

Prevalence and Determinants of Prone Sleeping Position in Infants: Results from Two Cross-Sectional Studies on Risk Factors for SIDS in Germany

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The authors investigated whether there was a decline in infants sleeping prone and other modifiable risk factors for sudden infant death syndrome (SIDS) in Germany, where, as in some other countries, no nationwide intervention campaign against the prone sleeping position had been initiated. Data were obtained from parents by mailed questionnaires in two cross-sectional studies in 1991 ($n = 3,330$) and 1995 ($n = 3,124$). Prevalence of prone sleeping decreased from 37.6% to 8.7% ($p < 0.05$) in the German population and from 44.1% to 32.0% ($p < 0.05$) in the Turkish immigrant population. Parents who laid their infants prone in 1995 were less likely to follow advice from physicians, public media, and other parents (relative risks < 0.5 , $p < 0.05$) and were more likely to have a low educational level, to be < 20 years old, to be single parents, to have two or more children, to be raised in West Germany, or to be of Turkish ethnicity. Although the information on prone sleeping being a risk factor for SIDS became known among the population, these data suggest that subgroup-specific public intervention campaigns may be needed to reduce the prevalence of prone sleeping even further in those countries where no nationwide campaign has been initiated. *Am J Epidemiol* 1999;150:51–7.

cross-sectional studies; infant care; infant, sleeping position; intervention studies; prevalence; risk; sudden infant death

For the last decade, there has been increasing evidence that the prone sleeping position may be positively associated with the risk of sudden infant death syndrome (SIDS) (1–16). Although there is evidence for subtle changes in physiologic parameters observed in infants sleeping prone (17–21), the mechanisms by which the prone sleeping position may increase the risk of SIDS are still not understood.

Because this risk factor is easily modifiable by behavioral changes, recommendations not to let infants sleep prone were given to pediatricians (9, 22), and public intervention campaigns aimed at the reduction of this modifiable risk factor (23) have been initiated in many countries. It was possible to demonstrate that these interventions were successful in reducing the prevalence of infants sleeping prone (24–26). At the same time, a substantial reduction in the SIDS incidence could also be observed (27–33), supporting the

hypothesis that the prone sleeping position may be a causal risk factor for SIDS.

In Germany, there was a decreasing trend in the official mortality statistics from approximately 1.5–2.0 SIDS cases per 1,000 live births during 1986–1991 to 0.8–1.0 per 1,000 live births in 1994–1995 (figure 1). This gave rise to the question whether the decline in SIDS may be due to a reduction in the prevalence of the prone sleeping position or some other modifiable risk factors for SIDS, which might have arisen even without a nationwide public intervention campaign, comparable with the governmental “back to sleep” campaign in England (34). Therefore, we carried out a cross-sectional study on the prevalence of these risk factors in three states of Germany in 1995. In comparison to a virtually identical study in 1991 (35), which had been performed when the public was still unaware of this association, this second study provided the opportunity to demonstrate potential trends over time.

MATERIALS AND METHODS

A cross-sectional study was carried out in three German states, Lower Saxony, Northrhine-Westphalia, and Berlin, in November and December 1995. From Berlin, a sample of the German population and a sample of the Turkish immigrant population were included; participation in the two remaining states was restricted to Germans.

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Abbreviation: SIDS, sudden infant death syndrome.

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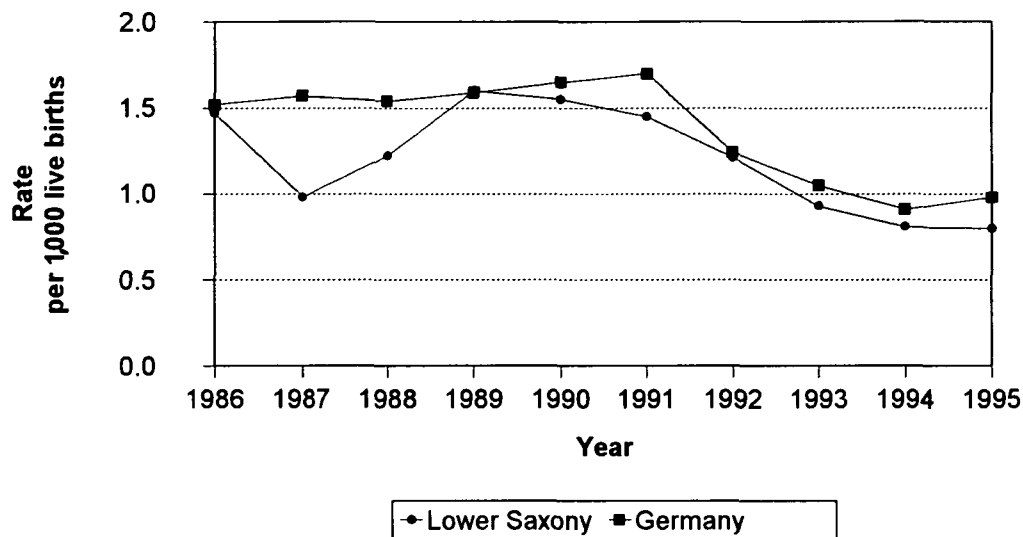


FIGURE 1. Annual incidence rates for sudden infant death syndrome (SIDS) in the German state of Lower Saxony and in all of Germany according to national vital statistics for SIDS (*International Classification of Diseases*, 9th Revision code 798.0), 1986–1995.

In each state, a stratified random sample of rural and urban communities was identified. The authorities in each community were asked to provide all addresses of parents with a baby born between June 1 and October 31, 1995. Addresses were selected from the official registries of local residents (*Einwohnermeldeämter*), in which 100 percent of all local residents are listed. A 4-page questionnaire in the German language was sent out to parents by the study center in mid-November, i.e., when the infants were 1–6 months old. Due to budget constraints, only half of the parents who had not replied within 2 weeks could be sent a reminder.

The 1995 questionnaire was a refinement of the one used in 1991 and covered basic characteristics of parents and child, feeding and sleeping habits, reasons for the choice of the infant's sleeping position, sweating and minor illnesses of the child, and the parents' education. Parents were asked to provide information on their baby's health and sleeping position both for the day on which the questionnaire was completed and for the preceding week.

The same study design had been used in the 1991 survey (35) with only minor differences: In both Berlin and Northrhine-Westphalia, study participants had been sampled from the Turkish population and sent a questionnaire in the Turkish language. Again, due to cost restrictions, both could not be replicated in the 1995 study.

Descriptive and analytical statistics of both surveys were performed using the *Statistical Package for the Social Sciences* (SPSS) version 6. Ninety-five percent confidence limits of prevalence estimates were calcu-

lated by the method described by Ahlbom and Norell (36). The alpha error was restricted to less than 5 percent.

RESULTS

Of the 5,258 questionnaires sent out in 1995, 3,177 were returned, resulting in an overall response rate of 60.4 percent. After data quality checks, 3,124 reply forms remained to be included in further analyses. Major characteristics of the study sample, compared with those from 1991, are shown in table 1. The response rate of the German population remained quite similar at around 70 percent, while that of the Turkish population declined from 40 percent to 24 percent. Distributions of sex, age at time of study, gestational age at birth, and proportions of single parents among study participants were almost identical. There was a slight, but statistically significant increase (t test: $p < 0.001$) in both mothers' and fathers' age between the two samples studied, even within subgroups of German and Turkish ethnicity.

Prevalence estimates of risk factors for SIDS broken down by ethnic group are presented in table 2. Between 1991 and 1995, there was no significant change in the prevalence of maternal cigarette smoking during pregnancy in either group. Households with at least one member who was a current smoker became slightly less frequent among the German sample (from 44 to 39 percent), but substantially more frequent in the Turkish sample (from 36 to 64 percent). Both results were statistically significant. The proportion of infants that were fully breastfed at the time of study

TABLE 1. Basic characteristics of the study samples of 1991 and 1995: studies on risk factors for sudden infant death syndrome in Germany

Characteristic	Study sample year	
	1991†	1995‡
No. of participants	3,330	3,124
Response rate (%)		
Overall	62.9	60.4
German population	66.9	76.1
Turkish population	40.3	23.9
Children's gender (%)		
Male	51.4	51.7
Female	48.6	48.3
Children's age (days), mean (SD§)	108.9 (45.3)	109.2 (38.3)
Gestational age (weeks), mean (SD)	39.3 (2.0)	39.4 (2.0)
Birth weight (g), mean (SD)	3,390 (588)	3,414 (578)
No. of siblings, median	1	1
Mothers' age* (years), mean (SD)	27.5 (4.9)	29.1 (4.5)
Fathers' age* (years), mean (SD)	30.4 (6.1)	31.8 (5.7)
Single parent (%)		
Mother	2.8	3.1
Father	<0.1	0.1

* t test: $p < 0.001$, unconfounded by ethnicity.

† Nolting et al. (35).

‡ Present study.

§ SD, standard deviation.

increased significantly in both groups, with a higher prevalence among the German population in both years. The most prominent change in risk factor prevalence occurred in the sleeping position of the German children, showing a decline from 38 percent in 1991 to 9 percent in 1995, with regard to the information given for the day on which the questionnaire was completed. During the preceding week, 40 percent infants had been predominantly laid prone in 1991 compared with 9 percent in 1995. Both results are statistically significant. The 1995 prevalence proportion of prone sleeping was found to be lowest in Northrhine-Westphalia (from 32.7 percent [95 percent confidence interval (CI) 29.3–36.1] in 1991 to 6.5 percent [4.6–8.4] in 1995), intermediate in Lower Saxony (from 50.8 percent [47.1–54.5] to 7.7 percent [5.9–9.5]) and highest in Berlin (from 34.2 percent [30.2–38.2] to 10.5 percent [8.9–12.1]). Among the Turkish sample, the prevalence of prone sleeping also declined from 41 to 34 percent. This difference, however, failed to yield statistical significance. There was no major overall difference in either ethnic group between the position the infants were laid to sleep and the position in which they were found after waking.

Within the 1995 study sample, we further investigated what factors discriminate between infants who were put to sleep in the prone position compared with

those who were laid in some other position on the day on which the questionnaire was completed. Parents who claimed to follow advice from pediatricians, their maternity hospital, other parents, or public media (books/magazines, radio/television) regarding the choice of the sleeping position were less likely to place their infants prone, with statistically significant relative risks well below 0.5 for each category (table 3). On the other hand, parents who chose their infant's sleeping position on the grounds that the "infant sleeps better" were over tenfold more likely to place them prone.

Individual factors that were positively associated with the prone sleeping position are shown in table 4, with magnitudes of effect estimated as relative risks. Apart from Turkish ethnicity, the following variables indicated a higher likelihood of prone sleeping: low parental education, low parental age, single parenthood of the mother, the index infant having older siblings, and mother or father having grown up in West Germany compared with East Germany.

Multicollinearity of risk factors is likely to occur in these crude analyses. To evaluate what factors were independently associated with prone sleeping, we used unconditional logistic regression and applied a stepwise forward model building strategy. The final model is shown in table 5. More likely to be placed prone were young infants (<12 weeks), infants who lived with their mothers only, infants whose fathers had grown up in West Germany rather than East Germany, infants of Turkish ethnicity, and infants whose parents chose their infant's sleeping position for the reason that "the infant sleeps better." Furthermore, children of parents who claimed to follow advice given by books or their maternity hospitals were significantly less likely to be placed prone.

DISCUSSION

Temporal changes in the prevalence of infants who sleep prone may be appropriately evaluated by repeated cross-sectional studies, as long as good comparability of the study samples and their underlying populations is assured. In order to accomplish this goal, the sampling technique, the area of research, the season of the year, and the questionnaires were virtually identical in our studies of 1991 and 1995. To avoid any information bias introduced by parents who may tend to answer what they believe is expected of them, no questions were asked about whether the parents knew about the prone sleeping position being a risk factor for SIDS. Because the public was aware of this association in 1995, it cannot be ruled out that some parents may have given answers biased toward the recommended child care practice. This potential bias,

TABLE 2. Population prevalence (and 95% confidence intervals) of risk factors for sudden infant death syndrome in Germany, 1991 and 1995, by ethnic group

Ethnic group and risk factor	Prevalence (%) by study year	
	1991†	1995‡
German	(n = 3,007)	(n = 2,936)
Smoking during pregnancy	21.8 (20.3–23.3)	21.8 (20.3–23.3)
Household smoking§,*	43.9 (42.1–45.7)	38.5 (36.7–40.3)
Breastfeeding¶,*	34.7 (33.0–36.4)	43.9 (42.1–45.7)
Laid prone same day*	37.6 (35.9–39.3)	8.7 (7.7–9.7)
Found prone same day*	38.1 (36.4–39.8)	9.0 (8.0–10.0)
Predominantly laid prone last week*	39.5 (37.7–41.3)	9.3 (8.2–10.4)
Predominantly found prone last week*	39.8 (38.0–41.6)	9.4 (8.3–10.5)
Turkish	(n = 323)	(n = 188)
Smoking during pregnancy	22.7 (18.0–27.4)	29.1 (22.2–36.0)
Household smoking§,*	35.7 (30.4–41.0)	64.3 (57.4–71.2)
Breastfeeding¶,*	17.6 (13.4–21.8)	23.2 (17.0–29.4)
Laid prone same day*	44.1 (38.7–49.5)	32.0 (25.1–38.9)
Found prone same day	40.9 (35.5–46.3)	33.7 (26.6–40.8)
Predominantly laid prone last week	45.1 (39.6–50.6)	38.9 (31.9–45.9)
Predominantly found prone last week	43.1 (38.1–48.1)	35.5 (28.6–42.4)

* χ^2 test: $p < 0.05$.

† Nolting et al. (35).

‡ Present study.

§ At least one household member was a smoker at time of study.

¶ Fully breastfed at time of study.

TABLE 3. Crude relative risks of prone sleeping and parents' reasons for their infants' sleeping position: study on risk factors for sudden infant death syndrome in Germany, 1995

Reason for the sleeping position chosen	Relative risk	95% CI*
Pediatrician's advice	0.29	0.19–0.44
Advice from the maternity hospital	0.14	0.09–0.22
Advice from other parents	0.32	0.19–0.54
Advice from books/magazines	0.12	0.07–0.22
Advice from radio/television	0.16	0.04–0.64
Infant sleeps better	11.8	8.4–16.6

* CI, confidence interval.

however, is inherent to any population-based cross-sectional study and is very difficult to quantify.

Although response rates among the German samples increased slightly from the first to the second survey, this is unlikely to fully explain the major decrease in the observed prevalence of infants who are placed to sleep prone. Response rates among the Turkish immigrant samples, however, were low in 1991 and poor in 1995. When we restricted our analyses to Turkish parents from Berlin, the 1991 prevalence estimates for all risk factors were virtually the same. Nevertheless, some major selection bias must be suspected, espe-

TABLE 4. Crude relative risks for determinants of the prone sleeping position in infants: study on risk factors for sudden infant death syndrome in Germany, 1995

Variable	Reference category	Relative risk	95% CI*
Mother: low education†	Higher education	1.9	1.6–2.2
Father: low education†	Higher education	1.2	0.9–1.6
Mother's age <20 years	Age \geq 20 years	2.4	1.3–4.2
Father's age <20 years	Age \geq 20 years	2.2	0.7–6.8
Mother is single parent	Not single	2.1	1.4–3.1
Household smoking‡	No smoking	1.4	1.1–1.7
Siblings	No siblings	1.6	1.2–2.1
Mother is from West Germany	East Germany	1.9	1.3–2.7
Father is from West Germany	East Germany	2.8	1.8–4.4
Turkish ethnicity	German ethnicity	3.7	2.9–4.7

* CI, confidence interval.

† *Hauptschule* school or less. Note: *Hauptschule* is the lowest possible school education in Germany, lower than high school.

‡ At least one household member was a smoker at time of study.

TABLE 5. Risk factors independently associated with the prone sleeping position, evaluated by stepwise logistic regression analysis (final model): study on risk factors for sudden infant death syndrome in Germany, 1995

Risk factor	Odds ratio	95% CI*
Infant's age (weeks)		
<12	2.4	1.6–3.5
12–19	1.1	0.8–1.6
≥20	1.0	†
Infant lives with		
Mother only	2.1	1.1–3.9
Both parents	1.0	†
Father grew up in		
West Germany	3.3	2.0–5.6
East Germany	1.0	†
Ethnicity		
Turkish	2.2	1.4–3.2
German	1.0	†
Reason for the chosen sleeping position		
“Infant sleeps better”		
Yes	9.5	6.9–13.1
No	1.0	†
“Advice from books”		
Yes	0.3	0.2–0.5
No	1.0	†
“Advice from the maternity hospital”		
Yes	0.4	0.2–0.6
No	1.0	†

* CI, confidence interval.

† Reference category.

cially in the 1995 sample and most likely toward the more educated and better assimilated Turkish parents. It is possible that the prevalence of infants who sleep prone may be higher among the Turkish immigrants who are not fluent in German and who are therefore both unaware of the association between prone sleeping position and SIDS and under represented in this study. However, when interpreting our results among the Turkish immigrant population, one should keep in mind that the direction by which prevalence estimates may be biased cannot be predicted with certainty.

Apart from this, there were no major differences in the demographic characteristics between the 1991 and 1995 samples. The statistically significant difference in maternal and paternal age, which is unconfounded by ethnicity, may at least in part be attributed to a general trend in the population. According to data from the Federal Statistical Office of Germany (*Statistisches Bundesamt*), there was an increase in the average age

of mothers who delivered infants between 1991 (37) and 1995 (38). Although some selection bias by parental age cannot be fully ruled out, it is unlikely to influence prevalence estimates to a significant extent.

A substantial decrease in the prevalence of infants who sleep prone has been observed in several western countries. There were, for example, reports from New Zealand (from 36.8 percent in 1987–1988 to 2.5 percent in 1993 (39)), Tasmania (from 29.9 percent in 1988 to 5 percent in 1991–1992 (31, 40), and England (from 59 percent to 2 percent in 1991–1992 (41)). The magnitudes of the earlier prevalence estimates are similar to the figures found in our study in 1991, when the public was still largely unaware of sleeping prone being a risk factor for SIDS. Our 1995 prevalence estimates of about 9 percent, however, are substantially higher than those from the above mentioned countries, suggesting some potential for further risk factor reduction.

There are similar results from US surveys on infant sleeping position, which was found to have significantly changed (24, 42, 43) after publication of the official American Academy of Pediatrics Sleep Position Statement in 1994 (22, 44). Recent studies suggest that the overall prevalence of US infants who sleep prone dropped from 70 percent in 1992 to 24 percent in 1996 (45). In prospective cohort studies, the proportions of infants placed in a prone position at 6 months of age was 33 percent (46), and 36 to 40 percent in infants born to predominantly low-income, inner-city mothers (47).

In all of the studies cited above, the decrease of prone sleeping could be attributed to nationwide public intervention campaigns aimed at the reduction of this modifiable risk factor. In Germany, some regional promotion activities (48) have taken place, and articles and recommendations against the prone position were published in several journals (49–51). However, no nationwide public intervention campaign has so far been undertaken in Germany. Nevertheless, the information that prone sleeping position is a risk factor for SIDS found its way into public media such as newspapers, magazines, or books for expecting parents. Our data suggest that these activities were successful in increasing public awareness and reducing the prevalence of infants who sleep prone to a major extent. In Northrhine-Westphalia, where promotion activities had been most intense, the lowest prevalence proportion of infants sleeping prone was found in 1995, although the difference to Lower Saxony did not yield statistical significance. Evidence from international intervention studies indicate that thoroughly planned, large-scale, and subgroup-specific public interventions might have been able to reduce the prevalence of prone sleeping to an even greater extent.

Our data also suggest that there are still some groups of parents in Germany who are unaware of the association between prone sleeping position and SIDS. These groups can be identified and described by factors such as Turkish ethnicity, low education, young age, single parenthood, smoking, and West German origin. All those associations are plausible: Turkish parents may be less likely to read and fully understand publications written in German, as may be parents with low education and those of young age. Parents with lower health consciousness, indicated by smoking, may also be less conscious about the risks of the prone sleeping position for their infants. Before the reunification of Germany, the East German government had promoted the avoidance of prone sleeping of infants in 1972 (52). Thus, it is plausible that parents with East German origin are less likely to place their infants prone. Furthermore, parents who still place their infants prone seem not to have received or not to follow advice from doctors, other parents, and public media. Nearly identical results on predictors of the prone sleep position and on sub-populations who apparently have not received the educational message about the prone sleeping position-SIDS association have recently been found in several US studies (53).

Associations between sociodemographic factors and sleeping position have been described before (54); in particular, young mothers and single mothers were found to be over tenfold more likely to place their infants prone (55). On the other hand, Chessare et al. (24) could not demonstrate any association between socioeconomic and other factors and the choice of the sleeping position in parents, which may be due to the relatively high prevalence of US parents who still prefer to place their infants in the prone position.

Due to the high likelihood of multicollinearity between those factors that identify parents who still place their infants prone, we carried out a multiple logistic regression analysis with a stepwise forward model building strategy (56) using all variables associated with prone sleeping in univariate analyses. The final model consisted of seven variables: four individual factors and three reasons given by parents for the chosen sleeping position. These variables identify independent subgroups of parents who continue to place their infants prone and may be useful for planning subgroup-specific interventions in the near future.

In conclusion, our finding of a major decline in the prevalence of German infants who are placed sleeping prone, parallel in time with a reduction in the SIDS incidence rate by about one half, may explain this reduction and further supports the hypothesis that the well-established association between the prone sleeping position and SIDS may be causal. In international

comparisons, the prevalence of the prone sleeping position is still high in Germany and may be further reduced by large-scale, subgroup-specific intervention campaigns. Major efforts should be made in the near future in order to achieve behavioral changes in those groups of parents who continue to place their infants prone.

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