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SPATIAL ANALYSIS OF MATERNAL MORTALITY

ANÁLISE ESPACIAL DA MORTALIDADE MATERNA

ANÁLISIS ESPACIAL DE LA MORTALIDAD MATERNA

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ABSTRACT

Objective: analyzing, spatially, maternal mortality, identifying areas of risk and potential risk groups. **Method:** a descriptive, exploratory, retrospective, documentary study with a quantitative approach, based on secondary data obtained at DATASUS. The analyses were performed using the R software and the results provided on graphs, maps and tables. **Results:** Maranhão, Piauí and Bahia have the highest rates of Maternal Mortality Ratio, but all states had higher mortalities comparing to what is acceptable by the World Health Organization. Regarding the evaluation of the risk of maternal mortality, all states were considered at risk. **Conclusion:** Northeastern states need health actions to control maternal mortality, to be reassessed, because it was found a high maternal mortality, which increased over the years. Being relevant to the area of greatest risk, in the ten years analyzed, consisted by Bahia, Maranhão and Piauí. **Descriptors:** Maternal Mortality; Women's Health; Family Health.

RESUMO

Objetivo: analisar espacialmente a mortalidade materna, identificando áreas de risco, bem como os possíveis grupos de risco. **Método:** estudo descritivo, exploratório, retrospectivo, documental, com abordagem quantitativa, a partir de dados secundários obtidos no DATASUS. As análises foram realizadas com o software R e os resultados disposto em gráficos, mapas e tabelas. **Resultados:** o Maranhão, Piauí e Bahia apresentaram os maiores coeficientes da Razão de Mortalidade Materna, mas todos os estados apresentaram mortalidades superiores ao que é aceitável pela Organização Mundial da Saúde. Quanto à avaliação do risco de mortalidade materna, todos os estados foram considerados de risco. **Conclusão:** os estados do Nordeste necessitam que as ações de saúde para controle da mortalidade materna sejam reavaliadas, pois se constatou alta mortalidade materna, que aumentava com o passar dos anos. Sendo relevante que a área de maior risco, nos dez anos analisados, era composta por Bahia, Maranhão e Piauí. **Descritores:** Mortalidade Materna; Saúde da Mulher; Saúde da Família.

RESUMEN

Objetivo: analizar la mortalidad materna espacialmente, identificando áreas de riesgo y potenciales grupos de riesgo. **Método:** estudio descriptivo, exploratorio, documental y retrospectivo, con enfoque cuantitativo, basado en datos secundarios obtenidos en DATASUS. Los análisis se realizaron utilizando el software R y proporcionaron resultados en gráficos, mapas y tablas. **Resultados:** Maranhão, Piauí y Bahía tienen las tasas más altas de Razón de Mortalidad Materna, pero todos los estados tenían mayor mortalidad a lo que es aceptable por la Organización Mundial de la Salud. Con respecto a la evaluación del riesgo de la mortalidad materna, se consideraron todos los estados en situación de riesgo. **Conclusión:** los estados del noreste requieren que las acciones de salud para el control de la mortalidad materna sea reevaluado, pues se constató alta mortalidad materna, que aumentó con los años. Ser relevante para el área de mayor riesgo, en los diez años analizados, consistió en Bahía, Maranhão y Piauí. **Descriptores:** La Mortalidad Materna; Salud de la Mujer; Salud de la Familia.

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INTRODUCTION

The problem of maternal mortality is evident by reflecting that every minute a woman dies in the world as a result of problems in pregnancy and/or complications in childbirth and the puerperium, and the information that in Brazil, in the period 2000-2009, the Maternal Mortality Ratio (MMR) was 54,83 deaths per 100 000 live births. Thus, at the end of nine years, there was an increase of 11,92% in maternal mortality in the country, being the Northeast region with the highest MMR.¹

The MMR is an indicator of the health of a population, as well as the level of economic, social and human development; soon, its accompanying and assessment are extremely important for targeting of health to providing its decline as the proposal of the Millennium Declaration to reduce the MMR by three quarters by the year 2015.^{2,3}

In order to reduce maternal mortality, Brazilian states, even in the 1990s, should develop actions aimed at women's health or intensify them; however, such practices were only implemented effectively, from the year 2000.³

Once this period of 10 years (1990-2000) occurred in Brazil, an attempt to develop an adequate for the health needs of women could be seen to influence and, in the near future, in social policy making environment, in structuring a network of health care of women and work process in health, it was important to provide quality care for the pregnant woman and help reduce the MMR. Therefore the achievement of public health efforts focused on women's health only occurs from 2000.^{4,5}

The recognition of women's health as a health problem influenced the development of social policies, the development of the health

care network of women, as well as in the implementation of health actions that should be in the social-informed health needs of women, however, such events did not allow the reduction of MMR, thereby, Brazil and the Northeast continue to present high MMR.¹

OBJECTIVE

- Analyzing, spatially, maternal mortality by identifying areas of risk and potential risk groups.

METHOD

A descriptive, exploratory, retrospective, documentary study with a quantitative approach from secondary data obtained from the Department of the SUS (DATASUS) for the Northeastern states, which have a total area of 1.554.257 km², comprising the States of Maranhão/MA, Piauí/IP, Ceará/EC, Rio Grande do Norte/RN, Paraíba/PB, NY/PE, Alagoas/AL, Sergipe/SE and Bahia/BA, which together have a population of 51.871.449 inhabitants, according to the 2010 Census.

To obtain data on the site DATASUS, it was followed the steps:

- 1) Health Information
- 2) Vital Statistics
- 3) Mortality - 1996-2010, by ICD-10
- 4) Deaths in women of childbearing age and maternal deaths
- 5) Brazil by Region and Unity Federation
- 6) Maternal deaths identified according to ICD-10
- 7) Period 2001-2010 in the Northeast.

It is noteworthy that it was regarded as the maternal death occurring during pregnancy, childbirth, postpartum and immediate and mediate that for obtaining the RMM, the data collected were associated estimates of live births in the same period and residents in the Northeast.

$$RMM = \frac{\text{\textit{óbitos por causas maternas}}}{\text{\textit{nº de nascidos vivos no período}}} \times 100.000$$

The choice for the period 2001-2010 is justified by the relevance of the theme and the agreement signed by the Millennium Declaration. The situation of maternal mortality in nine Northeastern states was obtained by analysis of data by annual impairment in function of the states, they are presented in figures.

To meet the objective of the study was also calculated the relative risk (RR), which was obtained from the ratio of RMM for each state by RMM in the Northeast. When the RR

state is less than one, it is also lower than the Northeast and when risk is greater than the RR of this state is greater than the Northeast, such information was plotted on an annual forum that allows you to check the development of areas of risk over time. The formulation of risk maps was performed by R software version 2.14.2 with DCluster and maptools packages.

With risk maps, we determined the states of highest risk and for each of them we calculated the relative risk or risk ratio (RR)

with the variables years of study, color / ethnicity, marital status and age, with the purpose of identifying those at risk for maternal mortality.

The RR of maternal death was estimated by the ratio of product cross OpenEpi through software, using the following equation:

$$RR = \frac{a/a + b}{c/c + d}$$

Where a, b, c, and d are obtained by means of a contingency table, her and b correspond to the category you want to check it acts as a risk factor, just to match the number of maternal deaths and b to mothers alive until the mediate postpartum. Since c and d correspond to the class that is used as a basis for comparison, thus c is the number of maternal deaths and of the number of living women.

In order to assess the association between categorical variables, we used a method of decision making based on statistical hypothesis testing, which is capable of rejecting or not a particular assumption about a problem related to a given population. To investigate whether categorical variables shared the same or different proportions, as the maternal deaths, the chi-square test was used. The null hypothesis (H_0) for the chi-square is that the proportions are similar. This hypothesis is rejected when p-value obtained in the test is less than 0.05, in such cases it is assumed that the ratios are statistically different.

RESULTS

Through the analysis of secondary data it was found that there were 5868 maternal deaths in the period 2001-2010, in the Northeast, including the states of Bahia (1632

deaths) and Maranhão (1087 deaths) were those with the highest number of deaths, followed by Ceará (933 deaths), Pernambuco (822 deaths), Piauí (465 deaths), Alagoas (259 deaths), Paraíba (242 deaths), Sergipe (228 deaths) and Rio Grande do Norte (200 deaths).

The raw data does not allow to evaluate the health and socioeconomic development that each state has achieved or made available for the purpose of controlling maternal mortality, and does not determine the states that have influence on the high mortality in the Northeast, and for that calculated Maternal Mortality Ratio (MMR).

The states with the highest mortality were Maranhão with 87,82 maternal deaths per 100 000 live births, with Piauí 85,59 maternal deaths per 100 000 live births and maternal Bahia with 71,9 per 100 000 live births (Figure 1) deaths.

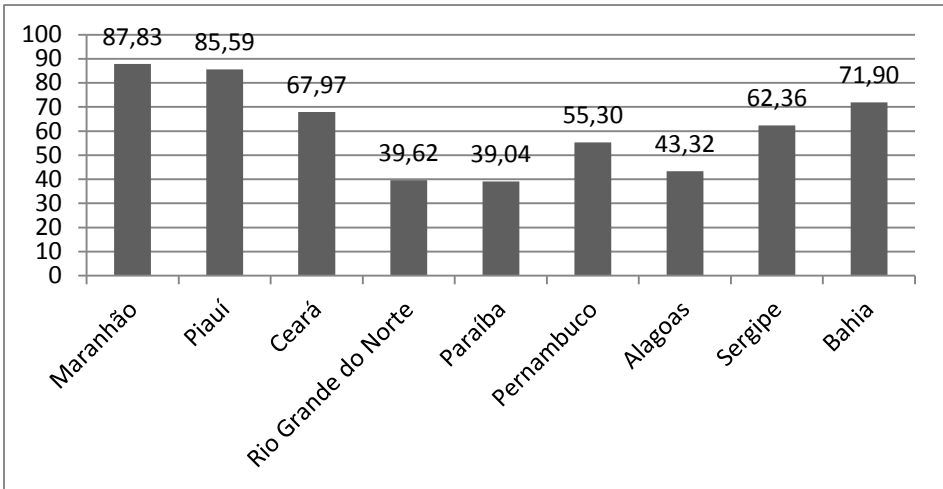


Figure 1. Maternal mortality ratio in the period from 2001 to 2010, in the States of the Northeast region.

The maternal mortality ratios were also evaluated annually by state, and it was found that all nine states had an increase in MMR over time. Admittedly declines occurred, such as those seen in 2003 and 2006, but this

reduction is not maintained over the years (Figure 2).

Over the years DSS has not decreased, the states of Maranhão and Piauí remained responsible for the highest rates of maternal mortality in the Northeast. The State of

Alagoas, which had the lowest maternal mortality at baseline, set in 2010, is the

fourth largest in maternal mortality (Figure 2).

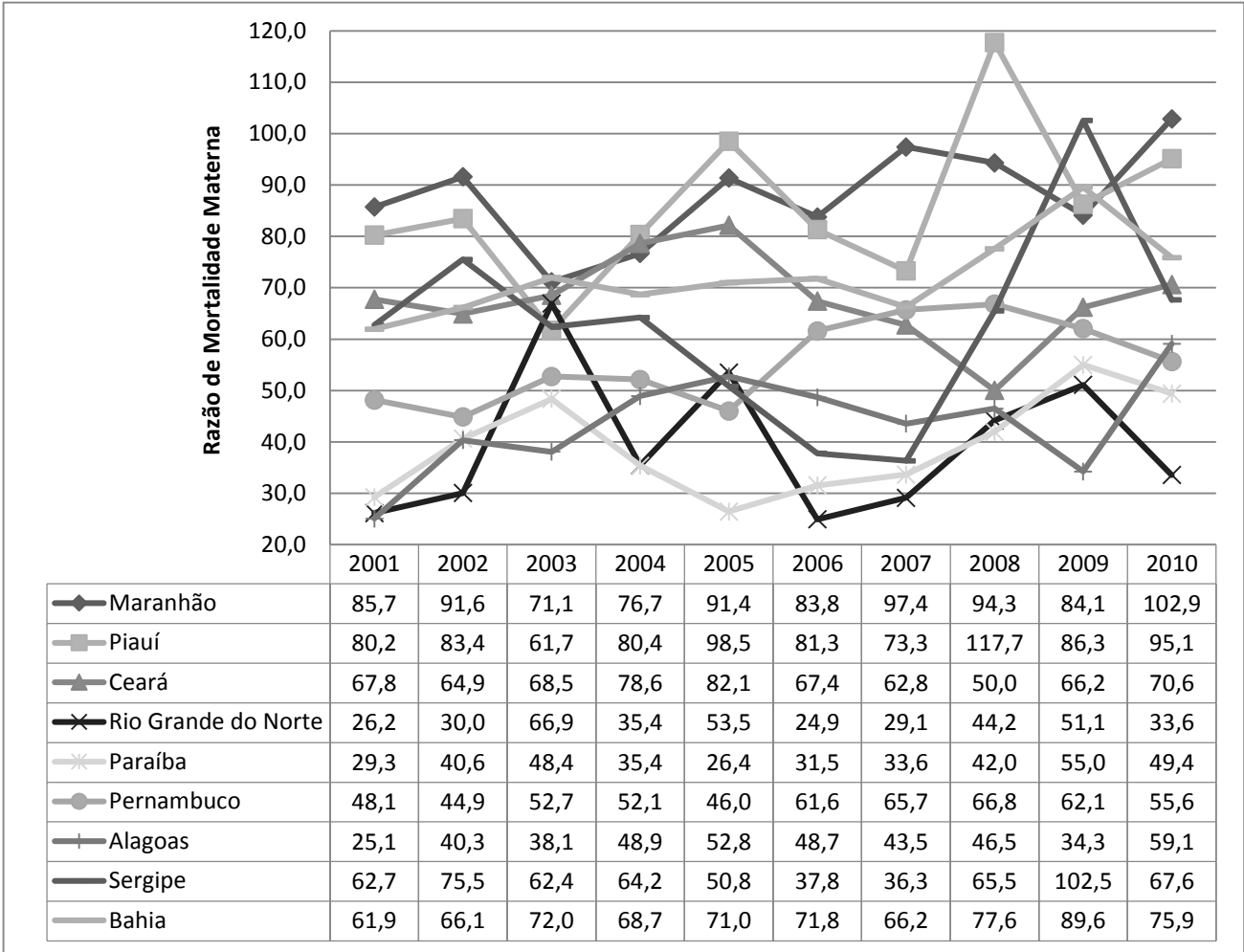


Figure 2. Evolution of MMR Northeast Region States in the period of 10 years. Caption: RGN - Rio Grande do Norte.

With the analysis of risk maps presented in Figure 3, it was found that during the 10 years the area of greatest risk of maternal deaths remains largely unchanged, consisting primarily by Bahia, Maranhão and Piauí, which

had higher risk than 1 in virtually every year. The states of Rio Grande do Norte and Alagoas, which had the lowest risk of maternal death in 2001, showed an increase in relative risk values from 2002.

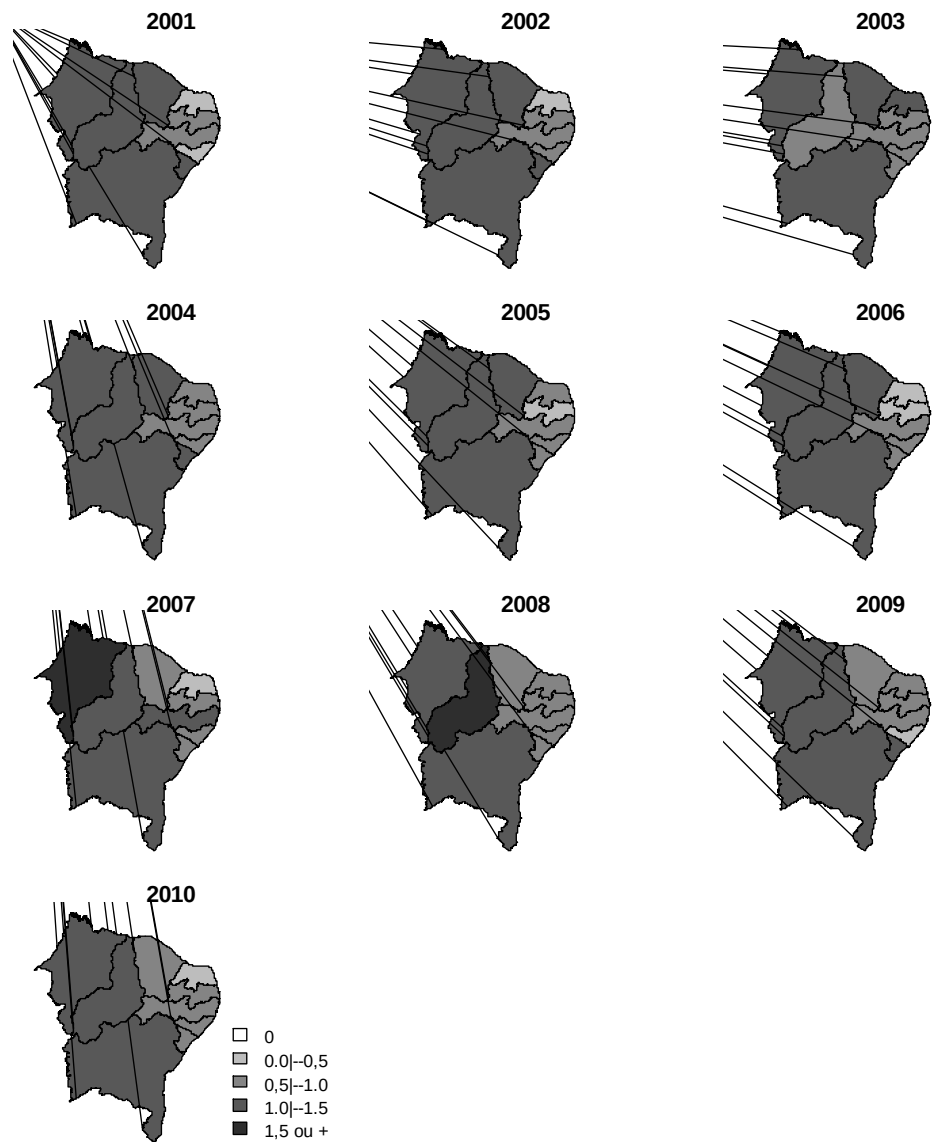


Figure 3. Areas of greatest risk for maternal deaths from 2001 to 2010.

Once identified the states with higher risk, it is time to assess whether there is distinction between the variables related instances of maternal mortality. Years of study, color / ethnicity, age and marital status: some social factors in order to identify potential risk groups, they were being evaluated.

The States of Maranhão, Piauí and Bahia comprise the area of greatest risk of maternal mortality in the 10 years analyzed. However, to support the planning and management as well as identify the area of risk is important to determine the women who are dying, and the need to focus attention on the possible risk groups.

By chi-square analysis and the RR was possible to identify three states that have the highest risk groups most vulnerable to maternal death and that each state has specific characteristics regarding risk groups.

To Maranhão, maternal mortality of women with less than eight years of schooling has a greater likelihood of death by 50% with respect to deaths of women with eight years or more of study, a situation which is reaffirmed with the Chi-square test which was significant, thus the proportions used to analyze the RR were statistically different.

When assessing the risk of death taking into account the color / ethnicity of women, only two groups had risk compared to white women: black women, who had a probability of dying 4,5 times higher, and women of Indian ethnicity. However, the latter group cannot be considered as a risk group since the p-value was greater than 0,05, then the proportions of white and indigenous women are statistically similar. Importantly, women brown and yellow color had a risk lower than that of white women, the death that is relevant, since the ratios analyzed are statistically significant ($p < 0,05$). (Table 1)

By analyzing the category, marital status, widows and separated women compared to married women had a risk of death 2,36 times higher and the proportions are evaluated statistically significant. With respect to age, underage (10-14 years) women should be considered as a risk group, but the proportions used for analysis are similar. Children older than 30, women constituted groups more likely (2,45 times higher compared to women aged 20-29 years old) maternal death, as evidenced in Table 1.

The state of Piauí / PI women had less than eight years of study as a risk group for maternal death, that compared women with

more than eight years of study, although this higher risk than 30%, restated to evaluate the Chi-square, which was statistically significant. As for color / ethnicity of women, both brown, like the yellow, indigenous and black stand as risk groups, however, only black women were statistically significant, their risk of death was 6 times greater than that of white women. For category, marital status, both single women as separate, cannot be considered as risk groups compared married women, because the Chi-square test showed that the groups studied were statistically similar.

The age category was the last variable analyzed and once again showed the minors (10-14 years old) and aged 30 and older women as risk groups, which are at risk, respectively, 31% higher and 2,44 greater than for women aged 20-29 years. Such groups are statistically different since the p-values are less than 0,05. A different issue identified for Piauí is that women aged 15-19 have a lower risk of the women aged 20-29 years relevant death situation since chi-square test was statistically significant ($p<0,05$) (Table 1).

Table 1. Risk for maternal mortality ratio second years of study, color/ethnicity, marital status and age in the period from 2001 to 2010 for the States most at risk.

	Maranhão		Piauí		Bahia	
	RR	p-value	RR	p-value	RR	p-value
Years of study						
<8	1,50	<0,0000001	1,70	0,00001269	1,89	<0,0000001
≥8*	1,00	-	1,00	-	1,00	-
Color/Ethnicity						
White*	1,00	-	1,00	-	1,00	-
Black	4,50	<0,0000001	6,24	<0,0000001	4,32	<0,0000001
Yellow	0,29	<0,0000001	1,29	0,3113	0,42	0,03737
Dark	0,74	0,0001217	1,21	0,1013	0,54	<0,0000001
Indigenous	1,21	0,2624	1,10	0,4635	0,93	0,4285
Marital Status						
Single	0,93	0,1515	1,086	0,2157	0,96	0,2426
Married*	1	-	1	-	1	-
Widow	2,36	0,02456	-	-	2,74	0,001629
Separated	2,36	0,03915	2,22	0,1251	1,35	0,2323
Consensual union	0,90	0,2488	-	-	-	-
Age						
10-14 years old	1,40	0,07514	1,31	0,2531	0,86	0,3121
15-19	0,94	0,2320	0,76	0,02173	0,82	0,005185
20-29 *	1	-	1	-	1	-
≥30	2,45	<0,0000001	2,44	<0,0000001	3,09	<0,0000001

Taylor series, a significance level of 95%, * base group, RR-Risk ratio, IC-confidence interval. In bold are significant p-values.

Bahia, in turn, shows that women with less than eight years of study have a high risk of death, which is 89% higher than that of women with eight years or more of study, black women had a risk of that exceeds the dying woman stand in four times, the marital status also acts as a risk factor for maternal mortality, since widows have a risk of death twice that of married women. As to age only women 30 years and older is presented as a risk group for maternal death, that this risk is three times higher than that of women aged 20-29 years, all categories analyzed possessed p-value less than 0,05, then the conclusion that they really correspond to risk groups is appropriate, since it was found that its proportions are statistically different (Table 1).

Each state has its specificities, but it is important to pay attention to the profile of women in the study that had a high risk of maternal death: black, separate and 30 years of age and older.

DISCUSSION

A review of maternal mortality provided worrying results because there was high MMR, which were higher than what is considered acceptable by the World Health Organization which is 20 thousand deaths per 100,000 live born. Allied to this is found in RMMs increased over time for all states, is therefore important question about how are working the actions taken by primary care, and think because they apparently failed to reduce maternal mortality.⁴

The Family Health Strategy (FHS) is primarily responsible for providing a safe pregnancy for both the woman and the child, and from their possible actions to promote women's health, prevent diseases and treat them as soon possible.^{2,6-7}

All states showed high increase in the proportion of the population covered by ESF in the study period, reaching in 2010 a ratio of 58.60% for Bahia, Pernambuco to 68,34%, 68,63% for Ceará, 71, 51% to Alagoas, 76,55% for the Rio Grande do Norte, 81,18% for Maranhão, 86,21% for Sergipe, 95.,34% to

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97,37% for Paraíba and Piauí, but this apparently not reflected on maternal mortality, once again, that this study remains high with the passing of years.⁸

This situation of high MMR is not a new issue, a similar result was identified in the state of Pará, Pernambuco and city reef, they showed no reduction of MMR with passage of time, and it remained high at 51,91 maternal deaths per 100,000 live births, 77 maternal deaths per 100,000 live births and 75 maternal deaths per 100,000 live births respectively. Soon the search had already portraying the high MMR, which increased over the years, ie, already showed signs of lack of efficiency of health on reducing maternal mortality.⁹⁻¹¹

Study conducted in the state of Ceará has also identified a high maternal mortality, 85.9 maternal deaths per 100,000 live births, however over time the MMR decreased, unlike what was observed in this study.¹² addition to high mortality, it appears the states of Bahia, Maranhão and Piauí comprise the areas of greatest risk of maternal death, that in almost every year. Since this finding is incompatible with the high coverage of the FHS, which in Maranhão is 81,18% of families and 97,37% of Piauí families, which are the largest in the Northeast covers.⁸

Amid such information is a clear need to evaluate the actions that are being developed for the control of maternal mortality, it is clear that there is a gap between the theory and practice of the actions proposed to reduce maternal mortality, as well as between service availability and its effectiveness, this observation has already been shown in other studies, as performed evaluating by Morse¹³ Brazilian MMR.

In search of better targeting of assistance also evaluated whether risk groups for maternal mortality, which can be seen that however great the publication of manuals and guidance of the Ministry of Health that depict an increased risk of death related to teens, women with low education or illiterate, who are separated, which are another color / ethnicity other than white, such information was not sufficient to, in care practices, develop actions that are in line with the needs of women, therefore, to assess the risk groups to the state of Bahia, Maranhão and Piauí risk groups remained the same as they were already mentioned in the scientific literature.¹⁴ Moreover, regardless of state has the highest risk groups remain virtually unchanged, being composed by women with less than eight years of study, color / black race, which is separated and / or widowed, and has aged 30 years and over, which is

alarming because such groups are already the focus of priority health actions and yet are still at risk groups with high risk of death.¹⁴

Studies in Rio de Janeiro and Rio Grande do Sul has portrayed the greatest risk of maternal death among women with few years of schooling, black, unmarried (separated, and widowed) and aged 40 years and older, and these groups of similar risk to that seen in this study.¹⁵⁻⁸ Another study conducted in the state of Paraíba to be evaluated for possible variables that had association with maternal mortality, also showed that non-white women have a higher risk of death when the white assessed the direct obstetric causes chance that this is three times larger.¹⁹

Research in Recife / PE also showed association of maternal deaths with over 35 women, moreover, demonstrated association of maternal mortality with the number of prenatal visits, the lower the number of consultations was greater the risk of death, thus reflecting the need to assess the actions undertaken in primary care, which was also identified in this study.²⁰

This study found an unexpected situation, for women aged 15-19 for both Maranhão and Piauí not presented as group risk of maternal death, compared with women aged 20-29 years old, and this was unusual, for pregnant women in this period constitute a group at risk of maternal death, but it was distinct from the literature that shows women in this age group as a risk group due to anatomical and physiological immaturity and lack of "maturity" to assume the social role of mother.^{3,6,21-2}

CONCLUSION

In evaluating the states that make up the Northeast, it was possible to understand a bit the size of the problem, which urgently requires actions that may impact in order to reduce maternal mortality.

The actions developed by FHS lead to believe does not meet the needs of women, it is important to evaluate the actions that are developed for women by the multidisciplinary team, so as to understand why even with the Millennium Declaration, with greater coverage of the population and with the development of public health efforts should be geared to the needs of women, it was not possible to verify the reduction of MMR, by states, in the Northeast region in the period 2001-2010. Such situation is aggravated to find that over time the RMMs increased, and that groups that were already considered risk remained as such in this study with high risk of death.

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This assessment should be performed giving immediate attention to the areas of greatest risk and targeted to the groups at greatest risk of maternal death, if not possible immediate intervention in all studies, since they all have a high risk of maternal death.

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