

【Original Article】

Development of 18-month-old infants born to women who smoked during pregnancy: Outcome of a health examination at a municipality health center

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Summary

Various influences on children due to maternal smoking during pregnancy have become evident. However, not many studies have been published on the growth and development of children born to women who smoked during pregnancy. This study aims to investigate the growth and development pattern of children born to women who smoked during pregnancy; these women were first identified and their children were observed from birth up to 18 months of age. Maternal smoking during pregnancy was found to be an important factor influencing various developmental milestones in children, such as physical balance of the body, skilled finger movements, physiological adjustment, and behavioral control. Therefore, we suggest that the children born of mothers who smoked during pregnancy need regular follow-up. These results indicate that maternal smoking during pregnancy should be considered an important index while analyzing results of infant and child health examinations.

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Keywords: pregnant women, smoking, development, health examination

I. Introduction

Although the health risks of smoking are well known, the smoking rate among women in Japan is increasing, especially among those in their reproductive years (20s–40s).¹⁾ In addition, the smoking rate among pregnant women has doubled from 5.6% in 1990 to 10% in 2000.²⁾

It is well known that maternal smoking during pregnancy leads to many disorders in those children, including sudden infant death syndrome,³⁾ congenital abnormalities,⁴⁾ and asthma.⁵⁾ In addition, recently published reports have suggested a relationship between maternal smoking during pregnancy and impulsiveness,⁶⁾ aggressiveness,⁷⁾ and attention-deficit/hyperactivity disorder.⁸⁾ The

impact of maternal smoking on the neurological development of children is also documented.⁹⁾ There are some reports on the relationship between maternal smoking during pregnancy and attention-deficit/hyperactivity disorder in Japan¹⁰⁾; however, there are few studies on the growth and development pattern of children born to mothers who smoked during pregnancy. This study aims to observe the growth and development pattern of these children. We followed the procedure of identifying mothers who smoked during their pregnancy and subsequently followed up their children from birth up to 18 months of age, because major developmental changes occur during this period.

II. Methods

1. Investigation period: May–December, 2009.

2. Study subjects: A total of 209 women who reported their pregnancy status to a health center in city A between August 2006 and March 2007 gave their approval to participate in this study. We also included 175 children (83.7%) born to these women between April and October 2007, who underwent overall health examinations for 18 months after birth, and recorded the results of these examinations.

3. Study contents. Information collected for this study included the smoking status of the mothers and their physical condition, the childrens' physical characteristics at the time of delivery, the childrens' developmental status, and results of the examination performed during the 18-month follow-up. We measured 5 developmental milestones on the basis of the new editions of the Kyoto Scale of Psychological Development:^{11,12)} 1. motor development, 2. language development, 3. development of interpersonal character, 4. ability for independent handling of one's affairs, and 5. sensitivity and persistence.

To test motor development, we observed how skilled a child was at walking, climbing stairs with or without assistance, scribbling, and building with blocks. To test language development, we observed whether a child followed simple verbal instructions, could indicate a known object with a finger, and verbalize 3 or more meaningful words. To test development of interpersonal character, we observed the ability of a child to copy someone's actions, express delight when someone played with him/her, showed interest for interacting with other children, and properly played with a toy automobile or doll. To test independent handling of affairs, we observed the ability of children to adequately feed themselves using a spoon or a fork, to drink water using a cup, and to remove their jackets without assistance. To test sensitivity and persistence, we assessed their sleeping habits,

including difficulty in falling sleeping or having irregular sleeping habits, their ability to place objects in a line, and their shyness around people.

According to the results of the health checkups, we identified those children who required follow-up regarding their psychomotor development; i.e., who were considered to need consultations or services in a specialized medical institution.

4. Methods of analysis: All the expecting mothers were divided into 2 groups as smokers and nonsmokers. The following factors were then assessed for the 2 groups: abnormal labor, gestational age, physical characteristics of the child at birth, development of the child at 18 months of age, and the need for further follow-up in the children.

Statistical significance was tested using the chi-square test and the Mann–Whitney U-test. Multiple logistic regression analysis was performed by the forced-entry method using the following variables: smoking status was used as the dependent variable whereas questions and variables that were significant according to the chi-square test were used as independent variables. The significance level was set at 5%. SPSS17.0J for Windows was used for all analyses.

5. Ethical Considerations: Approval was obtained from the Nara Medical University School of Medicine and Faculty of Nursing Research Review Committee.

III. Results

1. Smoking status at the onset of pregnancy

Of the total, 29.1% (n = 51) were smokers and 70.9% (n = 124) were nonsmokers at the time of onset of pregnancy.

2. Relationship between abnormal labor and smoking

There was no significant relationship between smoking and abnormal labor; abnormal labor occurred in 40.8% (n = 20) of the smoking group and 29.6% (n = 34) of the nonsmoking group.

3. Relationship between gestational age, physical status at birth, and maternal smoking status

Gestational age was not significantly different between the smoking group (mean, 38.8 weeks; range, 33–42 weeks; standard deviation [SD], 1.40 weeks) and the nonsmoking group (mean, 39.0 weeks; range, 35–42 weeks; SD, 1.31 weeks). Weight of the child at birth was not significantly different between the smoking group (mean, 2978.1 g; range, 1908–3950 g; SD, 399.79 g) and the nonsmoking group (mean, 3057.4 g; range, 1946–4140 g; SD, 385.20 g). Length at birth was not significantly different between the smoking group (mean, 49.5 cm; range, 43.0–53.5 cm; SD, 2.17 cm) and the nonsmoking group (mean, 49.4 cm; range, 43.5–54.0 cm; SD, 1.99 cm). Head circumference at birth was not significantly different between the smoking group (mean, 33.0 cm; range, 29.0–36.0 cm; SD, 1.60 cm) and the nonsmoking group (mean, 32.8 cm; range, 20.8–

36.5 cm; SD, 1.75 cm).

4. Infant development and maternal smoking status

1) Delayed motor development

Delayed motor development was significantly more common in the smoking group (31.4%, n = 16) than in the nonsmoking group (5.6%, n = 7; P < .001).

2) Delayed language development

Delayed language development was not significantly different between the smoking group (29.4%, n = 15) and the nonsmoking group (21.8%, n = 27).

3) Delayed personality development

Delayed personality development was not significantly different between the smoking group (7.8%, n = 4) and the nonsmoking group (3.2%, n = 4).

4) Delayed independence in handling affairs

Delayed independence was not significantly

Table 1. Development and need for follow-up among 175 children born to mothers who did and did not smoke during pregnancy n = 175

	Smokers n = 51		Nonsmokers n = 124		χ^2 value	P Value
	n	%	n	%		
Motor development						
Delayed	16	31.4	7	5.6	20.95	0.000 ***
Normal	35	68.6	117	94.4		
Language development						
Delayed	15	29.4	27	21.8	1.16	0.282
Normal	36	70.6	97	78.2		
Personal development						
Delayed	13	25.5	23	18.5	1.07	0.302
Normal	38	74.5	101	81.5		
Personal independence						
Delayed	12	23.5	42	33.9	1.81	0.178
Normal	39	76.5	82	66.1		
Hypersensitivity and dependence						
Yes	37	72.5	57	46.0	10.27	0.001 **
No	14	27.5	67	54.0		
Follow-up needed						
Yes	17	33.3	20	16.1	6.42	0.011 *
No	34	66.7	104	83.9		

*** p < .001, ** p < .01, * p < .05

different between the smoking group (23.5%, n = 12) and the nonsmoking group (33.9%, n = 42).

5) Hypersensitivity and obsessive-compulsive behavior

There was a significant difference in the frequency of hypersensitivity and obsessive-compulsive behavior between the smoking group (46.0%, n = 57) and the nonsmoking group (72.5%, n = 37; P = .001). More children required follow-up in the smoking group (33.3%, n = 17) than in the nonsmoking group (16%; n = 20; P = .011).

5. Impact of maternal smoking during pregnancy on growth and development pattern (Table 2)

Multiple regression analysis indicated that “Delayed motor development” (OR = 8.12 95% CI 2.88–22.88), “Hypersensitivity and obsessive-compulsive behavior ” (OR = 3.68; 95% CI, 1.67–8.11), and the “Need for follow-up” (OR = 2.46; 95% CI, 1.07–5.70) were 3 important outcomes associated with maternal smoking during pregnancy.

IV. Discussion

1. Relation between motor development and maternal smoking during pregnancy

Motor development was determined on the basis

Table 2. Adjusted odds ratio for association of factors with smoking n = 175

	Adjusted odds ratio	95% CI
Motor development		
Normal †	1.00	
Delayed	8.12	(2.88–22.88)
Hypersensitivity and dependence		
No †	1.00	
Yes	3.68	(1.67–8.11)
Follow-up needed		
No †	1.00	
Yes	2.46	(1.07–5.70)

† control group

of factors that related to physical balance of the body or skilled finger movements; i.e., how skilled the child was at walking, climbing stairs with or without assistance, scribbling, and building with blocks. The results of these tests determined that there is a relationship between the physical balance of the body or skilled finger movements and maternal smoking during pregnancy. A previous study on motor development of children reported that 18-month-old children who presented with immature development of motor skills at the end of the follow-up period required a further follow-up for 3 years.¹³⁾ Concurrent with the results of the abovementioned study, children in this study with immature motor development at the end of the 18-month period also needed a further follow-up for 3 years. Therefore, we determined that children born to mothers who smoke during pregnancy need continuous monitoring of motor development with provision of the necessary support.

2. Relationship between sensitivity or persistence and maternal smoking during pregnancy

As previously mentioned, sensitivity or persistence was tested according to factors on the basis of the difficulty in physiological adjustment and behavioral control: difficulty in sleeping or irregular sleeping habits, ability to place objects in a line, and shyness around people. The results indicated that there is a relationship between difficulty in physiological adjustment and behavioral control and maternal smoking during pregnancy. Children exhibiting the above characteristics are considered difficult and hard to raise.¹⁴⁾ Sakaguchi et al.¹⁵⁾ reported that parents of children who are difficult to control suffer from stress and hence psychological support should be provided to such parents.

3. Analysis of results of the 18-month follow-up examination.

The results of this study showed a relationship between maternal smoking during pregnancy

and psychomotor development of the children at the end of 18 months. Slow psychomotor development in childhood indicates possible presence of developmental disorders. The presence of a secondary developmental disorder that results from a negative experience with a family member or society has also been reported.¹⁶⁾ As a result, some early preventive interventions are considered necessary, which can help reduce the stress of the parents.¹⁷⁾ Thus, it is important to intervene and provide necessary care and support for children with immature motor development at 18 months and who need further follow-up.

4. Limitations of this study.

In this study, we observed the growth and development pattern of children from birth up to 18 months of age. However, since 18-month-old children exhibit many individual differences in their developmental progress, it is preferable for their development to be continuously monitored. In addition, multiple hereditary and environmental factors must be taken into account as reported by Beker et al.¹⁸⁾ Furthermore, it is difficult to determine the exact number of actual smokers using a paper-based questionnaire. In future, the smoking behavior must be analyzed using biomarkers.

V. Conclusions

The results of this study demonstrated that maternal smoking during pregnancy exerted some influences on embryonic factors associated with physical balance of the body, skilled finger movements, physiological adjustment, and behavioral control. Furthermore, children born to mothers who smoked during pregnancy need a further follow-up of their motor development. From these results, we determined that maternal smoking during pregnancy must be considered an important factor during overall health examinations of children.

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妊娠中の喫煙者から出生した1歳6か月児の発達 —保健センターでの健康診査結果から—

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要 旨

妊娠中の喫煙による子どもへの様々な影響が、明らかにされている。しかし妊娠中の喫煙者から出生した子どもを追跡した、発育発達に関する研究は多くはない。本研究は、妊娠期における喫煙者を把握しその後出生した子どもを追跡し、生後 18 か月までの発育発達の特徴を明らかにすることを目的とした。その結果、妊娠中の喫煙は、身体のバランスや手指の巧緻性や生理的調整や行動の制御に対する、胎児期における何らかの要因であることが考えられ、喫煙者から出生した子どもはフォローを要する対象となる可能性の高いことが示唆された。これらの結果から、幼児健診ではアセスメントを行う際に、妊娠期の喫煙状況も指標の1つとして考慮することが必要ではないかと考える。

キーワード：妊娠女性、喫煙、発達、健康診査

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