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Anaesthetic Health Hazards Among Belgian Nurses and Physicians

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Summary. A questionnaire study was undertaken among Belgian nurses and physicians with the aim of evaluating whether there is a risk to the health of those persons whose professional life is spent in the operating theatre. Two professional groups occupied in operating theatre were chosen for study; firstly, the membership of the Belgian Society of Anaesthetics and, secondly, operating theatre nurses in Belgium. The control groups chosen for the anaesthetists were the membership of the Belgian Society of Dermatologists and the Belgian Society of Occupational Physicians. The control groups chosen for the operating theatre nurses were nurses working in intensive care units and a small group of social nurses.

A total of 1,027 questionnaires was employed for the study and the number of pregnancies studied was 1910. The results did not indicate any statistically significant effects on pregnancy attributable to work in the operating theatre. With the possible exception of more frequent headaches, the health of operating theatre personnel does not seem to have been adversely affected by volatile anaesthetics.

Key words: Anaesthetic gases – Operating theatre – Occupational exposure

During the last 15 years, several epidemiological studies have been undertaken to evaluate the health hazard for operating theatre personnel. The results are not consistent. Some studies suggest that working in the operating theatre has deleterious effects on the reproductive system of female workers (chiefly an increased rate of abortion) and increases the incidence of suicide and possibly of certain diseases (cancer, liver, kidney, central nervous system) (for reviews see Edling 1980; Siddons 1980).

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It is not yet clear whether these effects are to be attributed to exposure to volatile anaesthetics or to other environmental factors. There has as yet been no demonstration of dose-effect and dose-response relationships of volatile anaesthetics in man.

Furthermore, some studies have not confirmed the existence of specific health risks for operating theatre personnel (Edling 1980; Siddons 1980).

We have undertaken a questionnaire study among Belgian nurses and physicians with the aim of evaluating whether there is a risk to the health of those persons whose professional life is spent in the operating theatre. Since the published material on the subject points particularly to the possibility of effects on the reproductive system, particular attention was paid to this aspect.

The first enquiry in Belgium was directed chiefly to the simple question of whether there is, or is not, evidence for such a risk, and did not attempt at this stage to go further into the question of what might be the cause of such risk. Because of the design of the study only morbidity data could be collected.

Material and Methods

Population Studied

Two professional groups occupied in operating theatre were chosen for study; firstly, the membership of the Belgian Society of Anaesthetics and, secondly, operating theatre nurses in Belgium.

The control groups chosen for the anaesthetists were the membership of the Belgian Society of Dermatologists and the Belgian Society of Occupational Physicians. The official support of these professional societies was sought and obtained.

The control groups chosen for the operating theatre nurses were nurses working in intensive care units and a small group of social nurses.

Letters were sent to all hospitals in Belgium known to have operating theatres or intensive care units, asking for the names and addresses of their nurses working or having worked in these services.

Questionnaire

The questionnaire sent to the members of the exposed and control groups covered:

1. General questions, such as age, sex, specialty, marital status, etc.
2. Various habits: sport or other spare time activities smoking, alcohol, coffee, and tea consumption.
3. The subject's professional career if working in operating theatre (duration of exposure in years, number of hours worked per day in operating theatre at different periods of the working life, types of anaesthetics and apparatus used, presence or absence of ventilation).
4. Health status and any medicines taken regularly.
5. The obstetric history of the subject if female, or his wife if male, with details on each pregnancy, its fate, complications, whether either or both partners worked in the operating theatre during the pregnancy.

Anonymity was assured by means of two envelopes; an inner one, bearing no name in which was placed the completed questionnaire and an outer one, bearing the subject's name and addressed to the secretary of the professional group concerned. The inner, anonymous, envelope alone was forwarded to the team responsible for the study, followed later by a list of those who had responded. This was done in the hope that the assurance of anonymity would encourage full disclosure of information, but it means of course that unsatisfactorily completed questionnaires

could not be sent back to the sender for correction, as was done in the case of a large American study (Cohen et al. 1974).

However, by the method described above, it was possible toknow who had replied, in spite of the preservation of anonymity, and a second questionnaire was sent to those who had not responded to the first sending. To avoid duplication of replies by nurses who might have worked in several hospitals or clinics, they were asked in the accompanying letter to complete only one questionnaire, and to return the others which they might receive, uncompleted. The information contained in the replies to the questionnaire was coded and transferred to punched cards for computer analysis.

Results

The questionnaire was sent to a total of 2,839 persons (1,305 physicians and 1,715 nurses) and a second questionnaire was sent to those who did not respond.

A total of 1,335 completed questionnaires was received giving a disappointing overall response rate of 47%, but which was rather similar in all subgroups: anaesthetists 50.2%, dermatologists 51.9%, occupational physicians 47.4%, operating theatre nurses 47%, intensive care nurses 41.5%, social nurses 55.5%, respectively.

Three hundred eight bachelors were eliminated from the analysis since it had been decided, as mentioned earlier, to concentrate on the possible effects on pregnancy. Of the 1,027 responses which remained, 588 were from men, of whom 578 were married, six divorced or separated, and four widowed; and 435 women, of whom 421 married, 11 divorced or separated, and three widowed. The sex of four respondents was not indicated.

In some cases, the specialty mentioned on the returned questionnaire differed from that indicated on the mailing lists. The distribution of the respondents by specialty as declared in the response to the questionnaire is shown in Table 1. The average age of the physician groups varied from 42.5 to 48.1 years and that of the nurse groups from 27.2 to 31.6 years, respectively. The wives of 61 male respondents had worked in operating theatre, and in the case of nine this is

Table 1. Distribution of respondents by specialty indicated on questionnaire

Specialty	Male	Female	Unknown	Total
Anaesthetists	121	28		149
Dermatologists	62	27		89
Occupational Physicians	290	22	2	314
Other doctors	8	1		9
Operating theatre nurses	63	176	1	240
Intensive care nurses	14	33		47
Social nurses	0	20		20
Other nurses	11	41		52
Unknown	19	87	1	107
Total	588	435	4	1,027

Table 2. Distribution of illnesses by specialty

Specialty	*N*	Illnesses (%)											
		Liver	Kidney	Heart	Lung	Stom-ach	Intes-tine	Gonads	Blood	Nervous system[a]	Head-ache	Other	None
Anaesthetists	149	24.9	9.4	10.1	10.7	20.1	10.1	8.7	0	8.7	16.8	10.1	30.2
Dermatologists	89	15.7	9.0	6.7	9.0	10.1	1.1	7.9	2.2	7.8	13.5	11.2	44.9
Occupational physicians	314	17.8	11.5	12.1	9.5	9.6	9.5	3.2	2.5	8.9	7.6	15.9	40.4
Other doctors	9	11.1	11.1	0	0	22.2	0	33.3	0	0	0	0	55.6
Operating theatre nurses	240	10.0	6.7	2.5	3.3	7.5	6.7	6.7	2.5	5.0	26.2	10.8	46.9
Intensive care nurses	47	6.4	8.5	4.2	6.4	8.5	10.6	2.1	2.1	2.1	6.4	6.4	59.6
Social nurses	20	5.0	10.0	0	0	0	0	10.0	10.0	0	0	0	70.0
Other nurses	52	11.5	1.9	9.6	9.6	15.4	5.8	1.9	1.9	3.8	17.3	3.8	50.0
Unknown	107	12.1	7.5	1.9	1.9	3.7	6.5	4.7	4.7	5.6	20.5	7.5	56.0

[a] Excluding headache

Table 3. Distribution of families by specialty in relation to the number of pregnancies per family

Specialty	*N*	Number of pregnancies per family								
		0	1	2	3	4	5	6	7	≥8
Anaesthetists	149	21	16	39	29	18	8	8	7	3
Dermatologists	89	8	10	25	27	8	8	2	0	1
Occupational physicians	314	39	38	63	57	49	30	19	10	9
Other doctors	9	2	3	2	1	1	0	0	0	0
Operating theatre nurses	240	66	73	76	18	6	2	2	0	0
Intensive care nurses	47	17	11	13	6	0	0	0	0	0
Social nurses	20	0	8	9	2	0	1	0	0	0
Other nurses	52	16	19	14	1	1	1	0	0	0
Unknown	107	21	47	23	12	3	1	0	0	0

χ^2 between physician subgroups and between nurse subgroups: not significant

Table 4. Number of pregnancies in relation to the exposure of the mother before and after marriage (father not exposed)

Exposure		Number of pregnancies									
Before marriage	After marriage	0	1	2	3	4	5	6	7	≥8	Total
–	–	25 (23.4)[a]	30 (28)	39 (36.4)	7 (6.5)	3 (2.8)	0	3 (2.8)	0	0	107
–	+	14 (14.4)	37 (38.1)	31 (32)	8 (8.2)	3 (3.1)	3 (3.1)	1 (1.0)	0	0	97
+	–	6 (18.8)	13 (40.6)	7 (21.9)	3 (9.4)	1 (3.1)	1 (3.1)	1 (3.1)	0	0	32
+	+	36 (22)	55 (33.5)	49 (29.9)	19 (11.6)	4 (2.4)	0	0	1 (0.6)	0	164

$\chi^2 = 23.3$, $P > 0.05$

[a] Number within brackets: percentage

Table 5. Number of pregnancies in relation to the exposure of the father before and after marriage (mother not exposed)

Exposure		Number of pregnancies									
Before marriage	After marriage	0	1	2	3	4	5	6	7	≥8	Total
–	–	37 (15.1)[a]	28 (11.4)	49 (20)	47 (19.2)	30 (12.2)	25 (10.2)	15 (6.1)	7 (2.9)	7 (2.9)	245
–	+	6 (6)	14 (14)	25 (25)	23 (23)	15 (15)	9 (9)	3 (3)	2 (2)	3 (3)	100
+	–	4 (8)	5 (10)	13 (26)	10 (20)	8 (16)	6 (12)	2 (4)	0	2 (4)	50
+	+	17 (11.4)	22 (14.8)	46 (30.9)	27 (18.1)	19 (12.8)	5 (3.4)	5 (3.4)	7 (4.7)	1 (0.7)	149

$\chi^2 = 27.8$, $P > 0.05$

[a] Number within brackets: percentage

unknown; in the case of female respondents, 49 had spouses who had worked in operating theatre, and in 16 cases, it is not known.

Two types of analysis were carried out, one in relation to the respondents, the other in relation to the pregnancies. In the first analysis, we have examined whether the work in operating theatre was associated with an increased prevalence of some illnesses. In the second analysis, we have attempted to evaluate the outcome of pregnancies in relation to the presence or absence of exposure to anaesthetic gases of one or both parents either during or in the year before the pregnancy.

Results in Relation to the Respondents

No statistically significant differences were found between the physician subgroups of the nurse subgroups with regard to smoking habits and drug consumption.

The prevalence of the reported illnesses is shown in Table 2. In both physicians and nurses, headache was statistically more frequent in the subgroup working in operating theatre than in the other subgroups (χ^2, $P < 0.005$). The prevalence of stomach disorders was significantly more important in anaesthetists than in the other physician subgroups (χ^2, $P < 0.05$).

The difference was not found among the nurses but their duration of work in operating theatre (median: 4.5 years) is significantly lower than for physicians (median: 10 years).

The distribution of the number of pregnancies per family does not differ between the different physician subgroups, nor between the different nurse subgroups (Table 3). For 944 respondents, their exposure to volatile anaesthetics before and after the marriage was known. The results shown in Tables 4 and 5 confirm again that the distribution of the pregnancies is not influenced by the exposure of the mother or the father to volatile anaesthetics. In view of these negative results, a further analysis based on the type of anaesthetics used was not considered to be useful.

Results in Relation to Pregnancies

We have evaluated the outcome of pregnancies in relation to the presence or absence of exposure to anaesthetic gases of one or both parents either during or in the year before the pregnancy.

The pregnancies were subdivided into ten groups as shown in Table 6. The anaesthetic gases used did not differ greatly in the different exposure groups (nitrous oxide, ether, trichloroethylene, cyclopropane, halothane, methoxyflurane, enflurane).

Table 7 shows a general breakdown of pregnancies into the exposure groups and the results of these pregnancies, whether full-term, malformed, premature (≤ 35 weeks), stillborn, or miscarried. No significant difference was found between the groups with regard to the prevalence of malformations, premature births, stillbirths, miscarriages or the sum of all abnormal pregnancies. The same conclusion is reached when the statistical analysis is carried out after combining groups 4–6 (maternal exposure 1 year before pregnancy) and groups 7–9 (maternal exposure during pregnancy). There was no significant difference in smoking habits

Table 6. Classification of the pregnancies on the basis of the exposure of parents to anaesthetic gases before and during pregnancy

Group	*N*	Exposure of the mother		Exposure of the father	
		During pregnancy	1 year before pregnancy	During pregnancy	1 year before pregnancy
1	1056	no	no	no	no
2	31	no	no	no	yes
3	432	no	no	yes	not determined
4	81	no	yes	no	no
5	2	no	yes	no	yes
6	49	no	yes	yes	not determined
7	210	yes	not determined	no	no
8	9	yes	not determined	no	yes
9	40	yes	not determined	yes	not determined
A	701	A subgroup from group (1) where neither parent had at anytime been exposed before or during the pregnancy			

Table 7. Results of pregnancy in relation to exposure of mother and/or father to anaesthetic gases

	Exposure groups[a]									
	A	1	2	3	4	5	6	7	8	9
Full-term, not malformed	563	846	25	361	58	2	42	158	8	34
Full-term, malformed	15	36	1	10	2	–	1	6	–	1
Premature, not malformed	60	81	3	25	11	–	2	19	–	2
Premature, malformed	7	1	–	4	–	–	–	3	–	–
Still-births, not malformed	10	27	–	1	3	–	1	5	1	–
Still-births, malformed	3	2	–	1	1	–	–	–	–	–
Miscarriages	43	63	2	30	6	–	3	19	–	3
Total	701	1,056	31	432	81	2	49	210	9	40

[a] For definition of the groups see Table 6

of the mothers between the different exposure groups but the prevalence of radiographic examination during pregnancy, that of contraceptive use in the 12 months preceding pregnancy, and that of illnesses of the mother during pregnancy are significantly higher in some exposure groups (groups 7–9 for X-ray; groups 2, 7, and 8 for contraceptive measures, and group 7 for illnesses of the mothers) than in the control group (A or 1).

Of a total of 1,683 children born, there were 51.5% boys and 48.5% girls. There was an excess of boys over girls in each of the groups, except for group 1 (control)

where there were 46.7% boys and 53.3% girls. This difference is significantly different (χ^2, $P<0.05$) which is surprising, since the opposite trend has been reported in other studies (Askrog and Harvald 1970; Wyatt and Wilson 1973).

Of a total of 1683 children born, 13.3% are reported as having had a subsequent illness of importance, but there is no statistically significant difference in the prevalence of illnesses in the children of the various groups.

Discussion

The principal objective of this study was the investigation of the possible effect of working in the operating theatre on pregnancy.

It must be admitted that the response rate to the questionnaire was rather disappointing (approximately 50%) in spite of two sendings. However, some comfort may be drawn from the fact that the response rates of the "exposed" and control groups were similar.

The groups chosen for exposed and control subjects were all either doctors or nurses, and thus the exposed groups are from the same socio-economic sector of society as the control groups.

Care was also taken, in view of the criticism of Rosenberg and kirves (1973) and Kratholm (1977) of the choice of control groups for comparison with the operating theatre nurses, to include in the control group intensive care nurses although the size of the sample was not great.

The study was deliberately made anonymous to encourage franker disclosure of information. This advantage was, however, outweighed by the fact that it was not possible, as in the case of non-anonymous studies, to check with individual respondents when the questionnaire had been incorrectly answered. The number of questionnaires usable for the study was 1,027 and the number of pregnancies studied was 1910. These numbers, although not approaching the very large numbers of the American study (Cohen et al. 1974) are considerably larger than those in many other studies (for review see Siddons 1980).

In the present study, no statistically significant differences were found between the exposed and control groups for miscarriages, congenital malformations, stillbirths, or premature births. Many studies so far published have consistently shown an increased rate of miscarriage among women working in operating theatre. This was not confirmed in this study, although there was a slight but non-significant increase in the rate of miscarriage in women exposed to anaesthetic gases during pregnancies (8.5%) as compared to non-exposed women (6%) (Table 7).

Although some studies (Askrog and Harvald 1970; Kratholm 1977) showed a relative decrease of male as compared to female children, among female anaesthetists, in the present study the only group with a higher percentage of girls than boys was the unexposed group.

No statistically significant increase of hepatic or renal disease was shown in persons working in operating theatre although such increases were suggested in earlier studies (Cohen et al. 1974, 1975; Spence and Knill-Jones 1978). The

incidence of stomach illnesses was considerably raised in anaesthetists as compared to the other groups of physicians.

Headaches were more frequent in anaesthetists than in other doctors and also more frequent in operating theatre nurses than in intensive care nurses. The increases in stomach illnesses and headaches may be associated with the stress of working in operating theatre and/or irregular hours of work, although the role of exposure to anaesthetic gases in the occurrence of headache cannot be excluded, since the intensive care nurses had a lower prevalence of this complaint than the operating theatre nurses.

In summary, this study did not show any statistically significant effects on pregnancy, attributable to work in the operating theatre.

With the possible exception of more frequent headaches, the health of operating theatre personnel does not seem to have been adversely affected by volatile anaesthetics. It should be stressed, however, that this study was not designed to evaluate the risk of cancer associated with exposure to volatile anaesthetics. In view of the results of previous studies the risk should be further assessed.

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