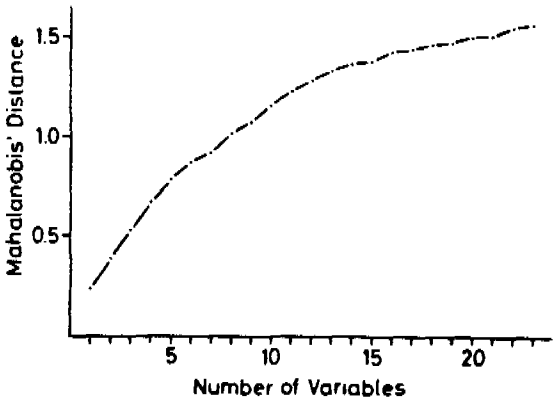

the discrimination of vector of means can be tested for significance.

A high discrimination between the malformation group and its matched controls appeared within the first 10 of the 24 variables (see accompanying figure). Even with 8 variables a significant discrimination of both groups at 1% level was found. The discrimination of both groups was also possible without the two factors "abortions/stillbirths in mothers family" and "hours of daily work".

So, even in a sample with factors each not discriminating significantly between both groups, the linear discriminance analysis makes it possible to discriminate between the malformation group and the matched controls. This might mean that the malformations in our sample can be explained as caused by the combination of many minor factors (extrinsic and intrinsic).

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CONGENITAL MALFORMATIONS AND VINYL CHLORIDE

SIR,—In March, 1975, a significantly increased rate of central-nervous-system (C.N.S.) malformations was reported in 3 Ohio communities where polyvinyl chloride (P.V.C.) polymerisation plants are located;[1] the increase was not uniform and appeared more prominent in the Painesville area. There are two P.V.C. plants in Painesville, one of which began operation in 1949 and the other in 1967. The birth-defect rates were computed from birth-certificate data for 1970–73 and were compared with similar data for the entire State of Ohio. This study suggested a relationship between the higher rates of C.N.S. malformations and the increased risk of exposure to vinyl chloride in these communities.

By analysing data collected through the Center for Disease Control's hospital-based birth defects monitoring programme (B.D.M.P.),[2] we examined this relationship. Two hospitals participating in the B.D.M.P. are located in cities with polymerisation plants: one is in Pennsylvania, the other in Painesville, Ohio. C.N.S.-malformation rates for white infants born in these two hospitals in 1970–74 were compared with the rates for white infants in each State. No increase was seen in the Pennsylvania hospital, but an increase, primarily in anencephaly and spina bifida, was noted in the Painesville hospital for the total time 1970–74 (see table).

ANENCEPHALUS AND SPINA BIFIDA IN OHIO STATE AND IN PAINESVILLE HOSPITAL, OHIO

	Anencephalus				Spina bifida			
	Painesville		State		Painesville		State	
Year	No. of cases	Rate*	No. of cases	Rate	No. of cases	Rate	No. of cases	Rate
1970	0	0·0	26	5·0	3	31·2	58	11·1
1971	1	10·3	38	7·3	3	30·9	44	8·5
1972	3	35·6	31	6·3	0	0·0	47	9·6
1973	2	24·9	27	5·4	2	24·9	46	9·2
1974	0	0·0	22	4·5	1	15·1	29	6·0
1970–1974	6	14·1	144	5·7	9	21·2	224	8·9

* Per 10 000 total white births

The B.D.M.P. hospital data for Painesville were compared with birth-certificate data from the Ohio department of health, and 1 additional case not included in the B.D.M.P. report was added, bringing the total to 15. 30 controls, the first normal white infant born before and after each case, were selected from the hospital birth registry. Medical records for cases and controls were reviewed to confirm the diagnosis and to obtain, among other data, the parents' occupation and residence at the time of the infant's birth. In addition, parents of 14 of the affected children were interviewed about previous occupations and residences.

The study revealed that none of the interviewed parents of affected infants had ever worked at either of the two P.V.C.-polymerisation plants in Painesville (1 set of parents could not be located, but records show that they did not work at these plants at the time of their infant's birth); 2 of the fathers of controls had worked at one of the plants at the time of their infants' births. None of the parents in either group lived within 2 miles of the two plants. The chi-square test of significance was used in comparing the distances from residence and work-place of mothers and fathers to the P.V.C. plants for cases and controls. Comparisons were made at distances of 1 to 10 miles, in 1-mile increments. A significantly larger proportion of control mothers than case mothers worked (including housewives) within a 10-mile radius of the P.V.C. plant, at the 95% confidence level. This is probably a chance occurrence among multiple comparisons.

Vinyl chloride is a known carcinogen,[3] and concern has arisen over its possible teratogenic effects. This concern stems from recent studies which have shown (a) an increase in mutagenicity in bacterial assay systems[4] and (b) increased breakage in chromosomes of P.V.C.-polymerisation workers.[5] The Ohio Department of Health study[1] is the only report that has suggested that vinyl chloride causes birth defects in man. Although the follow-up study reported here confirmed a moderate increase in C.N.S. malformations in Painesville, Ohio, no association was found with vinyl-chloride exposure.

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LATE COMPLICATIONS OF TUBAL LIGATION

SIR,—Unlike Mr Darwish and Dr Saafan (Nov. 15, p. 975), we are uncertain as to the ætiology of the late sequelæ of female sterilisation, which they refer to as menstrual irregularity, but in our study it will be noted we looked specifically at menorrhagia and dysmenorrhœa. It seems unlikely that a psychosomatic cause could be present when two different teci

1 Infante, P. in Proceedings of the Conference on Occupational Carcinogenesis at the New York Academy of Science, 25 March, 1975. New York (in the press)

2. Center for Disease Control. Congenital Malformations Surveillance Annual Summary 1974. Atlanta, 1975

3. Center for Disease Control. Morbidity and Mortality Weekly Report. Feb 9, 1974, p. 49

4 Rannug, U., Johansson, A., Ramel, C., Wachmeister, C. A. *Ambio*, 1974, 3, 194

5 Funes-Cravioto, F., Lambert, B., Lindsten, J. *Lancet*, 1975, 1, 459