Skin Color and Maternal Near Miss: Exploring a Demographic and Health Survey in Brazil

Cor de pele e Near Miss materno: explorando um inquérito demográfico de saúde no Brasil

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Abstract

Purpose In 2013, it was estimated that 289,000 maternal deaths occurred worldwide. The maternal mortality ratio has decreased in many countries in the past decades, due to early identification and treatment of obstetric complications, despite the dissimilarities observed in diverse locations and populations. Black women, for instance, have always been more susceptible to the occurrence of maternal mortality and severe morbidity. Therefore, the objective of this study is to assess skin color as a predictive factor for maternal near miss (MNM) in a sample of Brazilian women interviewed in the Brazilian National Demographic and Health Survey (DHS) of 2006.
Method A secondary analysis of the DHS database, a population-based cross-sectional nationally representative study was conducted. This database is of public domain. The risk of maternal complications according to ethnic group and the associated sociodemographic characteristics were evaluated. For the data analysis, the odds ratios and respective 95% confidence intervals were calculated.
Results In the sample interviewed, 59% of women were black or brown (mixed-race). Approximately 23% of women had some complication, and 2% of these women had at least one MNM pragmatic criterion. The MNM rate was 31 per 1,000 live births, and its occurrence was not statistically different among the ethnic groups. The only factors identified that were considered to be associated with the occurrence of MNM were maternal age above 40 and women not currently attending school, but only among white women.
Conclusion The 2006 DHS results did not show a higher occurrence of maternal complications, and specifically of MNM associated with black/brown skin color.

Keywords
- severe maternal morbidity
- maternal near miss
- pregnancy complications
- ethnicity
- maternal and child health

Resumo

Objetivo Estima-se que em 2013 tenham ocorrido 289.000 mortes maternas no mundo. Observou-se uma redução na razão de mortalidade materna em muitos países nas últimas décadas, e isso se deveu à identificação e tratamento precoce das complicações obstétricas, embora de forma não similar entre os diversos locais e

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populações. As mulheres negras, por exemplo, sempre estiveram mais sujeitas à ocorrência de mortalidade materna e de morbidade grave. Então, o objetivo desse estudo foi avaliar a cor da pele como fator preditor de Near Miss materno (NMM) em uma amostra de mulheres brasileiras entrevistadas na Pesquisa Nacional de Demografia e Saúde (PNDS) de 2006.

Método Análise secundária do banco de dados da PNDS, um estudo transversal de base populacional e com representatividade nacional, sendo este banco de dados de domínio público. Avaliou-se o risco de complicações maternas por grupo de cor da pele e as características sociodemográficas associadas. Para a análise dos dados, as razões de possibilidades e os respectivos intervalos de confiança de 95% foram calculados.

Resultados Na amostra entrevistada, 59% das mulheres eram negras ou pardas. Aproximadamente 23% das mulheres apresentaram alguma complicação, e 2% delas, pelo menos um critério pragmático de NMM. A taxa de NMM foi de 31 por 1.000 nascidos vivos, e sua ocorrência não foi estatisticamente diferente entre os grupos de cor da pele. Os únicos fatores identificados como associados à ocorrência de NMM foram a idade materna acima de 40 anos e não estar atualmente estudando, mas apenas entre as mulheres brancas.

Conclusão Os resultados da PNDS 2006 não mostraram uma maior ocorrência de complicações maternas e especificamente de NMM associadas à cor da pele negra/parda.

Palavras-chave
- morbidade materna grave
- near miss materno
- complicações da gestação
- etnia
- saúde materna e infantil

Introduction

In 2013, it was estimated that 289,000 maternal deaths occurred worldwide. A total of 2,300 of those deaths occurred in high-income countries. The figure for middle-income and low-income countries was 286,000 deaths, and 2,100 of those maternal deaths occured in Brazil in that year.[1] One of the United Nations Millennium Development Goals was to reduce the maternal mortality ratio by 75% from 1990 until 2015 in the world. However, from 1990 until 2013, the ratio decreased only 45%. The highest progress occurred between the years 2000 and 2013, when maternal mortality declined 3.5% per year.[1]

The reduction in the maternal mortality ratio observed in some countries is due to the early identification and treatment of obstetric complications.[2] In order to make this happen, information that is systematically collected on the occurrence of morbidities should be considered, especially life-threatening conditions termed maternal near miss (MNM), among more vulnerable women who comprise a high-risk group.[3]

It is well-known that certain ethnic groups are more prone to develop certain health conditions, and this is inter-related with chronic medical conditions and socioeconomic status.[4] According to a study conducted in the United Kingdom, women of African descent, or who are Caribbean and Pakistani tend to have more severe maternal morbidity than white women. This may be related to a preexisting maternal factor, or related factors during pregnancy, labor and childbirth.[5,6] In Brazil, it has already been identified that black women also have a higher maternal mortality rate.[7]

Although maternal skin color is most commonly considered, there are indications that paternal skin color may also be associated with the occurrence of unfavorable conditions during pregnancy. An American study demonstrated that preeclampsia was associated not only with maternal skin color, but also with paternal skin color.[8] The prevalence of preeclampsia, eclampsia, abruptio placentae, placenta previa and postpartum hemorrhage did not differ in black and white women, but the fatality rate of these conditions was 2- to 3-fold higher in black women.[9]

The aim of this study was to assess maternal skin color as a predictive factor for MNM events in a sample of Brazilian women interviewed in the Brazilian National Demographic and Health Survey (DHS) of Children and Women of 2006, as a contribution for increasing the knowledge on the role of ethnic differentials in determing severe maternal outcomes in Brazil.

Methods

This study is a secondary analysis of the database of the DHS. Ethical approval for this national survey was obtained before the beginning of the data collection. The respective database is currently of public domain, and can be used without restrictions.[10] The study was performed according to the Declaration of Helsinki, which was reviewed in 2008. The DHS used a questionnaire validated to recognize maternal complications and maternal interventions that were associated with severe maternal morbidity, according to the women's self-report. This questionnaire was validated and based on the results of a systematic review.[11,12]

The DHS was a household survey performed by probabilistic sampling that included a subsample of the 2005 National Survey of Households conducted in the five regions of Brazil. Details on the study methods were published previously.[10,11] Initially, 14,617 households were selected for the 2006 DHS. Women in reproductive age (15 to 49 years) living in a particular household, irrespective of marital status, as well as these women's children aged 5 years or younger at the time of the interview (born after January 2001) were included in this study. Thus, 13,056 households that had at least one eligible woman were included in the study.[10]

All characteristics reported by the interviewees who had given birth in the last five years, including their sociodemographic data, history of complications and interventions, were analyzed according to the region of the country where these women lived.[10]

Maternal near miss was assessed by a pragmatic definition of "near death," and was considered to have existed when the woman reported: eclampsia, hysterectomy, blood transfusion and/or admission to an intensive care unit (ICU), which had occurred at childbirth during the reference period.[13] This definition was based on the results of a secondary analysis of data from the World Health Organization (WHO). In that study, data was obtained from $\sim$ 100,000 deliveries in Latin America, and the same characteristics that defined the term *maternal near miss*, in addition to any cardiac or renal complications, were identified.[13] The components of this definition were confirmed by a validation study that correlated data from medical charts and information obtained from patient reports on the events that had occurred (hysterectomy, blood transfusion, ICU admission and eclampsia), and showed a good correlation between both.[11] Therefore, the reported complications that had not been included in the definition of MNM were identified as potentially life-threatening maternal conditions.

For the current analysis, which focused on ethnic determinants, we operationally defined three ethnic or skin color groups, formed by white, black, and brown (mixed-race) women; there were also other categories, and they were all self-reported by the women. The response rates and number of live births per ethnic group were evaluated. The ethnic distribution of women with at least one live child was estimated for each region of the country using weighted data. The proportion of pregnancies with self-reported complications/interventions related to each ethnic or skin color group was assessed. Crude and adjusted rates of self-reported MNM for each ethnic group were then estimated. The risks of maternal complications were then evaluated for each ethnic or skin color group based on some available sociodemographic characteristics. For the statistical data analysis, the diferences between groups for qualitative variables were evaluated by the chi-squared (χ^2) test. For the estimates of the indicators, the values of the respective 95% confidence intervals (95% CIs) were also provided. To analyze the factors associated with the risk of maternal morbidity in the different ethnic groups, the odds ratios (ORs) and their respective 95% CIs were calculated.

For the statistical analysis, characteristics (of regional stratification, primary sampling unit, and sampling weights) of the complex DHS sampling plan were taken into account. For the tests used, *p*-values lower than 0.05 were considered significant. The analyses were performed using the Statistical Package for the Social Sciences (SPSS, SPSS Inc., Chicago, IL, US) software, version 17.0, and the Stata (StataCorp, College Station, TX, US) software, version 7.0.

Results

The 2006 DHS selected 17,456 eligible women in the five regions of Brazil, interviewing 15,575 women. Of these, 5,025 women had delivered at least one live born child since January 2001, constituting the population to be aevaluated in our study. The total number of pregnancies in the last five years was 6,833, and live births numbered 5,056 during this same period. Thus, it was possible to estimate the expanded sample of 19,987,263 pregnancies in the entire national territory (►**Table 1**).

Table 1 Response rates and live births by skin color group. DHS, Brazil, 2006

Characteristics	Ethnic Group						Total with skin color	Total
	Black + mixed-race		White		Others			
	n	%	n	%	n	%		
Women eligible	–	–	–	–	–	–	–	17,456
Women interviewed	8,638	56.0	5,987	38.8	807	5.2	15,432	15,575[a]
Response rate among women (%)	–	–	–	–	–	–	–	89.2
Women with at least one LB	2,924	58.9	1,786	36.0	256	5.1	4,966	5,025[b]
LBs	3,019	60.4	1,716	34.4	260	5.2	4,995	5,056[c]
Pregnancies	4,080	60.4	2,308	34.2	365	5.4	6,753	6,833[d]
Pregnancies (expanded sample)	11,907.135	60.2	6,717.818	34.0	1,149.026	5.8	19,773.979	19,987.263[e]

Abbreviations: DHS, Demographic and Health Survey, LB, live birth.
Notes: [a] Missing information for ethnic group: 143; [b] missing information for ethnic group: 59; [c] missing information for ethnic group: 61; [d] missing information for ethnic group: 80; [e] missing information for ethnic group: 213,284.

Table 2 Ethnic distribution by region for women with at least one live birth. DHS, Brazil, 2006

Skin color	Region					
	Northern	Northeastern	Southeastern	Southern	Midwestern	Total
Black + mixed-race	786	671	545	305	617	2,924
	[79.8]	[72.4]	[54.9]	[29.0]	[60.0]	[59.0]
White	172	229	380	665	340	1,786
	[15.9]	[23.3]	[37.6]	[66.9]	[34.2]	[35.3]
Others	43	44	56	37	76	256
	[4.4]	[4.3]	[7.4]	[4.1]	[5.9]	[5.7]
Total	1,001	944	981	1,007	1,033	4,966

Abbreviation: DHS, Demographic and Health Survey.
Notes: [ ] % weighted data; $p < 0.001$ (design-based).

The majority of black and brown (mixed-race) women lived in the Northern, Northeastern and Midwestern Regions, and represented the majority of the women in reproductive age. In contrast, white women from the same group accounted for 35% of the sample, and lived most frequently in the Southern Region of the country (►**Table 2**).

►**Table 3** shows the proportions of pregnancies with self-reported complications and interventions per ethnic group. Approximately 23% of the women reported having at least one maternal complication or procedure related to the complication (eclampsia, hemorrhage, infection, hysterectomy, ICU admission, blood transfusion, inter-hospital transfer, mechanical ventilation, hospital stay lasting more than a week in the postpartum period), while only 2% of them reported having experienced some conditions characterized as a MNM events (eclampsia, hysterectomy, ICU admission or blood transfusion). White women had a higher rate of eclampsia (8%) and infection (1.2%). On the other hand, black and mixed-race women had a higher proportion of hemorrhage (19.2%), prolonged hospital stay lasting more than a week in the postpartum period (4.3%), and ICU admission (0.7%) than white women and the other groups. However, these differences were not significant for any of the complications evaluated.

►**Table 4** shows the rate of self-reported MNM events, according to the pragmatic definition that was used in our study, for the different ethnic groups considered. The global MNM ratio was 31 per 1,000 live births, meaning that ~ 3 out of 100 women delivering live newborns would have some type of maternal complication during delivery or the postpartum period. Although this ratio is higher in black and brown women, as well as in other ethnic groups, such ratios were not significantly different among groups.

When the sociodemographic characteristics of the women were associated with the risk of maternal complications according to the ethnic group, it was observed that a higher risk existed in white women and other ethnic groups, in the age range of 40 to 49 years (OR: 6.48 [1.28–32.90]). The estimated risk is still lower for white women and women of other ethnicities who are currently attending school (OR: 0.21 [0.04–0.97]). No associations were found between the occurrence of MNM and the amount of years of education, marital status, place of residence, region, employment during the last 12 months, number of live births, and family income (►**Table 5**) for any of the ethnic groups considered.

Discussion

The current analysis was conducted in an exploratory manner to confirm whether skin color, especially black, plays a role in determining a higher risk of severe maternal complications among Brazilian women. There is a relative scarcity of scientifically generated information about this association, especially in Brazil. In summary, the current study was based on interviews of women in the 2006 DHS, and showed a predominance of black and mixed-race ethnic groups, and other ethnicities (including the Brazilian Indians), in low-income Brazilian regions, notably the Northern and Northeastern Regions. This had already been expected. While ~ 23% of women reported having some type of severe pregnancy-related complication, the occurrence of an MNM event as defined pragmatically was of 31 per 1,000 live births, or ~ 3%. This rate was higher than those of other population-based assessments of MNM events.[14] Nevertheless, the occurrence of each of the diverse severe conditions, associations or at least one association studied, did not show a significantly different distribution among the distinct skin color groups considered, contrary to what had been imagined. This fact could possibly be explained by the high degree of miscegenation found in Brazil.

An ethnic predominance of black and brown women in the Northern and Northeastern Regions of Brazil could be observed in the DHS study. In fact, according to the 2010 Brazilian National Census data, 43.1% of the Brazilian population self-reported as being *pardo* (brown/mixed race in Portuguese), and the majority of these individuals were in the Northern Region (66.9%), while only 16.5% were found in the Southern Region. Those who self-reported as being black totalized 7.6%, with the highest percentage in the Northeastern Region (9.5%) and the lowest in the Southern Region (4.1%).[15]

Table 3 Proportion of pregnancies with complications and related interventions by skin color group. DHS, Brazil, 2006

Complications and related interventions	Skin color group			p^*	Total
	Black + mixed-race	White	Others		
Eclampsia (a)	37	17	4	0.472	58
	[0.5]	[0.8]	[0.2]		[0.6]
Hemorrhage (b)	720	383	57	0.446	1160
	[19.2]	[17.5]	[15.2]		[18.4]
Infection (c)	55	26	2	0.460	83
	[0.9]	[1.2]	[0.3]		[1.0]
Hysterectomy (d)	8	2	1	0.307	11
	[0.1]	[0.3]	[0.7]		[0.2]
ICU admission (e)	29	11	2	0.100	42
	[0.7]	[0.3]	[0.1]		[0.5]
Blood transfusion (f)	39	18	5	0.867	62
	[0.9]	[0.7]	[1.1]		[0.8]
Inter-hospital transfer (g)	91	39	11	0.122	141
	[2.4]	[1.6]	[5.5]		[2.4]
Mechanical ventilation (h)	66	32	8	0.173	106
	[1.9]	[1.1]	[3.9]		[1.7]
Postpartum stay > 1 week (h)	159	73	7	0.805	239
	[4.3]	[3.6]	[4.1]		[4.0]
Any of the previous complications/ interventions (i)	883	456	66	0.409	1405
	[24.0]	[21.1]	[22.0]		[22.9]
MNM (eclampsia, hysterectomy, ICU admission, blood transfusion) (j)	101	42	12		155
	[2.0]	[2.0]	[2.3]	0.963	[2.0]
Pregnancies in the 5 years before the interview (expanded sample)	11,907.135	6,717.818	1,149.026		19,773.979
Pregnancies (n) •	4,080	2,308	365		6,753

Abbreviations: DHS, Demographic and Health Survey; ICU, intensive care unit; MNM, maternal near miss.
Notes: * Design-based; [ ] % weighted data; • Missing information for ethnic group: 80 pregnancies. Missing information for more: (a) 102 pregnancies; (b) 73; (c) 113; (d) 410; (e) 81; (f) 92; (g) 76; (h) 83; (i) 287; (j) 435.

Women randomly eligible for the DHS study could be evaluated in diverse living, intellectual, social, economic and cultural conditions, including ethnic differences. It is well-known that all of these factors are also associated with the quality of the healthcare provided to women during pregnancy, childbirth and the postpartum period, which seems to be more closely associated with socioeconomic conditions. Another large national prospective study also failed to find any association between ethnic characteristics and the occurrence of MNM, although it identified that white women with a higher level of education had a more frequent and better access to prenatal and maternity healthcare.[16]

In the evaluation of the indicators, the MNM ratios did not vary significantly among groups, even though the women classified as belonging to other ethnic groups showed a higher ratio. This result may be due to the inclusion of Brazilian Indian women in this category. Although fewer in number, Indian women have very limited access to high-quality health services during pregnancy. Unfortunately, the number of native Indian women interviewed did not allow a particularized analysis of the occurrence of maternal morbidity in this group. Assessments performed in other contexts have already shown that Native American women and those native to Alaska have a higher risk of preeclampsia than white women, and this effect is also modulated by body mass index (BMI).[17]

In general, the results of the current study diverge from other studies in the literature that were related to the subject. In the United Kingdom, a case-control study demonstrated that black African women had twice the chance of having an MNM event in comparison to white Europeans.[6] The nationwide incidence of severe acute maternal morbidity was of 7.1 per 1,000 live births in the Netherlands, and was subject to wide variations according to skin color, with women from Sub-Saharan Africa exhibiting a risk that is 3.5-fold higher than for Turkish and Moroccan women.[18] The

Table 4 Skin color specific crude rates of self-reported MNM. DHS, Brazil, 2006

Indicator of MNM	MNMR (per 1,000 LBs)	Skin color specific MNMR		
		Black + mixed-race	White	Others
Eclampsia	11.6	12.3	9.9	15.4
	[8.8–15.0]	[8.6–16.9]	[5.8–15.8]	[4.2–38.9]
Hysterectomy	2.2	2.6	1.2	3.8
	[1.1–3.9]	[1.1–5.2]	[0.1–4.2]	[<0.1–21.2]
ICU admission	8.4	9.6	6.4	7.7
	[6.1–11.3]	[6.4–13.8]	[3.2–11.4]	[0.9–27.5]
Blood transfusion	12.4	12.9	10.5	19.2
	[9.5–15.9]	[9.2–17.6]	[6.2–16.5]	[6.3–44.3]
Any of the 4 previous indicators	31.0	33.5	24.5	46.2
	[26.4–36.2]	[27.3–40.5]	[17.7–32.9]	[24.1–79.2]
Number of LBs	4,995	3,019	1,716	260

Abbreviations: DHS, Demographic and Health Survey; ICU, intensive care unit; LBs, live births; MNM, maternal near miss; MNMR, maternal near miss rate.
Note: [ ] 95% Confidence interval for MNMR (exact binomial).

Table 5 Adjusted estimated risk of maternal complications by skin color group according to sociodemographic characteristics. DHS, Brazil, 2006

Patient characteristics	Skin color group: Black + mixed race			Skin color group: White + Others		
	Complication			Complication		
	Yes	No	OR (95%CI) #	Yes	No	OR (95%CI) #
Schooling, years						
No education/ primary education only	58	1,735	1.83 [0.70–4.74]	27	1,040	1.00 [0.45–2.24]
High school	17	1,071	1.00 (ref.)	15	916	1.00 (ref.)
Currently attending school						
No	65	2,432	1.00 (ref.)	38	1,742	1.00 (ref.)
Yes	10	375	1.61 [0.64–4.03]	4	214	**0.21 [0.04–0.97]**
Marital status						
Without partner	14	511	1.00 (ref.)	8	297	1.00 (ref.)
With partner	61	2,294	0.78 [0.28–2.16]	34	1,658	2.86 [0.62–13.18]
Maternal Age						
Up to 29 years	39	1,794	1.00 (ref.)	21	1,157	1.00 (ref.)
30–39 years	28	860	1.95 [0.80–4.72]	16	652	2.17 [0.46–10.24]
40–49years	8	154	0.64 [0.18–2.28]	5	147	**6.48 [1.28–32.90]**
Location of residence						
Rural	21	929	1.00 (ref.)	16	634	1.00 (ref.)
Urban	54	1,879	1.71 [0.70–4.18]	26	1,322	0.62 [0.20–1.99]
Region						
N, NE, MW	54	1,990	1.07 [0.39–2.92]	21	860	0.51 [0.17–1.55]
S, SE	21	818	1.00 (ref.)	21	1,096	1.00 (ref.)
Working in the last 12 months						
Yes	48	1,579	1.32 [0.57–3.05]	27	1,195	0.95 [0.20–4.64]

Table 5 (*Continued*)

Patient characteristics	Skin color group: Black + mixed race			Skin color group: White + Others		
	Complication			Complication		
	Yes	No	OR (95%CI) #	Yes	No	OR (95%CI) #
No	27	1,227	1.00 (ref.)	15	760	1.00 (ref.)
Number of live births						
≥ 2	51	1,743	1.09 [0.49–2.44]	27	1,126	0.50 [0.17–1.45]
< 2	24	1,065	1.00 (ref.)	15	830	1.00 (ref.)
Income						
≤ R$ 400	33	1,153	2.69 [0.73–9.89]	17	541	2.35 [0.57–9.64]
R$ 401–R$ 800	20	680	3.40 [0.84–13.82]	8	442	0.29 [0.08–1.05]
> R$ 800	10	661	1.00 (ref.)	12	693	1.00 (ref.)
Total women	75	2,808		42	1,956	

Abbreviations: 95%CI, 95% confidence interval; DHS, Demographic and Health Survey; MW. Midwestern Region; N, Northern Region; NE, Northeastern Region; S, Southern Region; SE, Southeastern Region; R$, real, the Brazilian currency; Ref., reference.
Notes: # Adjusted for the sampling design: weight, stratum and cluster (PSU, primary sampling unit), and for all aforementioned sociodemographic characteristics; $n = 2{,}551$ for the first, and $n = 1{,}712$ for the last ethnic group; values in bold mean they are statistically significant.

subject is more widely explored in the North-American continent, where multiple studies show similar results of a higher risk of maternal death and severe maternal morbidity among black women in comparison to white women. This demonstrates that the quality of the healthcare in locations where black women give birth has a limited role.[19–21]

The current study may have some limitations that should be considered. One limitation is that the woman self-defines her skin color, as well as the occurrence of pregnancy-related complications that characterize severe maternal morbidity and near miss events. Although self-reporting on maternal morbidity is used with some frequency, it is known that the degree of precision of such information is limited for some conditions such as hypertension and infection. The results were based on data collected in 2006, although they derived from a well-conducted Demographic and Health Survey (the 2006 DHS). Therefore, the survey did not contain all the data that could be useful to better investigate the determinants and consequences of possible ethnic differentials during childbirth care. Future population-based studies with an adequate number of women from all minority ethnic groups or underprivileged women, including the migrant population, may be important to generate a scientifically based understanding of such a vital and current topic.

Even though the current analysis, based on the 2006 DHS, did not demonstrate a significant increase in the occurrence of severe maternal morbidity and near miss events among black and brown (mixed-race) women in comparison to white women in Brazil, it indicated some sociodemographic characteristics that were most frequently associated with maternity among underprivileged women, including ethnic minorities. Only socioeconomic equality between populations, as well as improvements in the quality of the healthcare provided to all women, can minimize the differences in maternal and perinatal outcomes between different ethnic groups.

Conflicts of Interest

The authors do not have any conflicts of interest to disclose regarding the current study.

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