Do social factors and country of origin contribute towards explaining a “Latina paradox” among immigrant women giving birth in Germany?

Kim Alexandra Zolitschka 1*, Céline Miani 1, Jürgen Breckenkamp 1, Silke Brenne 2,3, Theda Borde 3, Matthias David 2 and Oliver Razum 1

Abstract

Background: The “Latina paradox” describes the unexpected association between immigrant status, which is often correlated to low socioeconomic status, and low prevalence of unfavourable birth outcomes. Social (e.g. culture, religion) and/or non-social factors related to country of origin are potentially responsible for this paradox.

Methods: Questionnaire survey of 6413 women delivering in three large obstetric hospitals in Berlin (Germany) covering socioeconomic and migration status, country of origin (Turkey, Lebanon), and acculturation. Data was linked with routine obstetric data. Logistic regressions were performed to assess the effect of acculturation, affinity to religion and country of origin on preterm birth and small-for-gestational-age (SGA).

Results: Immigrant women with a low level of acculturation (reference) were less likely to have a preterm birth than those who were highly acculturated (aOR: 1.62, 95%CI: 1.01–2.59), as were women from Turkey compared to non-immigrants (aOR: 0.49, 95%CI: 0.33–0.73). For SGA, we found no epidemiologic paradox; conversely, women from Lebanon had a higher chance (aOR: 1.72, 95%CI: 1.27–2.34) of SGA. Affinity to religion had no influence on birth outcomes.

Conclusions: There is evidence that low acculturation (but not affinity to religion) contributes towards explaining the epidemiologic paradox with regard to preterm birth, emphasising the influence of socioeconomic characteristics on birth outcomes. The influence of Turkish origin on preterm birth and Lebanese origin on SGA suggests that non-social factors relating to the country of origin are also at play in explaining birth outcome differences, and that the direction of the effect varies depending on the country of origin and the outcome.

Keywords: Latina paradox, Pregnancy outcome, Turkey, Lebanon, Germany

Background

Immigrants tend to have a lower socio-economic status and poorer health than the majority population of the country they migrated to [1]. However, in the US, Hispanic women have been shown to benefit from a specific form of the “healthy migrant effect” and to have better birth outcomes than white women despite their lower socioeconomic status [2]. This phenomenon, often called the “Latina Paradox”, was found for preterm birth, low birth weights (LBW) and small-for-gestational-age (SGA) when comparing native and immigrant population groups [3–5]. So far, the “Latina Paradox” has mostly been framed as being associated with origin from a particular country (Mexico) or region (Latin America). Yet “country of origin” is a proxy for several concepts that need to be disentangled:

- A set of immutable factors related to the genetics on population level that we will call “non-social factors”. Non-social factors are not immediately

* Correspondence: k.zolitschka@uni-bielefeld.de
1 Department of Epidemiology and International Public Health, School of Public Health, Bielefeld University, Bielefeld, Germany
Full list of author information is available at the end of the article

© The Author(s). 2019 Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.
affected by migration. These factors, which include maternal height and genetic polymorphisms among others on population level, stem from the country of origin. They probably vary across different countries of origin [4, 6].

- Social factors brought along from the country of origin such as culture and affinity to religion, which may change over time.
- Social position of immigrants in the target country of the migration, in particular the socioeconomic status of immigrants from a particular country or region relative to the host population – a confounder that needs to be controlled for when analysing the “Latina paradox” [4, 7].

Social factors include religion, culture, and related behaviours. Such factors vary between countries of origin [4, 6]. Immigrants bring along traditions, values and behaviour from their country of origin, which may positively (or negatively) affect perinatal outcomes [4, 8]. Such cultural factors, however, are likely to change in the course of time spent in the target country and over generations. They may be adapted to the culture of the new country, along with other health behaviours, which could influence birth outcomes [9].

Several studies have sought to explore a potential Latina Paradox in Europe, looking at the relationship between birth outcomes and country of origin. For example, in Belgium, Jacquemyn et al. (2012) and Racape et al. (2016) found that being of Turkish or North African origin had a protective influence on preterm birth and low birth weight, respectively [10, 11]. In The Netherlands Schulpen et al. (2005) reported higher death rates for newborns of immigrant women (Antillian, Turkish and Moroccan) compared to the Dutch population [12]. In Sweden, a large birth register study including women of many different origins produced less clear results: women from Chile and Syria were the only non-Swedes who showed better results than the native population in terms of LBW and preterm birth, leading the authors to conclude that the healthy migrant effect is ethnic- and outcome-specific [13]. Finally, in Germany, a recent study by David et al. (2017), which used the same data set that we will analyse, showed a lower frequency of preterm birth among immigrant women [14]. However, similar to the other studies mentioned above, the authors did not investigate this phenomenon in detail.

To better disentangle the role of the different sets of influencing factors including the role of the cultural factors and country of origin in explaining the Latina paradox, we take two steps. First, we investigate whether a Latina paradox regarding two birth outcomes commonly examined in this context, preterm birth and SGA, can be observed in immigrant women stemming from countries or regions other than Mexico or Latin America (here Turkey, Lebanon, EU15, EU27, other Europe, Middle East (excluding Turkey and Lebanon), North Africa, Sub-Saharan Africa, Far East, Latin America and Caribbean and North America), and in a target country different from the US (here Germany). We then examine whether the effect differs between countries of origin after adjusting for socioeconomic status in the target country. If this is the case, non-social components may play a role in explaining the Latina paradox.

Second, we assess whether the Latina paradox is (at least partly) explained by social factors which non-immigrant women are not exposed to, e.g. religion and culture of the country of origin. Effects of social factors linked to the country of origin are more likely to be causally associated with the birth outcomes if they vary with degree of acculturation, after adjusting for socioeconomic status. If social factors play a role in the Latina paradox, evidence that non-social differences matter as well will become stronger when – after adjusting for socioeconomic status, acculturation and religion – differences in outcomes remain.

**Methods**

**Setting**

The study is set in Berlin, Germany. In 2014, 20.3% of Germany’s population (16.4 out of 80.9 million persons) and 25.3% of Berlin’s population (911,000 out of 3.7 million inhabitants) had a migration background. This term comprises persons who immigrated themselves as well as persons born in Germany who have at least one immigrant parent [15]. The largest immigrant group in Berlin originates from Turkey (220,000 persons) [16].

**Data sources**

Data were collected between January 2011 and January 2012 at three large maternity hospitals in Berlin. Inclusion criteria were age 18 years and above, giving live birth at 24+ completed weeks of gestation and permanent German residency [17]. Women were interviewed by trained, female study staff with a standardised face-to-face interview and a questionnaire available in eight languages including Turkish, Arabic, English, and French. When necessary, an interpreter was consulted. Uniformly collected and standardised obstetric process and outcome data (the “perinatal data”) were linked from the hospital databases.

**Main outcome variables**

We selected preterm births and SGA newborns as outcomes of interest as both have been used in previous studies exploring the Latina Paradox [4, 5]. Preterm births and SGA have an increased risk for perinatal
morbidity, mortality and lifetime complications [18, 19]. Main risk factors for these two unfavourable birth outcomes include low social status [20, 21], low social support [22, 23], smoking [24, 25], absence of religious belief [26, 27], high or low maternal age [20, 28], low or high body mass index (BMI) [29, 30] and pre-existing maternal medical conditions [30, 31]. Overall, preterm birth and SGA incur high healthcare costs and are responsible for most infant deaths [32].

Preterm birth was defined as a birth which takes place before the end of the 37th week of pregnancy. SGA was defined as a birth weight below the defined limit for gestational age and sex (10th percentile). Adjusted data that served as reference dataset are available from the 23rd to the 43rd week of gestation for Germany [33].

Determinant variables

Immigrant status of the women was defined based on their own and their parents’ country of birth [34]. Women were classified as 1st generation immigrants if they were born outside Germany and as 2nd generation women if they were born in Germany and both parents were born abroad. Women with both parents born in Germany served as reference group (non-immigrant women). Additional women with only one parent born abroad (n = 302) were grouped with the non-immigrant women (previous analyses had shown them to be quite similar to women with non-immigrant women) [35].

Acculturation was measured with items of the “Frankfurt Acculturation Scale” (FRAKK) [36]. The required information for the acculturation was obtained from 1st and 2nd generation women. Scores ranged from 13 to 90 on a scale from 0 to 90. A high score means a high acculturation. Acculturation was grouped in three equal-sized categories: low (13–38), medium (40–65) and high (65–90). Low acculturation served as reference group.

Affinity to religion was grouped as following: no religion, no affinity to religion, low affinity to religion, medium affinity to religion and high affinity to religion. No religion served as reference group. Reporting of an affinity to religion was found to be consistent with answers to another question regarding religion in the FRAKK questionnaire.

Country of origin was used to single out women from the two largest immigrant groups in the dataset, i.e. women from Turkey and Lebanon. Non-immigrant women served as reference group.

Besides acculturation, affinity to religion and the country of origin we consider the following covariates, which may influence birth outcomes:

- Monthly household income (categorised as < 900 EUR, 900–1500 EUR, 1500–2600 EUR and > 2600 EUR) and education (low (no degree/primary education), medium (lower secondary education) and high (upper secondary/high education)) reflect social status [31, 37]
- Maternal age (grouped as 18–24, 25–29, 30–34 and > 35 years), diabetes mellitus (recorded in antenatal card) and preterm birth in anamnesis (only for preterm birth) [20, 28]
- Presence of family members in Berlin (at least one vs. none) reflects social support [22, 23]
- Smoking (non-smoker vs. occasional smoker and smoker during pregnancy) [24, 25]

The smoking status defined through responses to our questionnaire was found to be consistent with the smoking-related variable in the routine perinatal data set. For the variable “smoking” values were missing for 288 women. Those data sets were excluded from the analysis. Missing data for other variables were imputed. Information on monthly household income was missing in 10.2% and on affinity in religion in 5.2%. Imputation procedures using the average of five iterations based on linear or polytomous regression analyses were conducted. The imputations were based on age, migrant status and education.

Statistical analyses

Chi Square Tests were conducted to determine the relation of the different countries of origin to the outcomes. Separate logistic regressions were conducted to estimate Odds Ratios (OR) for the influence of acculturation, affinity to religion and country of origin on preterm and SGA births while controlling for potential confounders. Linear regression analyses were used to check for multicollinearity of confounders (data not shown as no statistical evidence for collinearity was detected). The dependent variables were the birth outcomes: preterm birth and SGA birth. Regression models were adjusted for the following confounders: smoking, maternal age, diabetes mellitus, family members in Berlin and possible predictors: education, monthly household income and migrant status. For the analysis of preterm birth, preterm birth in anamneses is an additional potential confounder. Adjusted odds ratios (aOR) were calculated with 95% confidence intervals (CI). The software “IBM SPSS Statistics 23” was used for the analysis. Statistical significance was defined as p < 0.05.

Results

8157 women delivered in the three hospitals in the period of data collection. 7100 women participated in
the study (response rate 89.6%) [17]. Complete data for all variables relevant for the analysis was available for 6413 out of the 7100 women. Of these women, 2552 were 1st generation immigrants (subgroups: 561 from Turkey and 317 from Lebanon); 885 were 2nd generation women. The proportion of women with low education was higher in the immigrant groups (1st generation: 25.0%; 2nd generation: 9.4%) than the non-immigrant group (3.3%), while the proportion of women with high income was lower in the immigrant groups (1st generation: 11.2%; 2nd generation: 10.6%) compared to non-immigrant women (37.4%). First generation women had a lower diabetes prevalence (0.6%) than non-immigrant women (1.1%), and diabetes prevalence was particularly low among women from Turkey (0.3%) and Lebanon (0.0%). The majority of non-immigrant women stated they followed no religion (49.6%) or had no or little affinity to religion (19.7%) whereas many immigrant women reported a high affinity to religion (1st generation: 41.1%; 2nd generation: 45.8%) (see Table 1). 14.3% of the 1st generation migrants had a low acculturation level vs. 2.6% of the 2nd generation women.

A table of countries of origin shows the distribution of 1st generation immigrants grouped in EU15, EU27, other Europe, Middle East (excluding Turkey and Lebanon), North Africa, Sub-Saharan Africa, Far East, Latin America and Caribbean and North America (see Additional file 1). Overall 9.8% of the births were preterm, with 10.6% in non-immigrant women. The lowest proportion of preterm births was in women from Turkey (5.3%) (see Table 1).

Additional file 2 shows the relation of the country of origin to the birth outcomes using Chi Square Tests. For preterm birth the regions, Sub-Saharan Africa, Latin America and Caribbean and the country Turkey were significant (see Additional file 2). Regarding SGA only Lebanon had a statistically significant association with the outcome.

Table 2 and Additional file 3 show the influence of the country of origin on preterm birth, while controlling for medical variables, age and smoking (model 1), socio-economic variables (model 2), as well as affinity to religion and acculturation (model 3). In all models, the association between a Turkish origin and preterm birth was statistically significant (model 3, Turkish origin: aOR 1.62, 95%CI: 1.01–2.95; model 1, Latin American origin: aOR 1.77, 95%CI: 1.05–2.99). 13.7% of all newborns were SGA newborns. Women from Lebanon had the highest proportion; they delivered 20.8% SGA newborns (see Table 1). Table 3 shows the influence of the country of origin on SGA, controlling for medical variables, age and smoking (model 1), socio-economic (model 2) variables, as well as affinity to religion and acculturation (model 3). In all three models the association between Lebanese origin and SGA was statistically significant (aOR: 1.72, 95%CI: 1.27–2.34) (see model 3 Table 3). The association between acculturation, affinity to religion, migration status (except Lebanese origin) and SGA was not statistically significant in any of the models.

Discussion
We found a Latina paradox for women of Turkish origin in Germany regarding preterm birth. The proportion of preterm births among Turkish women was half that of non-immigrant women and regression analyses confirmed that this protective effect persisted even after adjusting for a range of control variables. Our findings also confirm the hypothesis that some social factors are at play in explaining the Latina Paradox for Turkish women in Germany. A high acculturation level, i.e. a high affinity with the German culture and a less strong affinity with the country of origin, increases indeed the chance of preterm birth, erasing some of the protective effect that a Turkish origin may provide. In other words, low acculturation can be considered as a social factor which contributes to explaining the epidemiological paradox regarding preterm birth in our sample. There is no direct comparison in the literature. Several studies have used length of stay in the target country as a proxy variable for acculturation: immigrant women who had resided in Canada for fewer than 5 years had lower preterm risk than non-immigrant women, while those with ≥15 years of stay were at higher risk [38]. Latina women born abroad had better preterm birth outcomes than Latina women born in the US and non-Latina women [39], suggesting that the process of acculturation or integration to the new country attenuates the protective influence from which 1st generation immigrants benefit. More research is needed to identify which specific items of acculturation are responsible for the differences in preterm birth rates.

We also explored the role of affinity to religion as another social factor. First generation women more often reported a medium or high affinity to religion compared to non-immigrant and 2nd generation
| Table 1 Distribution of socio-demographic characteristics and obstetric indicators (in %, mean, SD) among study participants, by migration status, Berlin, Germany, 2011/12 |
|-------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Study population (n)                          | 2552           | 561            | 317            | 885            | 2976           | 6413           |
| Maternal age n=                                |                |                |                |                |                |                |
| 18–24 years                                   | 1288           | 19.9           | 19.4           | 19.3           | 18.2           | 20.7           |
| 25–29 years                                   | 1732           | 27.3           | 26.4           | 26.2           | 25.9           | 27.1           |
| 30–34 years                                   | 1883           | 29.5           | 28.5           | 27.4           | 30.6           | 28.9           |
| 35+ years                                     | 1510           | 23.8           | 25.1           | 26.8           | 25.2           | 23.3           |
| Mean (SD)                                      | 29.9 (5.8)     | 29.3 (5.9)     | 29.5 (6.0)     | 30.0 (5.8)     | 30.0 (5.8)     | 29.8 (5.8)     |
| Educational attainment n=                     |                |                |                |                |                |                |
| High                                           | 2521           | 34.3           | 41.0           | 39.4           | 16.8           | 50.2           |
| Medium                                         | 3071           | 40.6           | 45.8           | 47.0           | 73.8           | 46.5           |
| Low                                            | 821            | 25.1           | 13.2           | 13.6           | 9.4            | 3.3            |
| Family members in Berlin n=                    |                |                |                |                |                |                |
| Yes                                            | 4299           | 53.0           | 67.6           | 61.5           | 92.8           | 28.6           |
| No                                             | 2114           | 47.0           | 32.4           | 38.5           | 7.2            | 71.4           |
| Affinity to religion n=                        |                |                |                |                |                |                |
| No religion                                    | 1777           | 10.0           | 8.8            | 8.1            | 5.4            | 49.6           |
| No affinity to religion                        | 313            | 3.5            | 3.5            | 1.9            | 2.7            | 6.7            |
| Low affinity to religion                       | 664            | 8.4            | 8.2            | 6.3            | 7.2            | 13.0           |
| Medium affinity to religion                    | 1901           | 37.1           | 36.6           | 30.6           | 38.9           | 20.5           |
| High affinity to religion                      | 1758           | 41.1           | 42.9           | 53.1           | 45.8           | 10.2           |
| Smoking during pregnancy n=                    |                |                |                |                |                |                |
| No                                             | 5090           | 80.7           | 77.9           | 80.1           | 70.5           | 80.8           |
| Yes                                            | 1323           | 19.3           | 22.1           | 19.9           | 29.5           | 19.2           |
| Household income (monthly) n=                  |                |                |                |                |                |                |
| < 900 EUR                                      | 1572           | 19.8           | 20.8           | 13.8           | 24.7           | 28.5           |
| 900–1500 EUR                                   | 1228           | 27.1           | 29.3           | 34.4           | 22.6           | 11.3           |
| 1500–2600 EUR                                  | 2122           | 41.9           | 37.2           | 38.1           | 42.0           | 22.8           |
| > 2600 EUR                                     | 1491           | 11.2           | 12.6           | 13.7           | 10.6           | 37.4           |
| Diabetes mellitus n=                           |                |                |                |                |                |                |
| no                                             | 6353           | 99.4           | 99.6           | 99.7           | 98.6           | 98.9           |
| yes                                            | 60             | 0.6            | 0.4            | 0.3            | 1.4            | 1.1            |
| Preterm birth in anamneses n=                  |                |                |                |                |                |                |
| no                                             | 6191           | 96.8           | 97.9           | 95.3           | 96.5           | 96.3           |
| yes                                            | 222            | 3.2            | 2.1            | 4.7            | 3.5            | 3.7            |
| Acculturation n=                               |                |                |                |                |                |                |
| Low                                            | 387            | 14.3           | 6.1            | 10.0           | 2.6            | 0.0            |
| Medium                                         | 2016           | 59.4           | 61.2           | 61.9           | 56.6           | 0.0            |
| High                                           | 4010           | 26.3           | 32.7           | 28.1           | 40.8           | 100            |
| Preterm birth n=                               |                |                |                |                |                |                |
| No                                             | 5786           | 90.8           | 94.7           | 91.8           | 91.2           | 89.4           |
| Yes                                            | 627            | 9.2            | 5.3            | 8.2            | 8.8            | 10.6           |
women. However, regression analyses showed no statistically significant association between affinity to religion and preterm birth. We do not find the protective effect of religiosity on perinatal outcomes that has been shown for Latin American women in the US, where, for example, specific religious groups may promote positive health behaviours during pregnancy (e.g. no smoking, no alcohol) [3]. When trying to test the hypothesis that other religions may have a positive effect on perinatal outcomes through social support in the community, [3] we found no evidence indicating that high affinity to religion tends to lead to favourable health behaviour during pregnancy.

Still with regard to preterm birth, we found that women from Latin America and Sub Saharan Africa have higher odds of having a preterm birth than German women. Although a study which investigated factors for preterm birth in Germany found no significant association between a Latin American or Sub Saharan African origin and the outcome [40], evidence from other countries has shown on different occasions that immigrant women from Sub Saharan Africa tend to have poorer birth outcomes than the native population (see for example [41]). We found no equivalent in the European literature of the relatively poor birth outcomes of Latin American women in our cohort.

In line with some of the existing literature, we found no epidemiological paradox with regard to SGA [38, 39]. On the contrary, descriptive statistics showed that SGA was more frequent among 1st generation women compared to non-immigrant women, and that 1st generation immigrants from Lebanon had SGA rates about 1.5 times those of non-immigrant women. This resonates with evidence from the US where women of a Middle Eastern origin were found to have higher SGA rates than non-immigrant women [5]. After adjusting for socioeconomic status, acculturation and affinity to religion, Lebanon as a country of origin remained the only significant factor influencing SGA rates. Higher SGA rates in women of Lebanese origin may therefore at least partly be explained by non-social factors; one hypothesis being that standard SGA calculation based on birth-weight tables for Germans may not be an adequate measure for newborns from other ethnicities, with different average body types [14].

Strengths and limitations
Data were collected in a highly-standardised way in a large sample of women with a high response rate, comprising information on migrant status and other socioeconomic parameters which are lacking in routine perinatal data. A limitation is the restriction to Berlin where the proportion of immigrants in the population is high. Hence, the results cannot be generalised to rural areas or smaller cities where social support for immigrant women may be smaller. The absolute numbers of immigrant women from countries other than Turkey and Lebanon were too small for stratified analyses. Diabetes mellitus recorded on the antenatal card was used for analyses. This may lead to an underestimation of the gestational diabetes prevalence. Acculturation is difficult to measure and may be conflated with specific social determinants of health [42]. However, this may not be the case here, given that we could demonstrate differing effects for preterm birth and SGA.

We excluded nearly 21% from all deliveries in the hospitals (gross sample size). 9.2% of the women did not consent or could not be reached. 3.8% of the women were excluded based on the inclusion and exclusion criteria [17] and 8% of the women had missing values. The excluded women had a lower monthly household income and a lower education compared to the included women. This could possibly form a selection bias. As we found no difference between included and excluded women regarding preterm birth and SGA and the proportion (as well as the number) of included women is high we assume that the named differences have probably no influence on our conclusion. Nevertheless readers should consider the selection bias while reading our conclusion.

Conclusion
There is evidence that a social factor, namely the level of acculturation of pregnant women with a migration background, contributes to explaining the epidemiological paradox regarding preterm birth. Furthermore, independently of social factors, Turkey as country of origin

| SGA birth | 1st generation immigrants | 2nd generation women | non-immigrant women | total |
|-----------|---------------------------|----------------------|---------------------|-------|
|           | total (all origins)       | Turkish origin       | Lebanese origin     |       |
| No        | 5536                      | 85.7                 | 88.8                | 79.2  |
| Yes       | 877                       | 14.3                 | 11.2                | 20.8  | 13.7  | 13.7  |

SD standard deviation

Table 1 Distribution of socio-demographic characteristics and obstetric indicators (in %, mean, SD) among study participants, by migration status, Berlin, Germany, 2011/12 (Continued)
|                                | n= | Model 1      | p-value | Model 2      | p-value | Model 3      | p-value |
|--------------------------------|----|--------------|---------|--------------|---------|--------------|---------|
| **Country of origin**          |    | aOR (95% CI) |         | aOR (95% CI) |         | aOR (95% CI) |         |
| Germany                        | 2976 | 1.00         |         | 1.00         |         | 1.00         |         |
| Turkey                         | 561  | 0.46 (0.32–0.68) | < 0.0001 | 0.46 (0.31–0.68) | < 0.0001 | 0.49 (0.33–0.73) | < 0.0001 |
| Lebanon                        | 317  | 0.70 (0.46–1.07) | 0.098   | 0.71 (0.46–1.06) | 0.097   | 0.71 (0.46–1.10) | 0.114   |
| Other countries                | 2559 | 0.82 (0.69–0.97) | 0.051   | 0.82 (0.70–1.01) | 0.049   | 0.87 (0.72–1.06) | 0.168   |
| **Affinity to religion**       |    |              |         |              |         |              |         |
| No religion                    | 1777 |              |         |              |         |              | 1.00    |
| No affinity to religion        | 313  |              |         |              | 0.97 (0.65–1.44) | 0.884 |
| Low affinity to religion       | 664  |              |         | 0.90 (0.67–1.23) | 0.515   |
| Medium affinity to religion    | 1901 |              |         | 0.86 (0.68–1.09) | 0.220   |
| High affinity to religion      | 1758 |              |         | 1.01 (0.78–1.30) | 0.969   |
| **Acculturation**              |    |              |         |              |         |              |         |
| Low                            | 387  |              |         |              |         |              | 1.00    |
| Medium                         | 2016 |              |         | 1.49 (0.96–2.30) | 0.074   |
| High                           | 4010 |              |         | 1.62 (1.01–2.59) | 0.044   |
| **Education**                  |    |              |         |              |         |              |         |
| High                           | 2521 |              |         |              |         |              | 1.00    |
| Medium                         | 3071 |              |         | 0.91 (0.67–1.23) | 0.546   | 0.97 (0.71–1.32) | 0.821   |
| Low                            | 821  |              |         | 0.89 (0.72–1.09) | 0.248   | 0.89 (0.71–1.32) | 0.276   |
| **Age groups**                 |    |              |         |              |         |              |         |
| 18–24 years                    | 1288 | 1.00         |         | 1.00         |         | 1.00         |         |
| 25–29 years                    | 1732 | 0.96 (0.76–1.21) | 0.726   | 0.96 (0.76–1.21) | 0.726   | 0.96 (0.76–1.22) | 0.735   |
| 30–34 years                    | 1883 | 0.91 (0.72–1.15) | 0.438   | 0.91 (0.72–1.15) | 0.418   | 0.91 (0.72–1.15) | 0.417   |
| 35+ years                      | 1510 | 0.81 (0.63–1.04) | 0.100   | 0.80 (0.63–1.04) | 0.097   | 0.81 (0.63–1.04) | 0.096   |
| **Family members in Berlin**   |    |              |         |              |         |              |         |
| No                             | 2114 |              |         |              |         |              | 1.00    |
| Yes                            | 4299 |              |         | 1.08 (0.90–1.30) | 0.420   | 1.07 (0.89–1.29) | 0.481   |
| **Smoking**                    |    |              |         |              |         |              |         |
| No                             | 5090 | 1.00         |         | 1.00         |         | 1.00         |         |
| Yes                            | 1323 | 1.01 (0.82–1.24) | 0.925   | 1.01 (0.81–1.26) | 0.914   | 0.99 (0.80–1.24) | 0.989   |
| **Household income (monthly)** |    |              |         |              |         |              |         |
| < 900 EUR                      | 1572 |              |         |              |         |              | 1.00    |
| 900–1500 EUR                   | 1228 |              |         | 1.03 (0.81–1.32) | 0.784   | 1.04 (0.81–1.32) | 0.777   |
| 1500–2600 EUR                  | 2122 |              |         | 0.91 (0.69–1.19) | 0.472   | 0.90 (0.69–1.18) | 0.446   |
| > 2600 EUR                     | 1491 |              |         | 0.92 (0.69–1.23) | 0.577   | 0.92 (0.68–1.23) | 0.564   |
| **Diabetes mellitus**          |    |              |         |              |         |              |         |
| No                             | 6353 | 1.00         |         | 1.00         |         | 1.00         |         |
| Yes                            | 60   | 2.12 (1.11–4.03) | 0.022   | 2.16 (1.13–4.11) | 0.019   | 2.12 (1.11–4.04) | 0.022   |
| **Preterm birth in anamneses** |    |              |         |              |         |              |         |
| No                             | 6191 | 1.00         |         | 1.00         |         | 1.00         |         |
| Yes                            | 222  | 1.78 (1.23–2.58) | 0.002   | 1.81 (1.25–2.62) | 0.002   | 1.82 (1.25–2.63) | 0.002   |
has a protective influence on preterm birth whereas Lebanon as country of origin has a negative influence on SGA. Hence, the direction of the observed effect varies depending on the country and the outcome. This suggests that non-social factors that relate to the country of origin contribute to explaining differences in birth outcomes. Service providers therefore need to take a more differentiated view of the potential risks immigrant women face than what might be implied by a broad term like “Latina paradox” or “healthy migrant effect”.

Table 3 Chance (expressed as Odds Ratios) to give SGA birth, by country of origin, Berlin/Germany, 2011/12

| Country of origin     | n= | aOR (95% CI) | p-value | aOR (95% CI) | p-value | aOR (95% CI) | p-value |
|-----------------------|----|-------------|---------|-------------|---------|-------------|---------|
| Germany               | 2976 | 1.00       |         | 1.00        |         | 1.00        |         |
| Turkey                | 561  | 0.83 (0.62–1.10) | 0.191  | 0.82 (0.62–1.10) | 0.180  | 0.82 (0.62–1.10) | 0.192  |
| Lebanon               | 317  | 1.72 (1.28–2.30) | < 0.0001 | 1.72 (1.28–2.31) | < 0.0001 | 1.72 (1.27–2.34) | < 0.0001 |
| Other countries       | 2559 | 1.03 (0.88–1.20) | 0.742  | 1.02 (0.87–1.20) | 0.781  | 1.03 (0.86–1.22) | 0.762  |
| Affinity to religion  |     |             |         |             |         |             |         |
| No religion           | 1777 | 1.00        |         |             |         |             |         |
| No affinity to religion| 313  | 1.17 (0.84–1.63) | 0.363  |             |         |             |         |
| Low affinity to religion| 664  | 0.91 (0.70–1.19) | 0.503  |             |         |             |         |
| Medium affinity to religion| 1901 | 0.92 (0.75–1.13) | 0.408  |             |         |             |         |
| High affinity to religion| 1758 | 0.96 (0.77–1.21) | 0.737  |             |         |             |         |
| Acculturation         |     |             |         |             |         |             |         |
| Low                   | 387  | 1.00        |         |             |         |             |         |
| Medium                | 2016 | 1.09 (0.79–1.52) | 0.592  |             |         |             |         |
| High                  | 4010 | 1.05 (0.73–1.51) | 0.780  |             |         |             |         |
| Education             |     |             |         |             |         |             |         |
| High                  | 2521 | 1.00        |         |             |         |             |         |
| Medium                | 3071 | 0.89 (0.66–1.13) | 0.300  |             |         |             |         |
| Low                   | 821  | 0.91 (0.76–1.08) | 0.283  |             |         |             |         |
| Age groups            |     |             |         |             |         |             |         |
| 18–24 years           | 1288 | 1.00        |         |             |         |             |         |
| 25–29 years           | 1732 | 0.98 (0.79–1.21) | 0.866  | 0.98 (0.79–1.21) | 0.859  | 0.98 (0.80–1.22) | 0.870  |
| 30–34 years           | 1883 | 1.01 (0.81–1.23) | 0.990  | 1.01 (0.82–1.24) | 0.965  | 1.01 (0.82–1.24) | 0.955  |
| 35+ years             | 1510 | 1.07 (0.86–1.33) | 0.529  | 1.07 (0.86–1.33) | 0.545  | 1.07 (0.86–1.33) | 0.546  |
| Family members in Berlin|     |             |         |             |         |             |         |
| No                    | 2114 | 1.00        |         |             |         |             |         |
| Yes                   | 4299 | 0.93 (0.79–1.09) | 0.361  | 0.93 (0.79–1.09) | 0.376  |             |         |
| Smoking               |     |             |         |             |         |             |         |
| No                    | 5090 | 1.00        |         |             |         |             |         |
| Yes                   | 1323 | 0.91 (0.75–1.10) | 0.337  | 0.91 (0.75–1.10) | 0.312  |             |         |
| Household income (monthly) |     |             |         |             |         |             |         |
| < 900 EUR             | 1572 | 1.00        |         |             |         |             |         |
| 900–1500 EUR          | 1228 | 0.93 (0.75–1.14) | 0.478  | 0.93 (0.76–1.15) | 0.507  |             |         |
| 1500–2600 EUR         | 2122 | 0.97 (0.78–1.22) | 0.816  | 0.98 (0.78–1.23) | 0.845  |             |         |
| > 2600 EUR            | 1491 | 0.93 (0.72–1.19) | 0.550  | 0.94 (0.73–1.21) | 0.615  |             |         |
| Diabetes mellitus     |     |             |         |             |         |             |         |
| No                    | 6353 | 1.00        |         |             |         |             |         |
| Yes                   | 60   | 1.82 (0.98–3.38) | 0.058  | 1.85 (0.99–3.45) | 0.052  | 1.84 (0.99–3.42) | 0.056  |
Additional files

Additional file 1: Distribution of socio-demographic characteristics and obstetric indicators among 1st generation immigrant women, Berlin, Germany, 2011/12. Additional information about 1st immigration women. (DOXCX 20 kb)

Additional file 2: Chi Square Test for premature birth, by region of origin, Berlin/Germany, 2011/12. Results from Chi Square Test for premature birth, by country of origin (DOCX 13 kb)

Additional file 3: Chance (expressed as Odds Ratios) to give birth prematurely, by region of origin, Berlin/Germany, 2011/12. Additional regression analyses for Latin America & Caribbean and Sub Saharan Africa (countries which had significant associations with preterm birth in Chi Square Tests) (DOCX 16 kb)

Abbreviations
aOR: Adjusted odds ratio; CI: Confidence intervals; LBW: Low birth weights; OR: Odds ratio; SD: Standard deviation; SGA: Small-for-gestational-age

Acknowledgements
We acknowledge support for the Article Processing Charge by the Deutsche Forschungsgemeinschaft and the Open Access Publication Fund of Bielefeld University.

Funding
Data collection was supported by Deutsche Forschungsgemeinschaft (DFG), grant number DA 1199/2. The funder played no role in study design, analysis and reporting.

Availability of data and materials
The data that support the findings of this study are available from TB and MD but restrictions apply to the availability of these data, which were used for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of TB and MD.

Authors’ contributions
OR and KZ conceived the study question. KZ conducted the analysis with the help of JB and CM. KZ and SB wrote the first draft of the paper; CM and OR wrote the second draft which was thoroughly revised by OR. MD and TB were PIs of the Berlin Perinatal Study, and SB was in charge of data collection. KZ, CM, JB, SB, TB, MD and OR helped with data interpretation. KZ, CM, JB, SB, TB, MD and OR have contributed to and approved the final manuscript.

Ethics approval and consent to participate
Patient consent: Each woman interviewed in the original study gave written informed consent. For this paper, only anonymised data were processed. Ethics approval: Charité Ethics Committee, Berlin, Germany. 2009:22(1):96–109.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details
1Department of Epidemiology and International Public Health, School of Public Health, Bielefeld University, Bielefeld, Germany. 2Department of Gynaecology, Campus Virchow-Klinikum, Charité-Universitätsmedizin Berlin, Berlin, Germany. 3Alice Salomon Hochschule, Berlin, Germany.

Received: 28 November 2018 Accepted: 8 February 2019
Published online: 12 February 2019

References
1. Razum O, Samkange-Zeeb F. Populations at special health risk: migrants. In: Quah SR, Cockerham WC, editors. The international encyclopedia of public health. 2nd ed. Waltham, MA: Elsevier; 2017. p. 591–8.
2. Ribble JC, Franzini L, Keddle AM. Understanding the Hispanic paradox. Ethn Dis. 2001;11(3):496–518.
3. Magaña A, Clark NM. Examining a paradox: does religiosity contribute to positive birth outcomes in Mexican American populations? Health Educ Behav. 1995;22(1):96–109.
4. Cervantes A, Keith L, Wyszak G. Adverse birth outcomes among native-born and immigrant women: replicating national evidence regarding Mexicans at the local level. Matern Child Health J. 1999;3(2):99–109.
5. Stein CR, Savitz DA, Janevic T, Ananth CV, Kaufman JS, Herring AH, Engel SM. Maternal ethnic ancestry and adverse perinatal outcomes in New York City. A. J Obstet Gynecol. 2009;201(6):584–e1.
6. Spalek J, Zeeb H, Razum O. What do we have to know from migrants’ past exposures to understand their health status? A life course approach. Emerg Themes Epidemiol. 2011;8(1).
7. Abraido-Lanza AF, Doehrenwend BP, Ng-Mak DS, Turner JB. The Latino mortality paradox: a test of the “salmon bias” and healthy migrant hypotheses. Am J Public Health. 1999;89(10):1543–8.
8. Jones ME, Hughes ST Jr, Bond ML. Predictors of birth outcome among Hispanic immigrant women. J Nurs Care Qual. 1999;14(1):56–62.
9. Abraido-Lanza AF, Chao MT, Fozroz KR. Do healthy behaviors decline with greater acculturation? Implications for the Latino mortality paradox. Soc Sci Med. 2005;61(6):1243–55.
10. Jacquemyn Y, Benjalia N, Martens G, Yulkes H, Van Egmond K, Temmerman M. Pregnancy outcome of Moroccan and Turkish women in Belgium. Clin Exp Obstet Gynecol. 2012;39(1):181–5.
11. Racape J, Schoenborn C, Sow M, Alexander S, De Spiegelwaele M. Are all immigrant mothers really at risk of low birth weight and perinatal mortality? The crucial role of socio-economic status. BMC Pregnancy and Childbirth. 2016;16(1):75.
12. Schulpen TW, Van Wieringen JC, Van Brummen PN, Van Riel JM, Beemer FA, Westers P, Huber J. Infant mortality, ethnicity, and genetically determined disorders in the Netherlands. The European Journal of Public Health. 2005;15(3):290–3.
13. Juzniew SP, Revuelta-Eugercios BA. Exploring the ‘healthy migrant paradox’ in Sweden. A cross sectional study focused on perinatal outcomes. J Immigr Minor Health. 2016;18(1):42–50.
14. David M, Borde T, Brenne S, Ramsauer B, Henrich W, Breckenkamp J, Razum O. Obstetric and perinatal outcomes among immigrant and non-immigrant women in Berlin, Germany. Arch Gynecol Obstet. 2017;1–18.
15. Statistisches Bundesamt. Fachserie I Reihe 2.2, Bevölkerung und Erwerbstätigkeit. Ergebnisse der Mikrozensus 2010, Anhang 2: Glossar. 2010.
16. Statistisches Bundesamt. Bevölkerung und Erwerbstätigkeit. Ergebnisse der Mikrozensus - 2014. Fachserie 1, Reihe 22. Wiesbaden: Statistisches Bundesamt, 2015.
17. David M, Borde T, Brenne S, Ramsauer B, Henrich W, Breckenkamp J, Razum O. Comparison of perinatal data of immigrant women of Turkish origin and German women - results of a prospective study in Berlin. Geburtshilfe Frauenheilk. 2014;74(05):441–8.
18. Bernstein IM, Horbar JD, Badger GI, Olihson A, Golan A. Morbidity and mortality among very-low-birth-weight neonates with intrauterine growth restriction. Am J Obstet Gynecol. 2000;182(1):196–206.
19. Lindström K, Winblad B, Haglund B, Hjem A. Preterm infants as young adults: a Swedish national cohort study. Pediatrics. 2007;120(1):70–7.
20. Beinder E. Frühgeburt. In: Rath W, Gembuch U, Schmidt S, editors. Geburtshilfe und Perinatologie: Pränataldiagnostik – Erkrankungen -Entbindung. Stuttgart: Georg Thieme Verlag; 2010.
21. Räisänen S, Gissler M, Sankilampi U, Saari J, Kramer MR, Heinonen O. Obstetric and perinatal outcomes among immigrant and non-immigrant women in Berlin, Germany. Arch Gynecol Obstet. 2017;1–18.
22. Bryce RL, Stanley FJ, Gainer JB. Randomized controlled trial of antenatal social support to prevent preterm birth. Br J Obstet Gynaecol. 1991;98(10):1001–8.
23. Ahluwalia IB, Merritt R, Beck LF, Rogers M. Multiple lifestyle and psychosocial risks and delivery of small for gestational age infants. Obstet Gynecol. 2001;97(5):649–56.

24. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes of preterm birth. Lancet. 2008;371(9606):75–84.

25. Chiolerio A, Bovet P, Paccaud F. Association between maternal smoking and low birth weight in Switzerland: the EDEN study. Swiss Med Wkly. 2005;135(35–36):252.

26. Page RL. Positive pregnancy outcomes in Mexican immigrants: what can we learn? J Obstet Gynecol Neonatal Nurs. 2004;33(6):781–90.

27. Muhihi A, Sudfeld CR, Smith ER, et al. Risk factors for small-for-gestational-age and preterm births among 19,269 Tanzanian newborns. BMC Pregnancy Childbirth. 2016;16(1):1.

28. Lang JM, Lieberman E, Cohen A. A comparison of risk factors for preterm labor and term small-for-gestational-age birth. Epidemiology. 1996;7(4):369–76.

29. McDonald SD, Han Z, Mullà S, Beyene J. Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: systematic review and meta-analyses. BMJ. 2010;341:c3428.

30. Lee PA, Chenauske SD, Hokken-Koelega AC, Czernichow P. International small for gestational age advisory board consensus development conference statement: management of short children born small for gestational age. April 24 - October 1, 2001. Pediatrics, 111(6), 1253–1261.

31. Scianl K, Yip R, Schieve LA, Cogswell ME. High and low hemoglobin levels during pregnancy; differential risks for preterm birth and small for gestational age. Obstet Gynecol. 2000;96(5):741–8.

32. Liu L, Oza S, Hogan D, et al. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis. Lancet. 2015;385(9966):430–40.

33. Voigt M, Rochow N, Hesse V, Olbertz D, Schneider KTM, Jorch G. Kurzmitteilung zu den Perzentilwerten für die Körpermaße der Neugeborenen. Z Geburtshilfe Neonatol. 2010;214(01):24–9.

34. Schenk L, Bau AM, Borde T, et al. Mindestindikatorensatz zur Erfassung des Migrationsstatus. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz. 2006;49(9):853–60.

35. Razum O, Reiss K, Breckenkamp J, et al. Comparing provision and appropriateness of health care between immigrants and non-immigrants in Germany using the example of neuraxial anaesthesia during labour: cross-sectional study. BMJ Open. 2017;7(8):e015913.

36. Bongard S, Arslaner H, Pogge SF. FRAKK-Fragebogeninstrument. 2007; o. O.

37. Thompson J, Irgens LM, Rasmussen S, Daltevik AK. Secular trends in socio-economic status and the implications for preterm birth. Paediatr Perinatal Epidemiol. 2006;20(3):182–7.

38. Urquia ML, Frank JW, Moineddin R, Glazier RH. Immigrants’ duration of residence and adverse birth outcomes: a population-based study. Int J Obstet Gynecol. 2010;117(5):591–601.

39. Flores ME, Simonsen SE, Manuck TA, Dyer JM, Turck DK. The “Latina epidemiologic paradox”: contrasting patterns of adverse birth outcomes in US-born and foreign-born Latinas. Women’s Health Issues. 2012;22(5):e501–7.

40. Weichert A, Weichert TM, Bergmann RL, Henrich W, Kalache KD, Richter R, Bergmann KE. Factors for preterm births in Germany—an analysis of representative german data (KiGGS). Geburtshilfe Frauenheilkd. 2015;75(8):819.

41. Zeitlin J, Bucourt M, Rivera L, Topuz B, Papiernik E. Preterm birth and maternal country of birth in a French district with a multiethnic population. BJOG Int J Obstet Gynaecol. 2004;111(8):849–55.

42. Acevedo-Garcia D, Sanchez-Zavaahua EV, Viruell-Fuentes EA, Almeida J. Integrating social epidemiology into immigrant health research: a cross-national framework. Soc Sci Med. 2012;75(12):2060–8.