Diabetes During Pregnancy Among Immigrants in Sweden: A National Cohort Study of All Pregnant Women in Sweden

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Diabetes is increasing globally and has an estimated prevalence of 8% in women (1). Gestational diabetes mellitus is a risk factor for later onset of type 2 diabetes and may be preventable. Identification of high-risk groups could help tailor preventive interventions where they are most needed, including high-risk immigrant populations. In Sweden, the prevalence of diabetes is higher especially in women from non-European countries (2).

An increased risk of gestational diabetes mellitus has been found among almost all immigrant groups in Western countries and Europe (3). However, to our knowledge, no study has examined gestational diabetes mellitus among immigrant women in Sweden. The aim of this study was to examine the risk of both preexisting diabetes and gestational diabetes mellitus in first-generation immigrant women.

We used several national registers (Medical Birth Register, Total Population Register, and National Patient Register) to construct the present cohort with several covariates, described elsewhere (4,5). The follow-up period ran from 1 January 1998 until delivery, death, emigration, or the end of the study period on 31 December 2018, whichever came first. All women with a recorded delivery were included. The study outcome included all diagnoses of diabetes during pregnancy with ICD code O24 and specifically the following subtypes: *1*) gestational diabetes mellitus (O24.4), *2*) preexisting type 1 diabetes (O24.0), *3*) preexisting type 2 diabetes (O24.1), and *4*) other types of diabetes (O24.2, O24.3, and O24.9).

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was not applicable, as the study was based on pseudonymized data from registers. Research data are not shared. The study was approved by the Regional Ethical Review Board in Lund (reference no. 2008/471 and later amendments).

We used Cox regression analysis to estimate hazard ratios (HR) and 99% CI for diabetes during pregnancy (all forms and also by subtypes) in different groups of foreign-born women versus Swedish-born women during the follow-up, with adjustment for age, region of residence, educational level, marital status, neighborhood socioeconomic status, and comorbidities (hypertensive disorders, including preeclampsia and eclampsia [O10–O16], and cancer [C00–C97]).

In total, 1,238,199 deliveries were included, with 26,429 cases of diabetes during pregnancy. Adjusted HR for diabetes during pregnancy among foreign-born compared with Swedish-born women are shown in Table 1. Overall, the relative rate of any diabetes during pregnancy was increased among foreign-born women (HR 1.69, 99% CI 1.61–1.78), especially women from Eastern Europe, Africa, and Asia. The risk of gestational diabetes mellitus was twofold higher in foreign-born women (HR 2.09, 99% CI 1.96–2.22), particularly women from Eastern Europe, Africa, Latin America, and Asia, compared with Swedish-born women. For preexisting type 1 diabetes, the overall risk was lower among foreign-born women (HR 0.57, 99% CI 0.49–0.67) and specifically women from Eastern Europe, Central Europe, Latin America, and Asia. For preexisting type 2 diabetes, the overall risk was increased among foreign-born women (HR 2.38, 99% CI 1.82–3.13), particularly women from Africa, Latin America, and Asia. For other types of diabetes, the overall risk was higher in foreign-born women and particularly women from Africa and Asia.

The main findings of this study were that the overall risk of diabetes during pregnancy was increased in foreign-born women compared with Swedish-born women. Most risks were highest in immigrant women from Africa and Asia but also were significantly elevated in women from Eastern Europe.

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Table 1—Adjusted HR and 99% CI for diabetes during pregnancy in foreign-born versus Swedish-born women, stratified by different types of diabetes

	All forms of diabetes during pregnancy			Gestational diabetes mellitus			Preexisting type 1 diabetes			Preexisting type 2 diabetes			All other types of diabetes during pregnancy		
	n	HR	99% CI	*n*	HR	99% CI	*n*	HR	99% CI	*n*	HR	99% CI	*n*	HR	99% CI
Sweden	17,411	1		11,034	1		5,017	1		502	1		858	1	
All foreign-born	9,018	**1.69**	**1.61**	7,411	**2.09**	**1.96**	**2.22**	578	**0.57**	**0.49**	**0.67**	399	**2.38**	**1.82**	**3.13**	630	**1.66**	**1.30**	**2.11**
Nordic countries	429	1.01	0.87	1.16	317	1.10	0.93	1.30	79	0.86	0.62	1.20	15	1.13	0.53	2.43	18	0.86	0.43	1.72
Southern Europe	113	1.09	0.83	1.43	88	1.26	0.93	1.72	15	0.78	0.37	1.64	2	0.63	0.08	4.79	8	1.18	0.42	3.31
Western Europe	98	0.67	0.50	0.89	70	0.71	0.50	1.00	14	0.52	0.24	1.12	6	1.33	0.40	4.38	8	0.81	0.29	2.29
Eastern Europe	926	**1.33**	**1.20**	**1.48**	784	**1.71**	**1.53**	**1.91**	62	**0.42**	**0.29**	**0.61**	25	1.20	0.65	2.21	55	1.15	0.75	1.76
Baltic countries	46	0.54	0.35	0.83	36	0.64	0.39	1.03	6	0.42	0.13	1.37	3	1.16	0.22	6.19	1	0.14	0.01	2.40
Central Europe	254	0.91	0.75	1.09	211	1.13	0.92	1.39	19	**0.35**	**0.18**	**0.68**	6	0.71	0.22	2.34	18	0.88	0.44	1.80
Africa	1,624	**2.76**	**2.53**	**3.01**	1,291	**3.24**	**2.94**	**3.57**	90	0.83	0.60	1.15	107	**5.95**	**4.07**	**8.69**	136	**2.96**	**2.11**	**4.16**
North America	54	0.93	0.63	1.37	39	0.98	0.62	1.56	9	0.79	0.30	2.07	2	1.12	0.15	8.53	4	1.13	0.27	4.78
Latin America	296	1.18	0.99	1.39	233	**1.39**	**1.15**	**1.68**	27	**0.49**	**0.28**	**0.86**	17	**2.19**	**1.07**	**4.50**	19	1.32	0.67	2.61
Asia	5,029	**2.17**	**2.04**	**2.30**	4,225	**2.74**	**2.56**	**2.93**	242	**0.54**	**0.44**	**0.67**	212	**3.01**	**2.21**	**4.12**	350	**2.07**	**1.58**	**2.70**
Russia	98	**0.65**	**0.48**	**0.87**	74	0.72	0.51	1.01	11	0.42	0.17	1.00	2	0.42	0.06	3.24	11	0.94	0.38	2.30

HR was adjusted for age (continuous), region of residence in Sweden (large cities, southern, and northern), educational level (≤9, 10–12, and >12 years), marital status (married/cohabiting or unmarried/widowed/divorced), neighborhood deprivation (<−1, −1 to 1, and >1 SD from mean), and comorbidities (hypertensive disorders, preeclampsia and eclampsia, and cancer). Boldface denotes statistically significant values.

The higher risk in foreign-born women is consistent with a previous review that reported an increased risk of gestational diabetes mellitus among almost all immigrant women in Western countries and Europe (3). Elevated risks of diabetes overall also were previously reported in some immigrant groups in Sweden (2), mostly non-European immigrants.

Strengths of this study include the ability to examine different types of diabetes during pregnancy and in several subgroups. Although the number of women with preexisting type 2 diabetes was rather low, the patterns of risk were similar to those for gestational diabetes mellitus. Preexisting type 1 diabetes had quite different results, with lower risks in foreign-born women. Limitations include the use of ICD codes for the identification of diabetes without other clinical data for validation. However, the Swedish registers have previously been shown to be of high standard and validity (5). Residual confounding is possible, and information on lifestyle factors was unavailable.

In conclusion, foreign-born women had an approximately twofold increased risk of gestational diabetes mellitus during pregnancy compared with Swedish-born women. The elevated risk in immigrant women calls for increased awareness and tailored prevention of gestational diabetes mellitus in Sweden, which is currently not part of routine clinical practice. Women with gestational diabetes mellitus also need long-term clinical follow-up for screening, timely detection, and treatment of type 2 diabetes later in life.

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data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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