Infant Mortality and Mother's Religious Involvement in Brazil

Abstract

Although several variables have been recognized as determinants of infant mortality in Brazil, almost no attention has been given to the implications of religion involvement for this phenomenon. This paper helps to fill this gap employing data from the 1996 Brazil Demographic Health Survey (DHS) and a Cox proportional hazards model to examine the potential association between infant morality and mother's religious attendance. Unadjusted results show that differences in the hazard ratios of infant mortality by mother's religious attendance are large in magnitude and statistically significant. When controlling for demographic and socioeconomic variables, the baseline relationship is reduced, but mother's religious attendance is still associated with the risk of infant mortality. However, results also show that the pattern of the relationship between religious attendance and infant mortality is unclear. This study suggests the notion of mixed effects of religious participation on individual behavior as a potential explanation for this pattern.

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Introduction

The developing world witnessed a substantial decline in child and infant mortality during the 1990s, although the latter has declined to a lesser degree. The average decline in child mortality in developing settings was larger among children between 2 and 4 years of age (10.5% decrease) while among infants there was a 4% decrease. Moreover, infant deaths occurring during the neonatal and post-neonatal periods were marked by differences in the pace of reduction. A faster decline in deaths occurring in the post-neonatal period has caused an increasing proportion of infant deaths in the neonatal period, which is now accounting for two-thirds of deaths among children younger than one year old (Machado and Hill, 2003).

However, even after experiencing declines in infant mortality rates during the 1990s, some Latin American countries still display relatively high rates. According to the Population Reference Bureau (PRB), the Latin American infant mortality rate was 31/1,000 in 2001, which also varies considerably across nations. Some countries such as Chile, Uruguay, and Argentina presented relatively low infant mortality rates (10, 17, and 19/1,000 respectively) when compared to countries like Peru and Bolivia, which exhibited rates equal to 41 and 63 infant deaths per 1,000 births, respectively, in 2001 (PRB). In the same year, the Brazilian infant mortality rate (35/1,000) was somewhat higher than the average for the Latin American countries.

Machado and Hill (2003) provide a detailed analysis of the most important determinants of infant mortality in Brazil, using information obtained from the 1998 birth cohort from the city of São Paulo, the largest city of Brazil. These authors employed a set

of demographic, socio-economic, and health variables, as well as birth outcomes that are described in the literature as most likely to exert an effect on infant survival (Rutstein, 2000). The main results found by Machado and Hill (2003) showed that infants of adolescent mothers were more likely to die, as well as infants who were born at parities four or higher, low number of prenatal care visits, low birth weight, preterm birth and low Apgar scores were also associated with higher neonatal mortality. Moreover, mothers living in the most developed areas in the city of São Paulo had a decreased likelihood of infant death.

Virtually nothing is known about the implications of religion participation for infant or child mortality in Brazil. One of the few works which has contributed to this topic was done by Wood, Williams, and Chijiwa (2007). These authors analyzed the association between Protestantism and child mortality in Northeast Brazil in 2000. They were particularly interested in testing the hypothesis that the welfare of children (measured as child mortality) is associated with mother's religious affiliation. They have uncovered that children born to Protestant mothers are significantly more likely to survive childhood compared to children born to Catholic mothers. This finding is compelling enough to encourage further research, since there has been an explosive growth of Protestantism during the last 20 years in Brazil as well as in other Latin American countries (Chesnut, 2003; 1997). Furthermore, Wood, Williams, and Chijiwa (2007) were able to separate Protestants into traditional and Pentecostal subgroups, and demonstrated that the traditional subgroups had a lower mortality than the children of Pentecostal Protestants.

Brazil is the largest Catholic country in the world, although there has been a substantial reduction in the percentage of Catholics in recent decades, as found in census interviews. In 1980, for the first time, the percentage of Catholics fell below 90%; by 1991 and 2000, this percentage dropped to 83% and 74%, respectively. On the other hand, the percentage of individuals who identified themselves as being Protestants or as having no religion has increased. Protestants or Evangelicals, for instance, increased their participation from 2.6% in 1940 to 15.4% in 2000 (Mariano, 2004).

The growth of Protestantism in Brazil may be related to changes in behaviors and attitudes that may affect mortality and health-related outcomes. Some researchers have suggested, for instance, that Protestantism, and more recently, Pentecostalism may positively change behavior with regard to alcohol use, drug use, poverty, and violence (Chesnut, 1997 and 2003). These changes are very often translated into changes in male behavior, which can affect gender relations and equity, values of family life and the welfare of the household, and encourage the responsible fathering of children (Wood, Willians, and Chijiwa, 2007; McKinnon, Potter and Garrard-Burnett, 2006).

These recent transformations in the religious landscape in Brazil are likely to improve the welfare of infants and children, including positive results in their health outcomes and risk of death. Trying to understand better this connection, the purpose of this article is to examine the potential association between religion and infant mortality in Brazil. This study employs mother's religious service attendance as the measure of religiosity.

Previous Research

A substantial body of research documents that religion has widespread effects on the demographic behavior of individuals in the United States (Regnerus, 2007; Lehrer, 2004; Musick, House and Williams, 2004; Koenig, McCullough and Larson, 2000), including choices that affect health and mortality. The association between religion and health-related outcomes has received increasing attention in recent decades and revealed potential health benefits linked to religion participation (Hummer *et al.*, 2004, Hummer *et al.*, 1999; Ellison and Levin, 1998).

Classic and recent studies have conceptualized religious participation as a social phenomenon, which takes a variety of forms and measurements. Some of these studies have suggested different dimensions of religious participation that should be considered in the analyses of the religion-mortality association. They have focused on four major measures of religiosity, which include: (1) public participation (e.g., attendance at religious services); (2) religious affiliation (e.g., specific denominational affiliation); (3) private religious practices (e.g., prayer and mediation); and (4) religious coping (when individuals turn to religion when coping with problems) (George, Ellison, and Larson 2002).

In general, these dimensions of religion have been linked to positive heath outcomes. Studies have found, for instance, an inverse relationship between religious attendance frequency and U.S. adult mortality (Hummer *et al.*, 2004; Hummer *et al.*, 1999) illnesses, and time to recover from illness. Also, those individuals who attend religious services more often seem to live longer than those who attend less frequently (George, Ellison, and Larson, 2002). In terms of religious denominational differences in

mortality, researchers have given especial attention to religious groups with distinctive lifestyle guidelines, such as Mormons and Seventh Day Adventists (Hummer *et al.*, 2004). These religious denominations have been also linked to lower mortality risks and positive health outcomes.

Despite the lack of research on the religion-mortality associations in Latin American countries, there has been an increasing interest in better understanding such a connection in sub-Saharan African countries. Gyimah (2007), for instance, has investigated whether there are differences in child mortality by religious affiliation among infants born in Ghana in the five years preceding the 1998 and 2003 Demographic and Health Surveys. Using mother's denominational religion information, Gyimah (2007) found at the bivariate level that children of Muslim and Traditional women have a significantly higher risk of death than their counterparts whose mother identified themselves as Christians. However, after controlling for socioeconomic factors, the effect of religion decreased, giving support to the selectivity hypothesis.

In another study, Gyimah, Takyi, and Addai (2006) also using data from Ghana, tested the hypothesis of whether there is a relationship between religious affiliation and the use of maternal and child health services, and whether or not this association is mediated through socioeconomic, socio-cultural and demographic variables. They found that even when controlling for these factors, the religion effect was large and statistically significant. They concluded by calling attention to the potential power that religion may have on maternal and child health service utilization in Ghana, through social support networks and diffusion of health-related ideas.

Conceptual Framework and Hypotheses

Recent studies have suggested some hypotheses with regard to whether and how religious involvement may influence mortality and health outcomes. The first approach focuses on the notion that sacred teachings, beliefs and values offered by religious groups may directly affect mortality and health. This notion is sometimes called the 'particularized theology' pathway (Gyimah, 2007) and derives from the idea that religion often claims a strong therapeutic component and it is important enough to effect mortality and health regardless of other factors (Gyimah *et al.*, 2006). Such an approach, however, is not supported by any direct scientific evidence.

Other researchers have suggested that particular types of religious variables may be associated with certain behavioral constructs that are related to mortality and health (Ellison and Levin, 1998). This association very often leads to positive health outcomes, although some negative ones can be uncovered. Ellison and Levin (1998) have provided a set of the most important possible mechanisms or pathways for the religion-health connection. In fact, they emphasize seven indirect ways through, which religion can be associated with mortality and health. These pathways include: (1) regulation of individual lifestyles and health behaviors; (2) provision of social resources; (3) promotion of positive self-perceptions; (4) provision of specific coping resources; (5) generation of other positive outcomes; (6) promotion of health believes; and (7) additional hypothesized mechanisms, such as the existence of a heading bio-energy (Ellison and Levin, 1998, page 703).

Some of these possible mechanisms are also highlighted in Hummer *et al.* (2004) more succinctly suggest that the concepts of social integration and social regulation are

mechanisms through which religious variables influence health and mortality. The first concept refers to social ties and formal or informal support that result from involvement in a religious community. For instance, individuals who more religiously involved within their community may have more friendship networks and/or a lower likelihood of divorce, which might be strongly associated with lower adult mortality risks (Hummer *et al.*, 2004). Moreover, higher levels of social support may promote better health and longer life among religious people (George, Ellison, and Larson, 2002).

The second concept, social regulation, refers to the fact that religious communities may shape members' behaviors through regulations specified in sacred teachings, and in messages from congregational leaders. Certainly, individuals who are more socially integrated in religious communities may benefit more from those teachings. Hummer and colleagues, therefore, have associated religious involvement with some positive outcomes of health and mortality through the mechanisms of religious teachings, norms and values, and social interaction of the religious community members. Some examples of behavioral regulations that may contribute to positive health outcomes are the reduced use of alcohol and drugs, and distinctive values about the importance of physical activity, encouraging healthy dietary patterns and exercise regimes, and also preventive health care utilization (Hummer *et al.*, 1999). Furthermore, Hummer *et al.*, (2004) emphasized that social regulation may be related to fewer day-by-day stressors (such as divorce) and norms against exhibiting violent behavior. Moreover, George, Ellison, and Larson, (2002) have highlighted that most religions teach members to respect and take care of their bodies, encouraging them to adhere to the tenet that "the body is the temple of the soul".

Finally, two other mechanisms that may partially explain the health benefits of religious participation are (1) psychological resources, such as self-esteem, self-efficacy, and mastery, and (2) sense of coherence or meaning. However, as George, Ellison, and Larson (2002) pointed out, empirical evidence to date on these possible pathways by which religion promotes health are mixed or unclear and additional research on them is badly needed.

The hypothesis explained above suggests that associations between religious involvement and mortality work through indirect mechanisms. However, in fact, the 'selectivity approach' suggests something different. As Hummer *et al.*, (2004, page 1227) have pointed out: the basic idea inherent to the selectivity hypothesis is that people who are more religiously involved may differ in key ways from others who are less involved, and such differences may be the real reasons behind an observed relation between religious involvement and mortality risks.

This question of selectivity is of crucial importance, since it can help to successfully reveal or clarify the association between religion and demographic variables, such as mortality. Moreover, if these mechanisms can be properly established, it may be possible to provide them in ways that are acceptable to people unwilling to participate in religion (George, Ellison, and Larson, 2002).

The selectivity hypothesis is usually tested through multivariate models that are able to statically control key variables and isolate the residual effect of religion. Religious groups, for example, may have different mortality levels because of differences in essential characteristics, such as socio-economic and demographic variables (Van Poppel, Schellekens, and Liefbroer 2002), which can be controlled in multivariate models.

However, it is important to highlight that some confounding and mediating factors of the association between religion and mortality may not be measurable, making even more difficult the understanding of the religion-mortality association. Furthermore, some theoretical works have shown that the association between religious involvement and health and mortality is multifactorial in origin and that statistical models are not able to report the entire set of effects (Hummer *et al.*, 1999; Ellison and Levin, 1998).

Data and Methods

The data for this work come from the 1996 Brazilian Demographic and Health Survey (DHS) children's file. This is a nationally representative survey of women aged 15-49 years, and detailed information on socio-demographic variables and child health. The sample design was based on a probabilistic two-stage sample using enumeration areas (EAs). Insides these EAs, households and selected women within them were then interviewed. The total sample was composed of 12,612 women, from which 5,045 had at least one child in the five years preceding the survey. This work was restricted to the analysis of these recent births. This decision was made in part because the quality of information on them is better than for those born several years ago and also because the use of this sample may reduce the occurrence of changing behaviors related to previous and current conditions.

The dependent variable is the risk of death of the newborn children before one year of age (0-12 months) measured as duration from birth to the age at death or censoring. Although the DHS children's file contains information for children born five years preceding the survey, the question about age at death was collected only from those

mothers who lost their child by the age of two. From the sample of 5,045 children born between 1991 and 1996, 227 died before turning two years of age (although only 12 died between 13 and 24 months of life). Because roughly 95% of all information about age at death was concentrated among child deaths younger than one year old, this study has restricted the analysis to them. That is, as mentioned above, this study will focus on predicting the risk of infant mortality (deaths before the first birthday).

It is worth mentioning that the majority of those children in the DHS sample were right censored at the time of the survey. In order to account for censoring in the estimation of exposure time, an event history model may be employed. Thus, the Cox proportional hazards mode is used here (Allison, 2005).

Since the objective of this study is to examine whether mother's religious participation is associated with infant mortality, the main independent variable employed is the frequency of mother's religious attendance. This information was captured through the following question: "How often do you go to church, temple, or other religious services?" Women were requested to choose one out of five options, which are: once a week, twice a month, once a month, less than once a month, and never. In order to ease the descriptive and statistical analyses, the last four categories were aggregated into two groups. Thus, mothers who responded that they usually go to church twice and once a month were placed together in one group, while those who identify low religious attendance (less then once a month and never) were combined to form the third and last category of the religious attendance variable. Those who report attending church or services most frequently (once a week or more) are the reference group.

As mentioned above, many factors are viewed as mediating the relationship between religious attendance and infant mortality. Therefore, this work controls for some factors such as demographic, socioeconomic, and household variables traditionally known to affect child mortality and that could be viewed as confounding variables or mediating variables for the attendance-mortality association. The demographic controls used in this study are the mother's race, geographic region and place of residence. Mother's race is measured as a white-nonwhite dichotomous variable. Those mothers who identified themselves as nonwhite are the reference group. Geographic region of residence is broken down into five categories, which include "South, Rio de Janeiro and São Paulo", "Middle West", "Middle East", "Northeast", and "North". Northeast was demarcated as the reference group because it is the poorest region in Brazil. Finally, place of residence is measured as urban or rural area, in which the latter is the reference category.

The socioeconomic variables included here are mother's education, marital status, four measures of household assets, and two measures of housing quality. Maternal education was originally categorized into four groups: "No education", "Primary Level", "Secondary Level", and "Higher than Secondary Level". Because the latter group represents a small number of mothers in the sample, it was aggregated together with the third group (secondary level). The first category (mothers with no education) is defined as the reference group. Maternal education and infant mortality are strongly related, this is due to the higher income of well-educated women, which would promote access to more appropriate pre-natal and health care and a better diet.

Moreover, education increases knowledge about health practices (e.g., hygiene, nutrition), healthy behavior during pregnancy (Landale *et al.*, 2000), increases women's ability to access information, and is associated with female autonomy. Women with more education are also more able to negotiate the health care system and overcome obstacles to prenatal care. Such arguments indicate that maternal education should be negatively related to infant mortality.

Marital Status can be an important socioeconomic intermediating variable too because infants born to unmarried women may be at higher risk at mortality as a consequence of inadequate familial resources (Eberstein, Nam, and Hummer, 1990). Answers to marital status were divided into three categories: "Married", "Cohabitating", and "Unmarried and not cohabitating", (where the latter includes those who are single, divorced, widows, and not living together[1]). The first group (married) is the reference category.

Also incorporated as measures of socioeconomic status are the possession of four assets in the household, including electricity, a radio, a television, and a refrigerator. For these assets, the reference category is the answer "no", which means that the mother's household does not possess the asset.

Two other household variables were also employed as controls: household water source and toilet facility. Both were divided into three sub-groups "Piped" (the reference group), "Well", and "Others" are the categories for the water source variable, and "Toilet" (the reference group), "Latrine", and "No Facility" represent the toilet facility information. These are variables of housing quality, which are strongly associated with socioeconomic status or standard of living; they might affect the risk of infant mortality.

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[1] This group is formed by women who had partner but were not living together with him.

Infants living in houses with piped water and with a toilet are expected to have lower mortality.

Finally, another variable included in the analysis is the mother's age at first birth, which was broken down into two categories: less than 20 years of age and 20 or more years. Teenage childbearing has been recognized in some studies as a social response to socioeconomic disadvantages, which could expose women to environmental factors that elevate infant mortality (Geronimus, 1987). Teenage motherhood in Brazil is increasing more concentrated among socioeconomically disadvantaged populations, especially among the least-educated women, those with lower income, and residents of urban areas (Berquó and Cavenaghi, 2005). In a study about the determinants of neonatal and post-neonatal mortality in São Paulo City, Machado and Hill (2003) observed that infants of adolescent mothers had substantially higher odds of dying both in the neonatal and in the post-neonatal periods as compared to infants of mothers 20 to 24 years old. This difference was statistically significant and net of demographic, socioeconomic, and child health variables.

In sum, as discussed above, in order to determine whether mother's religious involvement may be associated with infant mortality, this paper will control for demographic, socioeconomic and housing quality variables.

Findings

Table 1 presents the weighted descriptive statistics for mother's religious attendance and independent variables for the entire sample composed by all births (colummm1) and for infant deaths (column 2) (both occurring between 1991 and 1996 in

Brazil). The religious attendance variable shows that births to mothers who attend religious services once a week exhibit a lower percentage of deaths (22%) relative to those who attend less frequently. The percentage of births to mothers who attend weekly (31%) is also lower than those of mothers who attend once a month or never (46%).

Those mothers who are white, with parity equal to one, more educated (secondary level and higher), and older than 20 when had their first child have children less likely to die. On the other hand, more than 50% of the infant deaths are among mothers who lived in the Northeast of Brazil, although these mothers are responsible for just 34% of all births between 1991 and 1996. Those living in urban areas have children more likely to die before age one (61%); however, the percentage of those mothers living in these areas is higher (75%). Marital status seems to follow the same pattern. That is, although 46% of all infant deaths occur among married mothers, these women contributed to 60% of all births.

The household characteristics variables in Table 1 show that mothers living in household with toilet facilities, a better quality household water source, and assets such as television and refrigerator, gave birth to infants less likely to die.

Table 1 - Weighted descriptive statistics of religious attendance and independent variables for infant deaths and the entire sample (births): Brazil 1996

Variables	Deaths	Births
Religion Attendance		
Once a week	22%	31%
Once or Twice a month	28%	23%
Less than once a month or don't attend	50%	46%
Demographic Variables		
Mother's race		
White	23%	37%
Parity		
One	8%	25%
Two	26%	31%
Three or more	66%	44%
Place of residence		
urban	62%	75%
Regions		
South, RJ, SP	27%	41%
Middle west	10%	12%
Northeast	52%	34%
North	5%	5%
Middle east	7%	7%
Socioeconomic variables		
Mother's education		
No education	14%	7%
Primary	49%	40%
Secondary and higher	37%	53%
Marital Status		
Married	46%	60%
Cohabitating	36%	25%
Not living together	18%	16%
Mother's age at first birth		
Younger than 20	67%	47%
20 and over	33%	53%
Household water source		
Piped	54%	68%
Well	37%	25%
Other	9%	7%
Toilet Facility		
Toilet	23%	39%
Latrine	41%	43%
No facility	36%	18%

(Table 1- Continued)

Variables	Deaths	Births
Household Assets		
Electricity – yes	83%	90%
Radio – yes	74%	83%
Television – yes	35%	57%
Refrigerator – yes	40%	66%
Unweighted Sample	215	5,033

Source: The 1996 Brazilian Demographic and Health Survey

Table 2 shows the bivariate distribution of births and deaths, as well as the unadjusted effects of the independent variables on infant mortality. The results display mother's religious attendance differences in infant mortality at the bivariate level. Among mothers who attended services weekly, there were 30 deaths per 1,000 births, while this rate increases to 53 among mothers who attended services once or twice a month and 49 for those who attended less than once a month or never. The unadjusted effects of mother's religious attendance suggest that the risk of death is about 81% higher among children born to mothers who attended twice or once a month compared with those who attended weekly. The risk ratio is 67% higher among children born to mothers who attended less than once a month or who never attend when compared with the reference group. However, when comparing those who attended twice or once a month and those who attended less frequently, the difference is not statistically significant (test not shown).

The unadjusted effects of the mother's education and race variables show that the hazard ratio of infant mortality for children born to more-educated and white mothers is lower when compared with their counterparts. The effects of region and place of residence are also consistent with what previous studies have shown. That is, infants born

to women who were living in the Northeast and rural areas in Brazil exhibit higher risk of mortality than those living in other regions and urban areas. With regard to household variables and assets, Table 2 shows that lower mortality risk ratios are observed among children whose mothers live in households with toilet facilities and piped water, as well as those with electricity, a radio, a television, and a refrigerator.

Table 2 - Bivariate distribution of births, deaths and unadjusted infant mortality risk rations, Brazil 1996

Variables	Deaths	Births	Deaths per 1000 births	Unadjusted risk ratios (exp b)
Religion Attendance				
Once a week	41	1,446	28	1.00
Once or Twice a month	62	1,234	50	1.79***
Less than once a month or don't attend	110	2,347	47	1.67***
Demographic Variables				
Mother's race				
White	40	1,664	24	1.00
Non-White	175	3,369	52	2.18***
Parity				
One	18	1,214	15	1.00
Two	56	1,524	37	2.50***
Three or more	141	2,295	61	4.21***
Place of residence				
urban	126	3,732	34	1.00
rural	89	1,301	68	2.05***
Regions				
South, RJ, SP	31	1,208	26	0.43***
Middle west	15	496	30	0.51**
Northeast	131	2,239	59	1.00
North	19	551	34	0.58**
Middle east	19	539	35	0.60***
Socioeconomic variables				
Mother's education				
No education	35	412	85	3.06***
Primary	108	2,066	52	2.87***
Secondary and Higher	72	2,555	28	1.00

Variables	Deaths	Births	Deaths per 1000 births	Unadjusted risk ratios (exp b)
Marital Status				
Married	92	2,903	32	1.00
Cohabitating	86	1,332	65	2.01***
Not living together	37	798	46	1.47**
Mother's age at first birth				
Younger than 20	144	2,508	57	1.00
20 and over	71	2,525	28	0.48***
Household water source				
Piped	104	3,212	32	1.00
Well	88	1,423	62	1.93***
Other	23	398	58	1.80*
Television				
no	156	2,444	64	1.00
yes	59	2,581	23	0.35***
Refrigerator				
no	138	1,977	70	1.00
yes	77	3,048	25	0.35***
Unweighted Sample	215	5,033		

Source: The 1996 Brazilian Demographic Health Survey;
† p<0.1 * p<0.05 ** p<0.01 ***p<0.001

Table 3 provides multivariate models of mother's religious attendance and infant mortality. The first model of Table 3 (Model 1) displays the baseline mother's religious attendance and infant mortality relationship, controlling for demographic variables, which are: mother's race, parity, place of residence, and geographic region. The hazard ratios show that mothers who most often attended services had infants with the lowest mortality risk. Compared with those who attended services weekly, mothers who attended once or twice a month had infants with a 56% higher risk of dying, and those who attended less than once a month or never, had infants with a 40% higher risk of dying during their first year of life. Although the infant mortality risk decreases from 56% to 40% when comparing mothers who attended once or twice a month with those who attended less than once a month or never (both comparisons with the reference

group), these groups, when compared with each others, display hazard ratios that are not statistically different.

Table 3 – Multivariate analyses including hazard ratios of infant mortality by mother's religious attendance and other variables: Brazil 1996

Variables	Model 1	Model 2	Model 3
Religion Attendance			
Once a week	—	—	—
Once or Twice a month	1.56*	1.42†	1.43†
Less than once a month or don't attend	1.40†	1.28	1.25
Demographic Variables			
Mother's race			
White	—		—
Non-White	1.78**		1.53*
Parity			
One	—		—
Two	2.35***		2.31**
Three or more	3.43***		2.99***
Place of residence			
urban	—		—
rural	1.51**		1.13
Regions			
South, RJ, SP	0.69		1.03
Middle west	0.69		0.97
Northeast	—		—
North	0.77		0.75
Middle east	0.87		1.07
Socioeconomic variables			
Mother's education			
No education		—	—
Primary		0.79	0.88
Secondary and Higher		0.71	0.92
Marital Status			
Married		—	—
Cohabitating		1.57**	1.57**
Not living together		1.35	1.62*
Mother's age at first birth			
Younger than 20		—	—
20 and over		0.66**	0.69*

(Table 3, Continued)

Variables	Model 1	Model 2	Model 3
Household water source			
Piped		—	—
Well		1.32 †	1.32
Other		1.28	1.27
Toilet Facility			
Toilet		—	—
Latrine		1.22	1.23
No facility		1.61*	1.52†
Household Assets			
Electricity			
no		—	—
yes		1.33	1.35
Radio			
no		—	—
yes		1.10	1.10
Television			
no		—	—
yes		0.65*	0.71†
Refrigerator			
no		—	—
yes		0.65*	0.71†
- 2 Log likelihood	3516.12	3497.04	3466.93

Source: The 1996 Brazilian Demographic Health Survey;
† p<0.1 * p<0.05 ** p<0.01 ***p<0.001

Model 2 of Table 3 includes socioeconomic variables, which are mother's education, marital status, mother's age at first birth, household water source, toilet facility, and the possession of some household assets. This model keeps the demographic variables out. To some extent, Model 2 alters the magnitude of the association between mother's religious attendance and infant mortality, as well as the results for the test of statistical significance for the hazard ratios. Indeed, mothers who most often attended religious services still had infants with the lowest mortality risk. Compared with those who attended services weekly, mothers who attended once or twice a month gave birth to

infants with 42% higher risks of dying, and mothers who attended less than once a month or never, had infants with 28% higher risks of dying during their first year of life (a nonsignificant difference).

Finally, Model 3 of Table 3 includes all demographic and socioeconomic variables simultaneously. It displays hazard ratios of infant mortality by mother's religious attendance almost identical to those show in Model 2. Such similarity may indicate that the inclusion of demographic variables has little or no influence on the association between mother's religious attendance and infant mortality when the socioeconomic variables are also incorporated as controls.

Conclusion

Notwithstanding the declines in infant mortality observed in recent years, rates are still relatively high in many Latin American countries, including Brazil. Although several variables have been recognized as determinants of these rates, almost no attention has been given to religion participation as a social phenomenon, which may affect infant mortality in Brazil. This paper tries to reduce this gap and employs data from the 1996 DHS to examine whether there exists an association between infant mortality and mother's religion attendance in Brazil.

The results of this paper show that mother's religious involvement is associated with infant mortality in Brazil, although not in a graded fashion. Findings for the unadjusted models show that differences in the hazard ratios of infant mortality by mother's religious attendance are large in magnitude and statistically significant. When controlling for demographic and socioeconomic variables, the baseline relationship is

reduced, but mother's religious attendance is still associated with the risk of infant mortality.

The multivariate results show that those births to mothers who attended services weekly exhibit lower risk of infant mortality than those births to mothers who (1) attended services once or twice a month, and (2) less than once a month or never. However, the hazard ratio for the latter group is smaller in magnitude (when compared to mothers who attended once or twice a month) and does not reach statistical significance. The results of this paper indicate, therefore, the existence of a protective role of mother's religious service attendance against infant mortality in Brazil.

One possible explanation for the highest hazard rates of infant mortality exhibited by those births to mothers who attended services once or twice a month is based on the notion of mixed effects of religious participation, either positive or negative, on individual behavior and health. As mentioned before, although religious involvement may produce positive outcomes, it may also have undesirable consequences to health and mortality (Koenig, McCullough and Larson, 2000). Social norms and pressures can increase the negative consequences of certain stressors, which may be framed as "sins", for instance, and thus attributing responsibilities for events or conditions to the flawed character of the individuals. This framing can encourage feelings of guilt, shame, and fear and/or lead to feelings of competence, self-worth, and hopefulness (Ellison and Levin, 1998). Moreover, religious congregations may practice rules and teachings against the use of certain technologies and medical treatments, which could promote better health outcomes and reduce the risk of infant mortality.

Consequently, to some extent, mothers who attend services less frequently – less than once month or never - are less or not exposed to these and other potential negative influences associated to religious involvement while mothers who attend once or twice a month may be affected by them. Nevertheless, among those mothers who attend religious services weekly and, hence, seem to be more convinced about the importance of their religiosity in their lives, the positive effects of religion might overcome the potential negative ones.

One important limitation of this study is the cross-sectional nature of the data, which makes it impossible to work with the notion of causal effects when analyzing the relationship between mother's religious attendance and infant mortality. It is not clear, for instance, whether or not some mothers may have changed their religious attitudes and behaviors (e.g., going more or less often to church, or converting from one religion to another) after the birth and/or death of their infants. Therefore, the use of cross-sectional data, such as the DHS, does not allow for the modeling of observing the causal direction of the relationship, that is, which event has caused the change and which has experienced the impact of the change. This kind of information is very often obtained through longitudinal data in which individuals are followed over time, or even using qualitative data, which permits asking in-depth and detailed questions regarding the time order of the events of interest.

Another limitation of this study is the lack of inclusion of health and social ties variables as controls for the association between mother's religious association and infant mortality. As the selectivity hypothesis for such a connection have suggested, these variables are probable confounding and mediating factors, through which religion can be

indirectly associated with mortality and health. Therefore, they should be included in the statistical models as control variables. Future work should explore how other mediating factors, such as health behavior and social ties, may work to link mother's religious participation and infant mortality in Brazil.

Finally, future studies should also pay attention to the usefulness of qualitative data in research on associations between mother's religion and infant mortality in Brazil. In-depth interviews and focus groups, for instance, may be essential in clarifying the causal direction, multiple mechanisms, and complex ways through which such associations are constructed.

References:

Allison, PD. Survival analysis using SAS: a practical guide. Cary, NC: SAS press, 2005.

Berquó, E, Cavenaghi, S. Increasing adolescent and youth fertility in Brazil: a new trend or a one-time event? Presented at the Annual Meeting of the Population Association of America, Philadelphia, Pennsylvania, March 30 to April 2, 2005.

Chesnut, A. Born again in Brazil: The Pentecostal boom and the pathogens of poverty. New Brunswick, NJ: Rutgers University Press, 1997.

Chesnut, A. Competitive Spirits: Latin American's new religious economy. New York , NY. Oxford University Press, Inc, 2003.

Eberstein, IW, Nam CB, Hummer RA. Infant mortality by cause: main and interaction effects. Demography, 1990: 27: 413-30.

Ellison CG, Levin JS. The religion-health connection: evidence, theory, and future directions. Health Education Behavior, 1998; 25: 700-20.

George LK, Ellison CG, and Larson DB. Explaining the relationships between religious involvement and health. Psychological Inquiry, 2002; 13 (3): 190-200.

Geronimus, AT. (1987) On Teenage Childbearing and Neonatal Mortality in the United States. Population and Development Review 13: 245-280.

Gyimah, SO, Takyi BK, and Addai I. Challenges to the reproductive-health needs of African women: On religion and maternal health utilization in Ghana. Social Science & Medicine 62 (2006) 2930-2944.

Gyimah, SO. What has faith got to do with it? Religion and child survival in Ghana. J.biosoc.sci (2007) 39, 923-937.

Hummer RA, Ellison CG, Rogers RG, Moulton BE, Romero RR. Religious involvement and adult mortality in the United States: renew and perspectives. Sout Med J 2004; 97: 1223-30.

Hummer RA, Rogers RG, Nam CB and Ellison CG. Religious involvement and U.S. adult mortality. Demography, 1999, 36: 273-285.

Hummer RA. Commentary: Understanding religious involvement and mortality risk in the United States: comment on Bagiella, Hong, and Sloan. International Journal of Epidemiology, 2005; 35: 452-453.

Koenig HG, McCullough ME and Larson DB. Handbook of religion and health. Oxford: Oxford University Press, 2001.

Landale NS, Oropesa RS, Gorman BK (2000). Migration and infant death: Assimilation or selective migration among Puerto Ricans? American Sociological Review. 65 (6): 888-909.

Lehrer, EL. Religion as a determinant of economic and demographic behavior in the United States. Population and Development Review, 2004, 30(4): 707-726

Machado, C J, Hill, K. Determinants of neonatal and post-neonatal mortality in the City of São Paulo, *Revista Brasileira de Epidemiologia*, v. 6, n. 4, 2003.

Mariano R (2004) "Expansão pentecostal no Brasil: o caso da Igreja Universal". *Estudos Avançados*, v.18 (52), p.121-138.

McKinnon S, Potter J E, Garrad-Burnett V. The impact of Protestantism on Fertility Behaviors of Adolescents in Rio de Janeiro, Brazil. In: Meeting of the Population Association of America; 2006 March 30 to April 1; Los Angeles: Population Association of America.

Musick MA, House JS, Williams DR. Attendance at religious services and mortality in a national sample. Journal of Health and Social Behavior, 2004, 45: 198-213.

Regnerus, MD. Forbidden Fruit: sex and religion in the lives of American Teenagers. New York: Oxford University Press.

Rutstein, SO. Factors associated with trends in infant and child mortality in developing countries during the 1900s. Bull World Health Organ 2000; 78: 1256-70.

Van Poppel F, Schellekens J, Liefbroer A C. Religious differentials in infant and child mortality in Holland, 1855-1912. *Population Studies* 2002; 56:277-289

Wood C., Williams P., and Chijiwa K. Protestantism and child mortality in Northeast Brazil, 2000. Journal for the Scientific Study of Religion (2007) 46 (3): 405 – 416

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