

Prevalence of exposure to occupational risks during pregnancy in Spain

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Abstract

Objectives We describe reported exposures to main categories of occupational agents and conditions in Spanish pregnant workers.

Methods Women were recruited at 12th week of pregnancy from main public gynaecological consults to be

included in the INMA Spanish cohorts study ($n = 2,058$). Through personal interviews with structured questionnaires, information on working situation and working conditions during pregnancy was obtained.

Results Fifty percent of the women reported frequent exposure to physical load (standing, heavy lifting) and

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45 % reported exposure to three or more indicators of job strain. Exposure to at least one physical agent (noise, vibrations, etc.) affected 25 % of the women. Exposure to chemicals was reported by 20 % of the women, mostly including solvents and cleaning products. Eight percent of the women worked at night shifts. Job strain was more prevalent in office workers and industrial operators. Industrial workers showed the highest prevalence of exposure to chemical and physical pollutants.

Conclusions Our data suggest that working conditions of pregnant women may need increased control in Spain.

Keywords Occupational exposure · Occupational health · Pregnancy · Spain

Introduction

Occupational settings are a source of exposure to environmental agents and conditions with negative effects on reproductive health, including chemicals, physical and biological agents, physical load and psychosocial factors (Barllow et al. 1994; McDonald 1995; Figa-Talamanca 2006). Many women are employed during pregnancy, and many countries have specific regulations aimed to protect pregnant workers from occupational reproductive risks. However, information on the effectiveness of these regulations for the control of deleterious occupational exposures in pregnant workers is mostly lacking.

Surveys of working conditions are regularly carried out in Spain and many other European countries (Narocki et al. 2009; European Working Conditions Observatory 2011). Through these surveys, valuable information is obtained on workers' referred exposure to a number of occupational contaminants and deleterious working conditions, allowing periodical assessment of priorities, effectiveness of preventive policies, research on workers' characteristics related to exposure (e.g., inequities or vulnerable groups), and much more. Although the questionnaires used in these surveys usually include some items related to different dimensions of health, information on workers' fertility or pregnancy at the time of the interview is not collected. However, this information, being protection of reproductive health at work a priority under European legislation, would be highly useful.

Data on the prevalence of exposure to occupational reproductive risks in pregnant women could be used for planning and evaluating preventive policies for reproductive health at work. Besides, prevalence data could be used together with specific risks ratios for the estimation of the number of cases of reproductive failures attributable to occupational exposures, valuable information for public and occupational health systems. This information should

also help clinicians to better care for the health of women working during pregnancy, alerting them about working conditions with potential detrimental effects (McDiarmid and Gehle 2006).

The aim of this report is to describe reported occupational exposures in a population-based sample of women employed during pregnancy. Women were recruited to be included in the INMA Spanish cohorts study (Ribas-Fito et al. 2006). Results from a similar analysis using a smaller regional subsample have been previously published in Spanish (Gonzalez-Galarzo et al. 2009).

Methods

Population and sample

The INMA Spanish cohorts study (INMA is the acronym for *Infancia y Medio Ambiente*, Environment and Childhood, see www.proyectoinma.org), is a network of Spanish research groups aiming to study environmental pollutants effects on pregnancy outcomes and children growth and development through population-based birth cohorts following a common protocol (Ribas-Fito et al. 2006). For the data presented in this paper, pregnant women were enrolled during the first trimester of pregnancy at public primary health care centres or hospitals located in four Spanish regions (Asturias, Gipuzkoa-Basque Country, Sabadell-Catalonia and Valencia). Data on maternal age, education, country of birth and occupational history, among other, were obtained during first and third trimester of pregnancy through personal interviews with the women using structured questionnaires. All participants signed informed consent forms and the study was approved by local Hospital Ethics Committees. In this analysis, we include data from 2,058 women employed during pregnancy and recruited between 2003 and 2008. Participation rates in the different regions ranged between 45 and 71 %. Some available data suggest that participants tended to be older, more frequently employed and with higher educational level than non-participants.

Occupational exposure information

The questionnaire gathered information about women's employment situation and occupational history (job title, economic activity, main sector of activity where the company operates, type of contract and working time schedule) and occupational exposures (specific items in the questionnaire referred to occupational exposure to chemicals, physical and biological agents, physical load and psychosocial factors, selected according to their

Table 1 Occupational exposures investigated in the questionnaire and criteria for exposure used in this analysis

Occupational exposures	Criteria for exposure
Physical loads	
Standing	Frequently (2–4 h day) or very frequently (>4 h day)
Heavy lifting (>5 kg)	Frequently (2–4 h day) or very frequently (>4 h day)
Heavy lifting (>20 kg)	Frequently (2–4 h day) or very frequently (>4 h day)
Psychosocial conditions	
Working very fast	Always/many times
Constant attention required	Always/many times
Repercussions of work on others	Always/many times
Monotonous and repetitive tasks	Always/many times
Time to accomplish deadlines	Never
Possibility of making decisions	Never
Support from workmates	Sometimes/never
Support from supervisors	Sometimes/never
Any physical agents ^a	Frequently (2–4 h day) or very frequently (>4 h day)
Any chemicals ^b	Frequently (2–4 h day) or very frequently (>4 h day)
Biological agents ^c	Frequently (2–4 h day) or very frequently (>4 h day)
Night work	Fixed and rotating shifts including nights

^a Includes closed items referred to noise, vibrations, extreme temperatures, radiations, electromagnetic fields

^b Includes closed items referred to solvents, benzene, lead, nickel, mercury, cadmium, arsenic, pesticides, formaldehyde, nitric oxide, antineoplastic drugs and any other reported chemical substance (open answer)

^c Includes any reported biological agents (open answer)

evidence to act as potential reproductive risks, Figatalamanca 2006) from 1 month before becoming pregnant up to the third trimester of pregnancy. Interviewers were specifically trained for the occupational part of the questionnaire, including examples and additional explanations in order to help the women to report relevant exposures. Table 1 details the occupational exposures considered in the questionnaire and criteria for exposure assessment established for this analysis. A copy of the questionnaire may be downloaded from the INMA Project web (www.proyectoinma.org).

Analysis

Working conditions and exposures in the longest employment held during the time window lasting between 1 month before becoming pregnant up to the third trimester of pregnancy were considered. Only women reporting high

levels in the different frequency scales for the different occupational agents evaluated were considered as exposed (Table 1). Exposure to individual agents or conditions, as well as exposure to any agent from the major categories of occupational risks (physical load, psychosocial factors, chemicals, physical and biological agents) was analysed. In joint analyses considering exposure to any “physical agent”, exposure to electromagnetic fields (mostly related to personal computers use) was excluded because of its qualitative and quantitative differences with remaining physical agents as concerns its potential to act as a reproductive toxicant. Exposure to “job strain” (psychosocial factors) was considered if the woman reported exposure to at least three psychosocial factors not related to social support at work, and to “job strain and social isolation” if job strain was associated to lack of social support from supervisors and/or co-workers.

Prevalence of exposure was analysed according to different occupational and personal variables: type of contract (fixed, temporary, other), job title (coded through the Spanish National Classification of Occupations-94), economic activity (coded through the Spanish National Classification of Economical Activities-93-Rev.1), age, education, and place of birth (Spain, Latin America, other). Some subanalyses were performed for the jobs with the largest number of interviewees and increased prevalence of exposure to the main categories of risks. All the analyses were performed using v.15 SPSS (SPSS Inc., Chicago, IL, USA) and v. 9 STATA (Stata Corporation, College Station, Texas).

Results

Table 2 shows main characteristics of pregnant workers in our sample. Most of the women are between 25 and 34 years old (range 17–43 years), have completed at least 12 years of education, are Spanish, have fixed contracts and are full time employees in services and wholesale companies as technicians, professionals and service workers.

As shown in Table 3, half of the women report exposure to at least one physical load, most of them standing for two or more hours/day at work. Around 40 % of the workers report fast working paces, monotonous and repetitive tasks or lack of supervisor’s support. According to previously established criteria (see “Methods”), 45 % of the women work under job strain and 24 % under job strain with social isolation. Exposure to electromagnetic fields (mostly from computers use), noise and extreme conditions of temperature or humidity are the most frequently reported exposures to physical agents. Around one out of five women reports exposure to chemicals at work, including solvents, lead or

Table 2 Characteristics of the sample of women employed during pregnancy ($n = 2,058$)

	<i>n</i>	% ^a
Age (years)		
<25	134	6.5
25–29	687	33.4
30–34	881	42.8
>34	355	17.3
Missing values without information	1	
Education (minimum equivalent years of education)		
No completed minimum level of education	21	1.0
Primary (8 years)	417	20.3
Secondary (12 years)	850	41.4
University (15–17 years)	767	37.3
Missing values without information	3	
Country of birth		
Spain	1,902	92.7
Latin America	105	5.1
Others	45	2.2
Missing values without information	6	
Economic activity ^b		
Agriculture, forestry and fishing	11	0.5
Construction	46	2.2
Healthcare and social assistance	200	9.7
Manufacturing	348	16.9
Services	930	45.3
Transportation, warehousing and utilities	62	3.0
Wholesale and retail trade	458	22.3
Missing values without information	3	
Job title ^c		
Management workers	60	2.9
Technicians and professionals	352	17.1
Support technicians and professionals	456	22.2
Office workers	224	10.9
Services and sales workers	517	25.2
Qualified agriculture and fishing workers	5	0.2
Industrial qualified workers	55	2.7
Operators and assemblers	148	7.2
Unqualified workers	239	11.6
Missing values without information	2	
Type of contract		
Fixed	1,268	63.0
Temporary	438	21.8
Self-employed	166	8.2
Without contract	141	7.0
Missing values without information	45	

pesticides. Six percent of the women report exposure to biological agents.

Eight percent of the women worked at nights, mostly in rotating shifts. In subsequent analyses, night work was

Table 2 continued

	<i>n</i>	% ^a
Working time		
Part time	533	26.1
Full time	1,512	73.9
Missing values without information	13	

Spain, 2003–2008

^a Missing values for each variable excluded from the % calculation

^b Categories in the Spanish National Classification of Economical Activities (CNAE-93) grouped based on the National Institute for Occupational Safety and Health proposal (<http://www.cdc.gov/niosh/nora/sector.html>)

^c Nine major categories according to the Spanish National Classification of Occupations (CNO-94)

found to be more frequent in workers from Latin America (10 %), in the youngest group of workers (<25 years old, 11 %), in temporary workers (15 %), in industrial operators and assemblers (17 %) and in health care and social assistance activities (32 %). Night workers reported significantly ($p < 0.001$) higher exposures than daytime workers to chemicals (respectively, 32 vs. 19 %), physical agents excluding electromagnetic fields (43 vs. 23 %), biological risks (30 vs. 4 %), physical load (86 vs. 47 %), job strain (73 vs. 42 %) and job strain with social isolation (36 vs. 23 %).

Table 4 shows reported exposures to any agent from the major categories according to sociodemographic and employment characteristics of the women. Prevalence of exposure to chemicals, physical agents and physical load is higher in the youngest group of workers (<25 years old) compared to the older ones ($p < 0.05$). Prevalence of exposure to all the categories of risks is also higher in workers with the lowest educational level (primary or less). As an example, 53 % of workers with primary or lesser level report job strain vs. 42 % of workers with university level of education ($p < 0.001$). Prevalence of exposure to physical load is also higher in non-Spanish workers (>60 %) than in Spain born workers (49 %, $p < 0.001$). Highest prevalence of exposure to chemicals and physical agents are reported in the manufacturing sector (respectively, 28 and 41 %), while qualified industrial workers are the workers in jobs more frequently exposed to chemicals (46 %) and operators to physical agents (66 %). Service and sales workers report the highest exposures to physical loads (83 %). Job strain and job strain with lack of social support is mostly observed in industrial operators (respectively, 79 and 47 %). Exposure to biological agents increases for workers with university level of education (10 %), workers at the healthcare sector (46 %), and technicians (19 %). For all the categories of risks,

Table 3 Prevalence of self-reported occupational exposures in women employed during pregnancy ($n = 2,058$)

	<i>n</i>	% ^a	CI 95 % ^b
Physical loads			
Standing	916	44.8	42.6–47.0
Heavy lifting (>5 kg)	546	26.8	24.9–28.8
Heavy lifting (>20 kg)	153	7.5	6.4–8.7
Any physical load	1,029	50.3	48.1–52.5
Psychosocial risks			
Working very fast	853	41.7	39.6–43.9
Constant attention required	1,536	75.1	73.2–77.0
Difficulties meeting deadlines	96	4.7	3.8–5.7
Monotonous and repetitive tasks	835	40.9	38.7–43.1
Repercussions of work on others	1,274	62.4	60.2–64.5
Limitations for decision making	211	10.3	9.0–11.7
Job strain ^c	916	44.9	42.7–47.1
Lack of colleagues' support	479	23.5	21.7–25.4
Lack of supervisors' support	828	40.6	38.4–42.7
Job strain and social isolation ^d	484	23.7	21.9–25.6
Physical agents			
Ionizing radiations	28	1.4	0.9–2.0
Noise	449	22.0	20.2–23.8
Vibrations	170	8.3	7.2–9.6
Extreme temperatures or humidity	450	22.1	20.3–24.0
Electromagnetic fields	893	43.9	41.7–46.1
Any physical agent ^e	505	24.7	22.8–26.6
Chemicals			
Solvents	132	6.5	5.4–7.6
Lead ^f	9	0.9	0.4–1.7
Pesticides	16	0.8	0.4–1.3
Cleaning products ^g	156	7.6	6.5–8.9
Other chemicals	83	4.1	3.2–5.0
Any chemicals	402	19.6	17.9–21.4
Biological agents			
Any biological agent	128	6.3	5.3–7.4
Night work			
Fixed	31	1.5	1.0–2.2
Rotating shifts with nights	133	6.6	5.5–7.8
Any night work ^h	168	8.3	7.1–9.6

Spain, 2003–2008

Only women reporting high frequency of exposure for the different occupational agents are considered as exposed (see criteria in Table 1)

^a Excluding missing values

^b 95 % confidence intervals

^c Exposure to at least three of the psychosocial conditions above

^d Job strain plus at least one of the lack of support conditions above

^e Excluding electromagnetic fields

^f Exposure to lead was only inquired in the cohorts from Asturias and Valencia. Percent of exposed women is calculated over the total sample ($n = 981$) from these two cohorts

^g Grouped from open-answered question

^h Four interviewees reported night work with unknown schedule

temporary workers report exposure more frequently than fixed contract workers do.

Inequalities in occupational exposures prevalence related to personal and employment characteristics were further explored in selected job titles considering job sectors too and grouped into industrial workers, hospitality workers, sales workers, cleaners and health workers, all of them with increased prevalence for some categories of exposure and with enough number of workers in our sample allowing further stratification (Table 5). When analysing the different categories of exposures in these job titles (selected examples shown in Table 6), most of the differences in prevalence of exposure according to sociodemographic (age, education, country of birth) and employment (contract type) characteristics disappear, but some inequalities for some combinations of exposures and job titles are still present ($p < 0.05$).

Discussion

Our results show that pregnant workers report frequent exposure to different categories of occupational agents and conditions, including contaminants and situations with recognised or suspected deleterious effects on pregnancy (Figa-Talamanca 2006). Inequities in the distribution and frequency of exposures reported in this study were also observed, although these differences were mostly explained by job titles. Although obviously not all the women reporting occupational exposures are at increased reproductive risk, our data show that some reported exposures and frequencies of exposure are worrying enough and, to our view, should alert authorities and practitioners about a needed reinforcement of pregnant workers protection. This increased attention should include proper quantitative assessment of occupational exposures in workstations involving pregnant workers, proper control of exposures exceeding safety levels and proper surveillance of pregnant workers' health.

In our study occupational exposures have been assessed through women's self-reports. No direct measurements or observations at occupational settings where women were employed during pregnancy were carried out in this study. Agreement between workers' self-reported exposure data and other approaches for exposure assessment is largely variable (Teschke et al. 2002). Underreporting of occupational exposures in workers' self-reports has been observed in community-based (McGuire et al. 1998) and reproductive health studies (Hemminki et al. 1995). Self-reporting of occupational exposure is, however, a feasible approach in population-based studies, and nearly the only one possible for some occupational exposures such as psychosocial conditions. Besides, job-specific questionnaires have been

Table 4 Prevalence of self-reported occupational exposures in women employed during pregnancy ($n = 2,058$) according to sociodemographic and employment characteristics

	Any chemicals		Any physical agent ^a		Any biological agent		Any physical load		Job strain ^b		Job strain and social isolation ^c	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Age (years)												
<25	44	32.8	41	30.6	4	3.0	93	69.4	64	47.8	36	26.9
25–29	139	20.4	183	26.9	43	6.3	399	58.7	316	46.6	166	24.5
30–34	148	16.9	187	21.3	53	6.1	381	43.3	389	44.5	201	23.0
>34	71	20.1	94	26.6	28	8.0	155	43.9	146	41.6	80	22.8
<i>p</i> value ^d	<0.001		0.015		0.234		<0.001		0.414		0.708	
Education												
Primary or less	140	32.2	176	40.6	13	3.0	320	73.7	227	52.5	129	29.9
Secondary	192	22.8	207	24.6	35	4.2	462	54.8	369	44.0	204	24.3
University	68	8.9	121	15.8	79	10.4	244	31.8	319	41.6	150	19.6
<i>p</i> value ^d	<0.001		<0.001		<0.001		<0.001		0.001		<0.001	
Country of birth												
Spain	364	19.2	478	25.3	119	6.3	927	49.0	849	45.1	445	23.6
Latin America	29	27.9	20	19.2	7	6.7	72	69.2	43	41.3	23	22.1
Others	8	17.8	6	13.3	2	4.4	28	62.2	21	46.7	13	28.9
<i>p</i> value ^d	0.093		0.077		0.863		<0.001		0.738		0.664	
Economic activity ^e												
Construction	1	2.2	1	2.2	0	0.0	3	6.5	18	39.1	8	17.4
Healthcare	34	17.1	42	21.1	91	46.0	134	67.3	101	51.5	46	23.5
Manufacturing	95	27.8	139	40.6	7	2.1	160	46.5	203	59.2	116	33.8
Services	199	21.4	202	21.8	21	2.3	411	44.3	344	37.2	177	19.1
Transport/warehousing	6	9.8	11	17.7	0	0.0	17	27.4	34	54.8	22	35.5
Wholesale/retail trade	63	13.8	104	22.8	8	1.8	297	65.1	212	46.6	112	24.6
<i>p</i> value ^d	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Job title ^e												
Management workers	8	13.3	6	10.0	2	3.3	19	31.7	23	38.3	10	16.7
Technicians and professionals	32	9.1	74	21.0	65	18.6	130	36.9	130	37.0	48	13.7
Support technicians and professionals	40	8.8	45	10.0	20	4.4	75	16.6	177	39.2	100	22.1
Office workers	15	6.7	11	4.9	1	0.4	51	22.8	122	54.5	65	29.0
Services and sales workers	125	24.3	173	33.6	26	5.0	429	83.3	227	44.4	115	22.5
Industrial qualified workers	25	46.3	34	63.0	0	0.0	34	63.0	28	51.9	19	35.2
Operators and assemblers	50	34.5	95	65.5	6	4.2	114	78.6	114	78.6	68	46.9
Unqualified workers	104	43.5	63	26.4	8	3.3	173	72.4	95	40.1	59	24.9
<i>p</i> value ^d	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001	
Type of contract												
Fixed	228	18.0	302	23.9	82	6.5	593	46.8	596	47.1	326	25.8
Temporary	91	20.8	140	32.0	39	8.9	257	58.7	221	50.7	119	27.3
Self-employed	41	24.7	43	25.9	6	3.7	84	50.6	51	30.9	9	5.5
Without contract	34	24.1	14	9.9	1	0.7	79	56.0	42	30.2	25	18.0
<i>p</i> value ^d	0.072		<0.001		0.003		<0.001		<0.001		<0.001	

Spain, 2003–2008

^a Excluding electromagnetic fields^b Exposure to at least three psychosocial conditions (support not considered, see footnotes in Table 3)^c Job strain plus at least one of the lack of support conditions (see footnotes in Table 3)^d *p* value for Chi-square test^e Nine major categories according to the Spanish National Classification of Occupations (CNO-94), excluding qualified agriculture and fishing workers because of low numbers

Table 5 Prevalence of self-reported occupational exposures in women employed during pregnancy in selected job titles

Job title (<i>n</i>) ^a	Any chemicals		Any physical agent ^b		Any biological agent		Any physical load		Job strain ^c		Job strain and social isolation ^d	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Industrial workers (198)	62	31.3	129	65.2	6	3.0	148	74.7	146	73.7	85	42.9
Hospitality workers (105)	28	26.7	51	48.6	0	0.0	98	93.3	54	51.9	24	23.1
Sales workers (269)	46	17.1	73	27.1	6	2.2	226	84.0	117	43.7	61	22.8
Cleaners (186)	92	49.5	32	17.2	6	3.2	133	71.5	62	33.5	39	21.1
Health workers (139)	30	21.7	35	25.4	81	58.7	104	75.4	81	59.6	39	28.7

Spain, 2003–2008

^a Workers are grouped according to selected job titles in selected job sectors^b Excluding electromagnetic fields^c Exposure to at least three psychosocial conditions (support not considered, see footnotes in Table 3)^d Job strain plus at least one of the lack of support conditions (see footnotes in Table 3)**Table 6** Prevalence of self-reported occupational exposures in women employed during pregnancy in selected job titles according to sociodemographic and employment characteristics

Job title (<i>n</i>)	Any chemicals Cleaners (186)			Any physical agent ^a Industrial workers (198)			Any biological agent Health workers (139)			Any physical load Sales workers (269)			Job strain ^b Hospitality workers (105)			Job strain and social isolation ^c Industrial workers (198)		
	<i>N</i> ^d	<i>n</i> ^e	%	<i>N</i> ^d	<i>n</i> ^e	%	<i>N</i> ^d	<i>n</i> ^e	%	<i>N</i> ^d	<i>n</i> ^e	%	<i>N</i> ^d	<i>n</i> ^e	%	<i>N</i> ^d	<i>n</i> ^e	%
Age (years)																		
<25	30	16	53	13	7	53	2	1	50	25	22	88	23	14	60	13	3	23
25–29	65	30	46	66	44	68	48	28	58	102	90	88	42	26	61	66	28	44
30–34	57	28	49	87	55	63	62	35	56	100	82	82	27	9	34	87	40	46
>34	34	18	52	32	23	74	27	17	65	41	31	75	13	5	38	32	14	45
<i>p</i> value ^f	0.889			0.512			0.879			0.251			0.091			0.481		
Education																		
≤Primary	92	47	51	96	72	76	4	1	25	83	71	85	50	25	50	96	41	43
≥Secondary	92	43	46	102	57	56	135	80	59	185	154	83	55	29	53	102	44	44
<i>p</i> value ^f	0.555			0.003			0.165			0.635			0.706			0.957		
Country																		
Spain	128	71	55	186	123	66	133	79	59	253	212	83	91	45	50	186	81	44
Other	58	21	36	12	6	54	6	2	33	15	13	86	14	9	64	12	4	36
<i>p</i> value ^f	0.015			0.402			0.197			0.768			0.320			0.608		
Contract																		
Fixed	51	35	68	111	71	64	81	50	61	195	166	85	45	25	55	111	50	45
Temporary	38	27	71	67	50	74	47	28	59	44	37	84	21	13	61	67	33	49
Self-employed	3	1	33	7	4	57	7	2	28	27	22	81	14	6	42	7	2	28
No contract	84	25	29	8	4	50	2	1	50	1	0	0	20	10	50	8	0	0
<i>p</i> value ^f	<0.001			0.312			0.391			0.131			0.735			0.051		

Spain, 2003–2008

^a Excluding electromagnetic fields^b Exposure to at least three psychosocial risks (support not considered, see footnotes in Table 3)^c Job strain plus at least one of the lack of support risks (see footnotes in Table 3)^d Total number of workers in the category^e Total number of exposed workers in the category^f *p* value for Chi-square test

shown to provide more accurate assessments than generic questionnaires as the one used in this study (Tielemans et al. 1999; Stewart 1999). The use of closed questions and closed lists of exposures, the inclusion of examples of tasks and conditions related to the exposures investigated in the questionnaire, and specific training of interviewers were strategies followed in this study in order to overcome potential limitations in our approach for exposure assessment. However, the use of different interviewers, due to geographical dispersion of the participating women, may have introduced some biased responses. A point against this potential interviewer-induced variability is that results from a previous analysis on a local subsample (Gonzalez-Galarzo et al. 2009) are in general quite similar to those reported here, except that in the case of the present study a larger sample has allowed further stratified analyses and more precise estimates. Similarly, recall bias is not expected to be a major problem as occupational history was assessed before delivery and the information of interest was referred to a time period simultaneous or only a few weeks previous to the interview time. Only women reporting higher frequencies of exposure were considered as exposed. Besides, only exposures reported for the longest employment held during pregnancy were considered. In fact, occupational exposures in women holding different employments in this period may be underestimated in our data.

Although our sample of pregnant women is not intended to represent the whole Spanish population, the regions included in the INMA Spanish cohorts study (Ribas-Fito et al. 2006) are representative of different geographical locations in the country (northern and eastern regions) and different residential areas (urban, semi-urban, rural). However, participation rates were low in some regions. Besides, participants in the sample seem to be older and have higher educational level than non-participants. In our sample (Table 4), younger women and women with lower education tend to be more frequently exposed to deleterious contaminants and conditions at work than older and more educated workers are. Hence, with our data we likely underestimate the frequency of some occupational exposures affecting pregnant workers in Spain.

We may compare prevalence of some exposures reported by pregnant workers in this study with similar data from the IV European Working Conditions Survey (European Working Conditions Observatory 2011), with nearly 30,000 European workers face-to-face interviewed, conducted in late 2005. This comparison is limited to some agents assessed through similar questions and answers categories in the questionnaire used in our study and in the European surveys, and it should be interpreted considering the differences between data available from the European survey (concerning female workers, all ages) and from our study (pregnant workers).

Twenty-five percent of female workers in the European survey report “carrying or moving heavy loads” a quarter of the working time or more. Prevalence of “heavy lifting” (>5 kg) during two or more hours in a working day in our sample of pregnant workers was 27 %. Heavy physical work of the woman has been related to spontaneous abortion (McDonald et al. 1988; Figa-Talamanca 2006), but not always (Wong et al. 2010). Low birth weight and reduced gestational age at birth have also been associated to exposure to physical workload in studies carried out in Spain and in other countries (Escriba-Aguir et al. 2001; Figa-Talamanca 2006; Bonzini et al. 2007).

Exposure to occupational psychosocial risks has been related to menstrual alterations (Figa-Talamanca 2006), but the relationship with other reproductive outcomes, such as spontaneous abortion or preterm delivery, is more doubtful and likely to be modulated by other concurrent exposures and/or conditions (Hickey et al. 1995; Brett et al. 1997; Meyer et al. 2007). In our sample exposure to at least three psychosocial risks at work affected around 45 % of the women. “Monotonous tasks”, were reported by 41 % of women in our sample and 44 % of women in the European survey (European Working Conditions Observatory 2011).

Exposure to metals, solvents and pesticides has been related to a variety of pregnancy negative outcomes, including increased risk of spontaneous abortion, developmental toxicity in the offspring and stillbirth (Barlow et al. 1994; Figa-Talamanca 2006). The prevalence of women reporting exposure to solvents during pregnancy was noticeable in our sample (6.5 %). In addition, a relevant number of pregnant workers reported frequent occupational exposure to cleaning products (8 %). Usually these products include a myriad of components in the formulas, solvents not discarded. Although attention and control of occupational exposure to cleaning products is increasing (Pechter et al. 2009), we are not aware of any epidemiological studies addressing reproductive risks related to occupational exposure to this wide family of chemicals.

In our sample, the more prevalent exposure in the category of physical agents was electromagnetic fields, mostly related to video-display terminals (VDTs) use. Contemporary equipments are likely not related to major reproductive risks, although a slight increase in the risk of miscarriage has not been discarded (Figa-Talamanca 2006). Exposure to noise was high in our sample of pregnant workers (22 %), slightly higher than reported by female European workers (19 %) (European Working Conditions Observatory 2011). Exposure to noise is a cause of stress and its potential interference with the endocrine system have been hypothesised to be a possible risk factor for adverse pregnancy outcomes, a hypothesis confirmed in animal studies (Figa-Talamanca 2006). Occupational

exposure to noise was related to low birth weight and decreased gestational age (Hartikainen et al. 1994), but the number of studies evaluating this potential association remains low (Nurminen 1995; Wu et al. 1996; Figa-Talamanca 2006). Besides, 8 % of the women reported exposure to vibrations and 6 % to infectious agents in general (nearly 60 % in health workers, Table 6). The potential risks or consequences related to these exposures are unknown.

In our sample eight percent of the women worked at night, mostly through rotating schedules. Prevalence of night work increased according to some personal and occupational characteristics. Shift work during pregnancy, especially rotating schedules, has been related to spontaneous abortion, low birth weight and preterm birth (Nurminen 1995; Croteau et al. 2006; Figa-Talamanca 2006). Oppositely, fixed night work was observed to increase the risk of late foetal loss in a Danish cohort study (hazard ratio 1.85, 95 % confidence interval 1.00–3.42, Zhu et al. 2004). In our data, night work was observed to be strongly associated with exposure to a wide range of other potentially deleterious occupational conditions, namely chemicals, physical agents, biological risks, physical load and job strain.

We have observed increased frequency of exposure related to some job titles. Industrial, hospitality, sales and health workers and cleaners frequently show exposure to a combination of risks (physical loads, job strain, contaminants, etc.) with mostly unknown interactive effects. Increased risk of low birth weight for industrial and service female workers has been observed previously (Ronda et al. 2009). Some differences in exposure prevalence according to personal and employment characteristics (age, education, country of origin, type of contract) mostly disappeared in homogeneous categories of job titles.

In global, results from our analyses suggest that more surveillance and protection on pregnant workers may be needed in Spain, as there are evidences that some of the reported exposures may alter the normal development of pregnancy. Indeed, no major differences were observed in the prevalence of some exposures reported in our sample of pregnant workers and in those reported in European general working population surveys. For surveillance, assessment and prioritisation of preventive actions, the inclusion of questions assessing reproductive situation of workers interviewed in routine working conditions surveys will greatly help. Besides, public health technicians and clinicians dealing with present or future pregnant women should improve their awareness and knowledge on environmental and occupational hazards related to reproductive health, and inclusion of information on these exposures in the standard health history form should help to better management and prevention on this field (McDiarmid and Gehle 2006).

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