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REVIEW PAPER

Pregnancy and Birth Outcomes Among Immigrant Women in the US and Europe: A Systematic Review

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Abstract Human migration is not a new phenomenon, but it has changed significantly with the advance of globalization. We focus on differences in the published literature concerning migration and health (EU vs the US), centering specifically on reproductive health outcomes. We conducted a literature search in the Pubmed and Embase databases. We reviewed papers that contrast migrants to native-born populations and analyzed differences between countries as well as challenges for future research. The prevalence of low birthweight among migrants varies by the host country characteristics as well as the composition of migrants to different regions. The primary driver of migrant health is the migrant "regime" in different countries at specific periods of time. Future health outcomes of immigrants will depend on the societal characteristics (legal protections, institutions and health systems) of host countries.

Keywords Migration · Systematic reviews · Birth weight · Small for gestational age

Abbreviations

LBW	Low birth weight
VLBW	Very low birth weight
MLBW	Moderate low birth weight
SGA	Small-for-gestational-age
PTB	Preterm birth
GDM	Gestational diabetes mellitus
RR	Relative risk
US	United States
NYC	New York City
EU	European Union
CA	California
FL	Florida
HI	Hawaii
ID	Idaho
IL	Illinois
KY	Kentucky
MN	Minnesota
MO	Missouri
NH	New Hampshire
NJ	New Jersey
NY	New York
OH	Ohio
OK	Oklahoma
PA	Pennsylvania
SC	South Carolina
TN	Tennessee
TX	Texas
UT	Utah

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Introduction

Population Mobility and the Health of Migrants

Human migration is not a new phenomenon, but it has changed significantly in volume and nature with the advance of globalization, including the growth of international transport and communication, and the interlinked destinies of nations following the recent economic recession [1]. In the US, the size of the immigrant population in 2012 was 40.8

million, corresponding to a 13 % share of the total population [2]. This share has been increasing in recent years. In Europe, Eurostat data indicate that the contribution of net migration has exceeded natural population growth since 1992, peaking in 2003 [3]. Since then, migration flows seem to have decreased. In total, compared with the year just before the economic crash (2007) immigration to EU Member States is estimated to have decreased by 6 % and emigration to have increased by 13 % [4]. Currently, Europe is facing new challenges with thousands of war refugees seeking asylum. As a result, population mobility is among the leading policy issues of the twenty-first century.

A topic of surpassing interest to both sending and receiving countries is the health status of migrants [4]. A contentious political issue is whether migrants impose an economic cost to the receiving countries through increased medical, educational, and social safety net expenditures. This topic is debated everywhere, whether it be in Hong Kong where the Chief Executive recently imposed a ban on mainland Chinese immigrants moving there in order to deliver babies (to qualify for citizenship), or in California counties where citizen referenda have attempted to deny health care for undocumented farm laborers. Nonetheless, information on migrant health in many countries remains scarce. Information about the health of migrants in Europe differs by region, which makes it difficult to monitor and improve migrant health [4].

We sought to review the published literature about migration and health contrasting the United States with the Europe region, since both have been regions with a traditional history of migration yet have differing results in terms of health outcomes (e.g. healthy migrant effect widely observed in the US compared to Europe). We aim to observe which features can influence health outcomes among immigrants. We suggest that the health outcomes of the current asylum seekers in Europe will depend on the characteristics of host countries. Our hypothesis is that in both regions the primary drivers that affect the health of migrants will depend not only on the migrants' profiles, but also on the migration regimes within receiving countries. The migration regime—understood as the system of laws, regulations, policies and institutions within each country—will have a profound impact on the lives of migrants. To illustrate the contrasting literatures on health and migration we focus on one particular health outcome for which our systematic review uncovered a substantial number of studies, viz. reproductive health outcomes. We specifically focus on low birthweight and small for gestational age (SGA). Using the example of reproductive health outcomes we aim to discuss differences between countries regarding health outcomes of immigrants and to elucidate why these differences arise. We also discuss some of the data challenges, the impact of the migration regime and the social environment of migrants in the receiving countries, and what we need to know in order to improve the evidence base for policy making in these challenging times.

The focus of our review is not directed toward a gendered analysis of migration, e.g. how differences in the profile of migrants can be highly patterned by gender, such as the flow of (virtually exclusively) female domestic workers from Southeast Asia to Hong Kong, or the migration of almost exclusively male manual labor from East Asia to the United Arab Emirates. A gendered analysis of migration and health necessitates a consideration of the economic structures, gender relations (rights, laws, structures of power), and gender-based cultural norms prevailing in both the sending countries as well as receiving countries. This is beyond the scope of the present review. Instead our focus on reproductive outcomes of migrant women was primarily driven by the consideration that: (a) there is a large literature on the subject, and (b) reproductive outcomes are a sensitive "mirror" of social conditions confronted by migrants in their host countries.

Methods

We conducted a literature search in Pubmed and Embase. Our search follows the PRISMA guidelines and we used the two databases to retrieve only articles in the published scientific literature. The search did not include low and middle-income countries since our focus was on studies from the US and the EU. The inclusion criteria to consider the articles in our analysis were: abstract available and information about low birth weight (LBW) or slow for gestational age (SGA) in migrants. From the total of articles we obtained, we selected 63 from the United States and 51 from Europe. In a second round, we read all the articles selected and excluded those according to the following criteria: articles written in a different language than English, do not include LBW or SGA as an outcome, intervention studies aimed at decreasing LBW or SGA, economic evaluations, do not provide data to compare migrants and native-born. After reading all the articles selected we finally included 38 articles from the United States and 30 articles from Europe. Information about the literature search strategy, the inclusion and exclusion criteria and the manuscripts included in the study are given on Table 1 and Fig. 1.

Results

The Healthy Migrant Effect in the US and Health Inequalities in Europe

The US literature on migration and health has been heavily dominated by discussions of the healthy migrant effect and

Table 1 Literature search strategy in Pubmed and Embase

Topics	Literature search	Number of manuscripts published with data from the United States	Number of manuscripts published with data from Europe
Migration and pregnancy outcomes (Pubmed)	("Emigration and Immigration"[Mesh] OR "Emigrants and Immigrants"[Mesh] OR emigration[ti] OR immigration[ti] OR immigrant[ti] OR immigrants[ti] OR emigrant[ti] OR emigrants[ti] OR foreign born[ti]) AND ("Pregnancy Outcome"[Mesh] OR "Birth Weight"[Mesh] OR "Infant, Low Birth Weight"[Mesh])	88	118
Migration and pregnancy outcomes (Embase)	'Migration'/exp OR 'migration' AND ('pregnancy'/exp OR 'pregnancy') AND ('birthweight'/exp OR 'birthweight')	75	48

Results of the comparison of pregnancy outcomes literature published with data from the USA and Europe

We performed the literature searches using "United States" and "Europe" as Mesh terms, separately

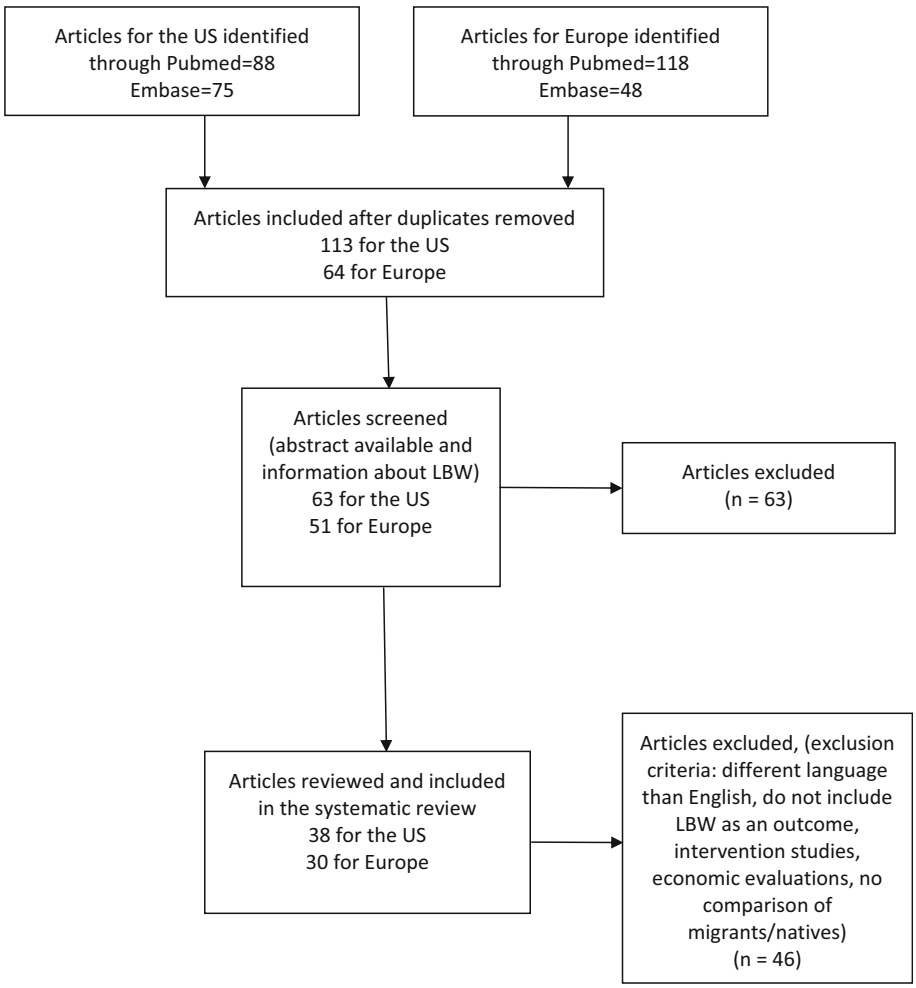

Fig. 1 Flow chart of the review process. Inclusion criteria first round: abstract available and information about low birth weight (LBW) or small for gestational age (SGA) in migrants. Exclusion criteria second round: articles written in a different language than English, do not include LBW or SGA as an outcome, intervention studies aimed at decreasing LBW or SGA, economic evaluations, do not provide data to compare migrants and native-born

the so-called "Latino health paradox". Studies have been devoted to dissecting the reasons behind the apparent paradox that immigrants—particularly Mexican immigrants—have been found to have better health outcomes (e.g. lower rates of LBW) compared to the native-born, in spite of their lower socio-economic backgrounds. The "Latino health paradox" in the United States has been in turn ascribed to three different strands of explanation:

(a) immigrant self-selection (i.e. those who are fit and healthy tend to migrate for work); (b) the "salmon bias" which posits that immigrants return home after they become sick (to be cared for by their relatives), and (c) the "ethnic enclave" hypothesis, which conjectures that immigrants are protected as a result of settling into residential areas with high immigration concentration, thereby providing them social integration (a kind of bonding social capital) at the same time as insulating them from the deleterious exposure to discrimination from society at large [5]. More recent literature has, however, begun to question the generalizability of the Latino health paradox, pointing out that when we examine the fine-grained detail of immigration from different sending countries, not all migrant groups from Latin America experience better health outcomes compared to the native born [6, 7]. Clearly, the "paradox" is contingent on many factors, including the specific country of origin of migrants, as well as the specific health outcome under consideration.

Pregnancy Outcomes

Table 2 is a summary of the results of articles published with data from the United States. The healthy migrant effect in pregnancy outcomes is reported in 21 articles, observed mostly in Latinas. However, the articles from Collins and Shay [40] and from Guendelman and English [9] show that second generation Latinas or those with a longer duration of residence in the US have worse pregnancy outcomes, suggesting that the healthy migrant effect tends to wane over time [8, 9]. In addition, the works from Kaufman et al. [10] or Rosenberg et al. [11] suggest that Puerto Ricans have worse pregnancy outcomes [10, 11]. In the case of immigrant black populations, two articles show worse pregnancy outcomes [12, 13]. Among Asian people, six articles show that pregnancy outcomes are not better compared to US borns [14–19]. Importantly, Kelaher and Jessop [20] and Reed et al. [18] show that there are no important differences between documented and undocumented migrants [18, 20].

Table 3 is a summary of the results with articles published with data from Europe. The results of these articles differ compared to the results of the analysis of American data. First, two countries report results that support a healthy migrant effect in pregnancy outcomes: Spain and Belgium. In Spain, the results reported by Speciale and Regidor [21] suggest that the LBW outcomes differ considering the groups of migrants, and that some groups of migrants have better LBW results compared to native-born [21]. Garcia-Subirats et al. [22] found that Spanish mothers have higher risk of moderate LBW, while migrants have higher risk of very LBW [22]. The other reports published with Spanish data did not replicate these observations. In the case of Belgium, three reports observed a healthy migrant effect, while Racape et al. [23] conclude that this effect depends on the origin of migrants [23]. Jacquemyn et al. [24] report there is no healthy migrant effect in Belgium when the native-born are compared with Moroccan and Turkish immigrants [24]. Small et al. [26] found a healthy migrant effect in Somalis compared to the native-born in Belgium, Canada, Finland, Norway and Sweden, and Lalchandani et al. [25] conclude that there are no differences between Irish native-born and refugees in terms of LBW [25, 26]. In conclusion, European data only report a healthy migrant effect in terms of pregnancy outcomes in two countries, and Somalis show a healthy migrant effect compared to native-borns from several European countries. There are no differences between refugees and the native-born in Ireland. Surprisingly, there is a lack of studies where the immigrant categories are specified. Hence, we conclude that little is known about what to expect in terms of pregnancy outcomes from asylum seekers.

Discussion

The results of our review highlight the differences in the reproductive health outcomes of migrants comparing the USA to the European region. Differences in pregnancy outcomes not only derive from the characteristics of the migrant population, but also stem from differences in how immigrants are defined in each society, as well as the migrant regime of each region. These results may be extrapolated to other health outcomes, and the data challenges apply to all the studies related to migration.

Who is a Migrant? Problems with Definition

During the process of looking for differences between regions we have found that part of the studies do not take into account the reasons for migration, which makes the comparisons between countries and health outcomes even more difficult [17, 19, 27]. In addition, to make sense of cross-national comparisons of migration and health we need to take into consideration the fact that each country defines migrants differently. Each country also has a unique history of migration flows. It is influenced by factors such as labor migration, historical links between countries of origin and destination, and established networks in destination countries [4]. The collection, interpretation and comparability of data about migrants and their health status is difficult. In the case of the US, for example, the Behavioral Risk Factor Surveillance System surveys of the Center for Disease and Control prevention (CDC) do include immigrants. However, given that the sampling frame of the surveys is through telephone

Table 2 Studies with US data included in the review (N = 38)

Origin of migrants	Authors and publication	Source	Sample size	Further details about the comparison	Study year	Study aims	Pregnancy outcomes
Foreign-born Asia, Latina	Fuentes-Afflick et al. [35]	Registry: California birth certificate database	497,868	Comparison with US-born Asians, Blacks, Latinos, Whites	1964–1976	To measure the relationship between maternal birthplace, ethnicity, and LBW	Foreign-born Latina women were less likely to have moderately LBW infants than US-born Latina. Foreign- and US-born black women remained at significantly higher odds of having very LBW infants relative to US-born white women[a]
Samoan	Baruffi et al. [36]	Registry: birth certificates	7942 live births to Samoan and 87,606 live births to Caucasian women		1979–1994	To explore temporal trend analysis of birth outcomes of Samoan women and identify changes	Samoan women showed a decline in LBW. VLBW didn't change
Immigrants all states and the District of Columbia	Acevedo-Garcia et al. [37]	Registry: US natality detail data	2436,890		1982–1983	To investigate whether foreign-born status confers a protective effect against LBW and whether this protective effect varies across racial/ethnic groups and by socioeconomic status within various racial/ethnic groups	On average, foreign-born status is associated with LBW and it has a protective effect. But, the direction and strength of this association varies across racial/ethnic groups. Foreign-born status has a protective effect among Black and Hispanic women, has no effect among White women, and has an adverse effect among Asian women
US Hispanic/Latino subgroups	Acevedo-Garcia et al. [38]	Registry: US natality detail data	634,797	Hispanic/Latino subgroups born at the US	1983–1987	To investigate whether maternal foreign-born status confers a protective effect against LBW	Hispanic/Latino birthweight paradox occurs among infants of foreign-born Mexican and foreign-born Central/South American women
Latinas	Hoggatt et al. [16]	Registry: birth records and survey data	2135	US born Latinas and non Latinas of Los Angeles County	1985–1987	To assess differences in LBW in US born Latinas and foreign born Latinas, and non-Latina whites in Los Angeles county	US born Latinas and foreign born Latinas had a higher prevalence of LBW infants compared to whites adjusting for demographic variables. When they adjust for environmental or behavioral factors the positive association is attenuated
Korean	Yi et al. [39]	Registry: US natality file	38,751	21 states included (CA, FL, HI, ID, IL, KY, MN, MO, NH, NJ, NY, OH, OK, PA, SC, TN, TX, UT, VA, WA, WV)	1985–1990	To evaluate the risk of adverse birth outcomes among US and foreign-born Korean women compared to US-born white women	US-born and foreign-born Korean women exhibited a lowered risk of LBW than white women. These differences were not significant
Hispanic	Collins and Shay [40]	Registry: Illinois birth certificates registry	22,892		1989–2004	To determine the contribution of maternal nativity and place of residence to study the incidence of LBW	Urban poverty is negatively associated with Hispanic birth weight only when the mother is Puerto Rican or a US-born member of another subgroup

Table 2 continued

Origin of migrants	Authors and publication	Source	Sample size	Further details about the comparison	Study year	Study aims	Pregnancy outcomes
All immigrants	Korenbrot et al. [41]	Registry: California electronic birth certificate database	All annual births		1990–1997	To determine whether passage of welfare and immigration policies was followed in California by changes in births to foreign-born women in California with respect to total numbers, payer sources, prenatal care use, or health outcomes	Low birthweight outcomes were better for foreign-born women than for US-born women
All immigrants	Centers for Disease Control and Prevention (CDC) [42]	Registry: CDC's National Center for Health Statistics natality files	All births registered in 1990 and 2000 disaggregated by state	US native-born	1990–2000	To present state-specific comparisons of live births in 1990 and 2000 to women born outside the 50 states and DC and compare maternal characteristics and live-birth outcomes for these women with those of state-born mothers	Women born outside the 50 states of the US had better birth outcomes than their state-born racial/ethnic counterparts
Japanese	Alexander et al. [43]	Registry: national linked birth and infant death records	37,941	US. Born Japanese American	1991–2001	To investigate the birth outcomes of Japanese Americans, focusing on the role of the mother's place of birth	Infants of foreign-born Japanese Americans had a slightly lower risk of low birthweight
Migrants that lived at the US that moment. Categories: white, black, Chinese, Japanese, Filipino, other Asian, Mexican, Puerto Rican, Cuban, central and south American	Singh and Yu [44]	Registry: national linked birth and infant death records and national maternal and infant health survey	Over 5000,000		1992	To examine whether there were significant differentials between US- born and foreign-born women in risks of infant mortality, LBW and preterm birth among US racial/ethnic groups	Foreign-born status was associated with 7 % lower risks of LBW
Mexican	English et al. [45]	Registry: birth certificates	4404		1992	To analyze differences in the proportions of pregnancy risk factors, low birth weight infants	US-born Spanish speakers had the highest odds for LBW and Mexico-born English-speakers had the lowest odds for preterm delivery compared to US-born English-speakers
Caribbean born blacks	Pallotto et al. [13]	Registry: Illinois vital records	103,746	US Black and US white	1992–1993	To determine the LBW components of infants delivered to US-born Black women, Caribbean-born Black women, and US-born White women	Infants delivered to US- born Black women have a greater moderately LBW rate than do infants delivered to Caribbean-born Black women. The two subgroups of Black infants have a greater VLBW rate than do White infants
Mexican	Collins and David [8]	Registry: Illinois computerized vital records of Mexican-American infants	45,445	US born Mexican-American	1992–1997 and 1999–2003	To determine whether duration of generational residence in the US is associated with the pregnancy outcomes of Mexican Americans	First-generation US born Mexican-American women had the greatest rate of LBW. Second generation or higher Mexican-American women had an infant birth-weight pattern similar to that of Mexican-born women

Table 2 continued

Origin of migrants	Authors and publication	Source	Sample size	Further details about the comparison	Study year	Study aims	Pregnancy outcomes
Mexican	Cervantes et al. [46]	Registry: birth–death records	57,324		1994	To assess if Mexican immigrants will exhibit lower rates of LBW and preterm deliveries than native-US born women of Mexican origin, non-Hispanic White and Black women, and Puerto Rican Women	Immigrant Mexican women had a significantly lower risk of LBW
Mexican	Romero et al. [47]	Registry: Colorado birth records	66,422		1994–1997	To test whether foreign-born status confers a protective effect against LBW outcomes	Mexican-born women had 24.5 % lower odds of LBW than US-born women
Migrants from 164 countries grouped into 8 geographic regions that delivered at Grady Memorial Hospital in Atlanta, Georgia	Forna et al. [48]	Data from hospital records	49,904		1995–2000	To compare pregnancy outcomes between foreign-born women and women born in the US	Foreign-born women had a higher mean birthweight
Chinese	Liu et al. [49]	Registry: livebirth and fetal death certificates compiled by the National Center for Health Statistics	950,624 singleton pregnancies in south-east China and 293,849 singleton births from the US		1995–2004	To compare perinatal outcomes in native Chinese, foreign-born and US-born Chinese-American women	Native Chinese and foreign-born Chinese-American women had substantially lower risks of having SGA infants compared with US-born Chinese-American women. Having a White or Black father had a reduced risk of SGA
Mexican	Guendelman and English [9]	Registry: birth records	1114	Mexican that are long term residents at two California counties San Diego and Contra Costa	1995–2007	To investigate the extent to which length of residence in the US affects the reproductive health of Mexican immigrant women	Long-term immigrants who have lived in the US for more than 5 years were more likely to deliver preterm infants and LBW infants than newcomers who have lived in the US for 5 years of less
Vietnamese, Cambodian/ Loatian, Korean, Chinese, Japanese, Filipino	Qin and Gould [50]	Registry: California linked birth/ infant death cohort files	486,451	Vietnamese, Cambodian/ Loatian, Korean, Chinese, Japanese, Filipino born at the US	1995 US and Belgium 1992	To study the relationship between maternal nativity, maternal risks and birth outcomes in six Asian sub-populations	US-born mothers of more recent Cambodian/Loatian and Vietnamese immigrants had higher risk and delivered more small and preterm births, while US-born Korean mothers had higher risk but no differences in preterm and LBW delivery
Asian Indian and Mexican	Gould et al. [12]	Registry: California link birth/date certificate files registry	1057,977	US-born black and white women	1995–1999	To define the sociodemographic risk profile and perinatal outcomes in women of Asian Indian birth and to compare these outcomes to foreign-born Mexican American and US-born black and white women	Black and Asian infants had the highest rates of LBW

Table 2 continued

Origin of migrants	Authors and publication	Source	Sample size	Further details about the comparison	Study year	Study aims	Pregnancy outcomes
Asian-Indians and Mexican	Madan et al. [17]	Registry: National registry	9100,000	US born white and Asian Indians from 11 states of the US: California, Hawaii, Illinois, New Jersey, New York, Texas, Washington, Minnesota, Virginia, Missouri, West Virginia	1995–2000	To compare perinatal risks and outcomes in foreign- and US-born Asian-Indian and Mexican women	Indian groups had a lower mean birth weight and a greater percentage of LBW and SGA compared to infants born to White women
Systematic review[b] Diverse	Urquia et al. [19]				1995–2000	To examine whether LBW and preterm birth differed between non-migrants and migrant subgroups, defined by race/ethnicity and world region of origin and destination	Compared with US-born black women, black migrant women were at lower odds of delivering LBW and preterm birth babies. Hispanic migrants also exhibited lower odds for these outcomes, but Asian and white migrants did not. Sub-Saharan African, Latin-American and Caribbean women were at higher odds of delivering LBW babies in Europe but not in the USA. South-central Asians were at higher odds in both continents, compared with the native-born populations
Mexico-born living at the US and North African born living in Belgium and France	Guendelman et al. [51]	Registry: birth certificate records in the United States and Belgium	3417,003 from the US, 107,968 from Belgium and 11,817 from Africa	Birth certificate records in the United States and Belgium	1995–2003	To compare maternal characteristics and birth outcomes of Mexico-born and native-born mothers in the US and those of the North African mothers living in France and Belgium to French and Belgian nationals	The adjusted odds for LBW were lower for immigrants than native/nationals by 32 % in the US, by 32 % in Belgium and by 30 % in France
Mexican	Wingate and Alexander [52]	Registry: National Center for Health Statistics live birth/infant death cohort files	2446,253	US-born mothers of Mexican origin	1995–2003	To examine the relationship between maternal mobility history and birth outcomes among infants born to US resident mothers of Mexican origin	Infants born to foreign-born mothers had the lowest rates and lower risks of adverse birth outcomes compared to infants of US-born mothers
Asian-Indian American	Alexander et al. [14]	Registry: birth certificate records	4975,449	White and African-American mothers (non-Hispanic). Selected births from California, Hawaii, Illinois, New Jersey, New York, Texas and Washington	1996–1997	To examine the maternal characteristics and birth outcomes of infants of US resident Asian-Indian-American mothers and compare those to infants of US resident Whites and African-American mothers	Asian-Indian-American had the highest risk of LBW
Foreign-born Chinese Americans	Li et al. [53]	Registry: national linked birth/infant death certificate file	165,660	Non Hispanic White mothers and US resident Chinese. 50 states and the district of Columbia	1996–1997	To examine nativity differences in adverse perinatal outcomes of Chinese-American mothers	Foreign-born Chinese-American mothers had significantly lower risks for LBW

Table 2 continued

Origin of migrants	Authors and publication	Source	Sample size	Further details about the comparison	Study year	Study aims	Pregnancy outcomes
European and African ancestry. Migrants are refugees	Krishnakumar et al. [54]	Registry: Central New York Perinatal Data System	146,431		1996–2003	To study the predictors of birth outcomes that consider the birthplace of the babies' fathers	Foreign born fathers were found to have 15 % fewer LBW infants than US-born fathers
Native-born Hispanic	Kaufman et al. [10]	Registry: Statistics birth data from the NYC Department of health and mental hygiene	258,680	Hispanic population	1998	To describe the effects of maternal education on adverse birth outcomes by nativity and Hispanic subgroup in the US	Descriptive statistics show that birth weight is bigger in all the Hispanic groups, except for Puerto Rican. But since the scope of the article is not the LBW, there are no further analyses that help us to go in depth into this issue
Russia, Ukraine, Poland and former Yugoslavia republics	Janevic et al. [55]	Registry: linked hospital and birth data from the New York State Department of Health	253,363	US born	1998–1999	To examine the risk of preterm birth or delivering a term small for gestational age infant among immigrants from Russia and Ukraine, Poland, and former Yugoslavia republics relative to US born non-Hispanic whites	There is partial support for the healthy migrant effect paradox. Women from Russia had a slightly lower risk of PTB but not SGA, and women from Poland had a lower risk of SGA but not PTB
Undocumented and documented Latinas	Kelaher and Jessop [20]	Data collected from those who initiated prenatal care at MIC-Women's Health Services in NYC	4173	US-born Latinas.	1998–2003	To study the healthy migrant effect previously studied at the literature	There were no significant differences between rates of LBW for undocumented foreign-born Latinas and US-born Latinas, or documented foreign-born Latinas
Latinas	Rosenberg et al. [11]	Registry: New York City birth certificate records	78,364	US-born Latinas in NYC	2000–2005	To examine the extent to which the paradox can be explained by differential distribution of risk factors	Positive birth outcomes of foreign-born women are largely due to their more favorable distribution of behavioral risk factors. The epi paradox does not account for the LBW rates among Puerto Ricans in NYC. A high percentage of whom are mainland-born
Migrants in Colorado who gave birth in a Colorado hospital.	Reed et al. [18]	Registry: Colorado birth certificate records	118,904		2002	To describe birth outcomes of undocumented migrants in Colorado	Undocumented women had a lower rate of LBW or preterm infants
Asian subgroups	Hayes et al. [15]	Registry: National Center for Health Statistics natality file	293,211		2002–2006	To analyze birth outcomes in two Asian subgroups to examine variation within the Asian population	Infants of non-US born Chinese mothers had a slightly higher mean birthweight compared to infants of US born Chinese mothers. Infants for non-US born Asian Indian mothers tended to have a slightly lower mean birthweight

Table 2 continued

Origin of migrants	Authors and publication	Source	Sample size	Further details about the comparison	Study year	Study aims	Pregnancy outcomes
Foreign-born black women from Sub-Saharan Africa and the non-Spanish speaking Caribbean.	Vang and Elo [56]	Registry: vital statistics birth record data from the state of New Jersey	73,907	Non-Hispanic US black born	2004	To examine the association between neighborhood minority diversity and infant birthweight among non-Hispanic US-born black women and foreign-born black women from Sub-Saharan Africa and the non-Spanish speaking Caribbean	There were differences in LBW. US-born had a weight similar to those from the Caribbean. But those from Africa had better weight. The differences were statistically significant[a]
Latinas	Flores et al. [57]	Registry: State of Utah Department of Health birth records	196,617		2004–2007	To investigate differences in risk for birth outcomes among Whites, US-born Latinas and foreign-born Latinas	Data support the existence of a variation of the "Latina paradox" among Latinas to birthplace, where US-born Latinas do not experience better birth outcomes than Whites, but foreign-born Latinas experience better birth outcomes for several endpoints compared with US-born Latinas
Honduras, El Salvador, Guatemala and Nicaragua.	Gaffney [58]	Data collected by public health nurses during home visits	296	US White and US black mothers (non Hispanic)	Not specified	To compare the incidence of empirically established prenatal risk factors for LBW outcomes among two groups of low-income mothers	Their rate of LBW delivered did not reflect the protective effect often attributed to foreign-born Hispanic mothers
Systematic review[b] Mexican	Callister and Birkhead [59]					The article reviews the literature including sociodemographic profiles, patterns of perinatal health care, acculturation and other related sociocultural influences	Multiple and complex factors contribute to the epidemiologic paradox seen in rates of LBW infants of Mexican immigrant mothers

[a] The manuscript indicates the analyses were adjusted for gestational age

[b] We included information of two systematic reviews because the conclusion of these studies about pregnancy outcomes was important for our study

Table 3 Studies with European data included in the review (N = 30)

Host country	Origin of migrants	Authors and publication	Source	Sample size	Study years	Study aims	Pregnancy outcomes
Systematic review[b]	All immigrants	Bollini et al. [60]		18,322,978	1966–2004	The systematic review aims to make a quantitative synthesis of available evidence on the association between pregnancy outcomes and integration policies comparing native versus immigrant women in European countries	Immigrant women showed a clear disadvantage for all the outcomes considered compared to native women. Immigrant women had 43 % higher risk of low birth weight
Norway	Asian and other countries	Stoltenberg and Magnus [61]	Registry: Norway Medical Birth Registry data and information on mother's country of birth from the Central Bureau of Statistics	146,133	1968–1991	To determine the influence of children born to immigrant mothers on the total proportions of LBW in Oslo	The observed increased proportion of children with LBW and low gestational age born after 1980–1982 is not the result of an increased proportion of children born to immigrant women
Sweden	All immigrants	Li et al. [62]	Registry: Swedish Medical Birth Registry	1060,467	1973–2006	To examine if there is an association between country of birth in parents and small-for-gestational-age in first singletons births	Immigrants from Southern European countries, Africa, and Asia had higher risks of SGA than those in the reference group, and the risks were even higher in compatriot parents
Sweden	All immigrants	Rasmussen et al. [63]	Registry: Swedish birth certificate data	1270,407	1978–1990	To estimate the occurrence of LBW and preterm birth among immigrant and Swedish women in Sweden	Remarkably small differences were found between women and native Swedish women
Denmark	Yugoslavia, Somalia, Lebanon, Pakistan and Turkey.	Pedersen et al. [64]	Registry: Danish Medical Birth Registry, Danish Civil Registration System and the Integrated Database for Labour Market Research	1684,807	1978–2007	To examine whether age at immigration and length of residence were associated with preterm and small-for-gestational age delivery among immigrant women in Denmark	All immigrant groups had an increased risk of SGA delivery with the highest risk among Lebanese-, Somali- and Pakistani-born women[a]
Spain	All immigrants	Fuster et al. [65]	Registry: Spanish National Institute for Statistics	9443,882	1980–2010	To analyze the influence of the rapid and intense arrival of immigrants in Spain on LBW variation	The progressively greater contribution of foreign women to total births in Spain and their differential numerical input to the various risk groups have slowed the pattern of reduction in the mean weight of newborns in Spain
Belgium	Algeria, Morocco, and Tunisia	Buekens et al. [66]	Registry: Belgian single-live-birth certificates	804,286	1981–1988	To study birthweights of North African immigrants in Belgium	The entire North African birthweight distribution was shifted toward higher birthweights than the Belgian distribution
England and Wales	All immigrants	Collingwood Bakeo [67]	Registry: birth records	11.4 million	1983–2001	To investigate trends in LBW singleton live births by mother's country of birth	The prevalence of LBW varies by mother's country of birth. More LBW in mothers born in India, Pakistan and Bangladesh. Decrease in mothers born in East Africa

Table 3 continued

Host country	Origin of migrants	Authors and publication	Source	Sample size	Study years	Study aims	Pregnancy outcomes
Sweden	All immigrants	Dejin-Karlsson and Ostergren [68]	Participants recruited from first antenatal care visits	826	1991–1992	To investigate the risk of small for gestational age in relation to country of origin of the mother	Small for gestational age deliveries were much more prevalent among Middle East-and North Africa-born women and sub-Saharan born women[a]
Spain	All immigrants	Garcia-Subirats et al. [22]	Registry: birth registry of Barcelona	192,921	1991–2005	To describe social and economic inequalities in non-fatal pregnancy outcomes in the neighborhoods of the city of Barcelona	Pregnancy outcomes for recent immigrant women are better than for women born in Spain. But there is a lack of homogeneity among immigrant women. It depends on the origin
US, France and Belgium	Mexico-born, North African	Guendelman et al. [51]	Registry: single live birth certificates	3536,773	1992–1995 (France and US 1995, Belgium 1992)	To compare maternal characteristics and birth outcomes of Mexico-born and native-born mothers in the US and those of North African mothers living in France and Belgium to French and Belgian nationals	The adjusted odds for preterm births were lower for immigrants compared with native/nationals by 11 % in the US and by 23 % in Belgium. In France, the odds for preterm births were comparable for immigrants and naturalized mothers[a]
Italy	Central Africa, Northern Africa and Middle East, Eastern Europe, Asia and Latin America.	Diani et al. [69]	Data from hospital records	13,945	1992–2001	To study the mode of delivery and quality of care given to 1014 pregnant women not belonging to the EU	The non-EU patients were delivered babies of very low birthweight
Belgium	Algeria, Morocco and Tunisia	Vahratian et al. [70]	Data from hospital records	1162	1994–1995	To compare birthweights and frequencies of preterm birth for North African and Belgian infants	North African immigrants had infants with less LBW. There is a paradox. The estimated difference in mean birthweight was significant. It was explained by differences in preterm birth and other risk factors
Italy	All immigrants	Bona et al. [71]	Data from hospital records	69,605	1996–1997	To evaluate health state of newborn of immigrated parents from developing countries	Infants of immigrated parents showed higher LBW[a]
Belgium	Algeria, Morocco and Tunisia	Delvaux et al. [72]	Data from hospital records	273	1997–1998	To further explore potential mechanisms explaining the high birth weight of infants of North African immigrants	Migrants had better LBW outcomes[a]
Australia, Belgium, Canada, Finland, Norway and Sweden.	Somalis	Small et al. [26]	Registry: national and regional birth registry	1616,977	1997–2004	To investigate pregnancy outcomes in Somali-born women compared with those women born in each of the six receiving countries: Australia, Belgium, Canada, Finland, Norway and Sweden	Compared with receiving country-born women, Somali-born women were less likely to have infants of LBW

Table 3 continued

Host country	Origin of migrants	Authors and publication	Source	Sample size	Study years	Study aims	Pregnancy outcomes
Spain	Low and middle income countries	Castelló et al. [73]	Registry: regional birth registry	21,708	1997–2008	To compare the risk of preterm and LBW among newborns from native and immigrant women and to assess the role of prenatal care in the association between the ethnic origin of the women and their reproductive outcomes	Results indicate a worse prenatal control in immigrants than in natives. VLBW was greater among immigrants, but MLBW was greater among native-borns
Belgium	All immigrants	Racape et al. [74]	Registry: Linked birth and death certificates from the Belgian civil registration system	137,974	1998–2006	To describe and measure inequalities in perinatal mortality and causes of perinatal deaths according to maternal nationality and socioeconomic data	Women from Maghreb and Egypt have fewer LBW babies and preterm babies than women from Belgium. Such a pattern was also found for Turkish women, although it was less pronounced. Women from other EU countries have fewer LBW babies than women from Belgium
Belgium	Moroccan, sub-Saharan, Turkey	Racape et al. [74]	Registry: data from linked birth and death certificates from the Belgian civil registry	83,622	1998–2008	To describe and measure inequalities in pregnancy outcomes, perinatal mortality and causes of perinatal deaths according to current citizenship versus national origin of the mother, in Brussels	The study confirms that the association between nationality at mother's birth and birth outcomes is not uniform but depends on the migrant subgroup. Natives and Sub-Saharan Africa have larger rates of LBW
Ireland	African, Romania, Kosovo, Russia and others. All refugees.	Lalchandani et al. [25]	Data from hospital records	271	1999–2000	To describe the obstetric profiles and pregnancy outcome of immigrant women with refugee status	There were no differences in birthweights between locals and refugees
Finland	All immigrants	Malin and Gissler [75]	Registry: Finish Medical Birth Registry	6532	1999–2001	To compare the access to and use of maternity services, and their outcomes among ethnic minority women having a singleton birth in Finland	Women from East Europe, the Middle East, North Africa and Somalia had a significant risk of LBW
Sweden	Somalis	Råssjö et al. [76]	Data from a retrospective case control study	771	2001–2009	To describe how Somali immigrant women in a Swedish county use the antenatal care and health services	There were significantly more children with LBW in the Somali group and more Somali babies were SGA
UK	Kosovo Albanian	Yoong et al. [77]	Data from hospital records	122	2002	To compare the obstetric performance of Kosovo Albanian women currently residing in the UK with their British-born Caucasian counterparts	The rates of LBW between the two groups were not statistically significant
Italy	All immigrants	Zuppa et al. [78]	Data from hospital records	3008	2005	To evaluate clinical and epidemiological characteristics of the maternal and neonatal immigrant population and to compare it with the Italian population	No statistically significant differences were found between immigrant and Italian newborns in birth weight

Table 3 continued

Host country	Origin of migrants	Authors and publication	Source	Sample size	Study years	Study aims	Pregnancy outcomes
Spain	All immigrants	Speciale and Regidor [21]	Registry: National birth registry of Spain	482,957	2006	To study the existence of an immigrant health paradox by evaluating the relationship between region of origin and the perinatal indicators of LBW and preterm birth in Spain	Mothers from Sub-Saharan Africa had the greatest frequency of LBW babies. The second group was from Asia. Spanish mothers had the third highest frequency of LBW. The lowest rate was observed in mothers from the US and Canada. In the adjusted analysis, there was a decreased risk of LBW in the immigrant population with respect to Spanish population. With the notable exception of women from Sub-Saharan Africa
Greece	All immigrants	Tsimbos and Verropoulou [79]	Registry: National birth registry of Greece	103,266	2006	To explore associations of socio-demographic factors with adverse pregnancy outcomes	Migrants have 0.613 RR of LBW compared to Greeks
Systematic review[b]	Diverse	Urquia et al. [19]			1995–2000	To examine whether LBW and preterm birth differed between non-migrants and migrant subgroups, defined by race/ethnicity and world region of origin and destination	Compared with US-born black women, black migrant women were at lower odds of delivering LBW and preterm birth babies. Hispanic migrants also exhibited lower odds for these outcomes, but Asian and Latin-American and Caribbean women were at higher odds of delivering LBW babies in Europe but not in USA. South-central Asians were at higher odds in both continents, compared with native-born populations
Spain	Hispanic	Pérez-Ferre et al. [27]	Regional data	459	2007–2008	To describe risk factors for the onset of GDM, the evolution of gestation and delivery, and newborns of Hispanic women living in Spain compared with those of Spanish women	Newborns from the Hispanic population were significantly heavier than newborns from Spanish women
Belgium	Turkish and Moroccan	Jacquemyn et al. [24]	Data of the Study Centre for Perinatal Epidemiology	241,906	2002–2006	To compare perinatal outcome in women from Turkish and Moroccan descent versus autochthonous women in Belgium	There were more babies with LBW in both the Moroccan and Turkish group

Table 3 continued

Host country	Origin of migrants	Authors and publication	Source	Sample size	Study years	Study aims	Pregnancy outcomes
Spain	All immigrants	Juárez and Revuelta-Eugercios [80]	Vital statistics	1393,095	2009–2011	To compare the main indicators related to LBW and SGA for immigrants and Spaniards	Most immigrants groups show lower or not significantly different risk of delivering LBW or preterm babies compared with Spaniards[a]

[a] The manuscript indicates the analyses were adjusted for gestational age

[b] We included information of a systematic review included in the previous table because the conclusion of the study about pregnancy outcomes had European data and the results were important for our study

surveys, the CDC loses populations that do not have access to landlines. Similarly in Europe, data are incomplete to meet the needs of public health policy or health-care provision [28]. Bhopal [28] concludes that existing data do not usually provide a national perspective as they are mostly from local studies [28]. In addition, only the first and second generation and another country of birth define migration status. Nevertheless, the EU immigration portal offers different definitions related to migration [29]. First, a migrant is considered 'a broader-term of an immigrant and emigrant that refers to a person who leaves from one country or region to settle in another, often in search of a better life'. The definition of immigration is the following: 'In EU context, the action by which a person from a non-EU country establishes his or her usual residence in the territory of an EU country for a period that is, or is expected to be, at least 12 months'. Going further, countries within Europe have different definitions of who is a migrant. In Germany, people who immigrated after 1950 and their descendants are described as people with immigrant background. The same also happens in Israel. Both countries adopted this definition after the Second Word War. In contrast to this approach, in the UK migrants are broadly defined as 'foreign born' [30]. Data collection is still guided by national legislative, administrative and policy needs, and follows national definitions and classifications, just as the determination of citizenship, residency and immigration in the EU remains to a large extent a national responsibility [31].

Migration Regimes

The composition of migrants varies across time and place, according to the migration regime that happens to be in place. In the case of Europe, several different categories of migrants can be distinguished: asylum-seekers and refugees, victims of trafficking, students, migrant workers, and reunified family members [4]. In the studies we include in our literature search about pregnancy outcomes, little is known about the different categories of migrants included in the investigations. However, this information is crucial to compare different migrant groups that would probably have quite different pregnancy outcomes. It poses a problem because these groups have specific health needs and may face particular legal or other barriers in accessing health services [32]. The results of Lalchandani et al. [25] do not find differences in pregnancy outcomes among native Irish and refugees [25]. This unexpected result makes the study of this population even more important now that Europe is facing a big challenge with thousands of refugees seeking asylum. In some countries, migrants face major barriers in accessing health services, whereas others are more integrative and less restrictive [33]. Furthermore, even within distinct categories of migrants, there is bound to be great variation in the problems faced [31]. The health of migrants also depends to a large degree on the specifics of the host country. We have observed that some countries in Europe do not accept asylum seekers and have denied the reception of immigrants. Others have accepted the reception of asylum seekers but with some reservations.

In the case of the United States, an important distinction (the issue that dominates public discourse) is between documented and undocumented migrants. The articles retrieved in our literature review with United States data rarely specify the legal status of migrants, which makes the comparability of groups difficult again. However, the pregnancy outcomes of documented and undocumented migrants can be very different. Unauthorized immigrant workers have been an important source of low-skilled labor supply to the United States economy for many decades. The persecution of unauthorized immigrants, but not employers of undocumented migrants, is the expression of the complex sociopolitical migration regime of the US.

In the case of Europe, the citizenship structure varies greatly between Member States. From the distinguished categories of migrants, the most important distinction is between regular or irregular migrants. As Rechel et al. [4] pointed out, the situation is further complicated through

short-term, circular, and return migration [4]. In addition, the variety of policies and the diversity of socioeconomic and living conditions of the European host countries make the situation of migrants even more complex. Considering the possible differences between countries, those that have to face the most difficult situations are undocumented migrants and asylum-seekers.

Policies of the different host countries may have different impacts on the health of migrants. The political attention paid to the health of migrants is also related to prevailing attitudes towards migrants and immigration in the hosting countries. Some countries in Europe have based their policies on restriction and control. Asylum-seekers and refugees frequently face a hostile reception in their receiving countries, as we have recently observed in Europe with refugees from Syria and Iraq looking for asylum. These attitudes towards immigration constitute the migration regime, are specific of the host country and will determine the citizenship rights of migrants as well. Overall, the health of migrants (e.g. their pregnancy outcomes) will depend on it.

Conclusions

We observe opposite patterns regarding reproductive outcomes among immigrant populations compared to native-born in the United States versus the Europe region [9, 23]. One explanation for the US/Europe difference may be ascribed to the composition of migrants in the two regions. However, only a few of the studies retrieved talk about the immigrant categories. Migrants to the US have been predominantly labor migrants and therefore strongly selected for health. However, this profile changed significantly when the Immigration and Naturalization Services allowed families of migrants to join their working relatives after the approval of the 1065 Immigration Act. Consequently, older relatives seeking to be reunited with their children could enter the country on a legal basis. This change in the profile of immigrants is reflected by the changing health status of immigrants entering the United States.

By contrast, immigrants to Europe have been suggested to be much more heterogeneous, as we have pointed out, and some groups (e.g. refugees) are less selected with respect to health status compared to labor migrants. However, we are unable to draw any definitive conclusions since only a few studies distinguish between migrant types (e.g. refugees, undocumented migrants). There is a need for studying the health outcomes of this community.

In addition, the definition of "immigrant" varies by country, which adds further complexity. For example, in the US, second-generation migrants are not classified as "immigrants". They are, by definition, citizens. However, in some studies they are still considered part of a group ethnically different. US studies show that the Latino advantage in birth outcomes disappears in second generation migrants. This trend towards convergence in health outcomes can be due to a possible acculturation effect, as the trends in obesity suggest [34].

Our literature search has pointed out the data challenges the European region has to face with regard to data collection and comparability of this data. Emerging reports of a healthy migrant effect in Europe need further investigation. But it is necessary to include the time migrants have been living in the new host country, the reasons for migration and continue with mortality studies, to investigate if the mortality rates tend to convergence over time, as has been suggested [4]. Nonetheless, these results will be subject to different categories of migrants and the migration regime of each country. The new political winds have put up barriers to make this access even more difficult than before. The current asylum seekers in Europe will face different challenges depending on the countries they are going to live in. Health inequalities are expected to be even bigger in those countries that reduce entitlements for undocumented migrants.

Social epidemiologists point out that the social environment of the new hosting country will have an effect on the health of migrants. To change the rules of the migration regime will change the profile of migrants, and their health related outcomes. In short, a specific understanding of the "migration regime" is required in order to properly understand the complex and evolving nature of the relationship between migration and health. Nevertheless, we expect that the association between migrant status and health will differ according to the background forces that shape migration patterns. As migration trends indicate, there are important period differences regarding who migrates and why, and the results concerning migrants and health will completely depend on it [3]. Hence, we expect that refugees from Syria and Iraq seeking from asylum in Europe will have different health outcomes depending on the countries they are going to live in.

Limitations of this Study

An important issue is that some articles with United States data do not talk about migrants or foreign-born since they investigate health related outcomes of Latinos and only have included the concept Latino as a key word. In this case, they have not been included in our literature search. We discarded the ISI Web of Knowledge for the literature search, since we only wanted to include manuscripts related to health.

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Compliance with Ethical Standards

Conflict of interest Authors declare to not have competing interests.

IRB Approval This systematic review did not require IRB approval.

New Contribution to the Literature The prevalence of low birthweight among migrants varies by the host country characteristics as well as the composition of migrants to different regions. Studies do not take into account the reasons for migration, which makes the comparisons between countries and health outcomes difficult. An equally important but frequently neglected driver of migrant health is the migrant "regime" in different countries. Differences in migrant regimes can only be assessed via an explicit cross-national comparative perspective, which is often lacking in studies of migrants.

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