Hindu-Muslim Differentials in Child Mortality in India

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Abstract

In India, Muslim children exhibit lower child mortality than Hindu children, in spite of the fact that, on average, their mothers are poorer and less educated -- characteristics typically associated with higher child mortality. Using data from the National Family and Health Survey (NFHS-1, -2 and -3), we seek explanations for this paradox. We test the hypothesis that this paradox may be explained by lower son preference among Muslims. Indeed, lower son preference could produce a more typical pattern of sex differentials in mortality among Muslims and generate lower child mortality among them at the national level, compensating for their lower socio-economic status. However, we find no evidence for this hypothesis in the NFHS data. We find that Muslims are subject to a number of advantages, in addition to the better known disadvantages, which appear to contribute to their lower child mortality. However, part of the Muslim mortality advantage remains unexplained.

Introduction

India's population includes adherents to a large variety of religions, including Hindus, Muslims, Sikhs, Christians, Parsis, Buddhists, Jains, and others. Hindus constitute the majority of the Indian population, comprising 80.5% of Indians as of the 2001 census. Given India's large population of over one billion, however, many other religious groups form sizeable minorities. Muslims form the largest of these minorities. The 2001 census enumerated 138 million Muslims, representing 13.4% of the total Indian population. India's Muslim population is the second largest in the world (Indonesia being the first). In fact, there are more Muslims in India than in Pakistan.

Muslims constitute an underprivileged minority in India, ranking below Hindus in many respects. In 2005, a committee was gathered to conduct a systematic study of the social, economic and educational status of the Muslim community of India. The report of this commission, referred to as the Sachar report, concludes that Muslims "exhibit deficits and deprivation in practically all dimensions of development" (Sachar 2006, p. 237). The deficits are particularly salient in the areas of female schooling and economic status.

One surprising exception to this negative picture is the fact that Muslims have been experiencing lower levels of child mortality than Hindus. This result, which stands out as an exception in the Sachar report, seems paradoxical, because variables such as maternal education and income are typically negatively associated with mortality. Throughout the world, subgroups with lower socio-economic status tend to experience higher child mortality than groups with higher socio-economic status.

In this paper, we discuss the various hypotheses that have been proposed to explain this Muslim advantage in child mortality. Using data from the three waves of the National Family and Health Survey (NFHS), we describe the dimensions of the Muslim advantage, and evaluate possible explanations.

Background

The existence of a Muslim advantage in child mortality in India is not well known and appears only sporadically in the literature. For example, in their studies of child mortality Ghuman (2003), Maitra (2004), and Kravdal (2004) briefly note that Muslims have lower mortality than Hindus, but do not address why that is the case. This lack of attention to the mortality differentials contrasts sharply with the very extensive literature on Muslim-Hindu fertility differentials, showing the extent to which Muslims have higher fertility and higher population growth prospects than Hindus. In fact the observation that Muslims experience lower mortality than Hindus first appeared in articles discussing the population growth prospects of Muslims versus Hindus in India (Shariff 1995, Kulkarni 1996, Bhat & Zavier 2005).

Bhat and Zavier (2005) do propose two hypotheses for the Muslim advantage in mortality: (1) that Muslims are more urbanized and may thus have better access to modern health facilities than Hindus, and (2) that Muslims may have lower son preference, and may thus exhibit less excess female mortality than Hindus. However, they did not examine these hypotheses, as the issue of the Muslim mortality advantage was not the main topic of their article.

The Sachar report (2006) includes a detailed section on Muslim versus Hindu child mortality. The authors find the Muslim advantage puzzling. Indeed, among all the major dimensions of development that they examine (including education, employment, and standards of living), mortality is the only one where Muslims rank higher than Hindus. They recognize that higher levels of urbanization among

Muslims can only be part of the explanation, because Muslims exhibit lower child mortality in rural and urban areas separately. They conclude that "why exactly Muslims should have some advantage in child survival over other socio-religious categories despite their lower levels of female schooling and lower economic status is a question that needs further explanation." (Sachar et al. 2006, p. 38).

The most extensive analysis to date of the Muslim mortality advantage was done by Basu et al. (2007). Using data from the second National Family Health Survey, they examine a number of variables typically associated with mortality, but find no outstanding socio-economic or behavioral variable explaining this pattern. They raise the "minority group status" hypothesis, speculating that the relative isolation of Muslims in India may have generated tight social networks among them that may paradoxically produce lower child mortality. They admit that they reach this conclusion by elimination and are not able to directly examine this hypothesis.

In this paper, we propose to go beyond previous work by taking advantage of all three available waves of the National Family Health Survey, including the most recent one which was not available to Basu and the Sachar committee. We also contribute by directly examining the son preference hypothesis, and by examining which variables potentially operate as advantages for Muslims, and which ones potentially operate as disadvantages.

Data and Methods

As noted above, our analysis uses all available waves of the Indian National Family Health Survey (NFHS) (IIPS 1995; IIPS and ORC Macro 2000; IIPS and Macro International 2007). These waves comprise NFHS-1, which was collected in 1992-93, NFHS-2 collected in 1998-99, and the most recent NFHS-3 collected in 2005-06. Each wave of the NFHS is a cross sectional, nationally representative sample of households that collected information in household interviews, as well as in individual interviews with eligible women residing in the households. Eligible women include ever married women aged 13-49 years in NFHS-1 (n = 89,777), ever married women aged 15-49 in NFHS-2 (n= 89,199), and all women aged 15-49 in NFHS-3 (n= 124,385). The bulk of information used here is drawn from the women's individual interviews, but some household level variables are also taken from the household interviews. The household and women's response rates for all three waves are 95% and higher (IIPS 1995, p.34; IIPS and ORC Macro 2000, p.12; IIPS and Macro International 2007, p.14).

The analytical sample includes 151,229 births that were reported by Hindu or Muslim women in the individual interviews and occurred within the five years previous to the time of interview. We do not include births to women of other religions, including Christians, Buddhists, and others, because we focus only on why Muslims, a disadvantaged group, have lower mortality than the more advantaged majority group, which, in this case, is Hindus. We include all Hindus, thus, our sample does include births among both scheduled tribe and caste families that identified as Hindu (but not scheduled castes or tribes that identified as other religions). (Other studies sometimes treat Hindus from scheduled castes and tribes (SC/STs) as a distinct category in their comparison with Muslims. We decided to include all Hindus in this study, because the focus of our paper is on religious differentials. However, the results presented later do not vary substantially when we exclude SC/STs from the Hindu category.) We limit the sample to births that occurred in the five years previous to the time of the survey to balance timing constraints. We wanted to minimize censoring by maximizing the amount of time during which we observe whether or not children died. However, we also wanted to ensure that variables which refer to the time of the survey would be reasonably applicable throughout the period ranging from the time of birth to the time of survey.

All analyses take into account the sample design using Stata's survey analysis options. The NFHS is a cluster sample that is stratified by state and includes some oversampling. Our analyses thus include robust standard errors that account for clustering on the primary sampling unit. All analyses are also weighted to account for oversampling and non-response. Thus, the results presented here are representative of the national, all India level.

The main outcome of interest is whether the children born in the five years previous to survey died before the time of survey. The time distribution of deaths during the five years preceding the survey is close to uniform for both Hindus and Muslims. Thus our main measure of mortality – the percent of children who died before the time of survey – amounts to ${}_5L_0/(5*l_0)$ in life table notation.

The independent variables used here are largely self-explanatory via the categories presented in the tables. However, there are a few variables which require explanation. Mother's diet refers to the mother's consumption of meat, fish, and eggs at the time of survey. If she ate meat, fish, or eggs at least daily or weekly she is classified as eating them often. Geographic region divides the states and territories into the six regions used in the NFHS final reports. North includes Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, and Uttaranchal. Central includes Chhattisgarh, Madhya Pradesh, and Uttar Pradesh. East comprises Bihar, Jharkhand, Orissa, and West Bengal. Northeast includes Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura. West comprises Goa, Gujarat, and Maharashtra. Finally, the south includes Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu.

The household wealth measure is an approximation of the standard of living index used in the final report of the NFHS-2 (IIPS and ORC Macro 2000, p. 41). Variables that measure aspects of household wealth, including housing materials, cooking fuel, ownership of consumer durables, and ownership of land and livestock, were assigned a score based on the points used in the standard of living index. Our measure is an approximation of the index used in the NFHS-2 report because there are differences in the variables available across waves. Only variables that were consistently available across all waves were used and some adjustments in the points assigned to certain variables had to be made as well due to changes in response options across waves. The points for each constituent wealth variable were summed together to give each household a total wealth score. Households were then divided into three equally sized groups of low, middle, and high wealth based on this wealth score. These wealth groups were then matched to births that occurred in those households.

We also explored using a more rigorous measure of household wealth. This alternative approach used principle components analysis and a weighted polychoric correlation matrix using Kolenikov and Angeles' (2009) polychoricpca routine in Stata. However, the first factor retained from the principle components analysis had an urban bias. Households which owned many consumer durables, but did not own land and livestock scored highly on the first factor retained from the principle components analysis. By contrast, households that were wealthy by rural standards – in that they owned land and livestock, but not many consumer durables – had low scores. Given that much of India is rural and depends on agriculture, we felt that land and livestock are important indicators of wealth that needed to be retained within the wealth measure. Thus, we chose to use the approximation of the standard of living index, which scores households who own land and livestock highly. The correlation between the wealth score created as an approximation of the standard of living index and the wealth score created using principle components analysis is 0.77.

Dimensions of Muslim versus Hindu child mortality

Consistent with others' findings discussed above, we also find a Muslim advantage in child mortality presented in table 1. The rates presented in table 1 are calculated with our analytical sample using the synthetic cohort life table approach employed for Demographic and Health Surveys. For all waves pooled together, the under five mortality rate is 77.4 per 1,000 births for Muslims compared to 90.6 for Hindus. These rates translate into 6.95% of Muslim children dying before the time of survey compared to 8.01% of Hindu children.

[Table 1 about here]

This Muslim advantage is pervasive across both period and age (table 1). Consistent with the pattern of mortality decline, child mortality has decreased steadily over time from NFHS-1 to NFHS-3. Both Muslims and Hindus experienced this mortality decline, yet the Muslim mortality rate remains consistently below that of Hindus in each succeeding wave. For example, the under five mortality rate of Hindu children declines from 105.6 per 1,000 in NFHS-1 to 71.6 in NFHS-3. The under five rate for Muslim children maintains a relatively constant difference from the Hindu rate, declining from 93.6 in NFHS-1 to 62.9 in NFHS-3. Similarly, both infant (0-12 months) mortality and child (1-4 years) mortality are lower among Muslims. The neonatal mortality rate (0-1 month) is also lower among Muslims. The Muslim neonatal rate is 38.4 per 1,000 births while the Hindu neonatal rate is 45.1 (not shown in table).

[Table 2 about here]

The Muslim advantage in mortality is also pervasive across basic social dimensions associated with mortality (table 2). Muslims have lower mortality than Hindus in four of the six geographic regions, including the north, central, west, and south regions. In the east, nearly the same percent of Muslim and Hindu children died (8.05% versus 7.93%). The pattern is reversed in the sparsely populated Northeast, where Muslims have significantly higher mortality than Hindus. The pattern also holds by gender. Both Muslim males have lower mortality than Hindu males and Muslim females have lower mortality than Hindu females. Muslims living in both urban and rural areas have lower child mortality than their Hindu counterparts, although this difference is not significant in rural areas. Similarly, among children with educated mothers, Muslims have lower mortality than Hindus and among those with *un*educated mothers Muslims have lower mortality. For example, among children whose mothers have at least some schooling 4.16% of Muslim children died compared to 5.35% of Hindu children. Finally, while both Muslim and Hindu children show the well established U-shaped pattern of mortality associated with birth order, Muslim children have lower mortality than Hindu children of all birth orders.

Remarks:
This review of basic dimensions finds no obvious categories in which the differential either disappears or reverses. This result suggests that no single variable will stand out as a simple explanation for the Muslim advantage.

The role of sex differentials in mortality

In their discussion of religious differentials in mortality, Bhat and Zavier (2005) raised the hypothesis that son preference might be less prevalent among Muslims. Indeed, lower son preference could produce a more typical pattern of sex differentials in mortality among Muslims and generate lower child mortality among them at the national level, compensating for their lower socio-economic status. To our knowledge, this hypothesis has never been directly tested.

If son preference was the main explanation for the Muslim mortality advantage, we would expect lower excess female mortality, or even a female mortality advantage, among Muslims. We would also expect male mortality to better reflect underlying socio-economic differentials between Muslims and Hindus.

The evidence on sex differentials in mortality presented in table 2 shows that this is not the case. We find excess female mortality among both Muslims and Hindus. The proportion dead among females is higher than among males for both Muslims and Hindus. This difference is significant among Hindus, but is not significant among Muslims. However, given that the size of the sex differential is similar for Hindus and Muslims (0.41% versus 0.36%), the fact that only the Hindu sex differential is significant appears to be due largely to the difference in sample size. The sample includes 25,511 Muslims and 125,718 Hindus. Also, the Muslim mortality advantage remains prevalent when considering males separately. As seen in table 2, 6.78% if Muslim males died compared to 7.81% of Hindu males. Thus, the overall pattern of the sex differential in child mortality does not favor the son preference hypothesis.

However, discriminating behaviors are best detected when taking into consideration the parity and sex composition of siblings already born. Indeed, there is a large literature showing that behaviors resulting from son preference vary depending on whether parents have reached their desired numbers of sons (e.g. Arnold 1992; Arnold et al. 1998; Clark 2000).

[Tables 3a and 3b and about here]

Tables 3a and 3b show sex differentials in child mortality among Muslims and Hindus, by number and sex composition of siblings already born. For births with zero surviving siblings at the time of birth, there is excess male mortality for both Hindus and Muslims. Thus, there is no clear sign of discrimination against females for these births, though interestingly the amount of excess male mortality is somewhat smaller for Hindus. For births with one surviving sibling at the time of birth, we find excess female mortality among Hindus if the surviving sibling is a girl. Among Muslims, the sex differential is not significant. Perhaps the most striking results are for births with two surviving siblings at the time of birth. If the two surviving siblings are two brothers, we find excess male mortality for both Hindus and Muslims, but the excess mortality is larger for Muslims. However, if the two surviving siblings are two sisters, we find excess female mortality for both Hindus and Muslims, but here also the excess mortality is larger for Muslims.

On the whole, we find that Muslims follow patterns of sex differentials in mortality that are similar to those observed among Hindus – yet in a more extreme fashion. Among Muslims, there appears to be less discrimination against girls than among Hindus whenever the family already has boys or in the case of first births (when there are still future opportunities to have boys). However, there appears to be more discrimination against girls among Muslims whenever the family already has girls. This result is consistent with the literature that suggests having at least one girl, in addition to sons, is more important to Muslims than Hindus. Within India, Bhat and Zavier (2003) find that Muslims exhibit less son preference than Hindus. Similarly at the regional level, Jayaraman et al. (2009) find that son preference is widespread in Nepal, India, and Bangladesh, yet it is more prominent in predominantly Hindu Nepal and India than in predominantly Muslim Bangladesh. Further, Bangladeshi women were especially likely to want a daughter after having a son.

While patterns of sex differentials are not strikingly different among Muslims, their levels of male mortality do have a tendency to be lower, regardless of the number and composition of surviving siblings. Indeed, in Table 3b, the Muslim/Hindu odds ratio for males is lower than one 10 out of 13 times, and the three odds ratios that are significant are all below one. Religious differentials in mortality among male

children do not appear to better reflect underlying socio-economic differentials between Muslims and Hindus.

In order to evaluate the role that differences in discrimination against females between Muslims and Hindus in explaining the Muslim mortality advantage, we also estimated what the level of child mortality among Muslims would be if they had similar patterns of sex differentials in mortality to Hindus (while preserving their observed level of male mortality). We find that the level of child mortality among Muslims would change little, from 6.95% to 6.97%. This difference of only 0.02% is due to the fact that, as shown above, patterns of sex differentials in mortality are quite similar among both groups, and that Muslim males tend to experience lower mortality than Hindu males.

Remarks:
These findings do not support the son preference hypothesis. If son preference was the predominant explanation for the lower mortality among Muslims, we would need to find a number of instances in which Muslim males experience similar or higher mortality than Hindus, combined with excess male mortality among Muslims. This is not the case, even after taking the number and sex composition of children into account.

Advantageous and disadvantageous characteristics of Muslim children

As said in the introduction, lower child mortality among Muslims is said to be paradoxical because Muslims are more likely than Hindus to be poor and have no education, characteristics that are typically associated with higher child mortality. As far as mortality is concerned, the educational distribution of Muslim children can be qualified as disadvantageous. Conversely, the urban/rural residence distribution of Muslims can be qualified as advantageous, because Muslims are more likely to live in urban areas where mortality is lower. Overall, Muslims experience a number of advantages and disadvantages which, on balance, generate the observed religious differential in child mortality.

In this section, we perform a systematic review of variables associated with child mortality among Muslims and Hindus, identifying characteristics that can be qualified as “advantages” or “disadvantages” for Muslim children. The goal is to clarify which variables may provide Muslims with an advantage and potentially explain the mortality paradox, and which ones may operate in the other direction.

In order to decide whether a given variable can be considered an advantage or a disadvantage for Muslims, we compared the distribution of Muslim and Hindu births across categories of that variable, and examined the relationship between that variable and child mortality for both Muslims and Hindus. If the distribution of Muslim births was systematically skewed (relative to Hindus) towards categories where mortality is higher for both Hindus and Muslims, that variable was considered a disadvantage for Muslims. Conversely, if the distribution of Muslim births was systematically skewed towards categories where mortality is lower for both Hindus and Muslims, that variable was considered an advantage. If the distributions were not substantially different for Hindus and Muslims, or if the relationship with mortality was unclear, that variable was considered neutral.

This is obviously a rough classification of variables, since it is based on bivariate relationships with mortality. We will examine the relative importance of these variables in a multivariate framework in the next section.

Table 4 shows the distribution of births by religion according to characteristics potentially playing a role in explaining the observed Muslim mortality advantage. The rightmost column shows whether these characteristics represent advantages or disadvantages for Muslims. As expected, mother’s education and

household wealth act as disadvantages among Muslims. We also find that birth order operates as a disadvantage among Muslims. In keeping with higher fertility among Muslims, Muslim births are more skewed towards higher-order births where mortality is higher. (In comparison with Muslim births, Hindu births are more likely to be first births, where mortality is also higher. But the detrimental effect of first births among Hindus is not as large as the detrimental effect of higher-parity births among Muslims.) Muslims are also disadvantaged in terms of antenatal care, as they tend to perform fewer antenatal checks than Hindus.

[Table 4 about here]

As seen in table 4, Muslims exhibit a number of advantages. As expected, urban/rural residence operates as an advantage for Muslims with a larger percentage of Muslim children residing in urban areas. Another advantageous variable for Muslims is caste. Muslims are much less likely than Hindus to belong to a scheduled caste or a scheduled tribe, categories that are associated with higher mortality. This results is not surprising since caste is, of course, a dimension of stratification associated with the Hindu religion, while Islam does not incorporate caste. Some Muslims do report that they are members of scheduled castes or tribes however. These are probably Muslim families that converted relatively recently and still maintain their caste identity. Another interesting advantage is mother's work location. Muslim children are more likely to have a mother who works at home, a characteristic that is associated with lower mortality for both Hindus and Muslims. Perhaps the most striking difference is with mother's diet. Muslim children are almost twice as likely as Hindu children to have a mother that often eats fish, meat, or eggs. Thus, mothers' diet represents an advantage for Muslim children. This result is in keeping with Hindu strictures against eating beef and high caste Hindu strictures against eating meat in general.

There are a number of variables that do not appear to act clearly as an advantage or disadvantage. These include survey wave, region of residence, gender, mother's age at birth, length of birth interval, place of delivery and size at birth. We take special note of the neutral role of region of residence. Although levels of child mortality vary considerably by region, there is no evidence that Muslims tend to live in regions that have either lower or higher mortality.

There is another potential explanation for the mortality differential in the existing literature, but it too is not supported by the data. Baqui et al. (2007) found that Muslims are significantly more likely than Hindus to engage in beneficial newborn care in rural Uttar Pradesh. The newborn care practices they examined include clean cord care, drying and wrapping the newborn after delivery, and early breastfeeding. This finding suggests that differences in newborn care practices might explain part of the mortality differential. However, this pattern of Muslims engaging in better newborn care found in rural Uttar Pradesh is not replicated at the national level. We found no significant differences between Muslims and Hindus in these three aspects of newborn care at the national level. Among all waves pooled together, the time to the start of breastfeeding was nearly identical. For example, 23% of Hindus and 22% of Muslims started breastfeeding within one hour of birth, while 28% of Hindus and 29% of Muslims did so within one day. In NFHS-3 (the only survey which collected newborn delivery care information), 43% of Muslim newborns delivered at home were wrapped and dried compared to 45% of Hindu newborns. Similarly, 95% of both Hindu and Muslim newborns delivered at home had clean blades used to cut their cords.

Remarks:
While Muslim births tend to have characteristics associated with higher mortality (such as low standard of living, no education, high parity, etc.), they also tend to have characteristics associated with lower mortality (such as urban residence, caste, mother's work location and consumption of meat). Given this mix of advantages and disadvantages (a list that is necessarily incomplete), it is not obvious that Muslims, on balance, should be expected to experience higher mortality than Hindus.

Multivariate analysis of factors associated with mortality among Muslims and Hindus

To examine the combined impact of these advantages and disadvantages on Muslim versus Hindu child mortality we undertook a multivariate analysis. We used multivariate logistic regression models to examine how the relative odds of mortality for Muslims versus Hindus change as different variables are taken into account (tables 5 and 6). When examining mortality, event history models are usually used to control for the censoring present in the data. Our logistic regression models do not account for this censoring. However, since we are focusing on the association between religion and mortality, not into account the censoring would only affect our results if Hindus and Muslims had significantly different timing in their mortality and censoring affected the two groups differently. We examined the timing of mortality among both groups and concluded that the timing of mortality is quite similar. Thus, we use the simple logistic regression model.

Our goal was to examine to what extent the combined impact of these advantages might explain the mortality differential. Thus, we compare how the odds ratio for Muslims versus Hindus changes across models mortality that control for different variables. Model 1, the baseline, is a bivariate model that includes only a Muslim dummy, showing the odds of a Muslim child dying compared to a Hindu child without controlling for any characteristics. Model 2 goes on to control for neutral variables, including survey wave, sex, and region. Given our results above, we do not expect the Muslim odds ratio to change substantially from model 1 to model 2 when these neutral variables are included in the model. Model 3 comprises model 2 plus variables that are Muslim advantages, including urban residence, caste, mother's work location, water source, type of toilet facility, and mother's diet. Model 4 consists of model 2 plus Muslim disadvantages, including mother's education, birth order, household wealth, and antenatal care. Finally, model 5 is a full model that includes neutral variables, advantages, and disadvantages. If the Muslim odds ratio goes to one in the final model then the combined weight of the advantages accounted for here explain the religious mortality differential.

These models are presented twice, once in table 5 and once in table 6, to account for differences in the availability of variables across survey waves and births. Unfortunately, mother's diet and antenatal care are available for limited samples. Mother's diet is only available in NFHS-2 and NFHS-3 (n=96,053) while antenatal care is only available for more recent births (n=104,882). (For NFHS-1, antenatal care is available for the most recent three births if they occurred in the last four years. For NFHS-2, it is available for the most recent two births if they occurred within the last three years. Finally, for NFHS-3, antenatal care is available for the most recent birth if it occurred within the last five years.) Table 5 includes the models for the full sample without including mother's diet and antenatal care. Table 6 shows the models for the sample for births that have information on both antenatal care and mother's diet (n=61,040). We begin our discussion of the multivariate analysis in reference to table 5 because it includes births from the full sample.

[Table 5 about here]

In the baseline model, the odds ratio for the Muslim dummy is 0.86 (table 5). As expected, the odds ratio remains basically constant at 0.85 when neutral variables of survey wave, sex, and region are added in model 2. When controlling only for the advantages in model 3 (urban/rural residence, etc.), the Muslim odds ratio increases from .85 to 1.02 and becomes insignificant. The direction of this change in the odds ratio is expected. Since these variables give an advantage to Muslims, the Muslim mortality advantage should diminish once we control for them.

When controlling only for disadvantages (education, etc) in model 4, the odds ratio for religion decreases from .85 to .83 (table 5). This result is also expected, because these variables give a disadvantage to

Muslims in the real world. Once we control for them, the mortality differential should become even more advantageous for Muslims.

Finally, when controlling for both advantages and disadvantages, the odds ratio increases from .85 to .93 and remains only marginally significant. This result suggests that the combination of advantages and disadvantages that we measure in our data explains part of the Muslim mortality advantage. The beneficial effect of advantages appears to overcompensate for the detrimental effect of disadvantages. The advantageous variables that retain significance in the full model include water, sanitation, and mother's place of work. While the odds ratio is only marginally significant and there is a very large sample size, the point estimate of 0.93 suggests that part of the mortality differential remains unexplained. The list of explanatory variables included in our full model, while improving our understanding the Muslim/Hindu mortality differential, accounts for only a part of this differential.

[Table 6 about here]

When we restrict the sample to NFHS-2 and 3 and more recent births we can further examine if mother's diet and antenatal care account for an additional part of the differential (table 6). When restricting the sample to the births that have information on mother's diet and antenatal care, however, the results are not entirely consistent with those presented in table 5 for the full sample. In the baseline and neutral models, the Muslim odds ratio is .84 and .83 respectively, consistent with the previous results. Also, consistently with previous results, when the advantages are added in model 3, the Muslim odds ratio approaches one and loses significance and when the disadvantages are added in model 4 the Muslim odds ratio decreases slightly to .81. However, in the full model, the Muslim odds ratio is a statistically significant .86. Thus, the Muslim odds ratio only increases slightly from 0.84 to 0.86 and retains significance. This result suggests that mother's diet and antenatal care do not account for an additional part of the Muslim/Hindu mortality differential. Further, given that this change is substantially smaller than that presented from model 1 to model 5 in table 6 for the full sample, it suggests that the advantages controlled for here are not as efficacious in explaining the mortality differential among NFHS-2 and 3 alone. Compared to Table 5, water source looses significance in the full model, but this appears to be due to the smaller size of the restricted sample, rather than the inclusion of two additional variables. Indeed, in a model that includes the same variables as in Table 5, but uses the restricted sample, water source is also insignificant. Mother's place of work, however, remains strongly significant in the full models in both Table 5 and 6.

Discussion

In this paper, we first dismiss one of the important hypotheses put forward for explaining the Muslim mortality advantage in India. We find no evidence that Muslims do not discriminate against girls. Patterns of sex differentials in mortality among Muslims are quite similar than among Hindus, and they do not explain the Muslim mortality advantage.

We then enrich the description of Muslims in India by showing that, while they are subject to a number of disadvantages which may contribute to increased mortality among them, they are also subject to a number of advantages which may operate in the other direction. Rural/urban residence, water source, toilet facility, caste, mother's diet and mother's place of work may endow Muslims with an advantage with respect to mortality.

In the multivariate models presented in this paper, the advantageous variables that appear to matter most are water, sanitation, and mothers' place of work. There is a large literature showing that access to safe water and sanitation is associated with reduced mortality. The better access to safe water and sanitation that Muslims have does appear to play a role in their mortality advantage. In spite of their lower levels of

education and lower standards of living, Muslims are more likely to have piped water and flush toilet in their residence. Our analysis suggests that this contributes to their lower mortality.

As for the role of mother's work location, we find that Muslim mothers are more likely than Hindu mothers to work at home or to not work. This category is associated with lower mortality for both Hindus and Muslims. The variable remains significant in the full model, and appears to explain part of the Muslim mortality advantage. Obviously this variable could be a proxy for many other influences on child mortality. For example, Ladusing and Singh (2006) also find that children of working mothers experience greater mortality in Northeast India. They suggest that this is the case in part because working women are less able to engage in childcare. They further suggest that the mother's own health is adversely affected by the heavy physical labor that most working women are engaged in, which in turn may adversely affect their children's health and mortality. In India, where joint living arrangements are common, children are often take care of by grandparents and other family members when their mothers are working. However, the quality of this care may be less than that of mothers' care and, of course, in families where family members are not available children may simple receive less care when their mother's work. In the extreme case of mother-headed households, Rani (2006) finds that childcare is particularly difficult and of low quality for working mothers. Family members may also not always engage in childcare when mothers are unable to. In New Delhi, Suppal and Roopnaraine (1999) find that fathers' time spent on childcare did not increase when mothers were employed. Drawing from this literature, it might be the case that Muslim mothers, while less involved in work outside the home, might be more able to engage in childcare.

On balance, however, the combination of advantages and disadvantages that we measure with our data explain only part of the Muslim mortality advantage. The odds ratio for religion remains marginally significant at .93 in the full sample, and remains significant at .86 in the restricted sample. We are obviously limited in this analysis by the measures we have in our data. Muslims certainly differ from Hindus in many other characteristics for which we don't have adequate measurements. Nonetheless, the results of this paper provide a partial answer and some direction for future research. It might be particularly worthwhile to carry out detailed observations of child care practices among Muslims and Hindus, and to measure the extent to which the additional time that Muslim women spend at home actually translates into better child care practices and lower child mortality.

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Table 1. Child mortality by religion and wave of the National Family Health Survey for births from the five years previous to the survey.

	Under five mortality rate		Infant mortality rate		Child (1-4) mortality rate		Percent died	
	Muslim	Hindu	Muslim	Hindu	Muslim	Hindu	Muslim	Hindu
NFHS-1	93.6	105.6	69.8	78.6	25.5	29.3	8.23	9.16
NFHS-2	76.3	93.3	56.8	69.4	20.7	25.7	6.82	8.20
NFHS-3	62.9	71.6	50.5	57.7	13.0	14.8	5.82	6.53
All waves	77.4	90.6	59.0	68.9	19.5	23.3	6.95	8.01

Table 2. Percent of children born in the five years previous to survey who died by religion and other basic characteristics for all survey waves.

	Muslim % (n = 25,511)	Hindu % (n = 125,718)	*p-value from χ^2 test*
Region			
North	7.08	7.53	*0.41*
Central	8.19	10.07	*0.00*
East	8.05	7.93	*0.80*
Northeast	9.62	7.88	*0.03*
West	3.32	6.23	*0.00*
South	3.86	6.11	*0.00*
Gender			
Male	6.78	7.81	*0.00*
Female	7.14	8.22	*0.00*
Residence			
Urban	4.51	5.68	*0.00*
Rural	8.12	8.63	*0.12*
Mother's education			
No schooling	8.64	9.91	*0.00*
Some schooling	4.16	5.35	*0.00*
Birth order			
First	7.82	8.15	*0.48*
Second	5.54	6.78	*0.00*
Third	6.30	6.96	*0.24*
Fourth	6.44	8.55	*0.00*
Fifth and higher	7.98	10.44	*0.00*
Total	6.95	8.01	*0.00*

Table 3a. Percent of children born in the five years previous to survey who died by religion, gender, and composition of siblings for all survey waves.

	Muslims		Hindus	
Sibling number: composition	Male % (n = 12,997)	Female % (n = 12,514)	Male % (n = 65,301)	Female % (n = 60,417)
0 siblings	9.15	6.42	8.77	7.49
1: 1 brother	5.67	4.76	7.01	6.93
1: 1 sister	5.18	6.59	6.06	7.17
2: 2 brothers	9.18	5.45	8.10	6.36
2: 1 brother, 1 sister	5.26	6.54	6.55	7.70
2: 2 sisters	4.63	7.46	5.22	7.86
3: 3 brothers	5.09	5.95	8.65	6.54
3: 2 brothers, 1 sister	7.38	5.09	10.03	9.37
3: 1 brother, 2 sisters	4.46	9.20	7.54	8.99
3: 3 sisters	4.44	8.99	5.27	10.60
4+:4+ brothers, 0 sisters	5.39	2.08	7.55	11.38
4+:1+ brothers, 1+ sisters	6.73	9.49	9.52	11.81
4+: 0 brothers, 4+ sisters	8.54	8.87	7.17	10.15

Table 3b. Odds ratios from bivariate logistic regression models of mortality for children born in the five years previous to survey by religion, gender, and composition of siblings for all survey waves.

	Comparison of females to males by religion		Comparison of Muslims to Hindus by gender	
Sibling number: composition	Female vs. male OR among Muslims	Female vs. male OR among Hindus	Muslim vs. Hindu OR among females	Muslim vs. Hindu OR among males
0 siblings	0.68**	0.84**	0.85†	1.05
1: 1 brother	0.83	0.99	0.67**	0.80†
1: 1 sister	1.29	1.20*	0.91	0.85
2: 2 brothers	0.57*	0.77*	0.85	1.15
2: 1 brother, 1 sister	1.26	1.19†	0.84	0.79
2: 2 sisters	1.66†	1.55**	0.94	0.88
3: 3 brothers	1.18	0.74	0.90	0.57
3: 2 brothers, 1 sister	0.67	0.93	0.52**	0.71
3: 1 brother, 2 sisters	2.17*	1.21†	1.03	0.57*
3: 3 sisters	2.13	2.13**	0.83	0.84
4+:4+ brothers, 0 sisters	0.37	1.57	0.17**	0.70
4+:1+ brothers, 1+ sisters	1.45**	1.27**	0.78**	0.69**
4+: 0 brothers, 4+ sisters	1.04	1.46†	0.86	1.21

†p<0.10 *p<0.05 **p<0.01

Table 4. Distribution of births in the five years previous to survey by religion and other characteristics for all survey waves.

	Muslim % (n = 25,511)	Hindu % (n = 125,718)	Muslim advantage? *(p-value from χ^2)*
Survey wave			Neutral
NFHS-1	33.9	35.7	*(0.27)*
NFHS-2	31.8	32.3	
NFHS-3	34.4	32.0	
Region			Neutral
North	8.4	12.0	*(0.00)*
Central	28.4	31.7	
East	30.1	22.5	
Northeast	6.8	2.6	
West	11.3	13.0	
South	15.0	18.2	
Gender			Neutral
Male	50.9	51.7	*(0.06)*
Female	49.1	48.3	
Residence			Advantage
Urban	79.0	67.6	*(0.00)*
Rural	21.0	32.4	
Mother's education			Disadvantage
No schooling	62.4	58.3	*(0.00)*
Some schooling	37.6	41.7	
Birth order			Disadvantage
First	23.0	29.3	*(0.00)*
Second	21.8	26.0	
Third	16.3	17.3	
Fourth	12.0	11.0	
Fifth or higher	26.9	16.5	
Caste			Advantage
Scheduled caste	2.1	20.8	*(0.00)*
Scheduled tribe	0.6	10.6	
Other	97.3	68.6	
Household wealth			Disadvantage
Low	49.3	43.0	*(0.00)*
Middle	32.8	34.5	
High	17.9	22.5	

(Table continues on next page)

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Water source			Advantage
Piped into residence	36.0	27.1	*(0.00)*
Well	35.2	37.9	
Public tap or handpump	25.6	31.3	
Surface water	3.2	3.7	
Toilet facility			Advantage
Flush	28.1	19.4	*(0.00)*
Pit	19.8	5.8	
None	52.1	74.8	
Mother's work location			Advantage
At home or does not work	89.5	69.6	*(0.00)*
Away from home	10.5	30.4	
Mother's age at birth			Neutral
<20 years	22.8	23.6	*(0.00)*
20-35 years	70.7	72.3	
35+ years	6.5	4.2	
Length of birth interval			Neutral
<2 years	22.3	19.2	*(0.00)*
2-3 years	28.3	25.9	
>3 years	26.4	25.7	
First birth	23.0	29.3	
Antenatal check-ups [a]			Disadvantage
None	34.9	32.0	*(0.00)*
1-2 check-ups	22.8	22.2	
3 or more check-ups	42.3	45.8	
Place of delivery			Neutral
Home	70.6	67.6	*(0.01)*
Health facility	29.4	32.4	
Size at birth			Neutral
Larger than average	18.0	17.6	*(0.53)*
Average	60.5	60.3	
Smaller than average	21.5	22.1	
Mother's diet [b]			Advantage
Rarely eats fish, meat, or eggs	37.2	68.0	*(0.00)*
Often eats fish, meat, or eggs	62.8	32.0	

[a] Antenatal care is available for a limited sample of births that occurred closer to the time of survey (n=104,882).
[b] Mother's diet is available for NFHS-2 and NFHS-3 only (n=96,053).

Table 5. Odds ratios from multivariate logistic regression models of mortality for births in the five years previous to all survey waves (n=151,229).

	Model 1: Baseline	Model 2: Neutral	Model 3: Advantages	Model 4: Disadvantages	Model 5: Full
Child is Muslim	0.86**	0.85**	1.02	0.83**	0.93†
Survey wave					
NFHS-1 (ref)		1.00	1.00	1.00	1.00
NFHS-2		0.88**	0.88**	0.93*	0.92**
NFHS-3		0.68**	0.70**	0.76**	0.76**
Child is female		1.06*	1.05*	1.05*	1.05*
Region					
North (ref)		1.00	1.00	1.00	1.00
Central		1.34**	1.29**	1.23**	1.23**
East		1.09*	1.03	0.98	0.96
Northeast		1.17*	1.24**	1.09	1.16*
West		0.76**	0.79**	0.80**	0.81**
South		0.75**	0.74**	0.78**	0.76**
Urban residence			0.94†		0.98
Caste					
Scheduled caste			1.14**		1.07†
Scheduled tribe			1.13**		1.04
Other (ref)			1.00		1.00
Mother works away			1.15**		1.09**
Water source					
Piped into residence (ref)			1.00		1.00
Well			1.23**		1.16**
Public tap or handpump			1.16**		1.11**
Surface water			1.18**		1.10
Toilet facility					
Flush (ref)			1.00		1.00
Pit			1.16**		1.11†
None			1.62**		1.39**
Mother has schooling				0.62**	0.70**
Birth order					
First (ref)				1.00	1.00
Second				0.77**	0.77**
Third				0.72**	0.71**
Fourth				0.80**	0.78**
Fifth or higher				0.90**	0.88**
Household wealth					
Low (ref)				1.00	1.00
Middle				0.87**	0.89**
High				0.66**	0.72**

†p<0.10 *p<0.05 **p<0.01

Table 6. Odds ratios from multivariate logistic regression models of mortality for recent births previous to NFHS-2 and NFHS-3 (n=61,040). This table is similar to table 5, but includes only births that have information on the mother's diet and antenatal care.

	Model 1: Baseline	Model 2: Neutral	Model 3: Advantages	Model 4: Disadvantages	Model 5: Full
Child is Muslim	0.84**	0.83**	0.97	0.81**	0.86*
NFHS-3 (vs. NFHS-2)		0.60**	0.61**	0.66**	0.66**
Child is female		1.07	1.06	1.05	1.05
Region					
North (ref)		1.00	1.00	1.00	1.00
Central		1.25**	1.19**	1.10	1.10
East		0.97	0.94	0.86†	0.86*
Northeast		1.02	1.10	0.97	0.98
West		0.69**	0.72**	0.82*	0.80*
South		0.66**	0.68**	0.85†	0.80*
Urban residence			0.95		1.02
Caste					
Scheduled caste			1.10†		1.02
Scheduled tribe			1.08		0.98
Other (ref)			1.00		1.00
Mother works away			1.24**		1.19**
Water source					
Piped into residence (ref)			1.00		1.00
Well			1.06		1.02
Public tap or handpump			1.06		1.02
Surface water			1.04		0.97
Toilet facility					
Flush (ref)			1.00		1.00
Pit			1.22*		1.16
None			1.47**		1.21*
Mother often eats meat			0.95		1.03
Mother has schooling				0.72**	0.77**
Birth order					
First (ref)				1.00	1.00
Second				0.79**	0.79**
Third				0.64**	0.63**
Fourth				0.69**	0.68**
Fifth or higher				0.81**	0.79**
Household wealth					
Low (ref)				1.00	1.00
Middle				0.92†	0.92
High				0.75**	0.78**
Antenatal check-ups					
None (ref)				1.00	1.00
1-2 check-ups				0.82**	0.82**
3 or more check-ups				0.58**	0.60**

†p<0.10 *p<0.05 **p<0.01