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MATERNAL-FETAL MEDICINE

The impact of migration background on maternal near miss

Matthias David[1] · Oliver Razum[2] · Wolfgang Henrich[3] · Babett Ramsauer[4] · Dietmar Schlembach[4] · Jürgen Breckenkamp[2]

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Abstract

Purpose (1) To evaluate the association between immigration background and the occurrence of maternal near miss (MNM). (2) To identify medical co-factors, health-care utilization, and health-care disparities as explanations of a possibly higher risk of MNM among immigrants.

Methods We compared perinatal outcomes between immigrant women (first- or second-generation) versus non-immigrant women, delivering at three maternity hospitals in Berlin, Germany, 2011–2012. Near-miss events were defined as: HELLP syndrome, eclampsia, the occurrence or threat of uterine rupture, postpartum hemorrhage (PPH) > 1000 ml, sepsis, peripartal hysterectomy, cardiovascular complications, lung embolism. Logistic regression analyses were performed to determine the associations of immigration status, acculturation, and language competency with near-miss events, and of near-miss events with the perinatal outcomes.

Results The databank included 2647 first-generation immigrants, 889 second-generation immigrants, and 3231 women without an immigration background (total $N = 6767$). Near-miss events occurred in 141 women. The likelihood of near-miss events was lower among multiparous women (OR 0.6; 95% CI 0.42–0.87; $p = 0.01$). No other factors had a statistically significant influence. Near-miss events are associated with an elevated likelihood for an unfavorable perinatal condition: the ORs ranged from 2.15 for an arterial umbilical cord pH value < 7.1–2.47 for premature delivery.

Conclusions Immigration status does not change the risk of near-miss events. Besides parity, no medical or socio-demographic factors were identified that were associated with an elevated likelihood for the occurrence of severe peripartal complications.

Keywords Migration · Perinatal data · Acculturation · Maternal near miss

Introduction

Maternal mortality has for a long time been used as the measurement of success of obstetric interventions. Due to its current low incidence in high-resource settings, maternal mortality can no longer be used as the sole indicator for high-quality peripartal care of pregnant and delivering women. Due to that low event rate, the evaluation of health-care quality should also take into consideration and analyze so-called "near-miss" events. In this way, improvements and deteriorations of the aspects of health care that are relevant to safety can be identified and appropriate measures can be taken [18, 10]. According to the WHO, maternal near-miss morbidity (MNM) or severe (acute) maternal morbidity (SAMM) is defined as these kinds of almost not-survived life-threatening events and severe peripartal complications that affect a woman during pregnancy or birth or during

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✉ Matthias David
matthias.david@charite.de

[1] Department of Gynecology, Campus Virchow-Klinikum, Klinik für Gynäkologie, Charité University Hospital, Augustenburger Platz 1, 13353 Berlin, Germany

[2] Department of Epidemiology and International Public Health; Bielefeld School of Public Health, Bielefeld University, Bielefeld, Germany

[3] Department of Obstetrics, Virchow and Mitte Campuses, Charité University Hospital, Berlin, Germany

[4] Department of Obstetrics, Vivantes Hospital Neukölln, Berlin, Germany

the first 42 days after the end of pregnancy [13, 14]. Studies have shown that such near-miss events are often associated with an unfavorable perinatal birth outcome (stillbirth, premature birth (too) low birth weight, postnatal mortality, neonatal asphyxia, or transfer to a neonatal unit [1, 7, 19]). The results from two studies from Brazil also point to the associated elevated fetal and neonatal morbidity and mortality for maternal near-miss complications [11, 9].

Worldwide between 2003 and 2009, half of all peripartal maternal mortality was caused by heavy postpartum bleeding, hypertensive conditions, or sepsis. Calculations from the USA have shown that for every case of maternal mortality, there are ca. 50–100 women with several maternal morbidities (SMM) [4]. So it must be our goal to find measures for the prevention or timely intervention against SMM. Maternal pregnancy outcomes can be viewed conceptually as a continuum from the normal/healthy pregnancy through mild troubles and illnesses during pregnancy and then SMM to maternal mortality [4]. The WHO has recommended thorough investigations of SMM for so-called high-income countries with low maternal mortality, to recognize deficiencies in care and systems and from that to be able to derive possibilities for intervention [13].

Women who are socioeconomically disadvantaged or belong to ethnic minorities potentially have a higher risk of peripartal morbidity [3]. A study from Great Britain has shown furthermore that women of African origin are affected twice as often by near-miss events than "white European" women. Pregnant women from the Caribbean and from India had severe sepsis more often, while immigrant women from Bangladesh, Pakistan, and sub-Saharan Africa more frequently had a placenta accreta, a uterine rupture, or a postpartum hysterectomy; inadequate antenatal care appears to double the risk for near-miss events [6]. Studies from Great Britain have shown overall a higher risk for maternal morbidity for women of so-called non-white ethnic groups [6]. Knight et al. postulated that this increase of the risk could be caused by preexisting medical factors and/or disparities of care during pregnancy or delivery [12].

Many of the internationally published results on the topic of near-miss/SMM are based on retrospective case–control studies. Important details are often not available that as confounders could influence the peripartal and perinatal outcomes, so it cannot always be clearly differentiated, whether the unfavorable delivery outcomes are due to the near-miss events alone or other co-factors. This differentiation is important when striving to prevent severe complications. For Germany, on this topic there is so far only one retrospective evaluation of registry data [20]. The aims of the present study were: (1) the quantification of the maternal risk for severe peripartal complications or the occurrence of near-miss events during birth, depending on immigration status and (2) the identification of medical co-factors, health-care utilization, and health-care disparities, to clarify a suspected higher risk for MNM among women with an immigration background.

Methods

Study setting

The prospective data collection took place during 2011/2012, within the framework of a DFG-funded study (FKZ: DA 1199/2–1), in three Berlin obstetric hospitals (Virchow Campus of Charité, Vivantes Hospital at the Urban, and Vivantes Hospital Neukölln) on the basis of standardized interviews with the help of sets of validated questionnaires. The primary data collected was linked with the so-called perinatal data collected in the hospitals. This perinatal data was provided by the departments of obstetrics and corresponds to the data that are routinely collected and evaluated centrally nationwide in the framework of statutorily prespecified quality control.

Questionnaires

The set of questionnaires consisted of three parts: questions on socio-demographics (23 items), on health-care aspects (9 items), and on possible immigration (8 items). First- or second-generation immigrant women were also given the Frankfurt Acculturation Scale (FRAKK), a one-dimensional instrument for the measurement of acculturation. The FRAKK consists of 15 items on the use of language and media and the integration into social networks [2]. The items were added up to a total score (0–90). If one or two items were missing, missing values were replaced by the mean of the other answers (8.0%). In cases of more than two missing answers (15.3%), the total score was calculated by imputation. As a cutoff for low/high acculturation, the median value was applied (≤ 56 vs. > 56, resulting in 1910 vs. 1855 women.

The operationalization of the immigration status took place according to Schenk et al. [15]. The "country of birth" principle forms the basis of the immigration status: first-generation immigrant: the woman was born outside Germany; second-generation immigrant: the woman was born in Germany, but both parents were born abroad. The self-rated knowledge of German was also recorded.

The questionnaires were available in eight languages besides Germany (Turkish, Russian, Arabic, Polish, Kurdish, Spanish, English, French). If needed, a translator could also be used.

Data collection and study sample

After pretesting, the data collection was performed by mostly bilingual project staff, from January 2011 to January 2012, daily (7:30–19:30), in the maternity wards of the three hospitals listed above. The target was to administer the questionnaires to the women a few hours before birth. During the data collection period, all pregnant women who were admitted to the three participating hospitals were invited to participate in the study, if they were at least 18 years old, had their permanent residence in Germany, and the birth of their child took place at a minimum of the 24th week of pregnancy with signs of life. Women were excluded if they were minors, tourists without a residence in Germany, or presenting for abortion, miscarriage, or stillbirth (with determination of fetal death at admission and prior to onset of delivery).

Drawing on Fernandes et al. [3], we defined near-miss events pragmatically and with consideration of the WHO criteria as the following eight diagnoses: HELLP syndrome, eclampsia, occurrence or threat of uterine rupture, postpartum hemorrhage (PPH) > 1000 ml, sepsis, peripartal hysterectomy in connection with a cesarean section, cardiovascular complications, lung embolism. Women who had a near-miss event during birthing were defined as the event group. Women who gave birth without any of these complications formed the non-event group. Women who gave birth to the child before completing 28 weeks of gestation were censored from this analysis. The immigration status (non-immigrants, 1st-generation immigrants, 2nd-generation immigrants), the self-assessed knowledge of the German language (medium/low/none vs. very good/good), as well as the degree of acculturation (high vs. low; only women with an immigration background) were assessed as predictors.

The following parameters were used as potential confounders: age (18–24 years, 25–29 years, 30–34 years, 35 years and older), education level (low: no graduation/primary education, middle: lower secondary education, high: upper secondary and higher), gestational diabetes (yes vs. no), parity (nullipara vs. multipara), BMI (< 25 kg/m^2, < 30 kg/m^2, 30 + kg/m^2), prenatal check-ups (< 10 vs. ≥ 10), and ultrasound examinations (≤ 3 vs. > 3) The division into "low and lower middle income countries", "upper middle income countries", and "high income countries" was done according to the definitions of the World Bank [17].

For the determination of the relevance of near-miss events (here, as a predictor) among the women included in the study, primary outcome parameters for the condition of the child were drawn upon: low birth weight (< 2500 g), premature birth (before the 37th gestational week), transfer to a neonatal unit, 5-min Apgar ≤ 7, and arterial umbilical cord pH value < 7.1. The calculations were adjusted for the potential confounders named above, as well as for cesarean section.

Data analysis

Besides descriptive calculations, logistic regression analysis was performed to determine the associations of immigration status, acculturation, and language ability with near-miss events (as the outcome), as well as the associations of near-miss events (as the predictor) with primary outcome parameters for the condition of the child. In these models, it was tested whether cesarean section is a mediator variable (intervening variable), i.e., whether cesarean section lies in the causal pathway between predictor (near-miss event) and outcome (e.g., transfer to a neonatal unit) and affects the relationship between predictor and outcome (by an indirect effect). Linear regression models were used to check for multicollinearity. Interaction terms were not found. The level for statistical significance was set at $p < 0.05$. All calculations were performed with SAS 9.4.

Data protection and ethics

The Data Protection Guidelines were observed during surveying and during the consolidation of the primary and secondary data. The Ethics Committee of Charité provided a positive decision for the investigation: approval dated 18 February 2009; reference EA1/235/08.

Results

A total of 8157 were invited to participate in the study. There were 235 women who fulfilled one of the exclusion criteria, and 363 women could not be reached despite multiple attempts. 381 women declined to participate, and 6 women did not agree to combining their study interview data with their clinical/maternity data. In 72 cases, the interview data collected could not be supplemented with hospital perinatal data. In the end, data from 7100 women were available for evaluation (participation rate of 89.6%), of whom 53% ($n = 3765$) were immigrants. In the analysis on near-miss events, datasets from 2647 first-generation immigrants, 889 second-generation immigrants, and 3231 women without an immigration background were included (total $n = 6767$ with complete data). The total score of the FRAKK is nearly normally distributed (skewness − 0.050, kurtosis − 0.317), with a minimum of 13, a maximum of 90, and thus a range of 77 points. The mean was 56.1 and the standard deviation was 13.9 (Table 1). During the study time period, 141 women in the three participating clinics had one (or in some cases more than one) of the 8 near-miss events (Table 2) corresponding to the definitions presented above (HELLP

Table 1 Characteristics of the study sample

	Non-immigrant women	First-generation immigrant women	Second-generation immigrant women
N	3231	2647	889
Age (*n*, %)			
18–24 years	549 (17.0)	564 (21.3)	301 (33.9)
25–29 years	788 (24.4)	781 (29.5)	285 (32.1)
30–34 years	1054 (32.6)	716 (27.1)	200 (22.5)
35 + years	840 (26.0)	586 (22.1)	103 (11.6)
Educational attainment (*n*, %)			
Low	484 (15.0)	1085 (41.0)	341 (38.4)
Medium	1145 (35.4)	649 (24.5)	404 (45.4)
High	1602 (49.6)	913 (34.5)	144 (16.2)
German language ability (*n*, %)			
Medium/low/none	0	1418 (53.6)	60 (6.8)
Very good/good	3231 (100.0)	1229 (46.4)	829 (93.3)
Acculturation (*n*, %)			
Low	–	1433 (54.1)	279 (31.4)
High	–	1214 (45.9)	610 (68.6)

Acculturation
Low: < median
High: median

syndrome: $n = 33$, eclampsia: $n = 1$, occurrence or threat of uterine rupture: $n = 8$, blood loss > 1000 ml: $n = 99$, postpartum hysterectomy after cesarean: $n = 3$, cardiovascular complications: $n = 1$, lung embolism: $n = 0$). All affected women survived.

Table 3 shows the likelihood for a near-miss event among women with and without an immigration background. Immigration status had no influence. Among the variables included in the logistic regression, only parity had a statistically significant relation to the likelihood of a near-miss event: multiparous women had a lower chance for a near-miss event (OR 0.6; CI 0.42–0.87; $p = 0.01$) (Table 3).

A comparison within the immigrant subgroup was also performed, which also included the variable of acculturation. Table 4 lists the variables included in the model; none of them had a significant influence on the likelihood of a near-miss event (Table 4).

The clinical relevance of near-miss events (here as a predictor variable) in the study sample was shown by the clearly elevated likelihood of unfavorable perinatal outcomes. The odds ratios ranged from an OR of 2.15 for an arterial umbilical cord pH value < 7.1 to an OR of 2.47 for premature birth. For all primary outcome parameters of the child—with the exception of arterial umbilical cord pH values—it was shown that about 20% of the total effect of near-miss events was "mediated" by cesarean section (Table 5).

Additionally, an evaluation was made within the subgroup of first-generation immigrants in regard to a possible relationship between the country of origin and the likelihood of a near-miss event, whereby they were sorted into three groups according to the criteria of the World Bank [17]. Additional Table 1 shows the results; there were no significant differences.

Discussion

Severe peripartal complications that are life threatening and that occur during pregnancy or up to 42 days postpartum were designated as maternal "near-miss" events, according to the definition of the WHO [16]. The incidence of severe maternal morbidity (SMM) or of near-miss events varies between 0.05 and 1.2%, according to the definition and the population studied [18]. Research groups from Nigeria, Brazil, and another eight Latin American countries, among others, have reported on an elevated risk for unfavorable perinatal outcomes, such as stillbirth, premature birth, low birth weight, birth asphyxia, and early neonatal mortality in connection with maternal near-miss events [7, 8]. The data from our study likewise show an elevated risk for unfavorable peripartal outcomes when a near-miss event occurs. In the framework of the present study, extensive data were prospectively collected and thoroughly analyzed that relate to pregnancy, birth, and the early postpartum period. The main result of the study presented here is that maternal peripartal near-miss events do not occur statistically significantly more frequently among women with an immigration background than among women without an immigration background,

Table 2 Medical characteristics of the study sample

	Non-immigrant women	First-generation immigrant women	Second-generation immigrant women
N	3231	2647	889
BMI (*n*, %)			
< 25 kg/m^2	2160 (66.9)	1539 (58.1)	516 (58.0)
< 30 kg/m^2	666 (20.6)	739 (27.9)	225 (25.3)
30 + kg/m^2	405 (12.5)	369 (13.9)	148 (16.7)
Gestational diabetes (*n*, %)			
No	3089 (95.6)	2532 (95.7)	851 (95.7)
Yes	142 (4.4)	115 (4.3)	38 (4.3)
Parity (*n*, %)			
Nullipara	1816 (56.2)	937 (35.4)	403 (45.3)
Multipara	1415 (43.8)	1710 (64.6)	486 (54.7)
Prenatal check-ups (*n*, %)			
< 10 examinations	746 (23.1)	934 (35.3)	235 (26.4)
≥ 10 examinations	2485 (76.9)	1713 (64.7)	654 (73.6)
Ultrasound examinations (*n*, %)			
≤ 3 examinations	1088 (33.7)	1079 (40.8)	360 (40.5)
> 3 examinations	2143 (66.3)	1568 (59.2)	529 (59.5)
Near-miss events			
No	3169 (98.1)	2588 (97.8)	869 (97.8)
Yes	62 (1.9)	59 (2.2)	20 (2.2)

Definitions:

Parity: The number of times a woman has given birth [Hughes G. Is this primip a nullip? The daily abuse of language in obstetrics. BJOG 2018, 1062–1064 (commentary)]

Nullipara: a woman that has not given birth

Multipara: a woman that has given birth

Near miss: variables available:

HELLP Syndrome, eclampsia, uterine rupture, hemorrhage > 1000 ml, sepsis, postpartum hysterectomy after cesarean, cardiovascular complications, pulmonary embolism

after controlling for socio-demographic co-factors such as education.

Other research groups have reported that near-miss events, such as eclampsia, heavy postpartum bleeding, and peripartal hysterectomies occur more frequently among indigenous women and women of black African ancestry than among "white" women [3]. A national study carried out in Great Britain showed a risk for severe maternal complications that was increased between 43 and 83% in the fully adjusted model for women of ethnic minorities in comparison to "white European" women. Besides the ethnic background, factors such as inadequate utilization of antenatal care, anemia, smoking, preexisting medical problems, age, and high parity were independent risk factors and explained a part of the disparity of risk, while the socioeconomic status, as in our results, did not influence the relationship with the occurrence of severe maternal morbidity [6]. As previously mentioned, the only other German study on near-miss events among immigrants was a retrospective analysis of registry data on 441,119 mothers from 2001 to 2007 from the so-called perinatal census. That study found an elevated risk for severe morbidity (sepsis, eclampsia, hysterectomy, and hemorrhage) for immigrants from Asia, Africa/Latin America, and the Middle East, in comparison to native German women. That was not confirmed though by our prospective data collection, albeit in a much smaller study sample.

We should also mention the results from a nationwide prospective study from the Netherlands, which reported a risk for near-miss complications 1.3 times higher among women from non-Western countries of origin (i.e., all immigrants who did not come from European countries, North America, Japan, or Indonesia) compared to "Western women" [5]. This risk was distinctly elevated among women from the sub-Saharan region. Zwart et al. explained the elevated risk partly with socio-demographic and lifestyle factors, as well as with factors that were connected with immigration [5]. Jonkers et al. determined in a qualitative study (interviews with 50 patients, including 40 immigrants) carried out in the Netherlands in 2006 that the elevated risk for near-miss complications was connected with low health literacy, language barriers, and low familiarity with the health-care system [4]. With the data from

Table 3 Likelihood of a near-miss event in the entire study sample

	OR	95% CI	*p* value
Non-immigrant women (ref.)	1.00		
First-generation immigrant women	1.33	0.85–2.08	0.21
Second-generation immigrant women	1.30	0.76–2.21	0.34
Age (continuous)	1.02	0.99–1.05	0.21
Nullipara (ref.)	1.00		
Multipara	0.60	0.42–0.87	0.01
Educational attainment: high (ref.)	1.00		
Educational attainment: medium	0.94	0.62–1.44	0.78
Educational attainment: low	0.99	0.61–1.59	0.95
German language abilities: very good/good (ref.)	1.00		
German language abilities: medium/low/none	0.89	0.54–1.47	0.64
BMI < 25 kg/m^2 (ref.)	1.00		
BMI < 30 kg/m^2	1.28	0.85–1.91	0.23
BMI ≥ 30 kg/m^2	1.58	0.99–2.54	0.06
≥ 10 medical check-ups (ref.)	1.00		
< 10 medical check-ups	1.26	0.88–1.82	0.21
> 3 ultrasound examinations (ref.)	1.00		
≤ 3 ultrasound examinations	1.00	0.71–1.42	1.00
Gestational diabetes: no (ref.)	1.00		
Gestational diabetes: yes	0.84	0.36–1.93	0.68

Table 4 Likelihood of a near-miss event among immigrant women only

	OR	95% CI	*p* value
First-generation immigrant women (ref.)	1.00		
Second-generation immigrant women	0.92	0.52–1.65	0.79
Age (continuous)	1.02	0.98–1.06	0.34
Nullipara (ref.)	1.00		
Multipara	0.69	0.42–1.14	0.15
Educational attainment: high (ref.)	1.00		
Educational attainment: medium	1.26	0.67–2.36	0.47
Educational attainment: low	1.27	0.67–2.29	0.50
Acculturation: high (ref.)	1.00		
Acculturation: low	1.59	0.96–2.64	0.07
German language abilities: very good/good (ref.)	1.00		
German language abilities: medium/low/none	0.69	0.40–1.18	0.18
BMI < 25 kg/m^2 (ref.)	1.00		
BMI < 30 kg/m^2	1.20	0.71–2.05	0.50
BMI ≥ 30 kg/m^2	1.62	0.88–2.97	0.12
≥ 10 medical check-ups (ref.)	1.00		
< 10 medical check-ups	1.24	0.78–1.99	0.37
> 3 ultrasound examinations (ref.)	1.00		
≤ 3 ultrasound examinations	1.48	0.94–2.34	0.09
Gestational diabetes: no (ref.)	1.00		
Gestational diabetes: yes	0.77	0.24–2.54	0.68

our quantitative prospective study, which included a sample of over 3500 women with an immigration background, we could not confirm that finding from Jonkers et al.

The strengths of our study are the size of the total patient population, the multicenter study design, and the high participation rate. A limitation of the study is that results

Table 5 Near-miss events as predictors for unfavorable primary pediatric outcome parameters of the condition of the child

	OR	95% CI	*p* value	Proptot**
Likelihood of low birth weight (< 2500 g)* near-miss event present	2.38	1.51–3.75	0.0002	$0.20^{\text{nonzero}***}$
Likelihood of preterm birth (< gestation week 37)* near-miss event present	2.47	1.60–3.80	< 0.0001	0.17^{nonzero}
Likelihood of admission to a neonatal unit* near-miss event present	2.20	1.50–3.22	< 0.0001	0.17^{nonzero}
Likelihood of Apgar 5 ≤ 7* near-miss event present	2.27	1.25–4.15	0.0074	0.21^{nonzero}
Likelihood of umbilical cord arterial pH < 7.1* near-miss event present	2.15	0.99–4.70	0.0545	0.01^{zero}

*Adjusted for migration status, age, parity, educational attainment, BMI, number of medical check-ups, number of ultrasound examinations, gestational diabetes, and cesarean delivery

**Mediation analysis with "near miss" as predictor (low birth weight, preterm birth, etc.) as outcome and cesarean delivery as mediator variable: Proptot = proportion of total effect of near miss mediated by cesarean delivery

***A significance of the predictor in M ← X model and of the mediator in the Y ← MX model suggest that the indirect effect is nonzero (source: SAS online documentation)

are obtained from a large city (high proportion of migrant women, maximum medical care) and therefore cannot be generalized to small towns or rural areas. It is possible that in rare events, such as near-miss events, a relatively large number of cases ($n = 6767$) are not enough. Here, another prospective study with an even larger number of cases would have to be carried out to obtain supplementary representative data. Summarizing, we can conclude that, contrary to our study hypothesis, there was no elevated risk due to immigration status for the occurrence of a peripartal near-miss event, and that with the exception of parity, no specific medical or socio-demographic factor was identified that had an elevated probability of occurrence of a severe peripartal complication.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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