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Indoor and outdoor smoking

Impact on children's health

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Background: Many children are exposed to ETS (environmental tobacco smoke), which has both immediate and long-term adverse health effects. The aim was to determine the prevalence and nature of smoking among parents with infants and the association of indoor or outdoor smoking with the health of their children. Methods: Mail-questionnaire study, which was performed in a county in the south-east of Sweden, as a retrospective cross-sectional survey including 1990 children, 12–24 months old. Results: 20% of the children had at least one smoking parent; 7% had parents who smoked indoors and 13% parents who smoked only outdoors. Indoor smoking was most prevalent among single and blue-collar working parents. In the case of smoking cessation during pregnancy, smoking was usually resumed after delivery or at the end of the breast-feeding period. Coughing more than two weeks after a URI (upper respiratory infection), wheezing without a URI as well as pooled respiratory symptoms differed significantly between children of non-smokers and indoor smokers. Conclusion: Further research of the common belief that outdoor smoking is sufficient to protect infants from health effects due to ETS exposure is warranted.

Keywords: children, environmental tobacco smoke, health effects, smoking behaviour

Due to scientific findings, and the intense attention media has paid to these, the awareness of the hazardous health effects of tobacco smoke on smokers as well as on people in their surroundings, has increased.[1–3] Over a short period of time, smoking in public places has been restricted, leading to a substantial decrease in smoking as well as changed smoking behaviours in Sweden.[4,5] However, the home is still private and a place where the rules are made by the adult residents, with consequences for the development of children.

The health effects of environmental tobacco smoke (ETS) exposure have been reported by many authors and have also been confirmed in meta-analyses[1,2] and health agency reports.[3] ETS is composed of sidestream smoke and exhaled mainstream smoke.[6,7] Exposure to ETS is one of the largest preventable threats to children's health.[1,8,9] In a literature review using meta-analysis, DiFranza and Lew[2] showed that children exposed to ETS have higher rates of prolonged coughing and wheezing and an increased risk of developing bronchiolitis, pneumonia, asthma, otitis media and sudden infant death syndrome (SIDS). Lund et al.[5] have shown that most smoking parents are aware of the hazards of ETS for children and make efforts to stop smoking or change their smoking behaviour to protect their children. Such precautions may include smoking close to the kitchen fan or an open outside door, or smoking outdoors with or without changing clothes afterwards. However, scientific evidence supporting the effectiveness of these precautions has been sparse and is not convincing. Two studies have measured the effectiveness of precautions undertaken with cotinine analyses of urine and saliva from children. Mascola et al.,[10] studying bottle-fed infants, showed that there was no significant difference in child exposure to ETS whether the parent smoked in the same room or only outside. Bahceciler et al.[11] reported a trend towards higher levels of urinary cotinine among 1–19 year-old children if the parent smoked, but no significant difference regardless of whether the parents smoked indoors or only outdoors. In a survey comparing the prevalence of child exposure to ETS in their homes,[12] Swedish children were shown to be less exposed than Norwegian, Icelandic and Danish children but more than Finnish children. However, no study has been found in which the health of the children is related to the smoking behaviour of the parents, e.g. the location of parents' smoking in the home. These results awakened our interest in determining the prevalence and nature of smoking among parents of infants during their first two years of life, with special reference to indoor/ only outdoor smoking related to socio-demographic background. The association of parental smoking behaviour with the health of infants was also analysed.

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MATERIAL AND METHODS

The study was performed in March 1996 as a cross-sectional survey using mail questionnaires sampled from the national registration of Sweden including all children

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aged 12–24 months (n=1990) born between 1 April 1994 and 31 March 1995 in four municipalities in the county of Östergötland, Sweden. The municipalities represented both rural and urban populations with a mixture of blue-collar workers, civil servants and academics. The questionnaires, along with addressed envelopes, were sent to the parents of each child to be answered by either of them. The responder described the smoking habits of both parents. For those who did not answer after four weeks, a new questionnaire was posted.

No previously used and validated instrument that was suitable for this purpose could be found. A special questionnaire was therefore designed for the study, which was scrutinized and commented on by specialists in paediatric allergology and pedagogy, and pretested by parents not included in the study. The questionnaire comprised 32 questions providing information about socio-demographic data, smoking habits of the parents, attitudes to smoking, child exposure to ETS and the health of the child. The questionnaire had yes/no and open-ended questions as well as some attitude scales.

Health variables

The parents were asked whether the child had ever suffered from otitis media, wheezing when they had an upper respiratory infection (URI) or without having a URI, prolonged colds (defined as duration longer than seven days), coughing more than two weeks after a URI and coughing at night. The respiratory symptoms, wheeze at URI, wheeze no URI, cough at nights and after an URI, were also pooled. All conditions are known to be related to ETS exposure and early signs of incipient asthma as well as to non-atopic obstructive bronchitis.[3]

Smokers

A respondent was considered a smoker even when smoking occasionally. Smoking in any part of the house, including standing near an outside, slightly open door, was defined as indoor smoking and smoking outdoors with the door closed, as outdoor smoking. According to the answers, the parents (i.e. mother and father or mother with another cohabitant than the father) were split into non-smokers, only outdoor smokers and indoor smokers. A child was considered to have indoor smoking parents if one or both of them smoked indoors.

Socio-economic background

The parents' statement about their membership in trade unions were used to characterize socio-economic background. The Swedish Trade Union Confederation (LO), organizing blue-collar workers, The Swedish Confederation of Professional Employees (TCO), organizing white-collar workers, and The Swedish Confederation of Professional Associations (SACO), which organizes university graduates, were selected. Using trade unions to characterize socio-economic background has been shown to give the same distribution of smokers among social classes as studies using education level as a background variable.[13]

Statistics

Analyses were performed using the SPSS® Version 9.0 (SPSS Inc. Chicago IL, USA). Since the data were not normally distributed, the chi-squared test was used to compare differences in proportions between categories when the expected frequencies were at least 5. Fisher's Exact Test was used to compare differences between categories when the assumptions for the chi-squared test were not fulfilled. The Mantel–Haenszel Relative Risk was used to compare the risk of getting a specific symptom among the children with indoor, outdoor or non-smoking parents. Adjustments were made for age of the parent, marital status, trade union membership and length of breast-feeding. The strength of the associations was expressed by odds ratios (OR) with confidence intervals (CI) and diagrams. A significance level of 5% was used. Multivariate analyses were performed in order to elucidate the association with each factor on being a smoker through logistic regression models. A variety of models were built using smoking as the dependent variable, and age of parents, trade union membership and marital status as the independent variables. They all gave similar results.

Ethics approval

The study design was approved by the local research ethics committee of the Faculty of Health Sciences, Linköping University, Sweden.

RESULTS

The participation rate was 80%, i.e. 1600/1990 children, 769 females and 831 males. The mean age of the children was 18.6 months (range 12–24), of the mothers 30.6 years (range 17–46) and of the fathers 33.2 years (range 19–59). Most parents, 69%, were 26–35 years old. The distribution according to trade union was 39% blue-collar workers (LO), 24% civil servants (TCO), 16% academics (SACO), and 21% had no membership. Most of the children lived with both mother and father (96%).

Smoking prevalence and behaviour

In 14% of parents, both mothers and fathers were smokers *(table 1)*; 20% of the children had smoking parents; 7% indoor and 13% only outdoor smokers. The most common places for smoking indoors were the kitchen (47%), often by the kitchen fan, and the living room (18%). Two respondents (0.1%) smoked anywhere.

Smoking in general as well as indoor smoking in particular was most common in the LO group, with 6% indoor and 13% only outdoor smokers among mothers and 5% indoor and 15% only outdoor smokers among fathers *(table 1)*. Parents with no trade union membership smoked to the same extent outdoors and indoors, 8–9% in each group. Smoking was least prevalent among 26–35-year-old parents (mothers and fathers respectively: 4% indoor and 8% only outdoor smokers). Parents younger than 26 years smoked most, and in this group a gender difference could be seen. Among the mothers 9% were indoor and 17% were only outdoor smokers. The corresponding pre-

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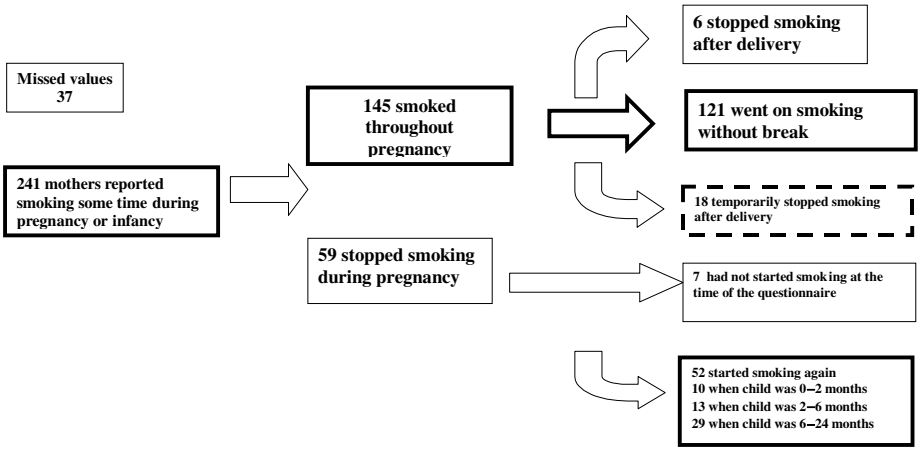

Figure 1 Mothers' smoking habits during pregnancy and infancy as reported at the time of the questionnaire. Bolded lines indicate smoking, normal lines non-smoking and broken lines indicate smoking sometime during the child's first two years

valence for the fathers was 13% and 14%. Single parents comprised 4% (n=65) of the total, 26% of whom were indoor and 23% only outdoor smokers.

Among mothers reporting smoking during pregnancy and/or infancy (n=241), 44% had smoked during pregnancy and all the time since the child was born *(figure 1)*. Fifty-nine mothers (24%) were able to stop smoking during pregnancy, however, a majority of them (n=52) had resumed smoking at the time of the questionnaire. Of the smoking fathers, 6% (n=13) stopped smoking during pregnancy and 4% (n=9) had started again before the child was 6 months old.

Table 1 Smoking habits among mothers and fathers according to age, trade union and marital status (per cent and number)

		Non-smokers		Outdoor only smokers		Indoor smokers		Total smokers		Totals
		%	n	%	n	%	n	%	n	N
Mothers	All	86	1358	9	143	5	75	14	218	1577
Age[a] (years)	<26	74	150	17	34	9	18	26	52	202
	26–35	89	1009	8	90	4	40	11	130	1139
	>35	85	200	8	19	7	17	15	36	236
Trade Union Membership[a]	All	86	1317	9	139	5	71	14	210	1528
	LO[b]	81	492	13	79	6	37	19	116	608
	TCO[c]	92	355	7	26	2	6	8	32	387
	SACO[d]	93	210	4	9	3	6	7	15	225
	Others	92	46	4	2	4	2	8	4	50
	No membership	83	215	9	23	8	20	17	43	258
Fathers	All	85	1310	10	148	5	74	15	223	1535
Age[a] (years)	<26	74	59	14	11	13	10	26	21	80
	26–35	88	878	8	79	4	42	12	121	999
	>35	82	375	13	59	5	22	18	81	456
Trade union membership[a]	All	86	1221	9	135	5	64	14	199	1422
	LO[b]	80	451	15	84	5	28	20	112	563
	TCO[c]	93	289	5	16	2	7	7	23	312
	SACO[d]	95	230	4	9	1	3	5	12	242
	Others	89	24	11	3	0	0	11	3	27
	No membership	82	229	8	23	9	26	18	49	278
Marital status[a] (n=family)	All	80	1256	13	210	7	109	20	319	1575
	Cohabitant	81	1223	13	195	6	92	19	287	1510
	Single	51	33	23	15	26	17	49	32	65

a: Missing values: age: mothers 23, fathers 65; Trade Union Membership: mothers 72, fathers 178; Marital status: 25.
b: The Swedish Trade Union Confederation (blue-collar workers).
c: The Swedish Confederation of Professional Employees (white-collar workers).
d: The Swedish Confederation of Professional Associations (academics).

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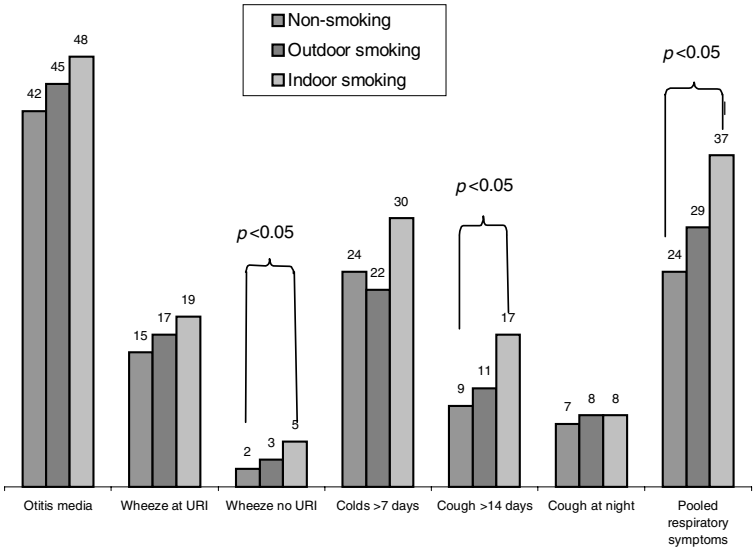

Figure 2 Prevalences of otitis media, prolonged colds, cough more than two weeks after URI (upper respiratory infection), wheeze with URI, wheeze with no URI, cough at night, pooled respiratory symptoms (i.e. wheeze with and without URI, coughing at night and more than 2 weeks after URI), related to smoking behaviour of the parents (per cent)

Risk of being a smoker and health consequences for the children

Odds ratios (OR) for being a smoker were calculated *(table 2)*. The risk of being a smoker was statistically significantly higher if the parent was younger than 26 years, single or a blue-collar worker. Logistic regression showed that living alone had a significant impact on being a smoker (OR 5.94, 95% CI: 3.56–9.89), and the father being a blue-collar worker (member of LO) raised the risk of being a smoker (OR 4.74, 95% CI: 2.56–8.78). In the sample, 20% of the children had at least one smoking parent, and 7% had parents reporting indoor smoking. Significantly more children of indoor smokers 'coughed more than two weeks after a URI', 'wheezed without a URI' and had more pooled respiratory symptoms than did children of non-smokers. Tendencies, though not statistically significant, were found to increasing prevalence of health problems related to increased ETS exposure. Regarding several conditions, and also if respiratory symptoms such as coughing and wheezing were pooled, children of outdoor smokers showed a tendency to more health problems than children of non-smokers and fewer than children of indoor smokers *(figure 2)*. Adjustment for age, marital status and trade union membership of the parents as well as length of breast-feeding did not change the results.

To elucidate the risk of health problems related to degree of ETS exposure, odds ratios were calculated *(table 3)*. A

Table 2 Factors predicting smoking among parents of children, 12–24 months old, as odds ratios (OR) with confidence intervals (CI) (non-adjusted values)

	Mothers		Fathers	
	n	OR (95% CI)	n	OR (95% CI)
Age (years)				
<26	203	2.68 (1.86–3.85)	80	2.59 (1.52–4.41)
26–35 [a]	1142	1.00	1001	1.00
>35	237	1.40 (0.95–2.08)	457	1.57 (1.15–2.13)
Marital status				
Spouse/cohabitant[a]	1510	1.00		
Single	65	5.94 (3.56–9.89)		
Trade union				
LO[b]	609	3.33 (1.90–5.83)	564	4.74 (2.56–8.78)
TCO[c]	390	1.29 (0.69–2.44)	313	1.52 (0.74–3.11)
SACO[a,d]	225	1.00	242	1.00
Others	50	1.22 (0.39–3.84)	28	2.30 (0.61–8.70)
No membership	259	2.94 (1.59–5.44)	278	4.10 (2.12–7.90)

a: reference category
b: Blue-collar workers; c: White-collar workers; d: Academics

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significantly higher risk of prolonged coughing after a URI, wheeze without a URI and for pooled respiratory symptoms, could be shown for children of indoor smokers. No significantly increased risk could be shown for other symptoms.

DISCUSSION

The majority of parents of infants did not smoke, and among smokers most smoked outdoors. However pregnancy had only a temporary impact on smoking habits, and 20% of infants still lived with one or two smoking parents. Single, young, blue-collar people and their children were at increased risk, respectively, of smoking or second-hand smoking. While children of non-smokers have less respiratory problems than children of smokers, the study did not find a clear association between parents' outdoor smoking and increased health problems in their children. The strength of the study was that it was performed during the children's second year of life. At this age, infancy is easily recalled by the parents and breast-feeding is usually terminated,[14] which seems to lessen the motivation to remain smoke-free. During the first two years, the child is especially vulnerable to tobacco smoke, which is one potent factor in the development of allergy, and is old enough to have shown early signs of allergic disease.[15–17]

Since outdoor only smoking is common (in this study 2/3 of the smoking parents), it was considered important to evaluate whether reduced ETS exposure was observable as fewer health problems among children of outdoor only than of indoor smokers. Exposure to ETS is difficult to measure, which has been stated by Couriel[18] and Bakoula[19] among others. Here, an attempt was made to grade the exposure in three groups: non-smokers, outdoor only smokers and indoor smokers. Outdoor only smoking, however, was shown to be an ambiguous concept among parents since some parents considered smoking by a slightly open outside door as such. They (n=10) were included here among indoor smokers. Since the effectiveness of this precaution, as well as smoking near the kitchen fan, has not been evaluated, they might have had an impact on the results. Another source of error might have been the instability of the smoking habits. Eriksen et al.[20] have shown that a child's birth has a substantial impact on the parents' smoking habits, which fluctuate with regard both to how much and where the parents smoke. One also has to consider the risk of underestimating the danger of health effects due to ETS exposure caused by parents reporting intended rather than fulfilled precautions as well as a tendency for parents to report less respiratory symptoms than are the case.[21] The use of non-validated questions, though pretested and scrutinized, and the fact that smoking and parenthood is a delicate issue in Sweden today may have influenced the results.

Group comparisons, as well as odds ratios, indicated a stepwise increase of health problems associated with higher level of ETS exposure. The wide confidence intervals indicate that the groups are too small to give significant results. The lack of further significant health differences between the groups, children of non-smokers, indoor and outdoor smokers may be due to the small number of smokers and an occurrence of a β-error.

It was found that being a single parent or if the father was a blue-collar worker (LO member) were strong predictors for smoking, which is in concordance with Lund,[5] Eriksen[20] and Bakoula.[19] Some predictors were of great importance for indoor smoking. For single parents, the practical problem of leaving the child alone indoors may explain why this was correlated to indoor smoking. Housing situation and lack of knowledge may also be plausible explanations for smoking indoors in these groups.[22] Of the smoking mothers who stopped smoking during pregnancy, 88% resumed smoking within two years after delivery and only four out of 13 fathers who stopped smoking had not started again when the child was six months old. The greater the age of the child, the more parents had started to smoke again. Comments such as 'If I don't smoke indoors, it does not affect the health of my child' indicate that these parents seem to have regarded

Table 3 Reported health of children related to smoking behaviour of their parents as odds ratios (OR) with confidence intervals (CI) (non-adjusted values)

		Children with non-smoking parents		Children with outdoor smoking parents		Children with indoor smoking parents	
	N	n	OR (95% CI)	n	OR (95% CI)	n	OR (95% CI)
Total N	1573[a]	1250		215		108	
Otitis media	678	530	1	96	1.09 (0.82–1.46)	52	1.28 (0.86–1.90)
Wheeze at URI [a]	241	183	1	37	1.22 (0.83–1.80)	21	1.42 (0.86–2.34)
Wheeze no URI [b]	31	19	1	7	2.20 (0.91–5.29)	5	3.17 (1.16–8.65)*
Colds >7 days	381	301	1	48	0.91 (0.65–1.29)	32	1.33 (0.86–2.05)
Cough >14 days	159	117	1	24	1.22 (0.76–1.93)	18	1.93 (1.13–3.32)*
Cough at night	115	89	1	17	1.13 (0.66–1.94)	9	1.19 (0.58–2.44)
Pooled respiratory symptoms[c]	409	307	1	62	1.25 (0.91–1.73)	40	1.84 (1.22–2.78)*

a: 27 missing values
b: Upper respiratory infection
c: Wheeze with and without URI and coughing at night and >2 weeks after URI
* $p<0.05$

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their precautions, like outdoor smoking or smoking by an open door, to be sufficient, thus weakening their motivation to remain smoke-free after delivery and end of breast-feeding. These results show risk groups, single parents, blue collar workers and parents who smoked before pregnancy, who are in great need of interventions to support a modified smoking behaviour or a prolonged cessation.

Although significant associations with health were found only for indoor smoking in this study, odds ratios were generally also increased in relation to outdoor only smoking. One therefore cannot exclude the possibility that the common belief that outdoor smoking is sufficient to protect infants from health effects due to ETS exposure is incorrect. This emphasizes the need for further research to evaluate commonly used precautions.

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