

Evaluation of Child Care Practice Factors That Affect the Occurrence of Sudden Infant Death Syndrome: Interview Conducted by Public Health Nurses

Tetsuro TANAKA¹ and Noriko KATO¹

¹Department of Maternal and Child Health, National Institute of Public Health, 4-6-1 Shirokanedai, Minato-ku, Tokyo

Abstract

We examined the child-rearing environmental factors that affect the occurrence of sudden infant death syndrome (SIDS) using a nationwide survey. Infants who died due to SIDS between January 1996 and June 1997 in Japan were identified from death certificates. Controls of the same gender, birthplace, and birth months as the corresponding SIDS were chosen from birth certificates. Interviews of both cases and controls were undergone in January and February, 1998 by public health nurses. The following child-rearing factors exhibited a significant relationship with the occurrence of SIDS: Concerning the sleeping position, the prone position was associated with increased risk compared with the supine position, with an odds ratio of 3.02 (95% c.i. 2.07–4.65). Regarding the feeding method, artificial feeding alone demonstrated a higher risk than breast feeding alone, with an odds ratio of 4.92 (95% c.i. 2.78–9.63). With regard to smoking, infants with both parents who smoked exhibited a higher risk than infants where neither parent smoked, with an odds ratio of 3.50 (95% c.i. 1.74–8.32).

Key words: sudden infant death syndrome, child care practice, prone sleeping position, smoking, artificial feeding

Introduction

In Japan, recent vital statistics have shown that sudden infant death syndrome (SIDS) is the third most frequent cause of deaths in infants, with the number of deaths being 579 in 1995 and 526 in 1996, suggesting that SIDS is a major health problem of children. In Western countries, the association between SIDS and sleeping prone has been suggested^{1,2)}, and a campaign for modification of this practice has been carried out³⁾. In Japan, there have been a few studies on SIDS, but no national survey has been performed, and the status of SIDS remains unclear. To prevent SIDS and provide basic information for health guidance, we analyzed cases of SIDS and evaluated the association between SIDS and child care practices.

Materials and Methods

Of infants who died between January, 1996 and June, 1997 837 were classified as SIDS infants by the Statistics and Information Department of the Ministry of Health and Welfare, Japan. With the permission of the Management and Coordination Agency,

a list of the names, dates of death, and addresses of these SIDS infants was produced using records of death stored in public health centers. Control infants matched with the SIDS infants for the following items were selected using records of birth stored in public health centers. The SIDS infants and controls were of the same gender, lived in the same municipalities, and were as close as possible to the birth date. When there were no controls with a birth date close to that of the SIDS infants, and widening of the birth date range in the same municipalities resulted in a different birth month, infants with the same birth month in the adjacent municipalities were selected as controls. When controls selected using birth records were absent for reasons such as moving out of the municipality, other controls were selected using the same procedures with a widening of the range of conditions. The SIDS infants and controls who differed in the birth date by 1 month or more were excluded from analysis.

The survey period was from January to February, 1998. A detailed visiting survey manual was produced, and investigators were given instructions to take consideration of the fact that the couples surveyed lost their child due to SIDS and to be careful about the protection of privacy. In addition, all the couples were given documents stating the purpose of this survey, and their consent for the survey was obtained. Documents were delivered to guardians by mail or a home visit.

Time spent in interview was considered to be longer in cases of SIDS infants. It is not only because the number of questions was greater in SIDS cases, but also because interviews were care-

Received Nov. 2 2000/Accepted Feb. 20 2001

Reprint requests to: Tetsuro TANAKA

Department of Maternal and Child Health, National Institute of Public Health, 4-6-1 Shirokanedai, Minato-ku, Tokyo 108-8638 Japan

TEL: +81(3)3441-7111 (ext.292), FAX: +81(3)3446-6495

Table 1 Age at death of SIDS infants

Age at death	Number	Proportion (%)
After birth <1 month	36	(9.3%)
1 month=< <2 months	49	(12.7%)
2 months=< <3 months	56	(14.5%)
3 months=< <4 months	35	(9.1%)
4 months=< <5 months	52	(13.5%)
5 months=< <6 months	41	(10.6%)
6 months=< <7 months	23	(6.0%)
7 months=< <8 months	19	(4.9%)
8 months=< <9 months	17	(4.4%)
9 months=< <10 months	11	(2.8%)
10 months=< <11 months	6	(1.6%)
11 months=< <12 months	5	(1.3%)
1 year=< <1 year 6 months	19	(4.9%)
1 year 6 months=< <2 years	7	(1.8%)
2 years=< <2 years 6 months	5	(1.3%)
2 years 6 months=< <3 years	4	(1.0%)
3 years=< <3 years 6 months	0	(0.0%)
3 years 6 months=< <4 years	0	(0.0%)
4 years=< <4 years 6 months	0	(0.0%)
4 years 6 months=< <5 years	0	(0.0%)
5 years=< <5 years 6 months	1	(0.3%)
Total	386	(100.0%)

fully conducted not to hurt the feelings of parents or guardians.

Responses to the survey were obtained from 425 of 837 couples, after excluding 107 who had moved away. After excluding 39 couples because the gender of the control child differed, the birth date of the control was ≥ 1 month earlier or later, or the description was incomplete, 386 couples were used for the analysis.

There were 227 males (58.8%) and 159 females (41.2%) each in the SIDS infants and controls. The survival period was between 2 months and less than 3 months in 56 SIDS infants (14.5%), and

less than 6 months in 269 (69.7%) (Table 1).

Both cases and controls were asked the following items: birth weight, gestation period, usual sleeping practices, nutritional method, parental smoking, head control, turning over, growth disturbance, room temperature, and bedding-clothing. Child-care practices asked of controls were the conditions at the same months of age as the SIDS babies died. For SIDS cases, additional questionnaires were asked: how the babies were placed at bedtime, and the sleeping position when the babies were found dead.

A 2x2 contingency table for case-control studies with matched data was produced. Based on this table, the odds ratio in paired cases was obtained, and the MacNemar test statistic was calculated. Tests using an odds ratio=1 as the null hypothesis were performed, and the interval of the odds ratio was estimated.

Logistic regression analysis of the following items was performed using SIDS infants or controls as a criterion variable: birth weight (<2,500 g·2,500 g), gestation period (<37 weeks·37 weeks), sleeping position placed on the day of death (prone·supine, recumbent), nutritional method, parental smoking (only father smokes·only mother smokes·both parents smoke·neither parent smokes), turning over (freely·became recently possible·not yet), growth disturbance (said something·said nothing), room temperature (high·slightly high·average·low), and bedding·clothing (much·slightly much·average·light). Since the findings were 1-to-1 matched data, the conditional logistic model was used, and analysis was performed by the backward elimination method. A total of 330 pairs were analyzed by logistic regression. SPSS 6.1 for Windows was used as statistical software.

Results

For each factor, the odds ratio for paired SIDS infants and controls was obtained, and tests were performed to determine whether there was a difference in the percentage of infants with the factor (Table 2).

Table 2 Paired odds ratio according to various factors concerning SIDS

Items	Category classification 1	Category classification 2	n ₁₁	n ₁₀	n ₀₁	n ₀₀	MacNemar's value	Odds ratio	Confidence interval (95%)	Level of significance
Birthweight	~2,499 g	2,500 g~	13	68	15	290	32.578	4.533	2.700~8.264	***
Gestational age	~36 weeks	37 weeks~	7	53	15	311	20.132	3.533	2.081~6.540	***
Usual sleeping position	prone	supine	20	69	32	190	12.832	2.156	1.453~3.351	***
Sleeping position on the day of death	prone	supine	25	94	31	171	30.752	3.032	2.066~4.647	***
Feeding method	artificial	breast	57	59	12	142	29.803	4.917	2.780~9.631	***
Smoking of parents	both	none	12	28	8	37	10.028	3.500	1.735~8.324	**
Room temperature (compared with other rooms)	higher rather high	the same lower	27	29	61	225	10.678	0.475	0.315~0.755	**
Clothing (compared with adults)	thicker rather thick	the same thinner	8	45	58	250	1.398	0.776	0.538~1.165	ns

*** p<0.001, ** p<0.01.

1) Counting of the number of matched pairs according to category classification 1 and 2.

	Control	
	Category classification 1	Category classification 2
SIDS	category classification 1	n ₁₁
	category classification 2	n ₀₁
		n ₁₀
		n ₀₀

2) Odds ratio ($=n_{10}/n_{01}$) indicates how many times the risk of category 2 is, compared to that of category 1.

Table 3 Sleep practices at death

	Number	Percentage
How the babies were placed at bedtime		
Prone	133	(34.5%)
Supine	219	(56.7%)
Side	10	(2.6%)
Forgotten	9	(2.3%)
Others	9	(2.3%)
No answer	6	(1.6%)
Total	386	(100.0%)
Sleeping positions when the babies were found dead		
Prone	186	(48.2%)
Supine	150	(38.9%)
Side	14	(3.6%)
Forgotten	13	(3.4%)
Others	19	(4.9%)
No answer	4	(1.0%)
Total	386	(100.0%)

The percentage of infants with a birth weight <2,500 g was significantly high ($p<0.001$) in the SIDS infants (odds ratio, 4.533). The percentage of infants with a pregnancy period less than 36 weeks was significantly higher ($p<0.001$) in the SIDS infants (odds ratio, 3.533).

Concerning the sleeping position routinely placed and that on the day of death (routine sleeping position was used in the controls), “prone” and “supine” were compared. Both the percentage of infants routinely placed “prone” and that of infants placed “prone” on the day of death were significantly high ($p<0.001$) in the SIDS infants (odds ratio of “prone” to “supine” on the day of death, 3.032).

As nutritional methods, “artificial feeding” and “breast feeding” were compared. The percentage of infants with “artificial feeding” was significantly high ($p<0.001$) in the SIDS infants (odds ratio of “artificial feeding” to “breast feeding”, 4.917).

As parental habitual smoking, “both parents smoke” and

“neither parent smokes” were compared. The percentage of infants with “both parents smoke” was significantly ($p<0.01$) higher in the SIDS infants (odds ratio of “both parents smoke” to “neither parent smokes”, 3.500).

Analysis of room temperature and bedding-clothing showed that the percentage of infants who slept at a “high-slightly high” room temperature was significantly lower ($p<0.01$) than that of infants who slept at the “routine or low” room temperature in the SIDS infants.

On the day of death, 133 infants were placed prone at bedtime, the number being 32 higher than the 101 infants who were placed prone in routine practice (Table 3). When an abnormality was detected, the infants were most frequently in the prone position, whose number was 53 higher than that of infants placed prone at bedtime on the day of death.

As a result of logistic regression analysis (Table 4), the presence or absence of head control, whether turning over was possible, and whether something had been said about growth were added to the explanatory variables. Concerning turning over, since there were many infants found prone at the time of detection of an abnormality although they were placed supine at bedtime, turning over ability was regarded as a risk, and infants who had not achieved turning over were considered to be the baseline.

The odds ratio did not markedly change for the sleeping position placed at bedtime, parental habitual smoking, and room temperature, decreased for birth weight and nutritional methods. The gestational period and head control could not be taken into the regression equation. The odds ratio of “said something about growth” was significant ($p<0.01$). The odds ratio of “recently began to turn over” was 1.809, which was significant ($p<0.05$).

Discussion

The SIDS cases in this study were classified according to the manual of the Statistics and Information Department of the Ministry of Health and Welfare, Japan. Those cases classified as “Sudden Infant Death Syndrome” were stated as such in the death cer-

Table 4 Conditional logistic regression analysis concerning SIDS

Dependent variables		Odds ratio	95% C.I.	Significance
Birthweight	~2,499 g	2.215	1.272~3.857	**
	2,500 g~	baseline		
Sleeping position on the day of death	prone	2.900	1.914~4.394	***
	supine	baseline		
	side	3.061	0.890~10.53	
Feeding method	breast	baseline		
	artificial	1.828	1.186~2.820	**
	mixed	1.709	1.127~2.590	*
Parents' smoking	both	3.015	1.796~5.060	***
	none	baseline		
Rolling over	beginning	1.089	1.039~3.149	*
	not yet	baseline		
Growth disturbance	present	2.099	1.314~3.352	**
	absent	baseline		
Room temperature	rather high	0.480	0.304~0.759	**
	the same	baseline		
Clothing	rather thick	0.472	0.283~0.790	*
	the same	baseline		
	thin	0.347	0.226~0.531	***

*** $p<0.001$, ** $p<0.01$, * $p<0.05$.

tificates. A total of 74% of the SIDS cases were without autopsy, so the SIDS classification is not a precise definition.

The odds ratio of sleeping prone in Japan (3.02) was slightly lower than that in other countries⁴⁻⁸⁾ (5.4~11.7). The odds ratio of parental smoking in other countries^{6,7,9-12)} has been reported to be about 2.5~8.5, in which the value in Japan (3.50) was included. The odds ratio of artificial feeding in other countries^{7,8)} has been reported to be 2.0~7.7, in which the value in Japan (4.92) was included.

Concerning room temperature and bedding·clothing, too warm or too much clothing could not be identified as a definite factor. The questions themselves may have been abstract and caused some problems.

When other factors were adjusted by logistic regression analysis, the odds ratios for birth weight·nutritional method were lower than those in the single analysis, and the gestation period·stable neck could not be taken into the regression equation. A significant odds ratio was obtained for growth abnormalities. These findings suggest confounding of these factors.

“Recently began to turn over” was isolated as a factor, which was consistent with various discussions on the influence of turning over¹³⁾. Both growth retardation and beginning of turning over were selected as risk factors. If growth was retarded, turning over occurs at later months of ages. So, it is impossible that two factors occur in the same baby. This finding indicates that if the babies are occasionally in the developmental stage of turning over, then the risk of SIDS also increases.

Analysis of infant care-related factors suggested the necessity

for promoting health guidance of sleeping supine, breast feeding, and parents' abstention from smoking. Among infants who died, there were some who were placed supine at bedtime but found dead in the prone position. This suggests that placing infants in the supine position is not always safe, and infants often turn over into the prone position before falling asleep. Although babies themselves turn over after placing supine, it is important to promote the opinion that placing infants supine is recommended.

In addition, as artificial feeding was pointed out to be a risk factor, mothers who cannot produce milk may become anxious. The present findings should be interpreted to indicate that the absence of breast feeding itself is not always a risk, but it should be stressed that the attitude of trying to breast feed is preferable when both artificial and breast feeding are possible. Excessive anxiety should not be created in mothers who cannot produce milk even if they make an effort to breast feed.

Though statistical analysis in this study showed factors associated with SIDS, their concrete relationship with SIDS is unclear. The actual mechanism of induction of SIDS by each factor should be evaluated by approaches other than the present method.

Acknowledgment

Supported by a grant of the Research on Mental and Physical Disability from the Ministry of Health and Welfare of Japan. We thank guardians of SIDS infants who were co-operative to interview and also local health center staffs for their contribution.

References

- 1) Mitchell EA, Taylor BJ, Ford RP, Stewart AW, Becroft DM, Thompson JM, et al. Four modifiable and other major risk factors for cot death: the New Zealand study. *J. Paediatr. Child Health* 1992; 28 (suppl 1): S3-S8.
- 2) Engelberts AC, de Jonge GA, Kostense PJ. An analysis of trends in the incidence of sudden infant death in the Netherlands 1969-1989. *J. Paediatr. Child Health* 1991; 27: 329-333.
- 3) Gibson AAM. Current epidemiology of SIDS. *J. Clin. Pathol.* 1992; 45 (suppl): 7-10.
- 4) Fleming PJ, Gilbert R, Alaz Y, Berry PJ, Rudd PT, Stewart A. Interaction between bedding and sleeping position in the sudden infant death syndrome: a population based case-control study. *BMJ* 1990; 301: 85-89.
- 5) Scragg RKR, Mitchell EA, Stewart AW, Ford RPK, Taylor BJ, Hassall IB. Infant room-sharing and prone sleep position in sudden infant death syndrome. *Lancet* 1996; 347: 7-12.
- 6) Oyen N, Markestad T, Skjaerven R, et al. Combined effects of sleeping position and prenatal risk factors in sudden infant death syndrome, the Nordic epidemiological SIDS study. *Pediatr.* 1997; 100: 613-621.
- 7) Brooke H, Gibson A, Tappin D, et al. Case-control study of sudden infant death syndrome in Scotland, 1992-1995. *BMJ* 1997; 314: 1516-1520.
- 8) Schellscheidt J, Ott A, Jorch G. Epidemiological features of sudden infant death after a German intervention campaign in 1992. *Eur. J. Pediatr.* 1997; 156: 655-660.
- 9) Mitchell EA, Ford RPK, Stewart AW, Taylor BJ, Becroft DM, Thompson JM. Smoking and the sudden infant death syndrome. *Pediatrics.* 1993; 91: 893-896.
- 10) Malloy MH, Hoffman HJ, Peterson DR. Sudden infant death syndrome and maternal smoking. *Am. J. Public Health* 1992; 82: 1380-1382.
- 11) Cowan S, Tappin D, Ford R. Kids against SIDS. *Health Education* 1996; 1: 20-25.
- 12) Wennergren G, Aim B, Oyen N, et al. The decline in the incidence of SIDS in Scandinavia and its relation to risk intervention campaigns. *Acta Pediatr.* 1997; 86: 963-968.
- 13) Schechtman VL, Harper RM, Wilson AJ, Southall DP. Sleep state organization in normal infants and victims of the sudden infant death syndrome. *Pediatrics* 1992; 89: 865-870.