Socio-occupational status and congenital anomalies

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Background: The aim of this study is to investigate the association between socio-occupational status and the frequency of major congenital anomalies in offspring. **Methods:** The study population comprised 81 435 live singletons born to mothers enrolled in the Danish National Birth Cohort between 1996 and 2002. A total of 3352 cases of major congenital anomalies (EUROCAT criteria) were identified by linkage to the National Hospital Discharge Register. Malformations were recorded at birth or in the first year of life. Information about maternal and paternal socio-occupational status was collected prospectively using telephone interviews in the second trimester of pregnancy and was categorized as high, middle or low. Associations were measured as relative prevalence ratios using the highest socio-occupational status within the couple as the reference group. **Results:** The prevalence of all recorded major congenital anomalies was similar, about 4%, in all the socio-occupational categories. Low social status of the couple did, however, correlate with a higher prevalence of congenital anomalies of the 'respiratory system'. No association was substantially attenuated when we adjusted for maternal and paternal age, smoking status, maternal alcohol habits, folic acid intake and body mass index. When malformations of the heart and the cardiovascular system were grouped together, they were more frequent in families where both parents presented a low socio-occupational status. **Conclusion:** We detected an association between low socio-occupational status and congenital anomalies of the respiratory system, the heart and the circulatory system. These malformations are good candidates for a large study on occupational, environmental and social determinants.

Keywords: congenital anomalies, environmental risk factors, social status.

Introduction

Congenital anomalies (CAs) are important causes of mortality and morbidity in childhood and later in life. The aetiology of most congenital anomalies remains unknown, although there are a few well established and avoidable external risk factors. It is likely that a number of external unknown causal factors are yet to be identified, but we need to know where to begin searching, and beginning with social correlates may be a starting point. Some lifestyle factors (like diet) and occupational/environmental exposures (like chemical use in the workplace) will correlate with low social status,[1,2] and if these factors play a causal role in CAs, the occurrence of CAs may be associated with social status. Identifying social indicators of CAs after adjusting for lifestyle factors can, therefore, be considered a screening tool to focus future studies on environmental factors. Analysing CAs with and without adjusting for lifestyle factors in terms of the social condition

provided some clues about the discovery of the micro-nutritional aetiology of neural tube defects (NTD).[3–8]

Low social status is a well-established risk indicator for a range of adverse perinatal and infant outcomes such as low birth weight[9–10] and perinatal, neonatal and post neonatal mortality.[11–14] Surprisingly, few studies have examined social inequalities of the prevalence of CAs.[15–20]

Studies published on all the CAs combined have either shown no clear social patterns[15–17] or a higher prevalence of CAs among children born to lower social class mothers.[18,19] Very few studies have been large enough to examine the association between social status and specific congenital defects with the exception of NTD,[3] heart defects and oral facial clefts.[20] Higher[18] and lower[15–21] prevalences of Down Syndrome have been reported for parents of a lower social status but these findings may have been confounded by parental age.[21] Several studies show trends of a higher prevalence of cleft lip/palate in lower social classes,[18,22–25] mainly related to cleft palate,[16,18,23–24] Inconsistent reports exist for hypospadias[18,23] and some have reported cardiovascular anomalies, genitourinary anomalies, polydactyly, syndactyly, limb reduction defects and hydrocephalus to be more frequent in less privileged segments of the population.[18,23,25–27,32] However, Knox and Lancashire[18] and Dolk *et al.*[28] reported no social class variations for a variety of CAs.

In a society where both partners work, social conditions depend on both the male and the female educational and economic contribution to the family,[29] while personal behaviours and attitudes may depend mostly on individual characteristics. Social inequalities in health should also, wherever possible, be studied by taking the social status of both partners into account. In this study, we investigated the associations between combined and individual socio-occupational status and overall and specific major CAs in offspring.

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Methods

Data were obtained from the Danish National Birth Cohort (DNBC), which is a nationwide study among pregnant women and their offspring, with recruitment between January 1997 and December 2002 (www.bsmb.dk).[27] Pregnant women were approached during their first prenatal care visit to a general practitioner, which usually took place from 6 to 10 weeks of gestation. Approximately 50% of all general practitioners in Denmark participated in the recruitment and ~60% of eligible women accepted the invitation and signed the consent form. All women who intended to carry their pregnancy to term and spoke Danish well enough to participate in the interviews were eligible for the study. In Denmark, almost all hospital treatments at that time (except for specific fertility treatments) took place within the National Health Services and 99.5% of the children were born in public hospitals.[30]

The data on socio-occupational status was obtained by computer-assisted telephone interviews (CATI) during which the mothers gave information about their current or most recent job within the last 6 months, or about the type of education if the woman was a student. They furthermore provided information about their partner's occupation and education. The mothers' and fathers' socio-occupational status were then categorized into three groups: The 'high' category included women or men in management positions or in jobs requiring higher education, generally more than 4 years beyond high school. Office workers, service workers, skilled manual workers and people in the forces constituted the 'middle' category. Unskilled workers, unemployed women/men and women/men outside the work force were classified as the 'low' category. Students were classified according to the type of job they aspired to get with their education because we believe that most students share lifestyle behaviours and attitudes with their future colleagues. In Denmark, all education is free and students receive government support during their education that enables most of them to make healthy lifestyle choices if they wish. Besides the individual socio-occupational status of each woman and man, we defined the couple's socio-occupational status as the highest status within the couple. Women and men with unknown status were categorized according to their partner's socio-occupational status. If the mother had no partner, her status determined the classification. We excluded couples if both mother and father had unknown socio-occupational status.

By using the mother's central identification number, we retrieved information about all pregnancy outcomes in the National Discharge Register and the National Birth Register. In the Central Registration System, we linked the mother's identification number to the child's identification number and identified all children with CAs codes DQ00.0 to 99.9 of the International Classification of Disease 10th version (ICD-10) at birth or during the first year of life.[31] We divided them into categories according to the European Surveillance of Congenital Abnormalities Classifications (EUROCAT) criteria (part 7 of the former EUROCAT Guide 1.2.).[32] CAs were classified into subgroups after excluding minor CAs with lesser medical, functional or cosmetic importance, as defined by EUROCAT.

We identified 85 976 live singleton births where we had information about the couple's socio-occupational status. We excluded births of women with ovarian or cervical cancer, and births with twins or triplets since anomalies are more common in this group and may present a different aetiology.[23–25] From the information in the register, we also excluded those whose pregnancies resulted in stillbirths and miscarriages, ectopic pregnancies and hydatiform mole. If a woman was registered in the cohort with more than one birth, we excluded all but the first births to avoid non-independent events. These exclusion criteria left 81435 (94.7%) births for analysis, including 3352 (4.1%) births with major CAs.

Data analysis

First, we examined the association between the prevalence of major CAs and the socio-occupational status of the couple by estimating relative prevalence ratios (RPR). High socio-occupational status was used as reference group. The prevalence proportion is the number of CAs registered at birth or during the first year of life divided by the number of births. Then we examined both major CAs in general, and those were divided into broad categories.

In the analyses of selected subgroups of CAs, we selected only those couples for whom we knew the socio-occupational status of both the mother and father. This criterion was met by 74489 (91.5%) births, including 3071 (4.1%) births with major CAs. We estimated the RPR of CAs for each of the nine different possible combinations of individual maternal and the paternal socio-occupational status with couples where both partners were classified as the high category, which was taken as the reference group. In this analysis, we combined CAs of the heart and the circulatory system' CAs into one group.

We used a logistic regression analysis to estimate RPRs while taking into account possible confounders. First, we adjusted for factors not directly related to lifestyle or occupational factors, such as the mothers' and fathers' age. Then, we also adjusted for maternal pre-pregnancy body mass index (BMI), folic acid intake in early pregnancy, smoking during pregnancy, alcohol consumption before and during pregnancy as well as paternal smoking habits.[16–19] Information about all these covariates were self-reported and came from pregnancy interviews. This analysis was done to evaluate whether any social differences persisted after adjusting for these lifestyle factors. Since the outcome was very rare, the estimated odds ratios were interpreted and presented as RPRs with 95% CI.

In the supplementary analyses, we extended the study population to include couples with unknown socio-occupational status as a category of its own. The analysis was done with the SPSS software (version 14.0; SPSS Inc., Chicago, III). The study was approved by all the Scientific Ethics Committees in Denmark and by the Danish Data Protection Board.

Results

We identified 54 011 (62.8%) live born singleton births classified by the highest social-occupational status of the couple; 24 104 were identified in the 'middle' category (28.0%), and 3320 in the 'low' category (3.9%).

For 55% of the couples, both mother and father presented the same social-occupational status. Among couples with different social-occupational status, 47% of the fathers and 42% of the mothers presented the highest level of social-occupational status.

Table 1 shows the characteristics of the study population. High socio-occupational status correlated with older age, higher intake of alcohol and being a non-smoker.

The overall prevalence proportion of CAs was around 4.0% in all the socio-occupational groups (table 2). For each subgroup of CAs, we calculated crude and adjusted RPRs. A higher prevalence proportion was found in the lowest socio-occupational group compared with the highest [RPR 4.5 (95% CI: 2.2–9.5)] for only the CA group 'respiratory system' (DQ30-DQ34). For CAs of the heart (DQ20-DQ24) and

Table 1 Characteristics of the study population and the Prevalence Proportion (PP) for major congenital anomalies in relation to the socio-occupational status of the couple in The Danish National Birth Cohort, 1996–2003

	Socio-occupational status								
	High			Middle			Low		
All	*N* 54 011	Percent 100.0	PP	*N* 24 104	Percent 100.0	PP	*N* 3320	Percent 100.0	PP
Age (years)									
24	1493	2.8	4.2	2875	12.1	3.5	715	22.1	4.2
24–29	16 508	31.1	4.3	9570	40.4	4.3	1139	35.1	4.0
>30	35 055	66.1	4.1	11 233	47.5	4.1	1387	42.8	4.6
BMI[a]									
Underweight (<20)	3644	7.1	4.0	1407	6.1	4.1	243	7.9	4.0
Normal weight (21–24)	29 915	58.4	4.0	10 708	46.9	4.2	1284	41.5	3.4
Overweight (25–29)	13 560	26.5	4.4	7162	31.4	4.2	917	29.6	4.3
Obesity (>30)	4086	8.0	4.5	3564	15.6	4.0	653	21.1	5.7
Folic acid									
No intake	27 252	50.6	4.4	10 165	42.3	4.4	1182	35.8	4.2
Intake	26 561	49.4	3.8	13 839	57.7	3.9	2120	64.2	4.1
Smoking									
Mother									
Non-smoker	42 619	78.9	4.0	15 563	51.9	4.0	1617	48.7	4.1
Smoker	11 392	21.1	4.5	8541	28.5	4.1	1703	51.3	4.8
Smoker >5 cig/day	6209	11.5	3.7	5856	19.6	4.3	1334	40.2	4.3
Father									
Non-smoker	39 728	73.6	4.1	14 776	61.3	4.2	1774	53.4	4.5
Smoker	14 283	26.4	4.2	9328	38.7	4.0	1576	46.6	4.0
Mother–Father									
Non-smokers	34 105	63.1	4.1	11 244	46.6	3.9	1074	32.3	4.1
One of them smokes	14 134	26.2	4.3	7851	32.6	4.2	1243	37.5	4.0
Both are smokers	5769	10.7	4.1	5009	20.8	4.0	1003	30.2	4.0
Alcohol consumption before pregnancy (gram/week)									
0	27 213	50.4	4.2	15 480	64.2	4.1	2334	70.3	4.5
1–20	3240	6.0	4.2	1405	5.8	5.0	189	5.7	3.7
20–40	10 057	18.6	4.0	3388	14.1	3.8	331	10.0	4.2
>40	13 501	25.0	4.2	3831	15.9	4.2	466	14.0	2.1
Alcohol consumption after pregnancy (gram/week)									
0	28 302	70.1	4.2	14 716	79.6	4.0	2300	85.4	4.4
1–20	6228	15.4	4.3	2024	10.9	4.0	211	7.8	5.2
20–40	4782	11.9	4.4	1365	7.4	5.0	139	5.2	1.4
>40	1040	2.6	3.0	393	2.1	3.5	42	1.6	4.7

a: BMI, Pre-pregnancy Body Mass Index (kg/m^2)
PP, Prevalence Proportion per 100 births
Percentages may not add up to 100 because of missing responses

'other circulatory system' CAs (DQ20-DQ28), we saw a similar, but not statistically significant, tendency.

For these two CA groups ('respiratory system' and 'heart' combined with 'other circulatory system'), we found that couples, where both mother and father were of low socio-occupational status, presented a higher prevalence of CA than couples who both reported a high status [RPRs adjusted for parental age 2.2 (95% CI: 1.2–3.8) and 1.6 (95% CI: 1.3–2.0), respectively] (table 3). We observed a similar social pattern for each partner, but perhaps with a minor tendency for a slightly stronger association between respiratory CA and the maternal socio-occupational group.

When couples with unknown socio-occupational status were included in the analysis, we diagnosed 133 CAs in this group with a prevalence of 3.0%. This group included women who were older, had lower BMI, smoked less and consumed less alcohol.

Adding missing data as a separate category produced an RPR for CAs of 1.1 (95% CI: 0.6–2.1) for this missing category. For CAs of the respiratory system, we found an RPR of 5.0 (95% CI: 0.6–36.5), 1.0 (95% CI: 0.3–4.2) for CAs of the heart and an RPR of 4.8 (95% CI: 1.1–20.3) for other CAs of the circulatory system.

Discussion

Most CAs were distributed equally in all the socio-occupational strata of the study population, and a lack of social gradient was also expected if most CAs were caused by random genetic mutations or external causes that affect all members of society, irrespectively of social conditions. The only exception was CAs related to the respiratory system. The social gradient here was not explained by the lifestyle factors we had data for, and more direct occupational or environmental exposures may be better causal candidates. In that respect, some studies have found a higher prevalence in low classes of repetitive work, low skill discretion, low influence at work, high job insecurity and ergonomic, physical, chemical and climatic exposures.[2] These factors could explain the social gradient found. This finding is of interest and merits further study.

Our results derive from an affluent society with less social discrepancies than in many other countries. In Denmark, access to health care and antenatal diagnostic facilities are provided free of charge to all patients. All mothers, regardless of their social status, have the same access to prenatal screening and thus the possibility to terminate an unwanted affected

Table 2 Major congenital malformations of the child according to the socio-occupational status of the couple among 81 435 Danish births and the relative prevalence ratio (RPR) of specific anomalies according to socio-occupational status using the high category as a reference

		Socio-occupational status									
		High		Middle				Low			
Major CAs		N (%)	RPRc	N (%)	RPRc[b]	RPRc	RPRd	N (%)	RPRc	RPRc	RPRd
All (3352, 4.1)	No	51 782 (95.9)	1 (Ref)	23 118 (95.9)				3183 (95.8)			
	Yes	2229 (4.1)	1 (Ref)	986 (4.1)	0.9 (0.9–1.1)	1.0 (0.9–1.0)	1.0 (0.9–1.0)	137 (4.1)	1.0 (0.8–1.2)	1.0 (0.9–1.2)	1.0 (0.9–1.3)
Multiple CAs	Yes	263 (0.5)	1 (Ref)	91 (0.4)				15 (0.4)			
Type of CAs[a]											
Nervous syst (DQ00–DQ07)		76 (0.2)	1 (Ref)	48 (0.2)	1.4 (1.0–2.0)	1.3 (0.9–1.9)	1.4 (0.9–2.1)	5 (0.2)	1.1 (0.4–2.6)	1.0 (0.4–2.4)	0.8 (0.3–2.5)
Eye, ear, face and neck (DQ10–DQ18)		64 (0.1)	1 (Ref)	29 (0.1)	1.0 (0.6–1.6)	0.9 (0.6–1.5)	0.8 (0.5–1.4)	6 (0.2)	1.5 (0.7–3.5)	1.4 (0.6–3.3)	1.1 (0.4–3.3)
Heart (DQ20–DQ24)		417 (0.8)	1 (Ref)	210 (0.9)	1.1 (0.9–1.3)	1.2 (1.0–1.4)	1.1 (0.9–1.3)	32 (1.0)	1.3 (0.9–1.8)	1.3 (0.9–1.9)	1.3 (0.9–1.9)
Other circulatory syst (DQ25–DQ28)		88 (0.2)	1 (Ref)	36 (0.1)	1.0 (0.7–1.4)	1.0 (0.7–1.4)	0.9 (0.6–1.5)	8 (0.2)	1.5 (0.8–3.0)	1.6 (0.8–3.3)	1.6 (0.7–3.7)
Respiratory syst (DQ30–DQ34)		60 (0.1)	1 (Ref)	33 (0.1)	1.2 (0.8–1.9)	1.4 (0.9–1.2)	1.4 (0.8–2.3)	13 (0.4)	3.5 (1.9–6.4)	4.2 (2.3–7.8)	4.5 (2.2–9.5)
Cleft lip and cleft palate (DQ35–DQ37)		101 (0.2)	1 (Ref)	53 (0.2)	1.2 (0.9–1.6)	1.1 (0.8–1.6)	1.2 (0.8–1.9)	2 (0.1)	0.4 (0.1–1.3)	0.3 (0.1–1.2)	0.4 (0.1–1.5)
Digestive syst (DQ38–DQ45)		132 (0.3)	1 (Ref)	58 (0.2)	1.0 (0.7–1.3)	1.0 (0.7–1.4)	1.0 (0.6–1.4)	7 (0.2)	0.9 (0.4–1.8)	0.9 (0.5–2.0)	1.3 (0.6–2.9)
Cryptorchisdim (DQ53)[e]		105 (0.2)	1 (Ref)	41 (0.2)	0.9 (0.6–1.3)	0.9 (0.6–1.3)	0.9 (0.6–1.5)	5 (0.2)	0.8 (0.3–1.9)	0.9 (0.3–2.1)	1.0 (0.4–2.9)
Hypospadias (DQ54)		106 (0.2)	1 (Ref)	51 (0.2)	1.0 (0.8–1.5)	1.1 (0.8–1.6)	1.2 (0.8–1.8)	6 (0.2)	1.0 (0.4–2.1)	0.9 (0.4–2.2)	1.2 (0.5–2.9)
Other genital organs (DQ50–DQ52 and DQ55–56)		18 (0.1)	1 (Ref)	9 (0.1)	1.1 (0.5–2.5)	1.0 (0.5–2.3)	1.5 (0.6–4.3)	–	–	–	–
Urinary syst (DQ60–DQ64)		159 (0.3)	1 (Ref)	57 (0.2)	0.8 (0.6–1.1)	0.9 (0.6–1.2)	0.9 (0.6–1.2)	9 (0.3)	1.0 (0.5–1.8)	1.0 (0.5–1.9)	1.0 (0.5–2.4)
Reduction of limb (DQ71–73)		41 (0.1)	1 (Ref)	18 (0.1)	1.0 (0.6–1.7)	0.9 (0.5–1.6)	0.9 (0.5–1.7)	3 (0.1)	1.2 (0.4–3.8)	1.1 (0.3–3.5)	1.0 (0.2–4.0)
Other musculoskeletal syst (DQ65–DQ79)		1038 (2.0)	1 (Ref)	400 (1.7)	0.9 (0.8–1.0)	0.9 (0.8–1.0)	0.9 (0.7–1.0)	5 (0.2)	0.9 (0.6–1.1)	0.8 (0.6–1.1)	0.9 (0.6–1.2)
Other (DQ80–DQ99)		169 (0.3)	1 (Ref)	67 (0.3)	0.9 (0.7–1.2)	1.0 (0.7–1.3)	1.0 (0.6–1.3)	6 (0.2)	1.0 (0.5–1.8)	1.0 (0.6–2.0)	0.6 (0.2–1.6)

a: CD-10 = International Statistical Classification of diseases and related Health Problems

b: RPRc, Relative Prevalence Ratio crude

c: RPR, Relative Prevalence Ratio adjusted by maternal age at conception

d: RPR, Relative Prevalence Ratio adjusted by maternal, paternal age at conception and preconceptional BMI of the mother, smoking, alcohol consumption pre- and post conceptional habit of the mother, folic acid intake and paternal smoking habits

e: Among boys

The number of CA's is higher than the amount of children because some have more than one malformation

TABLE 3 Adjusted[a] RPR (and 95% CIs) for all major congenital anomalies, Heart (DQ20–DQ24) plus other circulatory system (DQ25–DQ28) and respiratory system (DQ30–DQ34), according to the socio-occupational status of the father and the mother

Congenital anomalies	Socio-occupational status (mother)	Socio-occupational status (father)			
		High RPR[a] (95% CI)	Middle RPR[a] (95% CI)	High RPR[a] (95% CI)	RPR[a] (95% CI)
All	High RPR[a] (95% CI)	1 (Ref)	1.0 (0.9–1.1)	1.0 (0.8–1.3)	1 (Ref)
	Middle RPR[a] (95% CI)	1.1 (0.9–1.2)	0.9 (0.8–1.0)	1.1 (0.9–1.3)	1.0 (0.9–1.1)
	Low RPR[a] (95% CI)	1.0 (0.8–1.2)	1.1 (0.9–1.3)	1.1 (1.0–1.2)	1.0 (0.9–1.2)
	RPR[a] (95% CI)	1 (Ref)	1.0 (0.9–1.1)	1.0 (0.9–1.2)	
Heart (DQ20–DQ24) and Other circulatory system (DQ25–DQ28)	High RPR[a] (95% CI)	1 (Ref)	1.2 (0.9–1.5)	1.1 (0.6–1.8)	1 (Ref)
	Middle RPR[a] (95% CI)	1.2 (0.9–1.5)	1.0 (0.8–1.3)	1.3 (0.9–1.8)	1.1 (0.9–1.3)
	Low RPR[a] (95% CI)	1.0 (0.6–1.5)	1.4 (1.0–1.9)	1.6 (1.3–2.0)	1.2 (0.9–1.6)
	RPR[a] (95% CI)	1 (Ref)	1.1 (0.9–1.3)	1.2 (1.0–1.6)	
Respiratory system (DQ30–DQ34)	High RPR[a] (95% CI)	1 (Ref)	1.1 (0.5–2.2)	1.0 (0.2–4.4)	1 (Ref)
	Middle RPR[a] (95% CI)	1.1 (0.6–2.1)	1.1 (0.6–2.1)	1.6 (0.6–4.3)	1.1 (0.7–1.8)
	Low RPR[a] (95% CI)	0.3 (0.1–2.6)	1.3 (0.5–3.2)	2.2 (1.2–3.8)	2.0 (1.1–3.8)
	RPR[a] (95% CI)	1 (Ref)	1.0 (0.7–1.7)	1.3 (0.7–2.5)	

a: RPR, relative prevalence ratio adjusted by maternal and paternal age

pregnancy. Therefore, these results need not apply to societies with much larger differences in social conditions. Furthermore, social inequalities exist in Denmark and perhaps even to a larger extent than in other European countries.[33,34]

We excluded 4541 babies from the study in a separate analysis because we did not know their parents' socio-occupational status. In this group we diagnosed 133 CAs, showing a prevalence of 3.0%, which was lower than that identified in the other groups for whom we knew their socio-occupational status. These results could be explained if people who were difficult to classify into socio occupational status groups presented low PP of CAs. Most of the missing data stemmed from participants who were out of the work, such as students. Since there is no reason to believe this (missing data on social factors come from a particular low social group), these missing data need not bias the study results. Missing data are most likely unrelated to the quality of CA data because socio-occupational status data were collected prior to birth.

In the past, NTD occurred more frequently in low social groups,[35] which probably relates to diet habits with a low folic acid intake among poorly educated women with a low income. We found no association between NTD and socio-occupational groups, but the number of NTD was limited. The prenatal screening programme followed by induced abortions of affected pregnancies may have eliminated a possible social gradient that has been observed in the past.[36–39] A higher prevalence of congenital heart disease,[18] ventricular septum defects[22–23] and some specific cardiac defects[22,24] in lower social classes have also been reported by other authors, although the specific foetotoxic aetiology remains unknown. In Denmark, the majority of the population is Caucasian with a limited tradition of inbreeding.

In general, low participation is a common problem in cohort studies. Participation rates in many cohort studies are <40%.[40,41] Studies have been conducted to know whether this should be considered a serious problem for the estimation of exposure-risk relationships. Aagaard *et al.* found that a participation rate of 30% was enough for the non-participation effect on some risk estimates to be small. Although this finding is related to specific associations in a population of pregnancy women, it is reassuring for other observational epidemiology-based cohort studies in this population.[42] We, therefore, believe that the participation rate in our study (60%) is high enough for the estimates made. But our study is not without its limitations. Although the study was large, the number of CAs was limited and limited our ability to investigate more specific aetiological hypotheses that clarify the possible mechanism of the associations found.

Social class has been a well-documented risk factor for heart defects, but we found only a modest association in our data source. A 2- to 4-fold higher prevalence in lower social classes has been documented up until the mid-1970s.[3]

A low socio-occupational status will often correlate with environmental exposures such as indoor air pollution or living in the close proximity of industries or larger highways. Ritz *et al.*[43] reported an association between carbon monoxide and pulmonary and cardiovascular defects in California, and these findings were supported by Gilboa *et al.*[44]

We found no association between multiple malformed infants and socio-occupational grouping, as others found.[37] Oral clefts, both cleft palate and cleft lip presented no variation with deprivation in our data, but other authors have reported a higher prevalence in lower social classes, particularly for cleft palate.[18,23,25] Our study indicates that it may be worthwhile investing with a large study on anomalies of the 'respiratory system'. Recent studies identify similar results such as cardiovascular CAs in a low level of maternal education, and a higher risk of CAs in the lower social-occupational class.[45] Based on existing data from other sources, we suggest to also include CAs of the 'circulatory system' (we included CA from the heart, DQ20–DQ24 and other circulatory system, DQ25–DQ28 in this group). The study should focus on occupational and other environmental exposures, including genetic metabolic factors.

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Key points

- We investigate the association between socio-occupational status differences and overall and specific major congenital anomalies.
- The prevalence of all recorded major congenital anomalies was similar in all the socio-occupational categories.
- We observed an association between low socio-occupational status and congenital anomalies of the respiratory system.

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