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MEASURING EDUCATIONAL DIFFERENCES IN MORTALITY AMONG WOMEN LIVING IN HIGHLY UNEQUAL SOCIETIES WITH DEFECTIVE DATA: THE CASE OF BRAZIL

Elisenda Rentería
Cassio M. Turra

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MEASURING EDUCATIONAL DIFFERENCES IN MORTALITY AMONG WOMEN LIVING IN HIGHLY UNEQUAL SOCIETIES WITH DEFECTIVE DATA: THE CASE OF BRAZIL

Elisenda Rentería
Ph D Student in Demography – Cedeplar/Universidade Federal de Minas Gerais, Brazil

Cassio M. Turra
Associate Professor – Department of Demography and Cedeplar, UFMG, Brazil

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SUMÁRIO

RESUMO

Praticamente em todo o mundo pode ser observada uma desigualdade social e econômica na saúde e na mortalidade. Os indivíduos com menos status socioeconômico – definido, normalmente, pela educação, a renda ou a posição na ocupação – apresentam menores chances de sobreviver e maiores taxas de mortalidade que aqueles indivíduos com um status socioeconômico mais elevado (Goldman, 2001). Esta associação ocorre através de toda a distribuição das variáveis socioeconômicas, até nos grupos sociais mais elevados, definindo o que os pesquisadores chamam de gradiente social na saúde (Adler et al., 1994). Esta associação tem sido observada para os dois sexos, porém não está muito clara para as mulheres. Além disso, é uma questão pouco estudada nos países em desenvolvimento, seguramente por falta de dados confiáveis. Este é o caso do Brasil, onde apesar de existir uma grande e persistente desigualdade social e por renda, com uma grande tradição de estudos nesta área (Barros, Foguel e Ulyssea 2007), sabe-se muito pouco sobre a desigualdade na saúde ou na mortalidade. Alguns trabalhos anteriores sugerem que existe uma grande desigualdade na mortalidade por renda no Brasil (Wood & Carvalho, 1988). Porém, todos os esforços realizados para analisar desigualdade na mortalidade no Brasil, enfrentam a falta de informação, especialmente na idade adulta. Este artigo combina a informação sobre a sobrevivência e educação das mães proporcionada pela Pesquisa de Padrões de Vida (PPV) para 1996, para examinar como a mortalidade das mulheres adultas varia segundo o nível de escolaridade durante as ultimas décadas. Este trabalho contribui para a discussão dos diferenciais de mortalidade nos países desenvolvidos com falta de dados de qualidade.

ABSTRACT

Social and economic inequalities in health and mortality are widely observed around the world. Individuals with lower socioeconomic status – usually defined by education, income and occupational status – have lower chances of survival and higher morbidity rates than individuals with higher socioeconomic status (Goldman, 2001). This association extends across all the distribution of socioeconomic variables, also within the highest social groups, defining what researchers call social "gradient" in health (Adler et al., 1994). This association has been studied for both sexes, but the relationship among women remains unclear. Also, it is a question rarely studied in developing countries, mostly due to a lack of reliable information. That is the case of Brazil, were although social and income inequality has been very high and persistent over time, with a long tradition of studies in this field (Barros, Foguel e Ulyssea 2007), we know very little about health and mortality disparities. Some previous works suggest a great gap in mortality by income in Brazil (Wood & Carvalho, 1988). However, all the efforts to investigate mortality inequality in Brazil run into the lack of information, especially in adult ages. This article combines information about the mother's survival and education of respondents from a nationally representative household survey collected in Brazil in 1996 (Pesquisa de Padrões de Vida - PPV), to examine how mortality among adult women varied by level of education during the last decades. This study contributes to the discussion on the adult's mortality differentials in developing countries with defective data.

Classificação JEL: I120
Palavras-chave: Mortality Rates, Socioeconomic Status

INTRODUCTION

It has been extensively showed that individuals with lower educational levels, lower income or occupational status, have lower chances of survival and higher morbidity rates than individuals with higher socioeconomic status (Preston & Taubman, 1994; Goldman, 2001; Cutler et al., 2005). This association extends across all the distribution of socioeconomic variables, also within the highest social groups, defining what researchers call as social "gradient" in health and mortality (Adler et al., 1994).

The study of the association between adult mortality and socioeconomic status (SES) is of great importance to understand the causes and consequences of health inequality. As Preston and Taubman (1994) pointed out, examining inequality is important in itself, as societies are especially interested in knowing about the distribution of wellbeing. Also, looking at health inequalities has brought clues about the origin and causes of some diseases. Finally, studying differentials of mortality by social groups allows one to identify which groups have higher risks of mortality and morbidity and define better and more focused public health policies.

In many developed countries, particularly in the U.S., a variety of studies have shown great mortality and health differences by income, education and race (Preston & Taubman, 1994; Rogers et al., 2000; Elo & Preston, 1996; Goldman, 2001; Cutler et al., 2005). Similar patterns of inequality have been found in Canada (Wolfson et al., 1993) and in Europe, where there is a great interest in occupational disparities (Fox, 1989, Macintyre, 1997; Marmot & McDowall, 1986; Kunst et al., 1998) either.

Although there is a vast and old literature in mortality differentials by SES, the interest on this topic has been increasing in the last decades due to two findings, mainly. First, some studies have found increasing SES differentials over time, which goes against the expectation of improving distribution of health across population subgroups (Pappas et al., 1993; Preston & Elo, 1995; Kunst et al., 2004). Second, disparities in adult mortality seem to be lower at older ages than at younger ages (Kitagawa & Hauser, 1973; Elo & Preston, 1996; Lianga et al., 2005; Beckett 2000; House et al. 1994 and Hoffman, 2005), which may be caused by both selection and protection effects. These findings have intensified the debate about the role of health services for the population, particularly for the elderly.

Many of these studies include results for both sexes. Overall, they have shown that SES differentials are lower among women than among men (Feldman et al., 1989; Elo and Preston, 1996; Pappas et al., 1993; Koskinen and Martelin, 1994). However, McDonough et al. (1999) argue that these results may be misleading because of the different meanings that SES assumes for each gender. For example, when socioeconomic status is categorized using an occupation-based measure, the difficulties arise because many women are not in the paid labor force, and need to be classified according to the husband's occupation, or to the father's occupation or even as they had no occupation at all. When income is used as the SES measure, on the other hand, inconsistencies also come up because many women receive no labor income, and because women and men spend their own resources in very different ways (Pahl, 1999). To overcome all these limitations, some studies recommend the use of educational attainment to measure SES. While education can be measured for

everyone, returns from higher education are lower for women and this may affect the risk of mortality, underestimating the real mortality differentials by gender (McDonough et al. 1999). They show that measuring the relationship between socioeconomic status and mortality risk for women is a complex task and should be treated different than for men.

Although issues of SES measurement by gender may be even more relevant in the developing world, there are other primary data quality issues that preclude us for providing any estimates of adult mortality differentials by SES. Brazil, for example, is a country where social and income inequality is very high and persistent over time, with a long tradition of studies in this area (Barros, Foguel e Ulyssea 2007). However, we know very little about how the income and social inequalities translate into adult mortality disparities there. The greatest difficulty is to find reliable data to generate robust estimates. Unfortunately, Brazil doesn't have mortality follow-up studies where a socioeconomic survey is matched with death records such as those conducted in developed countries. In addition, data in Brazil (death records and demographic census) suffers from lack of information and inconsistencies in the report of socioeconomic variables. For example, death records miss, on average, almost one third of the information about education of the deceased and, certainly, missing in this case is not at random.

Despite the data issues, authors have looked for different alternatives to approach the analysis of social disparities in mortality in Brazil. One of the most prominent studies is the one from Wood and Carvalho (1988). The authors used indirect demographic methods based on infant mortality to estimate life expectancy by household income. The results show that people from higher income families can expect to live, on average, 12 years more than people living in families from the lowest income group.

Also, since Brazil is a country with large regional disparities, a great deal of studies has examined mortality differentials by region, associating the latter to a series of macroeconomic socioeconomic variables (Cerqueira & Paes, 1998; Duarte et al., 2002; Messias, 2003; Barros e Ramos, 2006; Ishitani et al., 2006). In general, these studies show that better social indicators, as such as better literacy rates, higher urbanization or higher PIB per capita, are highly correlated with lower mortality rates or greater life expectancy. Wood and Carvalho (1988) find that most of the mortality differences by region are, in fact, caused by unequal distribution of income by region, since poorer people tend to live in the less developed regions of the country. A similar pattern applies to rural-urban differences. However, in the 1960s, urban areas offered higher life expectancy only for rich families. Poorer families living in rural areas had an advantage when compared to the same SES groups in the urban sectors, probably due to the less aggressive environment they were exposed to.

Several other studies have included aggregate variables as PIB per capita, literacy rate and quality of infrastructure at a level of neighborhood or local district in the analysis of mortality disparities in an attempt to have approximations of individual characteristics (Drummond & Barros, 1999; Silva et al., 1999; Szwarcwald et al., 1999; Paes-Souza, 2002).

Other authors have ventured in the analysis of differentials mortality at individual level using occupational status data from death records (Duncan et al., 1994; Cordeiro e Silva, 2001). These studies, however, are restricted to very small areas (São Paulo State and the city of Botucatu, São Paulo, respectively), and analyze only men or do not provide results for each sex since the sample sizes are too small.

In this study we try to fill the gap in the literature by examining educational differences in mortality among women in Brazil using individual data. Extending the idea behind the orphanhood method for adult mortality, our study combines information on the survival and education of mothers, collected from the participants in the 1996 Living Standards Measurement Study (*Pesquisa sobre Padrões de Vida - PPV*). We estimate mortality rates for women at different ages and educational levels. The contribution of this study goes beyond the estimation of SES differences in mortality in a highly unequal society, as we are proposing an alternative method to estimate differences in mortality risk that could be easily applied in other populations with defective mortality data.

METHODS

Data and Variables

Data for this study comes from the Living Standards Measurement Study (Pesquisa sobre Padrões de Vida - PPV). PPV provides individual and household level data from 4,940 households located in the two largest regions of Brazil (the Northeast and the Southeast, which comprise about 70% of the Brazilian population). The Brazilian Bureau of Census (IBGE) performed all stages of the survey with the technical and financial assistance of the World Bank.

The PPV collected information on education, health, economic activity, fertility, migration, interhousehold transfers and consumption. The survey also asks about the early life conditions of the participants, including the survival status of their parents at the date of interview, the parents' level of education, their occupational status, and several other demographic and SES variables. We use education as the SES measure because, as discussed before, it is easier to collect and less susceptible to errors, particularly among women. Also, it has been shown that education is related to social status in many different ways (Preston & Taubman, 1994). Educational attainment is correlated with cognitive ability, health-related behaviors, and indicates the quality and amount of access to health information. Further, education is positively associated with occupational status and income, which determines the amount of health goods and services that individuals can purchase (Lleras-Muney, 2005).

The original PPV sample includes 19.409 people of all ages. We exclude 24 individuals for whom the difference between their ages and the mothers' ages was not feasible (more than 55 years). Also, we excluded 91 respondents who were born abroad, because the meaning of educational status may vary across countries. From the 19,294 individuals included in the study, about 22.60% had deceased mothers by the date of the interview.

Mortality Rates

The methodology of this study is inspired in the orphanhood method for adult mortality developed by Henry and Lotka and after improved by Brass and Hill (1973). The method relies upon a single question on the survival of the mother. The principle of the method is extended in this study to include information on mother's education and estimate mortality rates for different groups of women.

We estimate mortality rates for women by ten-year age groups (20-29 through 70-79) and years of schooling according to three levels of education: No schooling, 1 to 8 years of schooling, (equivalent to primary school), and 9 or more years of schooling (equivalent to secondary school or more). 792 respondents didn't answer the question about mother's educational level. While they represent a small fraction of the sample (4.1%), missing is not at random, and thus, we include them as a different category of education.

To estimate mortality rates we first calculate the time of exposure to death for all mothers. It corresponds to the time period between the respondents' date of birth (when all mothers were necessarily alive) and the date of death for mothers who died thereafter or the date of the interview for mothers who survived. We assign maternal age and date of death by using probability distributions of fertility and mortality. One of the main problems of the orphanhood method is the assumption of constant patterns of mortality and fertility. We try to avoid potential biases caused by this assumption by using different mortality and fertility functions to generate the age at death and age at maternity according to each period of exposure.

We use discrete historical fertility functions estimated by Horta, Carvalho & Frias (2000) for Brazil to randomly assign the maternal ages. We apply different period fertility functions according to the children's (respondents') age reported in PPV. To calculate age at death we randomly choose ages between maternal age and the age that the mother would have if she were alive at the time of the interview. We assume 100 years old as the highest age of survival. In addition, we use three distributions of probabilities of death to drawn ages at death, according to the period of exposure. When the median year of the time of exposure is before 1970, we apply the probabilities of dying from the 1965 Brazilian life table (Carvalho, 1974); when the period of exposure is between 1970 and 1980, we apply probabilities from the 1975 life table (Carvalho e Pinheiro, 1986); and when the median year of the time of exposure is after 1980, we apply the distribution from the 1985 life table (IBGE)[1].

Once we have all the ages assigned we use a Poisson regression to model the number of deaths by person-years lived (total time of exposure):

$$\log\left(\frac{E(deaths)}{\exp osure}\right) = \alpha + \beta_1 \cdot X \quad , \tag{1}$$

where X is a vector of covariates that includes age and education.

We estimate three regression models. First, we control only for age. In the second model, we control for age and education. Finally, in the third model, we include an interaction between age and education. We also present the estimated mortality rates by educational level for three age groups (20-29, 40-49 and 60-69).

We are aware that the errors that usually affect the orphanhood method may also bias our estimates. One source of bias comes from the selection effects in mortality. Infant mortality is higher

[1] We work with single years of age. Because life tables were constructed in 5-years age groups we use the multipliers of Karup-King (Shryock and Siegel, 1973) to ungroup the age interval. Further, to expand the probabilities of death until age 100 we use a relational model based on the adult mortality function estimated from Himes et al. (1994).

among children born from mothers who have lower education, leading to an underrepresentation of low SES groups in the sample survey. On the other hand, because of differences in fertility by SES, and since we do not distinguish the siblings in our analysis, we also expect an overrepresentation of the low SES groups in the sample survey. Unfortunately, it is not clear which effect prevails.

RESULTS

Table 1 shows the number of deaths and person-years lived by age and level of education. As expected, crude death rates increase with age and decrease at higher levels of education. Mothers with missing information on education have the highest mortality rate. Indeed because mother's death may help children forget about her SES status, we would expect a relatively larger number of deaths among the mothers of those who could not remember the mothers' education. We must emphasize however, that missing cases represents only about 4% of the whole sample size, including the deceased and the survivors.

TABLE 1
Number of deaths, person-years of exposure and mortality rates by age and education, for women in Brazil, 1996

	Deaths	Person-years	Mortality rate (x 1000)
Age			
20-29	127	62324	2.04
30-39	340	117471	2.89
40-49	566	111909	5.06
50-59	802	79925	10.03
60-69	940	47931	19.61
70-79	951	22158	42.92
Education			
no schooling	2056	190749	10.78
1-8 years of school	1173	190723	6.15
9 or + years of school	114	37248	3.06
missing	383	22997	16.65

Source: PPV 1996.

Table 2 shows the regression coefficients from the Poisson models. In the first model, which controls only for age, all age groups are statistically significant ($p<0.01$) and, as expected, positively related to deaths. Based on the regression coefficients we estimate a life expectancy at age 20 of 50.38 years. This result is similar to previous estimates of life expectancy: 49.49 years in 1975 and 50.74 years in 1980 for Brazil (IBGE, 1991). Since the median year of death in our sample is close to 1980, our results, controlling only for age, seem pretty accurate.

In the second Poisson regression model (Table 2), we add educational levels, which are all statistically significant. The coefficients for age groups are now slightly smaller, implying that part of the age effect is related to the fact that younger people are more educated. There is clearly a negative relation between education and number of deaths, controlling for age and time of exposure. Again, the missing category shows the highest mortality rates.

In the third model (Table 2) we include interaction effects between age and educational groups, since we want to examine whether education effects are different at different age groups. Not all coefficients for the interaction terms are statistically significant, although they are jointly significant (results not presented). The coefficients for the interaction terms are positive and increase with age and educational level, which suggests that educational differences in mortality are lower at older ages. This pattern confirms previous studies that claim both selection and protection effects at higher ages.

TABLE 2

Coefficients from Poisson Regressions of number of deaths by age and education for women in Brazil, 1996

	Model 1			Model 2			Model 3		
Age	Coef	S. E.	P>0	Coef	S. E.	P>0	Coef	S. E.	P>0
30-39	0.351	(0.104)	***	0.329	(0.104)	***	0.445	(0.151)	***
40-49	0.909	(0.098)	***	0.847	(0.098)	***	0.788	(0.145)	***
50-59	1.594	(0.096)	***	1.507	(0.095)	***	1.420	(0.141)	***
60-69	2.264	(0.095)	***	2.161	(0.095)	***	2.179	(0.140)	***
70-79	3.047	(0.095)	***	2.930	(0.095)	***	2.888	(0.140)	***
Education									
1-8 years of school				-0.387	(0.037)	***	-0.661	(0.203)	***
9 + years of school				-0.877	(0.097)	***	-1.340	(0.466)	***
Missing				0.395	(0.056)	***	1.250	(0.247)	***
Age*Education									
30-39*1-8 y.s.							-0.053	(0.237)	
30-39*9+ y.s.							-0.002	(0.543)	
30-39*miss							-0.875	(0.314)	***
40-49*1-8 y.s.							0.385	(0.223)	*
40-49*9+ y.s.							0.054	(0.541)	
40-49*miss							-0.762	(0.287)	***
50-59*1-8 y.s.							0.398	(0.218)	*
50-59*9+ y.s.							0.787	(0.503)	
50-59*miss							-0.736	(0.274)	***
60-69*1-8 y.s.							0.141	(0.217)	
60-69*9+ y.s.							0.516	(0.509)	
60-69*miss							-0.901	(0.270)	***
70-79*1-8 y.s.							0.394	(0.216)	*
70-79*9+ y.s.							0.791	(0.508)	
70-79*miss							-1.088	(0.273)	***
Constant	-6.196	(0.089)	***	-5.963	(0.0907)	***	-5.940	(0.132)	***

*** P>0.001, **P>0.05, *P>0.1

Source: PPV 1996

Table 3 presents mortality rates calculated from the coefficients of the third model (Table 2). Not surprisingly, mortality rates among those with less education are higher than among those with higher levels of education by about almost four times for women who are 20 to 29 years old. The educational disparities are therefore, substantial among women in Brazil. The ratio between mortality rates for women without any education and those with 9 years of schooling decreases with age, although it is still large among old women (2.28 at ages 60-69). This result confirms previous studies for other countries that suggest selection or protection effects at more advanced ages, unless that they are much higher than those observed in developed countries. In the case of the US, Pappas et al. (x), Feldman et al. (x) and Preston and Elo (x) estimated death rates for the more educated individuals were around 20% to 60% higher than those from lowest educational levels. They don't even double for men, who present higher differentials than women. In the case of Europe (Kunst et al., x), these differentials aren't bigger than 40% in any case.

TABLE 3
Mortality rates estimated (x 1000) by education and age, for women in Brazil, 1996

Age and education		Rates
20-29	no schooling	2.63
	1-8 years of school	1.36
	9 + years of school	0.69
	missing	9.19
Ratio		
no schooling/9 + y. school		3.82
40-49	no schooling	5.79
	1-8 years of school	4.39
	9 + years of school	1.60
	missing	9.43
Ratio		
no schooling/9 + y. school		3.62
60-69	no schooling	23.25
	1-8 years of school	13.83
	9 + years of school	10.20
	missing	32.97
Ratio		
no schooling/9 + y. school		2.28

Source: Author's calculations based in PPV, 1996

CONSIDERATIONS

In this article, we estimate mortality rates among adult women using information on the survival and education of mothers from respondents of a household survey in Brazil. Our study applies a methodology that has its roots on the traditional orphanhood method for adult mortality, allowing us not only to estimate female mortality rates by level of education at the individual level for the first time in Brazil, but also to analyze how these differentials vary by age and education simultaneously. We believe this method could be applied in other countries that face the same data quality issues. It is particularly useful to measure differentials in female mortality since the information on the survival of the mothers is known to be superior to the information on the survival of the fathers (United Nations, 1983).

Our results agree with the international literature in showing larger mortality rates for women with lower education. We show that the differences by educational levels for adult women are not trivial at all: mortality is about three to four times higher among the lowest educational group compared to the highest one. The differences reduce slightly at higher ages, suggesting that protection or selection effects may also operate also among Brazilian women.

Our results certainly call the attention for the harsher face of socioeconomic disparities in Brazil. Ignoring educational differences in adult mortality seems to be unacceptable in a country so unequal. Combining this type information with that of changes in the distribution of educational level among women will make possible to predict how public policies that promote the expansion of education will affect the general level in mortality.

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