INFLUENCE OF PRENATAL AND POSTNATAL EXPOSURE TO PASSIVE SMOKING ON INFANTS' HEALTH DURING THE FIRST SIX MONTHS OF THEIR LIFE

Kukla L.[1], Hrubá D.[2], Tyrlík M.[3]
[1]Department of Social Medicine and Public Health, Medical Faculty, Masaryk University, Brno
[2]Department of Preventive Medicine, Medical Faculty, Masaryk University, Brno
[3]Department of Psychology, Faculty of Philosophy, Masaryk University, Brno, Czech Republic

SUMMARY

On the Czech set of European Longitudinal Study of Pregnancy and Childhood (ELSPAC), we tried to verify whether it is possible to confirm the results of foreign studies which found out that the both prenatal and postnatal exposure of newborns to chemicals on cigarette smoke could influence the newborns´morbidity in the first six months of their life.

Mothers, who served as sources of data about their smoking behaviour during the pregnancy and after the birth as well as information about the health status of the children after the birth (N=3,871) were divided into four groups: 1. women who never smoked (74.3%), 2. women who stopped smoking in pregnancy and started to smoke after delivery (18.3%), 3. women who smoked both during pregnancy and after delivery (7.2%), 4. women who smoked during pregnancy and stopped after delivery. Unfortunatelly, the last group was very small (only seven mothers) and did not allow assessment of exclusively prenatal exposition.

Sucklings from Czech ELSPAC set exposed to chemicals in cigarette smoke either only after the birth or also during the prenatal period, showed significantly higher occurence of different symptoms of respiratory tract damages and their complications (like otitis media) when compared to children of non smoking mothers. Due to illnesses during the first six months after the birth, their parents had to look more often for the consultations of physician, including hospitalization. Our results, as well as results of foreign studies, confirm, that smoking of mothers during the pregnancy and after the birth represents significant risk for the first months of life. Illnesses of children in this early period can cause longitudinal consequences which emerge during the childhood as well as in adulthood. They also represent a strong stressogenic factor. Children´s health consequences of exposure to cigarette smoke request very often intensive and expensive care within health system.

Our results are the same as those of foreign studies and confirm that both prenatal and postnatal exposure to chemicals of cigarette smoke is significant risk factor which negatively influences the health status on the early periods life.

Key words: passive smoking, prenatal and postnatal exposure, infants´ morbidity

Address for correspondence: L. Kukla, Dept.of Preventive and Social Pediatrics, Bieblova 16, 613 00 Brno, Czech Republic. E-mail: lubomir.kukla@tiscali.cz

INTRODUCTION

There is sufficient evidence that exposure to environmental tobacco smoke (ETS) at home is causally associated with respiratory symptoms such as cough, wheezing and whistling in children. The evidence is particularly strong for infants, with odds ratios generally ranging between 1,2 – 2,4. The presence of causal relationship is strongly supported by the consistency of the results obtained from different geographic areas, such as North America, Europe, Japan, Korea, China, and by the positive findings in prospective studies that are less subject to selection and recall biases (1).

Unlike active smoking, involuntary exposure to ETS (or „passive smoking") affects individuals of all ages, particularly infants. An extensive analysis has shown that the lung of the small child, which is undergoing significant growth and remodeling may be much more susceptible to environmental insults. Chemicals in cigarette smoke may alter the pattern of lung development and increase the risk for both acute and chronic respiratory diseases (2, 3). It is difficult to distinguish between the possible effects of smoking during pregnancy and those of ETS exposure after birth. Nevertheless, several studies have found the independent effects of both the prenatal and postnatal exposure to tobacco smoke compounds (1).

ELSPAC study (European Longitudinal Study of Pregnancy and Childhood) which contains also the cohort of women from districts Brno and Znojmo, enables prospective observation of children´s exposure to life conditions and their health status during the different life stages: in this report the results of assessment of relationships between smoking behaviour of mothers during the pregnancy and after the delivery and health status of children during the first six months of their life are presented.

METHODOLOGY

Women included into ELSPAC study filled in a set of questionnaires which, among others, tried to gain information about their smoking behaviour: in the 18th week, in a half of pregnancy, right after the delivery, six weeks and six months after the delivery. The respondents were devided into four groups according to their smoking behaviour as follows:

1. never smokers (NS)
2. women who stopped smoking during pregnancy and started to smoke again after delivery (S1)
3. women smoking both during pregnancy and after delivery (S2)
4. women who were smoking during pregnancy and stopped after delivery

According to the statements of the women in the questionnaire PN–6/2 (My child), the health status in the first six months of life of those children, who were in different ways exposed to cigarette smoke was compared, considering the differentiated smoking behaviour of their mothers. Out of different health indicators those which characterize overall health status of the child and data relevant to respiratory tract damages and connected complications were chosen.

All answers were coded in standard way for computer processing. The differences between smoking and non-smoking mothers were assessed statistically in programme SPSS and EPI INFO (Mantel-Haenstel, F-test and ANOVA tests).

RESULTS

All observed data were gained from 3,871 women (Table 1). The group S3 containing the women who were smoking during pregnancy and stopped after the delivery was so small (7 women), that it was impossible to compare frequencies of observed health indicators of children. This group was therefore excluded from the analysis as isolated influence of exclusively prenatal exposure to chemicals present in tabacco smoke could not be assessed. Published results contain the data from 3,864 women devided into three groups according to their smoking behaviour during pregnancy and after delivery. Tests of statistical significancy of the differences in frequency of children´s symptoms and diseases which were stated by women from different groups showed their significantly higher occurence in children of smoking women. On the contrary, children exposed to passive smoking both in prenatal and postnatal periods, were more often ill than those exposed only in postnatal period, the significancy of the differences was not, however, important.

In the first part of the questionnaire, dedicated to health history of child in the first six months of his life, the introducing questions were aimed at overall assessment of his health by his mother.

Frequency of answers reporting frequent illnesses of the child in the first months of life (without closer definition) was in both groups of smoking women almost twice more often than in the group of non-smoking women. The same information which was touching only the last month of the child´s life, was also given more often by smoking women. Compared to non-smokers, the differences weren´t, however, the significant.

The children of smoking women had to be admitted to hospital significantly more often than those of non-smokers. Frequency of health disorders of children exposed to cigarette smoke only in postnatal period and those exposed both in prenatal and postnatal periods, did not significantly differ (Table 2).

When compared to non-smoking mothers, the smokers asked more often for professional consultation with the physician: the average number of physician´s visits in the home of the child was 13.9% higher in children exposed to cigarette smoke postnatally (S1), and 22.1% higher in those exposed both in prenatal and postnatal periods (S2) than in children who weren´t exposed to cigarette smoke at all (NS). In the households of mothers from the S2 group average frequency of the physician´s visits was 7.2 % higher than in S1 group. Approximately 70 % of all mothers looked for the physician´s help in his office: the average number of visits was also higher in children from S1 group (5.1% more) and the highest in children from S2 group (7.4 % more) when compared to children from the group of non-smoking mothers (Table 3).

Table 1. *Characteristic of samples*

Smoking habit		Symbol	Number	Child exposure
In pregnancy	no	NS	2,878	no
After delivery	no			
In pregnancy	no	S 1	709	postnatal
After delivery	yes			
In pregnancy	yes	S 2	277	prenatal and postnatal
After delivery	yes			
In pregnancy	yes	S 3	7	prenatal
After delivery	no			

Table 2. *Overall health status of children during the first six months after delivery (%).*

Overal health characteristic	NS	S1	p1<	S 2	p2<
Often /continually ill					
The first months of life	3.6	6.1	0.001	6.3	0.01
The last month	5.0	7.1	0.01	6.2	NS
Hospitalization	9.5	13.3	0.01	17.1	0.001

Notice: statistic significance tested between children of ever smoking mothers and both groups of smokers: p1 = NS : S1, p2 = NS : S2

Table 3. *The physician´s help due to child illness saught out (%)*

	NS	S1	p1<	S 2	p2<
Visit at home	7.1	13.0	0.001	14.3	0.001
In the physician´s office	70.2	73.1	NS	67.5	NS
Average number of home visits	1.22	1.39	1.49		
Average number of visits in the physician´s office	1.17	2.28	2.33		

In the next part of the health section, the women were given a list of chosen symptoms and diseases (alimentary, respiratory and skin) and answered whether or not their child suffered from any of given problems. The most of symptoms relevant to the respiratory diseases and its most typical complications were stated most often by mothers from both smoking groups (Table 4).

After several questions, trying to find out the data about possible operations and visits in preventive advisory centres, the questions about the most often symptoms, complications and diseases of respiratory tract repeated. The frequency of positive answers to repeated questions differed. In the question about the cough, the formulation was adjusted by specification of the lenght of coughing episode, which should last more than two days: approximately a half of all women in each group who stated that their children had cough episode gave positive answer also here. The difference between the answers of smoking and non-smoking women was statistically significant. The average frequency of long lasting episodes was 15.9% higher in children exposed to cigarette smoke in postnatal period (mothers S1) and 23.3% higher in children exposed also in prenatal period (mothers S2) than that of children of non-smoking mothers. The children from the S2 group had average frequency of these events 6.4% higher than the children from S1 group (Table 5)

On the contrary, the statements about the occurence of wheezing were in case of the second answer more often in all groups of women, with significant differences of prevalence between the children of non-smokers and children of mothers from both groups of smokers. The frequency of wheezing episodes was 9.7% higher in children from S1 groups and 16.8 % higher in children from S2 group than that of the children of non-smoking mothers (Table 5).

Table 4. *Frequency of some symptoms of respiratory damages during the first six months of child´s life (%)*

Markers of damages	NS	S1	p1<	S 2	p2<
Cough	49.5	60.3	0.001	58.9	0.01
Wheezing	6.1	6.3	NS	5.7	NS
Catching for breathlessness	1.5	1.3	NS	1.9	NS
Cold	75.1	80.0	0.01	80.7	0.01
Fever	30.6	36.9	0.01	37.6	0.01
Ear pain	6.8	9.7	0.01	11.2	0.001
Purulent matter from ear	2.2	3.8	0.05	3.0	NS

Table 5. *Frequency of some symptoms answered after repeated control questions (% and an average number of episodes)*

Markers of damages	NS	S1	p1<	S 2	p2<
Two or more days cough	29.3	36.6	0.001	36.0	0.05
Average number of such cough episodes	1.89	2.19	2.33		
Period of wheezing	9.2	13.8	0.001	14.7	0.001
Average number of such wheezing periods	1.85	2.03	2.16		
Contemporal strong cold always	26.6	20.6	NS	30.6	NS
Always/Sometimes	68.4	67.2	NS	72.4	NS
Contemportal fever always	13.7	9.1	NS	18.4	NS
Always/Sometimes	50.5	46.3	NS	59.2	NS

DISCUSSION AND CONCLUSIONS

A factor that may significantly modify the effect of passive smoking in infants is exposure to tobacco smoke components by the fetus during pregnancy. This type of exposure differs considerably from passive smoking. The fetus is exposed to chemicals that are absorbed by the smoking mother and that cross the placental barrier, whereas passive smoking directly affects the bronchial mucosa and the alveolus.

It is difficult to distinguish between the possible effects of smoking during pregnancy and those of ETS exposure after birth. Most mothers who smoke during pregnancy continue smoking after the birth of their child (4).

Researches which have studied infant lung function shortly after birth have shown that newborns whose mothers smoked during pregnancy showed significant increase in specific lung compliance (i.e. lung compliance/lung volume) when compared to infants of non-smoking mothers (5), and reduced levels of forced respiratory flows (6). They concluded that prenatal exposure to tobacco products detrimentally affects the elastic properties of the fetal lung.

There is evidence for similar effects of prenatal lung development in animal models. Pups of exposed rats showed reduced lung volume, number of lung succules and reduced lenght of elastin fibers in the lung interstitium (7), less parenchymal tissue, less extracellular matrix, collagen and elastin than found in lungs of controls (8). This may explain the observed increased lung compliance.

The existence of direct effects of postnatal exposure to ETS on the infants´ respiratory health has been also confirmed. These effects are independent on „in utero“ exposure to tobacco smoke products: several studies, including ELSPAC, found that children of smoking mothers were significantly more prone to acute respiratory diseases even after mothers who smoked during pregnancy were excluded from the analysis (9). Several studies have also reported a dose-response relationship between degree of exposure (as measured by number of cigarettes smoked in the household) and risk of acute respiratory diseases: this also supports the existence of a causal explanation for the association (10).

By altering the structural and functional properties of the lung, prenatal and early postnatal exposure to tobacco smoke products increase the likelihood of more severe complications during respiratory disease early in life. Infants with the lowest levels of various indices of airway size were three to nine times more likely to develop wheezing respiratory disease and episodes of cough during the first six months/ first year of life than the rest of population (11, 12).

A review of the literature that examines the effects of exposure to ETS on the acute respiratory disease also estimated that the increased risk of hospitalization for severe bronchitis or pneumonia ranged from 20% to 40% during the first year of life (2, 10). All

studies have shown a positive association between such illnesses and exposure to ETS.

It has been also repeatedly documented, that ETS exposure reduces the airflow parameters of lung function (1).

The increased likelihood of respiratory tract damages and pulmonary complications in infants of smoking parents have important long-term consequences:

- children with lower levels of lung function had significantly lower levels also later in life (13);
- adult subjects with chronic obstructive lung diseases have more often a history of childrens' respiratory diseases (14);
- young adults who were exposed earlier in life to ETS are also more susceptible to the effects of active smoking (15).

There is also some evidence suggesting a significant increase in the prevalence of middle ear effusion in infants and children exposed to ETS. The finding of a long-linear dose-response relationship between salivary cotinine levels and the prevalence of abnormal tympanometry adds to evidence favoring a causal link (16, 17). Biological mechanisms explaining the association between ETS exposure and middle ear effusion require further elucidation. Otitis media is usually attributed to a loss of patency of the eustachial tube, which may be enhanced by upper respiratory infection, impaired mucociliary function, or anatomic factors.

Increased prevalence of middle ear effusion attributable to ETS exposure has very important public health consequences. Middle ear effusion is the most common reason for hospitalization of small children, for an operation, and thus imposes a heavy stress for the child and financial burden to the health care system (18). Hearing loss associated with middle ear effusion may also cause long-term consequences on linguistic and cognitive development (19).

Sucklings from Czech ELSPAC set exposed to chemicals in cigarette smoke either only after the birth or also during the prenatal period, showed significantly higher occurence of different symptoms of respiratory tract damages and their complications (like otitis media) when compared to children of non smoking mothers. Due to illnesses during the first six months after the birth, their parents had to look more often for the consultations of physician, including hospitalization. Our results, as well as results of foreign studies, confirm, that smoking of mothers during the pregnancy and after the birth represents significant risk for the first months of life. Illnesses of children in this early period can cause longitudinal consequences which emerge during the childhood as well as in adulthood. They also represent a strong stressogenic factor. Children´s health consequences of exposure to cigarette smoke request very often intensive and expensive care within health system.

Acknowledgements

The study was supported by grant IGA No.: NE 7224 – 2

REFERENCES

1. U.S.EPA: Respiratory health effects of passive smoking: lung cancer and other disorders. EPA/600/6–90/006F, Washington, 1992.
2. National Research Council: Environmental tobacco smoke: measuring exposures and assessing health effects. Washington, DC, 1986, National Academy Press.
3. Ehrlich RI, Du Toit D, Jordaan E et al.: Risk factors for childhood asthma and wheezing: importance of maternal and household smoking. Am J Respir Crit Care Med, 1996; 154: 681–688.
4. Wright AL, Holberg C, Martinez FD, Taussig LM: Relationship of parental smoking to wheezing and nonwheezing lower respiratory tract illness in infancy. J Pediatr, 1991; 118: 207–214.
5. Neddenriep D, Martinez FD, Morgan WJ: Increased specific lung compliance in newborns whose mothers smoked during pregnancy Am Rev Respir Dis, 1990; 141: A282.
6. Hanrahan JP, Tager IB, Segal MR. at al.: Effects of prenatal smoking on infant lung function. Am Rev Respir Dis, 1990; 141: A 282.
7. Collins MH, Moessinger AC, Kleinerman J et al.: Fetal lung hypoplasia associated with maternal smoking: a morphometric analysis. Pediatr Res, 1985; 19: 408–412.
8. Vidic B, Ujevic N, Shabahang MM, Van de Zande F: Differentiation of interstitial cells and stromal proteins in the secondary septum of early postnatal rat: effect of maternal chronic exposure to whole cigarette smoke. Anat Rec, 1989; 165: 165–173.
9. Woodward A, Douglas RN, Graham NMH, Miles H: Acute respiratory illness in Adelaide children: breast-feeding modifies the effect of passive smoking. J Epidemiol Community Health, 1990; 44: 224–230.
10. US Department of Health and Human Services: The health consequences of involuntary smoking. A report of the Surgeon General. DHHS Publ No. (PHS) 87–8398, 1986.
11. Martinez FD, Morgan WJ, Wright AL et al.: Diminished lung function as a predisposing factor for wheezing lower respiratory tract illness in infants. N Engl J Med, 1988; 319: 1112–1117.
12. Young S, LeSouef PN, Reese AC et al.: Factors predicting cough and wheeze in the first 6 months of life. Am Rev Respir Dis, 1990; 141: A 901.
13. Sherrill D, Holberg CJ, Lebowitz MD: Differential rates of lung growth as measured longitudinally by pulmonary function in children and adolescents. Pediatr Pulmonol, 1990; 8: 145–154.
14. Samet JM, Tager IB, Speizer FE: The relationship between respiratory illness in childhood and chronic air-flow obstruction in adulthood. Am Rev Respir Dis, 1983; 127:508–523.
15. Lebowitz MD, Holberg CJ, Knudson RJ, Burrows B: Longitudinal study of pulmonary function development in childhood, adolescence, and early adulthood. Am Rev Respir Dis, 1987; 136: 69–75.
16. Strachan DP, Jarvis MJ, Feyerabend C: Passive smoking, salivary cotinine concentrations, and middle ear effusion on 7-year-old children. Br Med J, 1989; 298: 1549–1552.
17. Ey JL, Holberg CJ, Aldous MB et al.: Passive smoke exposure and otitis media in the first year of life. Pediatrics, 1995; 95: 670–677.
18. Black N: The etiology of glue ear: a case-control study. Int J Pediatr Otorhinolaryngol, 1985; 9:121–133.
19. Maran AGD, Wilson JA: Glue ear and speech development. Br Med J, 1986; 293: 713–714.

Received January 21, 2004
Received in revised form and accepted April 14, 2004