



Scand J Work Environ Health 1979;5(4):328-332

<https://doi.org/10.5271/sjweh.2650>

Issue date: Dec 1979

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The following article refers to this text: [1981;7\(1\):64-67](#)

Key terms: congenital defect; epidemiologic methodology; methodological approach; occupational exposure; occupational factor

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/538422



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Congenital defects and occupational factors

A comparison of different methodological approaches

by PETER C. HOLMBERG, M.D., and SVEN HERNBERG, M.D.¹

HOLMBERG, P. C. and HERNBERG, S. Congenital defects and occupational factors: A comparison of different methodological approaches. *Scand. j. work environ. & health* 5 (1979) 328—332. In a previous study of children with congenital CNS (central nervous system) defects ($N = 120$), it was shown that exposure had occurred more often among the study mothers than among their referents. In the present study this population, extended with a one-year material of parents of children with oral clefts ($N = 102$) and their referents, was analyzed in a conventional way concerning occupational factors. This procedure was carried out in order to determine whether information on occupational factors only would provide enough hints to confirm known information concerning exposure, which had been acquired with the more-detailed but laborious interview method. No significant differences were observed in a comparison between the study groups and their referents when work of the mothers outside the home during pregnancy was considered. According to the social class grouping, classes 3 and 4 appeared more often among parents of children with congenital CNS defects than among their referents. With respect to industrial classification, manufacturing and different community services occurred more often among mothers of children with congenital CNS defects and oral clefts than among their referents. Some clustering could be observed with regard to the occupations of the parents in the two study groups as compared to their referents. When the material was methodologically processed in the conventional way described, no obvious conclusions could be drawn about exposure.

Key words: congenital defects, epidemiologic methodology, occupational exposures.

Although the etiology of most congenital malformations is unknown, epidemiologic surveys have suggested that several environmental factors may play a role. Some of them, e.g., parental age and maternal medication and infections during pregnancy have been extensively studied, and there are indirect indications that parents' occupations may influence the outcome,

since a higher incidence of central nervous system (CNS) anomalies has been found to occur in the lower social classes (1, 3, 4). But specific explanatory etiologic factors have not been shown, and, especially, the possible impact of occupational exposures is largely unknown.

We have recently shown, by means of detailed occupational history-taking, that exposure to organic solvents during pregnancy had occurred significantly more often among mothers of children with CNS defects than among mothers with healthy children (2). The intention of the present communication was to investigate

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whether conventionally used occupational and other crude classifications could have revealed or suggested the excess occurrence of the specific exposures, which we knew existed in this material a priori. We have considered another marker defect, namely, oral clefts (cleft lip and/or palate) in a similar manner, but in this case the prior knowledge did not indicate the occupational factors as strongly (to be published).

MATERIAL AND METHODS

Compulsory notification of all malformations detected in liveborn infants during the first year of life was introduced in Finland on 1 January 1963. In practice, the notification forms are filled out by the physician at the maternity hospital and in the pediatric wards; reports of malformations detected later are rare. The information is compiled in the Finnish Register of Congenital Malformations (5).

In this study, the basic information about the mothers of children with congenital marker defects and their matched-pair referents was obtained from the register. The routine procedure runs as follows: The matched referent mother is the mother whose delivery immediately precedes that of the case mother in the same maternity welfare district. The mothers selected for special study (marker defects) and their referents are interviewed. A supplementary questionnaire is sent to the midwife in the maternity welfare center in the district where the birth has taken place. This questionnaire consists of 80 items and deals with parental occupational factors merely by stating the occupations, as well as information on whether the mothers have stayed at home or worked during pregnancy.

The present study was first restricted to mothers of children with congenital CNS defects and their referents. Later we decided to expand it to cover the mothers of children with oral clefts and their referents as well.

In addition to the information directly obtained through the register, the present

study utilized information on occupational factors such as parental occupational branch, mother's work during the entire pregnancy period (most of the time, sporadically, not at all) and details concerning occupational hygiene, collected in personal interviews and often by visits to the plants concerned. For this purpose a specially designed questionnaire (19 main questions) was used. The same interviewer visited each mother (case and referent) as soon as possible after the marker defect was reported to the register. Information on parental occupational factors, collected by the method described, thus formed the setting for the use of a conventional classification in detecting some possible differences between the study and reference groups with respect to exposures.

The series comprised 120 CNS defects (reported between 1 June 1976 and 31 May 1978) and 102 oral clefts (reported between 1 December 1977 and 30 November 1978) and their referents. In the social class grouping the code notation used by the statistical department of the city of Helsinki was used. When the parents were grouped by industrial classification and occupation, the International Standard Industrial Classification and the International Standard Classification of Occupations were used, respectively (6).

RESULTS

No differences for *working outside the home* during pregnancy could be observed in the two study groups when they were compared to their referents (table 1).

When the *social grouping* was evaluated (table 2), a slight although not statistically significant overrepresentation of class 3 among the mothers and class 4 among the fathers could be observed in the CNS study group. As regards the clefts, a slight overrepresentation of class 3 could be observed among the fathers.

When the parents were grouped according to *industrial classification* (table 3), a notable difference was that "manufacturing industry" seemed to be a more common work environment during pregnancy

Table 1. Mothers working outside the home during pregnancy.

Working	CNS defects		Oral clefts	
	Study group	Reference group	Study group	Reference group
Most of the time	78	80	68	68
Sporadically	11	11	4	7
Not at all	31	29	30	27

Table 2. Grouping of the study and reference parents according to social class.

Class	CNS defects		Oral clefts	
	Study group	Reference group	Study group	Reference group
<i>Mothers</i>				
1	11	7	9	7
2	21	30	21	19
3	57	44	38	40
4	26	27	28	32
Unknown	5	12	6	4
<i>Fathers</i>				
1	17	17	11	16
2	32	28	25	25
3	61	67	52	46
4	12	5	8	9
Unknown	8	3	6	6

Table 3. Industrial classification of the study parents and their referents.

Industrial classification	CNS defects (Number of pairs 120)		Oral clefts (Number of pairs 102)	
	Study group	Reference group	Study group	Reference group
<i>Mothers</i>				
Agriculture and forestry	7	11	6	4
Manufacturing	32	23	22	29
Electricity, gas and water	—	1	1	—
Construction	2	—	1	2
Trade, restaurants and hotels	25	24	14	22
Transport	2	4	4	2
Financing, insurance and business service	5	7	7	8
Community, social and personal services	44	45	41	31
None	3	5	6	4
<i>Fathers</i>				
Agriculture and forestry	16	15	14	12
Manufacturing	33	38	30	27
Electricity, gas and water	2	—	1	—
Construction	11	11	11	9
Trade, restaurants and hotels	17	16	5	13
Transport	9	17	8	6
Financing, insurance and business service	4	3	5	4
Community, social and personal services	23	18	15	23
None	5	2	13	8

among mothers of CNS defective children than among their referents. Similarly, "community, social and personal services" appeared more often among the mothers of children with oral clefts.

In this material of 444 mothers, 99 different occupations were reported. The corresponding number among the fathers was 116. The vast majority of occupations occurred only once. Those occupations that occurred more often among the study parents than among the referents (difference ≥ 2) are listed in table 4. Although the etiology regarding the two different marker defects can be fundamentally different and even found outside the sphere of occupational exposure, interest turns to those occupations that occurred more often among the study groups than among the referents. Table 4 shows that the trend of occupations occurring more often in the two study groups is more consistent among the mothers than among the fathers. Occupations irregularly represented among study and reference parents in the two

marker groups were "industrial seamstress" among the mothers and "engineer," "farmer," "driver," "melter," and "plumber" among the fathers.

DISCUSSION

Knowledge of the etiology of congenital defects is important not only for the understanding of their genesis, but also for the prevention of these disorders by means of eliminating environmental factors found to be causative. In order to serve both purposes, and especially the latter, specific data on possible etiologic environmental factors are required. As to chemical agents, the occupational environment offers a good opportunity both for etiologic studies and for prevention, since exposure qualities are often rather clear-cut, the intensities much higher than in the general environment, and found etiologic factors can be controlled.

Table 4. Occupations occurring more often (difference ≥ 2) in the two study groups or in their reference groups.

Occupation	CNS defects		Oral clefts	
	Study group	Reference group	Study group	Reference group
<i>Mothers</i>				
Nurse	3	2	4	2
Children's nurse	—	—	2	—
Person in a leading position (commerce)	—	—	4	—
Industrial seamstress	2	—	1	5
Furrier	2	—	—	—
Plastics worker	2	—	—	—
User of stationary device	2	—	—	1
Home-aide	6	3	7	2
Cleaning woman	7	5	3	2
<i>Fathers</i>				
Engineer	2	—	1	4
Technician	12	10	7	2
Teacher	2	—	1	1
Farmer	12	10	7	8
Driver (motor vehicle)	10	8	5	9
Melter	—	1	4	—
Machine-tender	4	1	—	—
Plumber	1	3	5	—
Painter	3	1	2	—
Printer	—	—	3	1
Plastics worker	—	—	2	—
Wrapper	2	—	—	—
User of stationary device	1	—	2	—
Production man	2	—	1	1

So far most surveys on congenital malformations have dealt with possible parental occupational exposures regarding pregnancy by merely stating the social classes of the parent(s). This is very crude information, since, besides being nonspecific, it probably also can even conceal strong teratogenic factors by reason of its broad classification frame. The present exercise was undertaken utilizing a study material with known overrepresentation of solvent exposure among the case mothers (2). Its results demonstrate the nonfeasibility of broad classifications, since they did not show any clear differences between the two marker groups and their referents irrespective of which conventional classification was applied. As to mothers working outside the home during pregnancy, the study was completely uninformative. When the social classes of the population were tested in a conventional way, class 3 appeared more often among the mothers and class 4 among the fathers in the CNS study group than among their referents. However, even this information is rather useless. According to the industrial classification, we found that "manufacturing industry" was overrepresented as a work environment among the mothers in the CNS study group, and "community, social and personal services" among the mothers in the oral clefts study group. No obvious difference could be observed for the fathers according to industrial classification. From both the viewpoint of etiology and that of prevention, such information is nonoperational.

When the parents were classified according to occupational title, a widespread number of singly occurring occupations was found in all groups. A slight clustering could be observed regarding some occupations in the study groups as compared to the reference groups, but whether this was a true trend or a result of chance is difficult to judge because of the small numbers. It is doubtful whether a larger material would have been more informative, since no obvious common denominator of occupational exposure could be traced. Moreover, some of the "excess" occupations were inconsistent in the two marker defect groups.

In conclusion, the different types of information gathered with an analysis of the population in a conventional way were quite ineffective for the purpose of giving any obvious hints regarding causative occupational factors for malformations. This result should be considered against our prior knowledge that exposure to organic solvents during pregnancy indeed had occurred more often among the same CNS cases than among their referents (13 cases, 2 referents, $p < 0.01$, McNemar test) (2). This information could only be gathered by means of a thorough occupational history-taking supplemented by information on possible exposures in the workplaces. It thus seems quite clear that possible embryotoxic factors can escape attention by reason of dilution when mere occupational titles, not to speak of even cruder information, are being used to classify exposure. The same rules certainly also apply to occupational cancer research.

ACKNOWLEDGMENTS

Thanks are due to Ms. T. Suomela for her technical assistance.

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Received for publication: 3 October 1979