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Risks of small-for-gestational-age births in immigrants: a nationwide epidemiological study in Sweden

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ABSTRACT

Aim: To examine if there is an association between country of birth in parents and small-for-gestational-age (defined as a birth weight of more than 2 standard deviations (SDs) below the mean) in first singletons births.

Methods: In this follow-up study, national population and health care registers were used to identify small-for-gestational-age births in all first singleton births in Sweden between January 1, 1982, and December 31, 2006. Odds ratios, standardized with regard to maternal age at birth, period of birth, marital status, family income, geographical region, employment, maternal height, and smoking history were estimated by maternal and paternal country of birth. Singletons with both parents born in Sweden were used as reference group.

Results: There were 1 060 467 records for first singletons births over the study period of whom 3.5% were small-for-gestational-age. The rate was higher in newborns with non-Swedish born than in those with Swedish born mothers (4.1% and 3.3%, respectively). Immigrants from Southern European countries, Africa, and Asia had higher risks of small-for-gestational-age in than those in the reference group, and the risks were even higher in compatriot parents.

Conclusions: Country of birth affected the risk of small-for-gestational-age; maternity care should pay a special attention to pregnancies in certain population groups.

Key words: Migrants, Small-for-gestational-age births, risk factors, Sweden

INTRODUCTION

Small for gestational age (SGA) increases an infant's risk of long-term morbidity and mortality [1], and the risks of SGA are particularly high among poor families and certain ethnic minority populations [2, 3]. In addition, previous studies have revealed that female refugees from Africa, Asia, and Latin America, who in Sweden often live in segregated, deprived neighborhoods [4], have an increased odds of delivering SGA babies compared to Swedish-born women [5].

The causes of SGA are still partly unknown; maternal education is, however, one aspect of socioeconomic status that most consistently predicts poor birth outcomes [6] as well as other social and demographic factors such as low social capital [7] and a maternal age of less than 20 or more than 35 years [8, 9]. Other maternal factors have been associated with these adverse birth outcomes, such as shorter maternal stature [2, 10], primiparity [2, 8], preexisting hypertension [2, 8], gestational hypertension [8], preeclampsia [2, 10], vascular lesions [9], smoking [2, 11], maternal undernutrition [2, 12], low maternal BMI [9, 10], and high maternal BMI [9].

While the racial/ethnic differences are a result of a large influx of refugees and other immigrants into Sweden over the past few decades, the socioeconomic differences are a result of longer-term differences in factors such as education and income that span generations. Sweden, like many countries, has experienced dramatic demographic changes due to increasing global migration. It has become a multicultural society in the new millennium. Today, approximately 19% of all people living in Sweden are first- or second-generation immigrants [13]. This large influx of immigrants, together with the nationwide health and sociodemographic data available in the unique Swedish nationwide registers [14], provides a unique opportunity to study risk of poor birth outcomes in immigrants from multiple countries and regions around the world and compare risk in these groups

with risk of native-born Swedes. The database used in the present study incorporates information on the entire national population over a period of 30 years, including all immigrants registered in Sweden during the study period.

Our aim was to determine whether country of birth affects risk of SGA among immigrants after accounting for maternal age at birth, period of birth, marital status, family income, geographical region, maternal body height, and smoking history.

MATERIAL AND METHODS

Data Sources

Data used in this study were retrieved from a national research database, the WomMed II Database [14], located at the Center for Primary Health Care Research at Lund University. This database contains information from the Swedish Medical Birth Register, i.e., data on all pregnancies, prenatal care, birth records, hospital admissions, and death records for children and mothers in Sweden between 1973 and 2006. This register covers 99% of all births in Sweden beginning in 1973 and includes prospectively collected information about complications during pregnancy and delivery [15]. The WomMed II database also contains data from the National Board of Health and Welfare (in-care register, and death register), and Statistics Sweden (population register and multi-generational data). In the present study, a total of 1 060 467 women aged 20–44 of age were followed from 1 January 1982 to 31 December 2006 for first singleton births. Women with Stillbirths were not included in the study.

Definition of Variables

Outcome variables

SGA (Small-for gestational-age births): Children with a birth weight of more than 2 standard deviations (SDs) below the mean for the gestational age in question (i.e., the 2.5th percentile) were categorized as SGA, which is in accordance with the Swedish reference curve for estimated fetal weight [16]. This corresponds to more than 24% (approximately 850 g) lower birth weight than expected for a full-term baby. Information on birth weight was gathered from the Medical Birth Registry.

Individual-level sociodemographic factors

Maternal age at birth: divided into 5-year age groups as follows: 20-24, 25-29, 30-34, and 35-44 years. In Sweden, very few children are born to women aged less than 20 or more than 44 years; they were therefore not included in the study population.

Period of birth: divided into 5-year groups from 1982 through 2006.

Marital status: based on the mother's marital status at the time of birth and divided into two groups: married/co-habiting and never married/widowed/divorced.

Family income: based on the mother's family income in the year of the birth, divided by the number of people in the family, i.e., individual family income per capita. This variable was provided by Statistics Sweden (the Swedish Government-owned statistics bureau). The income parameter also took into consideration the ages of people in the family and used a weighted system whereby small children were given lower weights than adolescents and adults. The calculation procedure was performed as follows: the sum of all family members' incomes was multiplied by the individual's consumption weight divided by the family members' total consumption weight. The final variable was calculated as empirical quartiles from the distribution.

Geographic region of residence was divided into (1) large cities (cities with a population of more than 200,000, i.e., Stockholm, Gothenburg, and Malmö), (2) middle-size towns, and (3) small towns/rural areas (according to the Swedish 1990 Census). Mother's geographic region of residence was used as a proxy for the family's region of residence.

Employment: based on the mother's employment status at the time of the birth and divided into two groups: yes and no.

Smoking history: based on the mother's smoking history during the pregnancy and divided into three groups: yes, no, and missing smoking history.

Maternal body height: Based on the mother's body height.

Immigration status: The WomMed II Database includes people from 64 countries and regions of birth. Immigration from a number of these countries and regions began relatively recently, so the number of people may be relatively small in certain categories. For this reason (less than 10 cases of any SGA births in the children), these countries of birth were excluded from the study. As a result, we included 10 regions (Nordic countries, Southern Europe, Western Europe, Eastern Europe, Baltic countries, Central Europe, Africa, North America, Latin America, and Asia) and 23 countries (Denmark, Finland, Norway, Greece, Italy, Great Britain/Ireland, Germany, Austria, (former) Yugoslavia, Croatia, Romania, Bulgaria, Estonia, Poland, Hungary, Chile, Turkey, Lebanon, Iran, Iraq, and Russia) in our analysis. Compatriot parents were defined as both parents born in the same country.

Statistical analysis

Risks for SGA births were calculated by parental birth country, using estimates obtained in logistic regression analysis. Odds ratios (ORs) with a 95% confidence intervals are presented. All risk estimates were adjusted for maternal age at birth, period of birth, marital status, family income, geographic region of residence, maternal body height, and smoking history. The reference group in the analyses was first singleton births with both parents born in Sweden. Because the initial sex-specific analysis showed no gender-specific effects, data are given for both sexes together. We used SAS version 9.2 for the statistical analysis [17].

Ethical considerations

This study was approved by the Ethics Committee at Lund University, Malmö, Sweden.

RESULTS

The 808 914 first singleton births with both parents born in Sweden constituted by far the largest group in our study. During the follow-up period, there were 26 620 first singleton births that were SGA (Table I). Among the total of 251 653 first singleton births with at least one parent born outside Sweden, 10 256 of them were SGA. SGA births represented 3.3% and 4.1% of the total births with two Swedish-born parents and at least one foreign-born parent, respectively. SGA births were progressively prevalent among both Swedish-born parents and foreign-born parents for older mothers at first birth, low family income, living in large cities, short stature, and smoking history.

Table II shows ORs for a SGA birth by parental birth country. The risk of SGA was increased in parents born in Southern Europe, Africa, and Asia, compared with the control group. Children with

Danish (1.21) mothers had a significantly higher risk of being SGA. Children with Eastern European or Latin American parents, and Yugoslavian, Central European, or Russian mothers had a decreased risk of SGA birth. The risk of SGA birth in compatriot parents was analyzed separately. The risks of SGA birth were increased when both parents were from Southern Europe, Spain, Africa, or Asia. Children with compatriot parents from the Nordic countries, Eastern Europe, Central Europe, Latin America, and Russia had decreased risks of SGA birth.

DISCUSSIONS

The results of this study indicate that country of birth affects risk of SGA birth. Parents from Southern Europe, Africa, and Asia had a significantly increased risk of SGA in their first singletons, and the risks were even higher in compatriot parents. To the best of our knowledge, this is the largest study to date to investigate the association between immigration status and risk of SGA births; in total over 1.1 million first singleton births were included in the study.

The findings of the present study represent new knowledge because the study was conducted in Sweden, which has a universal health care system including maternity clinics that cover urban as well as rural areas in the entire country. The Swedish maternity clinics offer health care free of charge to all pregnant women in Sweden. However, our findings show that even in an egalitarian country like Sweden that offers free health care to all pregnant women there are significant associations between sociodemographic factors and SGA. For example, we found that singletons with mothers who had a low level of family income, which can be seen as a proxy for low socioeconomic status, had a higher risk of being SGA. In addition, the proportions of people with a low family income was higher in foreign-born parents than in native Swedish parents (45.7% vs

18.9%).

Our results are in agreement with the results of earlier studies from Sweden and the United States [6, 18, 19], which found a positive association between lower socioeconomic status and an increased risk of SGA birth. Low socioeconomic status may be a risk factor for SGA birth because social and economic deprivation is associated with occupational exposure[20], low social participation [7], smoking [11], and poor nutrition [12]. Furthermore, a recent study from Scandinavia that pooled data from four countries and included 4 million women revealed a clear gradient between educational status and SGA births. Denmark, which has the highest population of low SES women, had the steepest gradient, followed by Norway, Sweden, and Finland [21]. In the U.S., data from the National Maternal and Infant Health Survey demonstrated that low educational and occupational status, especially among white mothers and fathers, and African American fathers, were significantly associated with SGA [6].

Our findings that immigrants from Africa and Asia had significantly increased odds of SGA compared with those born in Sweden are partly consistent with a previous study that showed that foreign-born women in Sweden have an increased risk of SGA [5]. Immigrants from Southern Europe in Sweden have been reported to have impaired working capacity and poor social networks, not taking regular exercise and not feeling secure in their daily life. They also suffer from poor self-reported health [22].

Furthermore, many refugees have been forced to migrate and they face a different society, a different language, and a gradual adaptation to a new culture, which means a loss of their social, cultural, and economic connections with their country of origin. They are also often unemployed,

live in deprived neighborhoods, and have an increased risk of social vulnerability that may influence their health negatively [4, 5]. Thus, refugees as well as other types of immigrants may be under strong pressure in the sociocultural segment of life where they live and work.

In addition to socioeconomic status, the other main maternal risk factors that have been associated with SGA birth are smoking, substance abuse, malnutrition, anemia, hypertension, chronic kidney disease, advanced diabetes, heart disease, and infection [10, 23, 24]. Predicted increases in risk factors related to these health conditions, such as the large increases in obesity and diabetes among women of childbearing ages, will also significantly impact the number of SGA births in the future, especially among low-income women [25, 26]. Maternal short stature has also been related to SGA births [27].

The present study has several limitations. First, we did not have information on maternal risk factors such as body mass index, alcohol drinking, and/or drug use that may be related to the risk of SGA births. Individual-level lifestyle factors, such as body mass index and alcohol drinking are, however, difficult to assess in an entire population, which was the study population in the present study. However, we adjusted for smoking and maternal body height in the analysis. Second, the curves used to determine SGA at birth underestimate the average weight of infants prior to approximately the 37^{th} week of gestation, and the percentage of infants misclassified as of appropriate weight for their gestational age increases as weeks of gestational age decrease [28]. This means that our data were characterized by a systematic underestimation of the number of SGA births among infants born < 37 weeks of gestational age. Another shortcoming of these references is that they are based only on live births and do not include data on fetuses that die while still in utero. It is also possible that residual confounding exists because socioeconomic status cannot be

measured entirely by family income, educational attainment, and employment status. Another limitation is that the database does not include the reason for migration, such as work, education, family reasons or refugee status. Such information is, however, seldom available in national registers.

This study also has a number of strengths. For instance, our study population included a well-defined open cohort of immigrants. Because of the civic registration number assigned to each individual in Sweden, it was possible to trace the records of every person for the whole follow-up period. A further strength was that approximately 95% of SGA births were classified as such on the basis of ultrasound examination [29]. Furthermore, data on socioeconomic status were nearly 100% (complete).

CONCLUSION

The findings of the present study showed that the odds of SGA was increased in certain immigrant groups as well as in those with low SES, irrespective of the universal access to health care in the Swedish society. Maternity care should pay a special attention to women from certain population groups.

CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest.

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Table I. Total population of parents and SGA events in first singleton births

	Parents born in Sweden					Foreign born parents				
	Total population		SGA events			Total population		SGA events		
Characteristics	No.	%	No.	%	Frequency (%)	No.	%	No.	%	Frequency (%)
Total population	808914		26620		3.3	251653		10256		4.1
Age at first birth (yrs)										
20-24	217869	26.9	6883	25.9	3.2	68647	27.3	2935	28.6	4.3
25-29	326840	40.4	9621	36.1	2.9	83657	33.2	3213	31.3	3.8
30-34	193918	24.0	6740	25.3	3.5	63481	25.2	2471	24.1	3.9
35-44	70287	8.7	3376	12.7	4.8	35868	14.3	1637	16.0	4.6
Period of birth (yrs)										
1982-1986	158241	19.6	6120	23.0	3.9	38238	15.2	1731	16.9	4.5
1987-1991	188517	23.3	7074	26.6	3.8	50244	20.0	2211	21.6	4.4
1992-1996	162846	20.1	5336	20.0	3.3	55607	22.1	2197	21.4	4.0
1997-2001	139194	17.2	3939	14.8	2.8	48536	19.3	1906	18.6	3.9
2002-2006	160116	19.8	4151	15.6	2.6	59028	23.5	2211	21.6	3.7
Marital status										
Married/co-habiting	347820	43.0	11319	42.5	3.3	159095	63.2	6383	62.2	4.0
Never married, widowed, divorced	461094	57.0	15301	57.5	3.3	92558	36.8	3873	37.8	4.2
Family income										
Low income	153065	18.9	6190	23.3	4.0	115114	45.7	5263	51.3	4.6
Middle-low income	227015	28.1	7749	29.1	3.4	56118	22.3	2247	21.9	4.0
Middle-high income	204504	25.3	6603	24.8	3.2	38743	15.4	1437	14.0	3.7
High income	224330	27.7	6078	22.8	2.7	41678	16.6	1309	12.8	3.1
Urban/rural status										
Large cities	261747	32.4	8928	33.5	3.4	80994	32.2	3395	33.1	4.2
Middle-sized towns	298817	36.9	9806	36.8	3.3	49916	19.8	2061	20.1	4.1
Small towns/rural areas	248350	30.7	7886	29.6	3.2	120743	48.0	4800	46.8	4.0
Employment										
Yes	673098	83.2	22085	83.0	3.3	141228	56.1	5630	54.9	4.0
No	135816	16.8	4535	17.0	3.3	110425	43.9	4626	45.1	4.2
Maternal body height (cm)										
<150	834	0.1	95	0.4	11.4	2581	1.0	220	2.1	8.5
150-159	64123	7.9	3897	14.6	6.1	47514	18.9	2729	26.6	5.7
160-169	395770	48.9	13529	50.8	3.4	114801	45.6	4465	43.5	3.9
170-179	229593	28.4	4927	18.5	2.1	46320	18.4	1177	11.5	2.5
>=180	13134	1.6	216	0.8	1.6	2656	1.1	38	0.4	1.4
Missing	105460	13.0	3956	14.9	3.8	37781	15.0	1627	15.9	4.3
Smoking history										
No	607524	75.1	15978	60.0	2.6	187488	74.5	6698	65.3	3.6
Yes	138382	17.1	8208	30.8	5.9	41041	16.3	2538	24.7	6.2
Missing	63008	7.8	2434	9.1	3.9	23124	9.2	1020	9.9	4.4

Table II. Risks of SGA births by parental birth country*

	By father's birth country				By mother's birth country				Compatriot parents			
Birth country in parents	O	OR	95% CI		O	OR	95% CI		O	OR	95% CI	
Nordic countries	1213	0.96	0.90	1.02	1438	0.96	0.91	1.02	392	**0.86**	**0.78**	**0.95**
Denmark	203	1.08	0.94	1.24	210	**1.21**	**1.05**	**1.39**	37	0.91	0.66	1.27
Finland	791	0.94	0.87	1.01	965	0.94	0.88	1.01	292	0.86	**0.76**	**0.96**
Norway	184	0.95	0.82	1.10	222	0.91	0.79	1.04	43	0.93	0.69	1.27
Southern Europe	334	**1.16**	**1.04**	**1.30**	175	1.13	0.97	1.32	60	**1.33**	**1.02**	**1.72**
France	52	1.26	0.95	1.66	33	1.12	0.79	1.59	4	0.93	0.34	2.51
Greece	113	1.16	0.96	1.41	49	1.07	0.80	1.43	33	1.21	0.85	1.72
Italy	42	0.79	0.58	1.08	12	0.59	0.33	1.04	3	0.96	0.30	3.05
Spain	54	1.20	0.91	1.58	35	1.20	0.85	1.69	8	**2.47**	**1.18**	**5.17**
Western Europe	368	1.00	0.90	1.12	264	1.08	0.95	1.22	29	0.71	0.49	1.02
Netherland	39	1.16	0.84	1.60	22	0.94	0.62	1.45	6	0.89	0.40	2.02
Great Britain and Ireland	168	0.97	0.83	1.14	80	1.05	0.84	1.31	7	0.48	0.23	1.02
Germany	117	1.00	0.83	1.21	128	1.15	0.96	1.38	14	0.82	0.48	1.39
Austria	25	1.04	0.69	1.55	15	0.97	0.58	1.63	0			
Eastern Europe	715	**0.89**	**0.82**	**0.96**	635	**0.82**	**0.76**	**0.89**	415	**0.82**	**0.74**	**0.90**
Yugoslavia	435	0.97	0.88	1.07	334	**0.85**	**0.76**	**0.95**	229	**0.85**	**0.75**	**0.98**
Croatia	23	0.84	0.56	1.28	16	0.69	0.42	1.13	3	0.38	0.12	1.18
Romania	39	0.73	0.53	1.00	53	0.79	0.60	1.04	26	0.76	0.52	1.13
Bulgaria	12	0.80	0.45	1.42	18	0.97	0.60	1.55	8	1.07	0.53	2.18
Baltic countries	8	0.78	0.38	1.57	30	0.85	0.59	1.22	2	0.46	0.12	1.88
Estonia	6	0.95	0.42	2.16	14	0.79	0.46	1.34	2	0.87	0.21	3.57
Central Europe	239	0.93	0.81	1.06	368	**0.84**	**0.76**	**0.93**	120	**0.81**	**0.68**	**0.97**
Poland	150	0.89	0.76	1.05	276	**0.80**	**0.71**	**0.90**	80	**0.71**	**0.57**	**0.89**
Hungary	59	1.01	0.78	1.32	55	0.98	0.75	1.28	27	1.07	0.73	1.58
Russia	24	0.68	0.45	1.02	87	**0.71**	**0.57**	**0.87**	10	**0.52**	**0.28**	**0.97**
Africa	910	**1.67**	**1.56**	**1.79**	855	**1.86**	**1.73**	**2.00**	560	**2.07**	**1.90**	**2.27**
North America	105	0.89	0.73	1.08	72	0.80	0.63	1.01	5	0.54	0.22	1.30
Lartin America	316	**0.80**	**0.72**	**0.90**	352	**0.85**	**0.76**	**0.95**	132	**0.69**	**0.58**	**0.83**
Chile	178	**0.73**	**0.63**	**0.85**	167	**0.70**	**0.60**	**0.81**	83	**0.57**	**0.46**	**0.72**
Asia	2723	**1.42**	**1.36**	**1.49**	2872	**1.34**	**1.28**	**1.40**	1894	**1.48**	**1.41**	**1.56**
Turkey	439	**1.31**	**1.19**	**1.45**	381	**1.37**	**1.23**	**1.52**	299	**1.39**	**1.24**	**1.57**
Lebanon	303	**1.37**	**1.22**	**1.55**	269	**1.37**	**1.20**	**1.55**	198	**1.45**	**1.25**	**1.68**
Iran	504	**1.28**	**1.17**	**1.40**	399	**1.23**	**1.11**	**1.36**	327	**1.24**	**1.11**	**1.39**
Iraq	548	**1.33**	**1.21**	**1.45**	529	**1.40**	**1.28**	**1.54**	430	**1.38**	**1.25**	**1.53**

O = observed SGA events; OR = odds ratio; CI = confidence interval.

*Analysis adjusted by maternal age at birth, family income, period of birth, geographical region, marital status, maternal height, and smoking history. Children with both parents born in Sweden were used as reference.