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Exploring the 'Healthy Migrant Paradox' in Sweden. A Cross Sectional Study Focused on Perinatal Outcomes

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Abstract Evidence shows that in some contexts immigrants have better health than natives in spite of coming from poorer socioeconomic contexts and of facing socioeconomic disadvantages in the host country. However, this is a country or origin- and outcome-specific phenomenon. This study compares different health outcomes derived from birthweight and gestational age among different migrant groups residing in Sweden. Cross-sectional study based on the Swedish Medical Birth Register for years 1987–1993. Multinomial regression models were performed to obtain crude and adjusted Odd Ratios and their 95 % Confidence Intervals. Overall, immigrants show a higher risk of LBW and preterm and a lower risk of macrosomia and post-term. Moreover, some groups performed worse than natives even in indicators at the two ends of the distribution. The healthy migrant paradox is also outcome-specific within different perinatal indicators and the selection explanation cannot fully account for this phenomenon.

Keywords Birthweight · Gestational age · Sweden · Macrosomia · Post-term · Migrants

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Introduction

A large corpus of evidence shows that in many countries immigrant mothers have equal or better health than natives despite coming from poorer socioeconomic contexts and experiencing social disadvantages in the host country [1–4]. Evidence of this 'healthy migrant paradox' in perinatal outcomes in particular has mainly been found in the context of the United States for their Latin American population [5–8], but there is also a growing number of studies finding this effect in European countries that host immigrants from very different origins such as France, Germany, Spain, and Greece [9–12]. Different explanations have been put forward, focusing on general mechanisms, such as selection in origin (the so-called 'healthy migrant effect' [13]) [14], unobserved confounders (such as smoking or diabetes) [8], cultural aspects (values, diet, lifestyles) [6], or even possible artificial effects (e.g., the very conceptualization of low birthweight (LBW) [15]). Recently, rather than unsuccessfully pursuing a single explanation to account for the whole phenomenon, research has tended to analyze its presence in new contexts and indicators, highlighting the outcome and origin-specific nature of the healthy migrant paradox [16].

For Sweden, previous studies have compared perinatal outcomes between natives and immigrant mothers with mixed results [17–19] focusing, like most other studies on the topic worldwide, on LBW and preterm births. However, a recent study carried out for Spain has highlighted new indicators, macrosomia and post-term births, that also contribute to the healthy migrant paradox debate [20].

Accordingly, this paper aims at examining the differences between Swedish and immigrant mothers in regards to both the traditionally studied LBW and preterm outcomes, and macrosomia and post-term births, in order to

explore the existence of outcome-specific healthy migrant paradox [16, 20]. Sweden in the period 1987–1993 makes a very interesting case study because its immigrant population has multiple origins, many of them composed mainly of refugees and asylum seekers–in fact, the 1980s in Sweden has been called "the decade of the asylum seeker'—while some are mainly comprised of labor migrants [21]. This variability in composition is important in the debate of the healthy migrant paradox, as refugees do not necessarily show the healthy selection in origin that has historically characterized international migration flows [22] and that has been used as the main explanation of the paradox. Additionally, Sweden is well-known as a social welfare state, with a long tradition of supporting a balance between work and family responsibilities through state-funded benefits such as parental leave, an affordable childcare network and a universal health system that includes free prenatal care [23].

Data and Methods

Participants and Data Collection

We based our study on the Swedish Medical Birth Register (MBR), which contains approximately 99 % of all deliveries in the country [24]. Of the 811,599 babies born during the period 1987–1993, we excluded babies with unknown maternal age and birth order (n = 15). To increase the homogeneity of our study population, we excluded multiple births (n = 19,167) because their growth is reduced from 28–30 gestational weeks onwards [25], and babies with malformations at birth (n = 13,539). Finally, we excluded observations with impossible combinations of birthweight and gestational age (n = 9,246) based on the thresholds published elsewhere [26]. The final sample is 769,632. The Regional Ethics Review Board in Southern Sweden approved the construction of the database.

Measures

We study perinatal indicators derived from the two tails of the birthweight and gestational age distributions: low birthweight (LBW, <2,500 g), macrosomia (>4,500 g), preterm birth (PB <37 gestational weeks) and post-term birth (PTB, >42 gestational weeks).

We classify maternal origin according to geographical proximity in the following large groups: Sweden; South America (predominantly Chile, Brazil, Colombia and Argentina), Central America and the Caribbean (mainly El Salvador and Mexico), USA & Canada, Western Europe (including Germany and the UK); Southern Europe (mainly Greece, Spain and Portugal); Eastern Europe (mainly Poland, the former Yugoslavia, Hungary and Romania); rest of Nordic countries (Finland, Norway, Denmark and Iceland); Maghreb (mainly Morocco, Tunisia and Algeria); Middle East (mainly Iran, Turkey, Lebanon, Syria, Iraq); Africa (mainly Ethiopia, Somalia, Gambia, and Uganda); East Asia, Oceania & Australia (mainly Korea, China, Australia, and Japan), Southeast Asia (mainly the Philippines, Vietnam, and Thailand); and South Asia (mainly India, Sri Lanka, and Bangladesh).

As some specific origins were very important within their groups or were largely made up of refugees, we extracted them from their group and analyzed them independently in the multivariate analyses. Origins with a large representation of refugee groups were Chile, Iraq, Iran, Lebanon, Syria and Turkey [21]. The different Nordic countries, as well as Germany and the UK in the Western countries group, have also been divided up due to their size. Ethiopia, although the main African origin, has not been disaggregated due to its small size.

Analysis

We applied multinomial regressions to model birthweight and gestational age. We study LBW and macrosomia using normal birthweight as the reference, and preterm and post-term using at-term as a reference. We estimated crude and adjusted models for those variables which have been shown to influence the outcomes under study: newborn's sex (male, female) [27], birth order (1, 2, >2) [28], maternal age (<20, 20–24, 25–35 > 35 years) [29, 30], marital status (single, married or cohabiting, divorced or widowed) [31], education (primary, secondary, university and missing) [32, 33], and smoking behavior (non-smoker, 1–9 cigarettes/day, >9 cigarettes/day, missing) [34], diabetes (yes/no) [35], hypertension (yes/no) [36], and urinary infections during pregnancy (yes/no) [27, 37].

Results

Table 1 shows the prevalence of the main perinatal outcomes under study and the maternal and newborn characteristics by maternal origin. The highest preterm prevalence is observed among mothers from South Asia (7.32 %), Southeast Asia (6.20 %) and Central America and the Caribbean (6.05 %). The highest post-term prevalence is found in Africa (11.54 %) and the Maghreb (9.47 %). The highest prevalence of LBW is found among mothers from South Asia (5.83 %), Africa (4.47 %) and Central America and the Caribbean (4.03 %). Macrosomia is more prevalent among native mothers (3.53 %) and mothers from the rest of the Nordic countries (3.45 %) and the Maghreb (3.26 %).

Table 1 Characteristics of the births according to maternal place of birth

	Sweden	South America	Central America and the Caribbean	Western Europe	Southern Europe	Eastern Europe	Nordic Europe	Maghreb	Middle East	Africa	East Asia and Oceania	South East Asia	South Asia	Missing
Obs.	664,160	5,922	744	5,554	2,164	13,615	33,097	1,657	20,570	4,185	2,018	4,400	1,680	9,866
%	(86.30)	(0.77)	(0.10)	(0.72)	(0.28)	(1.77)	(4.30)	(0.22)	(2.67)	(0.54)	(0.26)	(0.57)	(0.22)	(1.28)
Gestational age (*Weeks*)														
<37	4.63	4.14	6.05	4.45	4.53	5.67	4.80	4.47	4.60	5.23	5.85	6.20	7.32	5.95
≥37	88.05	89.45	89.11	87.50	88.22	86.95	87.91	85.70	88.98	82.87	87.56	89.30	88.33	83.70
>42	7.17	6.26	4.57	7.89	6.98	7.18	7.10	9.47	6.21	11.54	6.54	4.18	3.99	7.92
Missing	0.15	0.15	0.27	0.16	0.28	0.21	0.18	0.36	0.20	0.36	0.05	0.32	0.36	2.43
Birthweight (*Grams*)														
<2,500	2.91	2.33	4.03	2.90	2.96	3.78	3.18	2.29	3.31	4.47	3.52	3.84	5.83	4.20
2,500–4,500	93.57	95.07	94.62	94.24	95.15	93.85	93.36	94.45	95.01	93.43	94.80	94.64	93.45	94.27
>4,500	3.53	2.60	1.34	2.86	1.89	2.37	3.45	3.26	1.68	2.10	1.68	1.52	0.71	1.53
Birth order														
1	42.15	35.98	40.73	42.89	39.70	42.80	36.59	39.35	34.33	40.55	59.96	47.86	44.70	92.49
2	35.63	34.75	36.02	34.07	38.49	37.80	34.98	31.44	30.04	29.20	29.04	31.93	35.30	4.32
≥3	22.21	29.26	23.25	23.05	21.81	19.40	28.44	29.21	35.63	30.25	11.00	20.20	20.00	3.19
Maternal age														
<20	5.05	8.98	7.80	3.31	5.91	5.95	4.63	5.19	9.60	6.24	8.97	5.68	6.67	13.68
20–24	20.41	17.76	17.74	11.25	20.61	19.01	17.73	20.40	24.85	22.41	24.63	20.32	22.92	26.94
25–34	63.30	57.50	61.42	66.15	61.83	57.39	61.59	63.01	55.08	62.80	55.70	60.09	59.58	52.30
>35	11.24	15.75	13.04	19.28	11.65	17.66	16.05	11.41	10.47	8.55	10.70	13.91	10.83	7.07
Marital status														
Married-cohabiting	46.83	65.89	64.25	72.90	80.27	78.79	49.30	93.12	93.54	75.99	70.71	76.45	86.01	74.84
Divorced-widoved	3.25	9.56	4.70	3.98	6.38	8.70	6.85	4.41	2.27	5.69	2.68	5.27	3.81	0.65
Single	49.92	24.55	31.05	23.12	13.35	12.51	43.85	2.47	4.19	18.33	26.61	18.27	10.18	24.51
Maternal education														
Primary	16.79	35.75	23.92	14.85	35.26	19.38	24.49	40.43	41.27	32.16	26.86	43.36	33.57	9.35
Secondary	55.18	36.66	31.05	33.62	30.87	40.26	46.26	15.69	23.78	23.56	32.06	17.82	26.79	7.53
University	24.88	14.02	20.56	33.35	18.90	20.83	19.37	5.61	8.20	7.24	21.51	8.61	17.26	3.55
Missing	3.15	13.58	24.46	18.19	14.97	19.54	9.88	38.26	26.75	37.04	19.57	30.20	22.38	79.58
Smoking														
Non-smoking	70.39	76.51	87.77	77.03	70.19	70.06	61.30	88.05	77.25	84.44	81.47	86.36	89.52	63.72
1–9 cig/day	14.60	11.96	4.84	10.35	14.00	14.37	17.60	3.68	8.96	4.59	9.56	5.11	3.27	9.95

Table 1 continued

	Sweden	South America	Central America and the Caribbean	Western Europe	Southern Europe	Eastern Europe	Nordic Europe	Maghreb	Middle East	Africa	East Asia and Oceania	South East Asia	South Asia	Missing
>9 cig/day	8.97	2.53	1.48	5.58	7.49	8.38	13.85	1.39	4.78	1.55	2.53	1.86	0.89	4.29
Missing	6.04	9.00	5.91	7.04	8.32	7.19	7.25	6.88	9.01	9.41	6.44	6.66	6.31	22.04
Urinary problems														
Yes	6.97	6.91	7.66	6.14	4.81	4.90	6.54	3.92	4.43	3.94	4.66	3.55	5.18	3.07
Diabetes														
Yes	0.35	0.30	0.67	0.23	0.14	0.25	0.33	0.24	0.26	0.45	0.30	0.09	0.83	0.11
Hypertension														
Yes	0.43	0.22	0.13	0.16	0.14	0.24	0.60	0.18	0.14	0.14	0.35	0.16	0.06	0.24

The highest proportion of babies from higher parities (>3) is observed in mothers from the Middle East and Africa (35.63 and 30.25 %). The highest proportion of mothers under age 20 is found in the Middle East, South America, and East Asia & Oceania (9.60, 8.98 and 8.97 %, respectively) while the highest proportion of older than 35 appears in Eastern Europe, the Nordic countries, and South America (17.66, 16.05, and 15.75 %, respectively). The highest proportion of single mothers is found in Sweden and the Nordic countries (49.92 % and 43.85, respectively).

The origins with the highest proportion of mothers with primary education are Southeast Asia (43.36 %), the Middle East (41.27 %) and the Maghreb (40.43 %). The highest proportion of missing data on education is observed in mothers from the Maghreb (38.26 %), Africa (37.04 %), Southeast Asia (30.20 %) and the Middle East (26.75 %). The prevalence of smoking during pregnancy is higher in mothers from the Nordic countries, Sweden, Eastern Europe and Southern Europe than in the rest of origins. From them, the highest proportion of heavy smokers during pregnancy is observed in the Nordic countries (13.85 %), Sweden (8.97 %) and Eastern Europe (8.38 %). The highest proportion of mothers with urinary problems during pregnancy is observed in Central America and the Caribbean (7.66 %), Sweden (6.97 %), South America (6.91 %), Nordic Europe (6.54 %) and Western Europe, USA & Canada (6.14 %). Diabetes is at the highest levels among mothers from South Asia (0.83 %), Central America and the Caribbean (0.67 %) and hypertension among mothers from Nordic Europe (0.60 %) and Sweden (0.43 %).

Table 2 presents the results of the crude and adjusted birthweight models. Compared to native mothers, most origins have a higher risk of delivering LBW babies in both models: Central America (OR 1.64 in the adjusted model but not statistically significant in the crude model), Denmark (OR 1.43), Iceland (OR 1.54), Middle East (OR 1.63), Iraq (OR 1.40), Lebanon (OR 1.21), Africa (OR 1.38), Southeast Asia (OR 1.25) and South Asia (OR 2.14). The rest of origins shows no statistically significant differences from Swedes but for Chile, which shows significantly lower risks (OR 0.77).

In the case of macrosomia, differently from LBW, there are more differences between crude and adjusted models. The crude model shows advantages for Chile, Eastern Europe, the Middle East, Iran, Africa and South Asia. In the adjusted model, almost all groups of origin show a lower risk than Swedes with the exception of Iceland, which shows a higher risk (OR 1.52).

Table 3 shows the results of the crude and adjusted gestational age models. Compared to Swedes, a higher risk of preterm is observed for Eastern Europe (OR 1.17), Africa (OR 1.17), South Asia (OR 1.58) and Southeast

Table 2 Multinomial regression models for birthweight

	LBW						Macrosomia					
	Crude			Adjusted			Crude			Adjusted		
	OR	(IC-95 %)		OR	(IC-95 %)		OR	(IC-95 %)		OR	(IC-95 %)	
Sweden (ref.)												
South America	0.95	0.72	1.25	0.94	0.69	1.28	1.08	0.63	1.84	0.64	0.48	0.87
Chile	0.72	0.58	0.89	0.77	0.61	0.98	0.42	0.22	0.78	0.62	0.51	0.76
Central America and the Caribbean	1.38	0.96	2.00	1.64	1.09	2.47	0.57	0.14	2.38	0.35	0.19	0.66
Western Europe, USA and Canada	0.87	0.69	1.10	0.82	0.63	1.08	0.96	0.61	1.53	0.96	0.78	1.18
Germany	1.12	0.85	1.48	1.01	0.73	1.38	0.53	0.25	1.14	0.66	0.48	0.93
UK	1.12	0.82	1.55	1.14	0.79	1.65	0.88	0.44	1.75	0.49	0.32	0.75
Southern Europe	0.98	0.76	1.26	0.99	0.74	1.31	0.65	0.34	1.23	0.53	0.38	0.72
Eastern Europe	1.30	1.19	1.43	1.17	1.06	1.30	0.77	0.61	0.97	0.66	0.59	0.74
Denmark	1.44	1.22	1.70	1.43	1.18	1.73	0.76	0.48	1.18	1.07	0.90	1.29
Finland	1.06	0.98	1.14	0.97	0.89	1.06	0.92	0.78	1.09	0.96	0.90	1.04
Norway	1.06	0.91	1.25	0.88	0.73	1.05	0.86	0.60	1.24	0.96	0.81	1.13
Iceland	1.18	0.80	1.74	1.54	1.00	2.37	1.85	0.97	3.55	1.52	1.11	2.08
Maghreb	0.79	0.57	1.09	0.72	0.50	1.04	1.48	0.94	2.33	0.78	0.59	1.03
Middle East	1.45	1.13	1.85	1.63	1.23	2.17	0.26	0.08	0.81	0.38	0.25	0.56
Iraq	1.28	1.01	1.62	1.40	1.06	1.83	0.47	0.21	1.07	0.55	0.41	0.74
Iran	1.07	0.90	1.28	1.21	0.99	1.47	0.15	0.06	0.41	0.37	0.28	0.48
Lebanon	1.11	0.94	1.31	1.21	1.00	1.47	0.47	0.27	0.83	0.35	0.27	0.45
Syria	0.89	0.69	1.16	1.00	0.74	1.33	0.58	0.27	1.24	0.34	0.24	0.49
Turkey	1.11	0.96	1.27	1.08	0.92	1.27	0.72	0.50	1.04	0.43	0.36	0.52
Africa	1.53	1.32	1.77	1.38	1.15	1.65	0.41	0.27	0.64	0.53	0.42	0.65
East Asia, Oceania and Australia	1.20	0.95	1.52	1.13	0.86	1.48	0.67	0.34	1.31	0.51	0.36	0.72
Southeast Asia	1.31	1.12	1.53	1.25	1.04	1.49	0.64	0.35	1.14	0.40	0.31	0.51
South Asia	2.01	1.63	2.47	2.14	1.69	2.72	0.14	0.02	0.99	0.19	0.11	0.33
Missing	1.42	1.28	1.57	0.88	0.77	1.00	0.45	0.33	0.63	0.67	0.56	0.80
N		743,350			743,350			745,426			745,426	

Asia (1.24). A lower risk is found for Chile (OR 0.84 only in the adjusted model) and Syria (0.79). With respect to post-term births, the origins with lower risk are Chile (OR 0.80), Central America and the Caribbean (OR 0.61), Iran (OR 0.77), Syria (OR 0.73), Southeast Asia (OR 0.53), South Asia (OR 0.54). Maghreb and Africa are the only groups with a significantly higher risk of post-term than Swedes (OR 1.31 and 1.67).

Discussions

Our findings support the ethnic and outcome-specific nature of the healthy migrant paradox as it has been formulated elsewhere [16, 20, 38]. In the traditional indicators, LBW and preterm, we found some groups at lower risk of delivering LBW (Chile) and preterm (Chile and Syria) compared to Swedes, and most groups perform worse than natives in these outcomes (Central America, Eastern Europe, Denmark, Middle East, Iraq, Africa, South and Southeast Asia in LBW and Eastern Europe, Africa, and Southeast Asia in preterm). However, contrary to other studies, we do not find advantages in regards to LBW among Finns, as Rasmussen did [17], or in preterm among mothers from Africa, Lebanon and the UK as Li et al. reported [39]. However, these variations could be related to the small differences in the periods covered (Rasmussen et al. 1983–90) or the length of period studied (Li et al. covered 1982–2006), as well as by a different operationalization of the outcomes. In contrast to our approach, the above-mentioned studies included macrosomia and post-term in their reference groups when exploring LBW and preterm, which slightly biased their reference population.

As for macrosomia and post-term, we found the opposite picture to that observed for LBW and preterm. Almost all immigrant groups (except Iceland) show a lower risk of

Table 3 Multinomial regression models for gestational age

	Preterm						Post-term					
	Crude			Adjusted			Crude			Adjusted		
	OR	(IC-95 %)		OR	(IC-95 %)		OR	(IC-95 %)		OR	(IC-95 %)	
Sweden (ref.)												
South America	0.94	0.75	1.17	0.88	0.71	1.10	1.04	0.87	1.23	0.99	0.83	1.17
Chile	0.85	0.73	1.00	0.84	0.71	0.98	0.78	0.68	0.89	0.80	0.70	0.91
Central America and the Caribbean	1.29	0.95	1.75	1.31	0.97	1.77	0.63	0.45	0.89	0.61	0.43	0.86
Western Europe, USA and Canada	0.97	0.81	1.16	0.96	0.80	1.16	1.05	0.91	1.21	0.99	0.86	1.14
Germany	1.04	0.83	1.31	1.01	0.80	1.27	1.13	0.94	1.35	1.10	0.91	1.32
UK	0.86	0.64	1.16	0.85	0.64	1.14	1.21	0.99	1.48	1.16	0.94	1.42
Southern Europe	0.98	0.80	1.20	0.94	0.77	1.16	0.97	0.82	1.15	0.97	0.82	1.15
Eastern Europe	1.24	1.15	1.33	1.17	1.08	1.26	1.01	0.95	1.08	0.99	0.93	1.06
Denmark	1.06	0.91	1.24	0.99	0.85	1.15	1.09	0.96	1.23	1.10	0.97	1.24
Finland	1.04	0.98	1.10	0.99	0.93	1.05	0.96	0.91	1.01	0.96	0.92	1.02
Norway	1.06	0.93	1.21	0.97	0.85	1.11	1.05	0.94	1.16	1.04	0.93	1.16
Iceland	0.77	0.53	1.13	0.77	0.53	1.13	1.16	0.90	1.49	1.18	0.92	1.53
Maghreb	0.99	0.78	1.25	0.97	0.77	1.23	1.36	1.15	1.60	1.31	1.11	1.55
Middle East	1.16	0.93	1.44	1.18	0.94	1.47	0.96	0.79	1.16	0.96	0.79	1.17
Iraq	1.10	0.89	1.34	1.11	0.91	1.37	0.87	0.73	1.05	0.86	0.72	1.04
Iran	0.95	0.82	1.10	0.94	0.81	1.10	0.80	0.70	0.91	0.77	0.68	0.88
Lebanon	0.95	0.82	1.10	0.94	0.82	1.10	0.84	0.74	0.95	0.89	0.79	1.02
Syria	0.80	0.64	0.99	0.79	0.63	0.98	0.71	0.59	0.86	0.73	0.60	0.88
Turkey	1.02	0.91	1.15	1.00	0.89	1.13	0.93	0.84	1.02	0.99	0.90	1.10
Africa	1.20	1.05	1.38	1.17	1.02	1.34	1.71	1.55	1.88	1.67	1.51	1.84
East Asia, Oceania & Australia	1.27	1.05	1.53	1.19	0.98	1.43	0.92	0.77	1.10	0.85	0.71	1.01
Southeast Asia	1.32	1.17	1.49	1.24	1.09	1.40	0.58	0.50	0.67	0.53	0.46	0.62
South Asia	1.58	1.31	1.89	1.58	1.31	1.90	0.55	0.43	0.71	0.54	0.42	0.69
Missing	1.35	1.24	1.47	0.94	0.86	1.04	1.16	1.08	1.25	0.91	0.84	0.99
N	713,174			713,174			732,108			732,108		

macrosomia than Swedes and some groups for post-term (Chile, Central America, Iran, Syria, Southeast and South Asia) although some are not significantly different. Only two origins show higher risks for post-term (Maghreb and the rest of Africa). Therefore, our results support the idea that the healthy migrant paradox is outcome- and country of origin-specific, not only within the classic indicators, but also in a more comprehensive review of the latter.

In contrast with other contexts, such as the United States [40], the adverse outcomes found in Sweden in some migrant groups cannot be explained by a restricted access to the health system, since pregnant women are universally covered [41]. However, one study has pointed at a high degree of dissatisfaction with prenatal care among migrant women—related to cultural preconceptions, the barrier created by language, etc., as well as a lower utilization of antenatal planned care coupled with an overuse of emergency services [42]. In any case, although this is an important aspect to improve the quality of the service itself, it does not explain why some groups show better outcomes on the right tail of the distributions, where lack of medical care should also lead to more pregnancies leading to post-term and macrosomia.

The absence of a healthy migrant paradox in preterm and LBW outcomes in some immigrant groups is not limited to Sweden (it is also found in Finland, [43], Denmark [44] or England [45]) and cannot be seen as related to the characteristics of the Swedish migratory experience, which includes a large number of refugees or asylum seekers. In fact, our results do not only question this hypothesis (since some countries with large refugee contingents performed better than Swedes), but also challenge the explanation of the healthy migrant paradox as a function of a positive selection in origin, in line with a Greek study [12], which had already found a lower risk of LBW and preterm among refugees.

We find advantages—and lack of differences—in several perinatal outcomes for origins mostly comprised of refugees. These migrants probably arrived during the 1980s (as it is the decade of higher proportion of asylum receiver in Sweden) [46] as a consequence of wars and political conflicts and they are not expected to be positively selected in health (maybe the contrary). However, unexpectedly, some of them performed similarly—if not better—than Swedes in the two tails of both the birthweight and gestational age distributions (Syria and Chile), while others did so only in the two tails of the gestational age distribution (Iraq, Iran, Lebanon, and Turkey). On the other hand, we do find that Nordic mothers, who had the right to work and live in Sweden and may be considered as theoretically healthy migrants, fared similarly to Swedes in gestational age, while they showed worse outcomes in some indicators (Denmark in LBW and Iceland in both tails of the birthweight distribution). And, likewise, Western European and Asian migrants fared similarly to Swedes in gestational age but had a lower risk of macrosomia.

In agreement with the Spanish and the German cases, we find that most of the groups show advantages in one tail of the birthweight or gestational age distributions and disadvantages in the other. However, the direction of the effects is different: while the advantages in the Spanish and German cases are mainly observed in LBW and preterm [10, 20], in the Swedish case they are in macrosomia and post-term birth. These findings suggest that further studies are needed in order to disentangle to which extent the differences observed in these host contexts may be explained by characteristics of the native population rather than the foreign-born, for instance, by the fact that Swedes may be, on average, constitutionally bigger than Spaniards. In fact, a study carried out in 23 different countries pointed to the Nordic region as the area showing the highest prevalence of macrosomia [47], which could suggest that cultural, genetic and biological factors could be at work behind these population differences.

Interestingly, as in the Spanish case [20], we also document that some groups perform worse than Swedes in several, in principle contradictory, outcomes. For instance, Icelandic mothers have a higher risk of delivering both LBW and macrosomic babies, and African women show higher risks of both preterm and post-term births. In the Spanish study [20], the lack of important variables (such as smoking, diabetes and hypertension during pregnancy) was hypothesized as responsible for these contradictory results. Although it is still possible that natives and immigrants are affected by different sets of risk factors, further research is needed to better identify those involved in specific differences since, like in the Swedish case, we do control for most of the variables potentially responsible.

Another possibility highlighted in the literature is that some risk factors may not relate to perinatal outcomes in the same way across ethnicities, although it is not possible for us to deduce ethnicities from countries of origin. For instance, a study carried out in Sweden found differences in the way that gestational diabetes was associated with macrosomia according to migrant status. Thus, among women diagnosed with gestational diabetes, non-Nordic migrants had a lower risk of delivering a large-for-gestational age and macrosomic child than natives [48]. However, all of these hypotheses need further investigation since they could lead to the stigmatization of foreign populations rather than contributing to explain differences.

In any case, the simultaneous penalties or advantages derived from the same indicators (birhtweigth or gestational age) suggest that the country of origin is not a homogeneous entity but rather includes different sub-populations. Thus, as population averages only help us with general trends, we need to delve deeper to explain the relationship between these heterogeneous groups and perinatal indicators.

This paper has some limitations. We cannot identify from our data immigrants who obtained the Swedish citizenship and this may lead to an under-estimation of the differences due to misclassification of Swedish mothers born outside of Sweden or the omission of time of residence in the country, which has been shown to modify the association between migration and health [49, 50]. And, while using the country of origin and the proportion of migrants during the 80s helps us acquire a nuanced approach to the paradox, the lack of individual information on the type of migration prevents further study of these groups of migrants.

This paper also has strengths. The data quality, directly collected from hospitals, is very good, and we have information on almost all births occurred in Sweden in the period. We do not deal with the problems of self-reported birthweight and gestational age that have affected previous research [20]. We also have very detailed information on maternal country of birth in comparison to other study with a similar aim [10]. This paper evidences that the healthy migrant paradox debate is not only 'ethnicity-specific', as a literature review recently pointed out, mainly focusing on the North American case–which uses self-reported ethnicity-[16] but it is also "country of origin-specific", as this, and other European research suggest [10, 20].

Finally, the period we study is of great relevance to the understanding of the healthy migrant paradox: the 1980s, when most of the women delivering in our period probably arrived, is the so-called 'decade of the asylum seeker' in Sweden [51], although labor migrants from Europe and elsewhere also arrived then. However, an updated version

of this study may be of interest for current public health purposes and further assessment of the phenomenon.

New Contributions to the Literature

This study provides a new piece of evidence to the broad discussion regarding the healthy migrant paradox on perinatal outcomes. We consider outcomes less assessed in the literature in relation to the paradox such as macrosomia and post-term births. We have confirmed some of the findings of previous literature (higher risk of delivering LBW and, more exceptionally, preterm births) but, above all, we have showed that more groups have a lower risk of macrosomia and, to a less extent, of post-term. Furthermore, by studying groups from countries of origin with a high proportion of refugees and asylum seekers next to groups mainly composed by labor migrants in the *same* host country, we have underlined the complexity of the healthy migrant paradox and questioned the selection hypothesis as the main mechanism through which to explain it.

What is Already Known on this Subject?

Abundant evidence shows that immigrants residing in developed countries have a lower risk of delivering LBW and preterm babies (the healthy migrant paradox). However, less is known about macrosomia and post-term birth, which are acknowledged relevant indicators for infant health. Moreover, although the causes of this healthy migrant paradox are still unknown, the idea of selection in origin remains the strongest hypothesis.

What this Study Adds?

This study shows that in Sweden the healthy migrant paradox is outcome and country of origin-specific. Overall, immigrants show a higher risk of delivering LBW and preterm, but a lower risk of macrosomia and post-term. These findings—especially among origins largely comprised of refugees and asylum seekers—challenge the main explanation of selection in origin. The fact that the differences in perinatal health problems between immigrants and Swedes are located in different parts of the distributions of birthweight and gestational age suggests that different risk factors may be involved and, therefore, further research is needed in this direction.

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