ( $OR = 0.631, P = 0.027$ ). It is suggested that prolonged breastfeeding time is a protective factor for children's behavior. Breast milk is rich in essential nutrients for infants and, which can promote the development of the brain and nerves of infants and young children. In addition, the exchange between mothers and infants during breastfeeding is conducive to the psychological development of infants and young children. Extending the duration of breastfeeding is beneficial to children's neurobehavioral development.

In our study, it also suggested that taking medication during pregnancy was one of the risk factors for children's behavioral problems. Excessive or inappropriate use of drugs during pregnancy will have adverse effects on fetal brain nerve damage and development,

which will affect children's behavior in the future [10]. Population-based epidemiological studies showed that alcohol consumption during pregnancy could hurt children's neurobehavioral development [11]. Although alcohol consumption during pregnancy of Chinese women in our survey is relatively light compared to that of western women, maternal alcohol consumption even at low levels was adversely related to child behavior [12]. This study also suggests that Maternal alcohol use in pregnancy might also contribute to increase the risk of children's behavioral problems ( $OR = 2.591, P = 0.058$ ).

Therefore, preterm birth, history of being hospitalized during the neonatal period, breast-feeding duration, maternal medication use during pregnancy, maternal alcohol consumption during pregnancy were the important risk factors for children's behavior problems during prenatal and neonatal periods. The result shows that early interference and monitoring of the psychological and developmental behaviors of the premature infants, longer duration of breastfeeding, reducing harmful factors exposure during pregnancy (such as alcohol, medicine) will play an important role to prevent and reduce children's behavioral problems.

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### Conflict of interest

The authors declare that they have no conflict of interest.

### References

- Mu LJ, Lu Y, Zhao J (2018) Study on correlation between family rearing environment and behavior development of 3-6 years old children. *J Child Health Care* 26: 63-66.
- Liu T, Wang YR, Wu HS, Xu LQ, Qu LX, et al. (2017) Effects of Family Environment on the Behaviour of Children Left behind and Children Not Left Behind in Rural Areas. *China Maternal and Children Health* 4: 826-829.
- Hu M, Jing J (2011) Research Progress on Influencing Factors of Behavioral Problems in reschoolers. *Chin J Sch Health* 32(4): 509-511.
- Hutchinson EA, De Luca CR, Doyle LW, Roberts G, Anderson PJ; Victorian Infant Collaborative Study Group (2013) School-age outcomes of extremely preterm or extremely low birth weight children. *Pediatrics* 131: e1053-1061. [[Crossref](#)]
- Polić B, Bubić A, Meštrović J, Markić J, Kovačević T, et al. (2017) Emotional and behavioral outcomes and quality of life in school-age children born as late preterm: retrospective cohort study. *Croat Med J* 58: 332-341. [[Crossref](#)]
- Cassiano RG, Gasparido CM, Linhares MB (2016) Prematurity, neonatal health status, and later child behavioral/emotional problems: a systematic review. *Infant Ment Health J* 37: 274-288. [[Crossref](#)]
- Grace T, Oddy W, Bulsara M, Hands B (2017) Breastfeeding and motor development: A longitudinal cohort study. *Hum Mov Sci* 51: 9-16. [[Crossref](#)]
- Ye AX, Tao XY, Yan SQ, Zuo AZ, Pan WJ, et al. (2017) [Effect of breastfeeding on the behavioral development of infants and children: a birth cohort study in Ma'anshan. *Zhonghua Yu Fang Yi Xue Za Zhi* 51: 807-813. [[Crossref](#)]
- Poton WL, Soares ALG, Oliveira RA, Gonçalves H (2008) Breastfeeding and behavior disorders among children and adolescents: a systematic review. *Rev Saude Publica* 52: 9. [[Crossref](#)]
- Meng CJ (2014) Effects of medication on fetal brain nerve development during pregnancy. *Chinese J Pract Nerv Dis* 17: 82-83.
- Polanska K, Jurewicz J, Hanke W (2015) Smoking and alcohol drinking during pregnancy as the risk factors for poor child neurodevelopment - A review of epidemiological studies. *Int J Occup Med Environ Health* 28: 419-443. [[Crossref](#)]
- Gao H, Zhao S, Wang YL (2011) Survey on maternal self-reported alcohol use and childhood behavior associated with prenatal alcohol exposure. *J Child Health Care* 19: 423-425. [[Crossref](#)]