Scand J Work Environ Health 1985;11(5):353-356

<https://doi.org/10.5271/sjweh.2213>

Issue date: Oct 1985

Birth defects and exposure to video display terminals during pregnancy. A Finnish case-referent study.

by [Kurppa K](#), [Holmberg PC](#), [Rantala K](#), [Nurminen T](#), [Saxen L](#)

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/4071000

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

Birth defects and exposure to video display terminals during pregnancy

A Finnish case-referent study

by Kari Kurppa, MD,¹ Peter C Holmberg, MD,¹ Kaarina Rantala, MSc (Chem Eng),¹
Tuula Nurminen, MSc,¹ Lauri Saxén, MD, PhD²

KURPPA K, HOLMBERG PC, RANTALA K, NURMINEN T, SAXÉN L. Birth defects and exposure to video display terminals during pregnancy: A Finnish case-referent study. *Scand J Work Environ Health* 11 (1985) 353–356. In a test of the widely publicized allegation that exposure to video display terminals causes birth defects, interview forms of mothers of 1 475 children reported consecutively to the Finnish Register of Congenital Malformations to have defects of the central nervous system, orofacial clefts, skeletal defects, or cardiovascular malformations and the forms of the same number of their paired referents were studied. The scrutiny revealed 490 mothers with occupational titles indicating potential exposure to video display terminals. Of the 490, 235 were case mothers and 255 were referents. Then, unaware of the case-referent status, three members of the research team perused the mothers' interview descriptions of work-day activities for information indicating exposure to video display terminals. Work with such terminals during the first trimester of pregnancy was ascertained for 111 mothers. Of these, 51 were case mothers and 60 were referents. The comparison of the mothers exposed to video display terminals during the first trimester with those not exposed at all showed a crude odds-ratio point estimate of 0.9 with 95 % confidence limits of 0.6 and 1.2. Adjustment for potential confounders by multivariate logistic regression methods did not materially affect the risk estimates. The results did not indicate a teratogenic risk for operators of video display terminals.

Key terms: congenital malformations, office work, teratology.

While working with a video display terminal (VDT), some secretaries now wear leaded aprons for protection against assumed radiation risk. According to a newspaper story referred to by Chenier (3), four out of seven pregnant women who worked with such terminals in one company had babies with birth defects. Since that report appeared, the press, according to Bergqvist (1), has cited several other clusters of defective pregnancy outcomes among VDT users, particularly in North America. A high labor administrator in Canada, insisting he did not want to create panic, drew a comparison between video display terminals and the pesticide dichlorodiphenyltrichloroethane (DDT) and reminded that it had taken the best scientists a generation to discover the health effects of the latter (17). The fear has spread to other countries, including Finland.

The excitement elicited in society by the wide publicity given the VDT matter has made the topic urgent enough to deserve closer inspection. Large-scale epidemiologic studies have been started in several countries. Therefore, the available data from a Finnish matched-pair study on 1 475 birth defects were

analyzed. The preliminary results have been reported earlier (10).

Methods

A notification of all congenital malformations is compulsory in Finland. Defects are reported to the national Register of Congenital Malformations. A pathologist trained in teratology checks the reports for the validity of diagnosis. Each case mother in our study was time- and area-matched with a referent mother (delivery immediately preceding the case delivery in the same maternity health care district). The case and referent mothers were interviewed (particulars of previous pregnancies, diseases, drug consumption, etc) by midwives soon after the delivery. The retrieval rate of the questionnaires was of the order of 97 %. The validity of this approach has been previously discussed (15, 16).

The current inquiry was an extension of the standard operating procedure of the Register. In a study of possible teratogenic chemical and physical hazards, altogether 1 475 pairs of case and referent mothers were personally questioned by two trained interviewers from the Institute of Occupational Health, Helsinki. These interviews were usually performed during the mother's first postdelivery visit to her maternity health care center. The data cover the period from June 1976 until December 1982. Included were 365 defects of the

¹ Institute of Occupational Health, Helsinki, Finland.

² Department of Pathology, University of Helsinki, Helsinki, Finland.

Reprint requests to: Dr K Kurppa, Department of Epidemiology and Biostatistics, Institute of Occupational Health, Haartmaninkatu 1, SF-00290 Helsinki, Finland.

central nervous system (anencephaly, spina bifida, hydrocephaly, others), 581 orofacial clefts (cleft lip and/or cleft palate), 360 structural defects of the skeleton (reduction deformities), and 169 cardiovascular malformations reported consecutively to the Register. More than 95 % of the mothers agreed to participate in this special study.

During the "exposure interviews" no proforma questions covering VDT work were included. (In the planning phase, we did not anticipate that VDT exposure might become a worry.) The mother was first requested to describe her ordinary workday with its different workphases and exposures. The description was recorded in detail. The main function of the open question was to give the industrial hygienist a basis for estimating the possible exposures and work processes (9). This open work description enabled us to study the VDT question.

Occupational titles were utilized to pinpoint mothers with potential VDT exposure. In the selection process we used occupational titles that had been previously corrected, when necessary, to conform with the actual work description given by the mother (7). The interview forms of the mothers with potential exposure were then scrutinized for VDT information by an industrial hygienist and two experts in occupational medicine, all unaware of the case-referent status. The interview forms of the pairs of the potentially exposed mothers were similarly studied, as well as 100 randomly selected forms of mothers "not potentially VDT-exposed" (according to occupational title). In none of these last instances was probable VDT work detected.

The exposure during the first trimester was classified according to whether (i) VDT use was explicitly men-

tioned in the work description (75 mothers), (ii) VDT work, though not actually mentioned in writing, seemed obvious (31 mothers), (iii) VDT use was considered probable (5 mothers), or (iv) VDT exposure was improbable or could not be estimated (379 mothers).

Exposure time during the first trimester was categorized as an average of 4 h or more daily for 5 d a week (62 mothers), less than 4 h but at least 1 h a day (17 mothers), or less than 1 h daily on a weekly basis (32 mothers).

Confidence limits for the crude odds ratios were calculated according to the test-based method (13).

The data were also analyzed by multivariate logistic regression methods for matched case-referent studies (2). After the associations with birth defects in a bivariate analysis were examined, a number of "potential" confounders were included in the logistic analysis even though some of them are debatable as confounders from the biological point of view.

[The variables controlled (contrasting any VDT exposure to no exposure) were maternal age $\geq 35 / < 35$ years (adjusted odds ratio 0.9, 95 % confidence interval 0.7–1.3), birth order greater than three/three or less (1.0, 0.7–1.5), previous miscarriages yes/no (1.0, 0.8–1.3), previous stillbirths with premature fetus yes/no (1.4, 0.5–3.7), previous children with malformations yes/no (3.0, 1.6–5.6), two or more induced abortions yes/no (1.5, 0.8–2.9), "common cold" or fever during the first trimester yes/no (1.8, 1.4–2.2), intake of analgetics or antipyretics during the first trimester yes/no (1.8, 1.3–2.6), intake of sedatives or soporifics during the first trimester yes/no (1.6, 0.8–3.4), alcohol intake during pregnancy yes/no (1.0, 0.9–1.2), smoking during pregnancy yes/no (1.4, 1.1–1.8).]

Results

Altogether 490 mothers with potential VDT exposure were discerned according to occupational title (figure 1). Two hundred and thirty-five were case mothers, and 255 were referent mothers. Scrutiny of the interview forms of the 490 mothers indicated that 120 had obviously worked with a video display terminal during pregnancy. Exposure during the first trimester was evident for 111 of these.

Table 1 shows that the ascertained VDT exposure was similar among the case and referent mothers. There were 51 case mothers and 60 referent mothers exposed to VDT work during the first trimester of pregnancy. For them the unadjusted odds-ratio point estimate was 0.9 with 95 % confidence limits of 0.6 and 1.2. There were 31 case mothers and 31 referents who had continuously worked with a video display terminal at least 20 h a week during the first trimester.

Adjusting for potential confounders did not materially affect the risk estimates. The adjusted odds-ratio point estimate (for all malformations pooled) was 0.9 (95 % confidence interval 0.6–1.3) when mothers exposed to VDT work during the first trimester were contrasted with those not exposed at all.

Figure 1. Interviewed mothers according to potential and ascertained exposure to work with video display terminals during pregnancy.

Table 1. Case and referent mothers for types of congenital malformations and estimates of the crude odds ratios (and the associated 95 % confidence limits) contrasting exposure to video display terminals to no such exposure.

Type of malformation	Exposed member of discordant pair	Exposure time per day		Total (any ascertained exposure)		
		Less than 4 h (N)	4 h or more ^a (N)	Number	Odds ratio	95 % confidence limits
Central nervous system defects	Case	2	6	8	0.4	0.2—1.0
	Referent	4	14	18		
Orofacial clefts	Case	7	13	20	0.9	0.5—1.7
	Referent	17	5	22		
Skeletal defects	Case	3	7	10	0.8	0.4—1.9
	Referent	5	7	12		
Cardiovascular defects	Case	8	5	13	1.6	0.7—3.9
	Referent	3	5	8		
Total	Case	20	31	51	0.9	0.6—1.2
	Referent	29	31	60		

^a At least 20 h a week.

Table 2. Case and referent mothers by occupational titles representing potential exposure to video display terminals.

Code ^a	Occupations	Central nervous system defects	Orofacial clefts	Skeletal defects	Cardiovascular defects	Total
084	Journalists, editors, advertising copywriters					
	Cases	1	—	—	—	1
096, 14	Referents	1	1	—	—	2
	Automated data-processing directors, analysts, programmers, computer and keyboard operators					
12	Cases	2	3	4	2	11
	Referents	4	4	2	3	13
13	Clerical workers, including bookkeepers and bank, post office, and other office cashiers					
	Cases	5	8	4	3	20
15	Referents	10	9	12	5	36
	Secretaries and typists					
15	Cases	8	12	13	4	37
	Referents	7	15	6	4	32
15	Office clerical workers, including office, bank, insurance, and travel agency clerks					
	Cases	43	59	44	20	166
Total	Referents	45	69	36	22	172
	Cases	59	82	65	29	235
Total	Referents	67	98	56	34	255

^a Classification of occupations, Central Statistical Office of Finland, Handbook no 14, Helsinki 1981.

It has been speculated that factors other than VDT exposure, such as "stress," might present a teratogenic risk in office work and related tasks. Therefore we have tabulated (table 2) the data on the 490 mothers representing potential VDT exposure and also office work for the most part. Scrutiny of this table shows little reason for concern.

Discussion

The results of the present inquiry did not indicate a

teratogenic risk related to VDT work. Neither did our findings support the view that office work as such is associated with an increased occurrence of birth defects. The present results are well in line with those of two recent Swedish investigations, neither of which suggested a teratogenic hazard for VDT operators (6, 8).

Bergqvist (1) has recently published a summary on what is known of technical and occupational hygienic aspects of video display terminals. This review also summarizes the reported adverse pregnancy outcomes

among VDT operators and the experimental results of the effects of magnetic fields of very low frequency on chick embryogenesis. The report includes a detailed criticism of an epidemiologic study (12) that reported results which indicated that the spontaneous abortion rates (but not the birth defect rates) were increased in the use of video display terminals for at least 20 h a week. The analysis suggests that the finding might be due to error by selection bias.

Gross morphological abnormalities have been reported for chick embryos when eggs have been exposed to very low frequency magnetic fields (4). Bergqvist's review (1) gives an account of studies in this field and concludes that their relevance to the VDT situation has not been shown. There have been apparent problems in identifying the actual exposure conditions in some of these studies. (See reference 14.)

What, then, could explain the high rates of adverse pregnancy outcomes among some groups of VDT-exposed women? Such clusters have occurred and undoubtedly will appear in the future also. The problem is, we feel, that their interpretation in the scientific sense seems to have gone astray at times.

Clusters of birth defects may occur for various reasons, also in specified occupational groups. For instance, in a small region of Sweden a few years ago, a cluster of abnormal pregnancy outcomes, notably spina bifida aperta and perinatal deaths, was observed. Mass media made public the view that, because the area contained large areas of forest, the use of herbicides in forestry was the cause of the malformations. An epidemiologic study was initiated. The results did not support speculations of environmental teratogenic influences (5). Some other clusters of spina bifida were also investigated, but the results revealed no lead to an explanation. Ericson et al (5) contemplated various origins of such clusters, the most common probably being random occurrences.

Bergqvist (1) has examined the probability for a chance explanation in the emergence of clusters of adverse pregnancy outcomes among VDT-exposed groups. The calculations suggest, as might be expected, that chance appears to be a plausible explanation of the increased incidence of congenital defects among some groups of VDT operators. One temporal cluster of spontaneous abortions among VDT-exposed women has been thoroughly investigated so far. No association with the amount of VDT use was evident, and a prospective surveillance disclosed no continuing problems for those working with such terminals (11).

In summary, we did not detect an interdependence between VDT exposure and birth defects. According to results of hygienic measurements, the allegation that VDT exposure would result in birth defects had a low prior probability. The a posteriori credibility for such a causal association was not increased by our results. Nor, in our opinion, will it be much affected by the appearance of isolated future associations among occasional groups of VDT-exposed women.

Acknowledgments

We thank Ms T Suomela and Ms R Vesanto-Paavola for their skillful technical assistance, and the Finnish Work Environment Fund for its financial support.

References

1. Bergqvist UOV. Video display terminals and health: A technical and medical appraisal of the state of the art. *Scand J Work Environ Health* 10 (1984): suppl 2, 87 p.
2. Breslow NE, Day NE. Statistical methods in cancer research: The analysis of case-control studies. International Agency for Research on Cancer, Lyon 1980.
3. Chenier NM. Reproductive hazards at work: Men, women and the fertility gamble. Canadian Advisory Council on the Status of Women, Winnipeg 1982.
4. Delgado JMR, Leal J, Montegudo JL, Gracia M. Embryological changes induced by weak, extremely low frequency electromagnetic fields. *J Anat* 134 (1982) 533—551.
5. Ericson A, Källén B, Westerholm P. Clusters of malformations in Sweden: A study with central registers. *Environ Res* 30 (1983) 466—479.
6. Ericson A, Källén B, Westerholm P. Försäkringskassastudien: Ingen ökad risk för fosterskador hos kvinnor med bildskärmsarbete. *Läkartidningen* 82 (1985) 2180—2184.
7. Holmberg PC, Kurppa K, Hernberg S. Occurrence of congenital malformations in different occupational activities. In: Eustace IE, ed. XXI International Congress on Occupational Health, 1984, Dublin, Ireland, Abstracts. Dublin 1984, p 54.
8. Källén B. Dataskärmsarbete och graviditet. *Läkartidningen* 82 (1985) 1339—1342.
9. Kurppa K, Holmberg PC, Hernberg S, Rantala K, Riala R, Nurminen T. Screening for occupational exposures and congenital malformations: Preliminary results from a nation-wide case-referent study. *Scand J Work Environ Health* 9 (1983) 89—93.
10. Kurppa K, Holmberg PC, Rantala K, Nurminen T. Birth defects and video display terminals. *Lancet* 2 (1984) 1339.
11. Landrigan PJ, Melius JM, Rosenberg MJ, Coye MJ, Binkin NJ. Reproductive hazards in the workplace: Development of epidemiologic research. *Scand J Work Environ Health* 9 (1983) 83—88.
12. McDonald AD, Cherry NM, Commandeur C, Delorme C, Lavoie J, Marquis S. Work and pregnancy in Montreal — Preliminary findings. *Scand J Work Environ Health* 10 (1984) 132. (Abstract)
13. Miettinen OS. Estimability and estimation in case-referent studies. *Am J Epidemiol* 103 (1976) 226—235.
14. Mild KH, Paulsson LE. Magnetfält inom medicinen: Harmlös placebo, underkur eller riskfaktor? *Läkartidningen* 82 (1985) 1335—1338.
15. Saxén L. Twenty years of study of the etiology of congenital malformations in Finland. In: H Kalter, ed. Issues and reviews in teratology. Volume 1. Plenum Publishing Corporation, New York, NY 1983, pp 73—110.
16. Saxén L, Klemetti A, Härö AS. A matched-pair register for studies of selected congenital defects. *Am J Epidemiol* 100 (1974) 297—306.
17. ———. NIOSH to probe births to VDT users; panel recommends 5-hour VDT-day. The Guild Reporter (Official Publication of the Newspaper Guild (AFL-CIO, CLC), Washington, DC) 1982 November 12 (vol XLIX, no 20).

Received for publication: 27 June 1985