

# Maternal exposures and risk of spontaneous abortion before and after a community oriented health education campaign

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Received 3 November 2009, accepted 14 May 2010

**Background:** In a district of Veneto (North-east Italy) where numerous females of childbearing age were occupationally exposed to organic solvents in nearly 400 shoe factories, a case-control study found significant associations between maternal exposures (from occupation and risky behavior) and spontaneous abortion (SAB). Thereafter, a health education campaign was undertaken to increase awareness of risk factors for pregnancy in the population. To evaluate the effects of this campaign maternal exposures and SAB risks were compared before and after the campaign. **Methods:** Hospital records were collected from a local hospital for SAB cases and age- residence-matched controls with normal deliveries. Information on solvent exposure, coffee and alcohol consumption, smoking and the use of medication was collected using a questionnaire. Before and after differences were tested through a modified Chi-square test and linear and logistic regressions for survey data. Odds ratios (ORs) with 95% confidence interval (CI) were estimated using logistic regression models. **Results:** The consumption of coffee ( $P = 0.003$ ) and alcohol ( $P < 0.001$ ) was lower after than before the campaign, controlling for age at pregnancy and level of education. There were no differences in reported solvent exposure or smoking (smokers were few). The previously detected increased risks of SAB in relation to solvent exposure and coffee consumption were no longer present. **Conclusion:** The results suggest that health education campaigns might reduce harmful maternal exposures and the risk of SAB.

**Keywords:** coffee, health campaign, shoe industry, smoking, solvents, spontaneous abortion

## Introduction

In the 1970s and 1980s, numerous females of childbearing age were occupationally exposed to organic solvents in the nearly 400 shoe factories present in the local health authority (LHA) district of Mirano (Veneto region, North-east Italy). An epidemiological study was performed in the district from 1987 to 1988 and the occupational history was used to estimate the magnitude of exposure to organic solvents. An adjusted odds ratio (OR) of 3.85 (CI 1.24–11.9) for spontaneous abortion (SAB) was found in pregnant females with a high-solvent exposure. The number of previous SAB and the intake of coffee were also related to an increased risk.<sup>1</sup>

In order to decrease the risk, a comprehensive information programme was implemented from 1995 to 1998, involving a team of gynecologists, paediatricians, geneticists, psychologists and occupational physicians, who provided counselling actions. An information leaflet illustrating risks at pregnancy and the benefits provided by law was distributed on occasions of medical surveillance and to persons attending any office and outpatient department of LHA. Another leaflet, informing on risks factors at pregnancy related to solvent containing products, was mailed to females working at home as shoemakers.

To assess the impact of this information campaign, a second study was carried out in the same LHA district from 1997 to 1999 by the same team and using similar methods. The results from this study are reported and compared with those of the previous study. The efficiency and usefulness of information campaigns to prevent SAB is discussed.

## Methods

### Subjects

The study protocol was the same used for the previous study as described earlier.<sup>1</sup> Briefly, 146 cases of clinically diagnosed SAB (IX revision ICD codes 632, 634, 637) were selected from the local hospital (Dolo Hospital) who were admitted from 1997 to 1999 together with 146 controls (females with normal childbirth), individually matched to the cases for year of birth and residence. Cases and controls were interviewed by female occupational nurses using a standard questionnaire acquiring information on age, education, marital status and number of previous pregnancies and SAB. In addition information was obtained on major risk factors during pregnancy (daily consumption of coffee, cigarette and alcohol intake, medication and solvent exposure).

The occupational exposure to organic solvents was ranked in three categories (0 = non-exposed, 1 = low level and 2 = high level). Criteria for low exposure were: gluing time <2 h/day, gluing of small surfaces and use of glue containers with small openings. Use of medicine was ranked 0 (no medication during pregnancy, except use of supplements such as vitamins and minerals) and 1 (medication taken during pregnancy). Medication and solvent exposure were scored in both studies by the same occupational physician (RA) without knowledge of the case-control status of the subject.

Despite many attempts, six cases in both studies were not traced and another 19 and 17 refused to take part when asked to give informed consent prior to the start of the first and second study, respectively. The corresponding controls were excluded from the studies, resulting in a response rate of 81 and 84%.

The mean age (standard deviation) at the time of SAB was 32.1 (5.2) and 32.1 (5.1) years for cases and controls, respectively. In the previous study (1987–88), it was 30.0 (6.0) and 30.1 (5.9).

### Statistical treatment

To explore time trends in the prevalence of risk factors, data from cases and controls from the two studies were merged and post-stratification weights were obtained from discharge records of hospitalized SAB and normal childbirths according to calendar year (1987–88 and 1997–99) and age class ( $\leq 24$ , 25–34 and  $\geq 35$  years). The post-stratification scheme was applied to estimate proportions of exposure to risk factors in the source population in the two study periods and test differences through a modified Chi-square. Linear and logistic regressions for survey data were carried out to estimate the effect of the calendar period while controlling for education and age at pregnancy.

The OR with 95% confidence interval (CI) and the error probability ( $P$ ) for a two-tail test were calculated in a univariate analysis. When a variable was broken down into classes, the lowest class was used as the reference subgroup. A test for linear trend across ordered categories was performed entering a numerical (rather than factorial) variable term in the logistic regression model.<sup>2</sup>

In a multivariate analysis, the final model of logistic regression was built as follows. First, databases of the present and previous study were pooled, and stepwise logistic regression was used to select the predictor variables that significantly influenced the risk of SAB. Then, each database was separately analyzed, entering all the variables selected at the first step in a model of conditional logistic regression analysis. The same variables were therefore present in both analyses in order to allow a comparison of the risk estimates between the two studies. Logistic regression analyses were conducted by using the packages Stata9 and LogXact.<sup>3</sup>

## Results

The demographic and exposure characteristics are given in table 1 and compared with the data from the previous study.

Regarding demographic variables, the level of education was higher than that in the previous study ( $P < 0.001$ ). The exposure to solvents was slightly lower although not statistically significant. The consumption of coffee, alcohol and medication was significantly lower as compared to the previous study ( $P = 0.003$ ,  $P < 0.001$  and  $P < 0.001$ , respectively) but there was no difference in smoking. The number of smokers was, however, very low.

The downward trend over time was confirmed for coffee ( $P < 0.003$ ) and alcohol consumption ( $P < 0.001$ ) on linear

**Table 1** Distribution of risk factors (%) among study subjects (those hospitalized for SAB as well as those with normal delivery) estimated by post-stratification weighting in 1987–88 and 1997–99 and  $P$ -value for time changes (modified Chi-square)

	1987–88 ( <i>n</i> = 216)	1997–99 ( <i>n</i> = 246)	<i>P</i>
Education			
Up to age 14 years	64.8	49.1	0.008
Higher level	35.2	50.9	
Marital status			NS
Married	97.5	97.0	
Not married	2.5	3.0	
Pregnancy			NS
1	45.9	54.2	
2	34.0	30.1	
3	16.7	12.1	
4+	3.5	3.7	
Previous SAB			NS
0	90.2	84.3	
1	9.4	14.5	
2+	0.4	1.3	
Occupation			NS
Other	79.7	80.7	
Shoemaker	20.3	19.3	
Solvent exposure			NS
None	80.9	86.8	
Low	9.9	6.3	
High	9.2	6.8	
Coffee (cups/day)			0.003
0	39.3	59.4	
1	16.1	14.3	
2	35.4	18.0	
3	7.2	6.6	
4+	2.1	1.6	
Alcohol			<0.001
None	78.1	92.5	
Any	21.9	7.5	
Smoking habits			NS
Non smokers	93.0	93.3	
Smokers	7.0	6.7	
Use of medicines			<0.001
None/vitamins	87.8	98.0	
Others	12.2	2.0	

NS: not significant

and logistic regressions for survey data after controlling for age at pregnancy and level of education (data not shown).

Table 2 reports the ORs for different characteristics in terms of relative frequencies of cases and controls.

In contrast to the previous study, there was no increased risk in relation to solvent exposure or coffee consumption.

The results from the final model of logistic regression, summarizing the information collected in the two studies, are shown in table 3.

## Discussion

The major findings in the study were an absence of a risk of SAB in relation to the coffee consumption and solvent exposure that were both lower than that in the previous study. There was still an increased risk related to a previous SAB.

There are some methodological limitations in the study. The intervention effectiveness was evaluated by the before-and-after design, which is inherently limited by several threats to internal validity.<sup>4</sup> For example, the lower consumption of coffee and alcohol might be due to women growing older (so becoming more health knowledgeable) rather than to the intervention itself. However, this maturation bias was eliminated by using appropriate statistical techniques. The longer the time between the 'before' and 'after' measurements,

**Table 2** Relative frequencies (%) of cases and controls (123 vs. 108 in the first study); OR with 95% CI and error probability (*P*) for a two-tail test calculated by the exact method using conditional logistic regression analysis for matched case-control studies

	Previous study			Present study		
	Cases	Controls	OR (CI)	Cases	Controls	OR (CI)
Education						
Up to age 14 years	73.1	64.8	1	48.8	48.8	1
Higher level	26.9	35.2	0.62 (0.30–1.24)	51.2	51.2	1.00 (0.58–1.72)
Marital status						
Married	88.9	99.1	1	96.7	96.7	1
Not married	11.1	0.9	<b>12.0* (1.78–513)</b>	3.3	3.3	1.00 (0.19–5.37)
Pregnancy						
1	38.9	43.5	1	43.9	52.8	1
2	36.1	33.3	1.33 (0.65–2.79)	37.4	30.1	1.60 (0.82–3.19)
3	15.7	19.3	1.07 (0.36–3.19)	11.4	13.8	1.10 (0.40–3.03)
4+	9.3	3.7	2.88 (0.68–14.9)	7.3	3.3	2.56 (0.67–12.0)
Previous SAB <sup>§</sup>						
0	80.6	89.8	1	73.2	85.4	1
1	16.7	10.2	2.00 (0.81–5.40)	21.9	13.8	1.90 (0.93–4.06)
2+	2.8	0.0	4.80 (0.50–inf.)	4.9	0.8	7.29 (0.86–343)
Occupation						
Other	71.3	80.6	1	79.7	81.3	1
Shoemaker	26.7	19.4	1.71 (0.85–3.58)	20.3	18.7	1.12 (0.54–2.36)
Solvent exposure <sup>§</sup>						
None	72.2	81.5	1	82.9	87.8	1
Low	11.1	11.1	1.21 (0.46–3.22)	6.5	5.7	1.34 (0.41–4.54)
High	16.7	7.4	<b>3.09* (1.05–11.0)</b>	10.6	6.5	1.81 (0.64–5.60)
Coffee (cups/day) <sup>§</sup>						
0	26.9	39.8	1	58.5	59.3	1
1	22.2	16.7	1.91 (0.73–5.26)	9.8	14.6	0.61 (0.23–1.52)
2	24.1	38.0	0.84 (0.38–1.80)	17.9	17.9	0.98 (0.48–1.99)
3	19.4	4.6	<b>4.19* (1.43–15.1)</b>	9.8	5.7	1.79 (0.64–5.50)
4+	7.4	0.9	<b>8.25* (1.08–3.71)</b>	4.1	1.6	4.48 (0.44–2.23)
Alcohol						
None	75.9	76.9	1	93.5	91.1	1
Any	24.1	23.1	1.05 (0.53–2.08)	6.5	8.9	0.70 (0.23–2.04)
Smoking habits						
Non smokers	87.0	94.4	1	95.1	92.7	1
Smokers	13.0	5.6	2.33 (0.84–7.41)	4.9	7.3	0.67 (0.20–2.10)
Use of medicines						
None/Vitamins	92.6	88.9	1	96.7	98.4	1
Others	7.4	11.1	0.80 (0.50–1.28)	3.3	1.6	1.41 (0.60–3.30)

\**P* < 0.05; <sup>§</sup>*P* for trend < 0.05**Table 3** OR with 95% CI from a conditional logistic regression analysis for matched case-control studies

	First study OR (CI)	Second study OR (CI)
Solvent exposure		
Low vs. none	1.58 (0.63–4.01)	1.07 (0.36–3.22)
High vs. none	<b>3.85* (1.26–11.8)</b>	1.49 (0.54–4.46)
Coffee (cups/day)	1.35* (1.05–1.73)	1.14 (0.91–1.42)
Previous SAB	<b>2.58* (1.18–5.64)</b>	<b>2.03* (1.14–3.62)</b>

\**P* < 0.05.

the more opportunity is there for an extraneous interfering event to happen (history threat). In this context, the general increase in awareness of healthy living could play a role. On the other hand, coffee consumption is rarely targeted by information in general media health campaigns, legislation and/or health promotion initiatives at the workplace. In view of the above, history threats are less likely explanations for the absence of an increased risk of SAB after the education programme.

To strengthen the before-and-after approach, a control population not receiving the health information would have been required. Such a design is, however, unethical as it would have denied access to important information for preventive purposes in a population at risk.

When comparing the populations in the two studies, there are some interesting demographic differences. The proportion of subjects with a high-level education increased from 35.2% to 50.9%. This change mirrors the improvements in living conditions in the Italian population in general during the 10 years between the two studies. As a control group without SAB was included in the study design, this change did not influence the conclusions regarding risk factors for SAB.

The absence of an increased risk of SAB due to solvent exposure was probably an effect of the information campaign. Pregnant females are generally very cautious about factors that could disturb the outcome and it is possible that they became more cautious with the exposure to solvents even if the exposure assessment could not detect any differences. No increased risks were observed for women working with solvents in a retrospective cohort study of miscarriages among 1752 women in the Shanghai textile industry, where the ever/never approach was used to characterize solvent exposure.<sup>5</sup> Other studies attempted to estimate the magnitude or the frequency of exposure to organic solvents and, for most solvents the ORs for SAB were higher among women reporting a more intense exposure.<sup>6–10</sup> In the latter studies, women exposed to low levels of solvents had a risk of SAB not significantly different than that of women who had never been exposed.

Coffee consumption was a risk factor for SAB in the first study. In the second study, the consumption had decreased significantly and no relation to SAB could be found. There are several previous reports on the relation between coffee consumption and the risk of SAB. A study from Denmark found an increased risk at a consumption of 375 mg caffeine or more.<sup>11</sup> Among 2643 pregnant females in the UK, there was a strong association between caffeine intake and SAB and stillbirth.<sup>12</sup> In contrast, no increased risk was found in a study from the USA and the authors suggested that a reporting bias might have been present as the interviews were made after the SAB.<sup>13</sup> In addition, the coffee drunk in the USA is usually much weaker than the coffee drunk in Denmark and the differences between the studies might thus reflect a dose–response relationship. A recent review suggested that it may be prudent for pregnant women to limit coffee consumption to 3 cups/day providing no >300 mg/day of caffeine to exclude any increased probability of SAB or impaired fetal growth.<sup>14</sup>

The frequently made suggestions to minimize women's exposure to organic solvents—by ensuring appropriate ventilation systems and protective equipment<sup>15</sup> from the pre-conceptional period to the end of pregnancy<sup>16</sup> and to stop smoking and limit alcohol and coffee intake<sup>17</sup> are supported by the evidence for an influence exerted by the community-based health intervention programme presented here.

In conclusion, the results from the study reported here are suggestive for an effect of a community health education programme on personal risks factors during pregnancy, particularly solvents and coffee.

## Funding

Ministero dell'Università e della Ricerca Scientifica e Tecnologica, Progetti di Ricerca Scientifica e Tecnologica (art. 65 del D.P.R. 382/1980 – quota 60%).

*Conflicts of interest:* None declared.

## Key points

- Information on health risks for pregnancy decreases the risk of spontaneous abortion.
- Further assessments of the effects of health campaigns for healthier living during pregnancy should be performed to assess utility of this preventive measure.
- Among personal life style factors coffee drinking was related to the risk.

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