The Puzzle of Muslim Advantage in Child Survival in India

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Abstract

The socio-economic status of Indian Muslims is, on average, considerably lower than that of upper caste Hindus. Muslims nevertheless exhibit substantially higher child survival rates, and have done for decades. This paper analyses this seeming puzzle. A decomposition of the survival differential confirms that some compositional effects favour Muslims but that, overall, differences in characteristics and especially the Muslim deficit in parental education predict a Muslim disadvantage. The results of this study contribute to a recent literature that debates the importance of socioeconomic status (SES) in determining health and survival. They augment a growing literature on the role of religion or culture as encapsulating important unobservable behaviours or endowments that influence health, indeed, enough to reverse the SES gradient that is commonly observed.

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1. Introduction

Hindus and Muslim have cohabited in India for centuries, with Muslims ruling most of the Indian subcontinent from the early 16th to the mid-19th centuries. However, today, their socioeconomic condition is thought to be not much better than that of low caste Hindus, who have a long history of deprivation (Government of India 2006). Despite being, on average, less educated and poorer, Indian Muslims exhibit a substantial advantage in child survival over high caste Hindus. This paper analyses this seeming puzzle. It shows that the Muslim advantage is large, persistent, and hard to explain.

A number of recent studies document socioeconomic status (SES) gradients in health and survival, across countries, across SES groups within country, and within groups over time; for a survey see Cutler et al. (2006). Previous analyses of health inequalities along ethnic or religious lines tend to start out with a differential consistent with SES differences, as is the case, for example, with black-white differences in health in the United States. While it has been recognised that unhealthy behaviours like smoking or drinking may vary positively with SES (e.g. Rogers et al., 2000, p. 245), these are seldom large enough to alter the raw differential in favour of the lower-SES group. The case of Muslims in India is, in this respect, most unusual.

By age five, the Muslim survival advantage over Hindus is as high as 2.31%-points, which is about 17% of baseline mortality risk amongst Hindus. Restricting the comparison to upper-caste Hindus, who enjoy unambiguously higher social status than Muslims, the differential is 1.30%-points, or about 10% of baseline mortality risk. Based on the total number of births recorded in 2000 (Census of India 2001), and on the proportions of high- and low-caste children born that year (obtained from representative survey data used in this paper), this differential translates into an annual 127,955 (244,535) excess under-5 deaths amongst high-caste (low-caste) Hindus. To put the size of this differential in perspective, consider that the more widely discussed gender differential in under-5 mortality is 0.30%-points, which is less than a fourth of the differential between Muslims and high-caste Hindus. The average annual rate of decrease in under-5 mortality risk between 1960 and 2001 in India was 0.61%-points p.a., which is about half the differential. The Muslim-Hindu survival differential is not a new or an isolated phenomenon. It is evident for most of the last half century and across most of India. It has nevertheless claimed little public or academic attention. Although it is flagged by Shariff (1995), Bhat and Zavier (2005), Bhalotra and van Soest (2008) and Deolalikar (*forthcoming*), we know of no previous research that tries to explain this phenomenon. This paper fills this gap, using microdata on more than 0.6 million children born to about 200,000 Indian women during 1960-2006. The rest of this section summarises our approach and findings. The data and context are described in Section 2. Section 3 presents the first systematic profile of this seeming puzzle. Section 4 presents the estimation methods used. Baseline results are discussed in section 5 and extensions in section 6. Section 7 considers differences in nutritional status. Section 8 concludes.

A descriptive profiling of the religion differential yields some important insights. More than two-thirds of the survival advantage of Muslims over high-caste Hindus is apparent in the neonatal period (the first 30 days after birth), suggesting that explanations of the differential may have more to do with customs, attitudes, behaviours, maternal health, delivery and early feeding practices, and less with access to health and nutrition after birth. Muslims exhibit lower son preference in terms of a lower sex ratio (male/female) at birth and a smaller gender gap in child mortality. This suggests better survival chances amongst girls as a candidate explanation of the overall Muslim advantage, even if they also show some advantage for boys. While Muslims exhibit a survival advantage over low caste Hindus in rural and urban areas, their advantage over high caste Hindus is only significant in rural areas.

We find that the Muslim survival advantage apparent in the raw data is scarcely diminished by controlling for neighbourhood effects (which we model as cluster fixed effects), socioeconomic characteristics of the household (education, wealth, demographics) and state and cohort-specific unobservables. We specifically investigate state-level health and development expenditure, state-level income and inequality, and village-level health services and infrastructure, but they do not explain the religion differential. Using decomposition techniques, we show that, in general, *none* of the Muslim advantage in under-5 mortality over high caste Hindus can be explained by characteristics. Although we identify some factors that contribute to a Muslim advantage (such as their greater urbanisation) these contributions are more than balanced by characteristics that favour high caste Hindus (primarily their better education). In general, it is possible that there are omitted variables that improve survival and are inversely correlated with SES - for example, if high SES communities drink or smoke more they may exhibit poorer health despite their higher SES. The layering of religion and caste in Indian society provides us with an opportunity to investigate this possibility. We do this by considering the extent to which the Muslim advantage over low caste Hindus (of lower SES) is explained by the same set of characteristics. We find that less than half of their advantage in under-5 mortality is explained. This suggests that omitted variables that favour Muslims cut across SES groups. In other words, as Muslims have an unexplained advantage over two groups of Hindus with little in common except for their religion, we cannot rule out the hypothesis that attitudes and practices related to religion cause the differential.

Since nutritional status tends to be closely tied to SES and nutritional status predicts mortality, we also investigate community differentials in two indicators of net nutrition, stunting and wasting, for children 0-3 years old (section 7). We find small community differentials, especially for wasting. Stunting differences correspond to SES differences across communities. Decomposition of these differences shows that, when Muslims perform less well, as is the case compared with high caste Hindus, then most of their disadvantage is explained. However, when they do better, as is the case relative to low caste Hindus, their advantage is mostly unexplained. The latter is again consistent with Muslims owning unobservable traits that favour health.

These findings motivate consideration of what attitudes, behaviours or unobserved traits Muslims might have, unlocking the key to which could make an enormous impact on average mortality rates in India. We take one step in this direction, investigating richer specifications of the child survival model that include maternal health and diet, mother's employment, antenatal care, place of delivery, early initiation of breastfeeding and indicators for endogamy and son-preference. Maternal height and non-vegetarian diet contribute significantly to explaining the Muslim advantage. Some other variables like mother's employment, breastfeeding and antenatal care also contribute towards an explanation but as their effects are individually insignificant and they are potentially endogenous, we do not put much weight on these findings. Amongst hypotheses that we believe may hold the potential to explain the persistent Muslim advantage but that we are unable to investigate to our satisfaction, are that Muslims enjoy closer kinship, have a lower degree of son preference, and have healthier behaviours.

The results contribute to a recent literature in economics which finds that socioeconomic status as a determinant of health or survival may be less important than other factors, such as attitudes at the individual level (Fuchs 2004) or medical technology and services at the aggregate level (Cutler et al. 2006). This paper extends this discussion to incorporate the importance of culture or community. Although there is a surge of interest amongst economists in ethnicity effects, especially in education (e.g. Fryer and Levitt 2004, Wilson et al 2005), there remains limited research on religion effects. The effects of religion on fertility have been analysed, for example, for India (Bhat and Zavier 2005) and historical Europe (Guinnane 2005), but there is little work on religion and health. There is some relevant work in the sociological literature, see, for example, Dwyer et al. (1990) who find that religion explains a substantial share of the variation in cancer mortality rates across US counties. In their review of the sociological literature they argue that religion effects appear to work through social disapproval of unhealthy behaviours and the benefits of social networks.

2. Background and Data

Muslims constituted 13.4% of the Indian population in 2001, up from 9.9% in 1951. Their total fertility rate was 3.06, as compared with 2.47 for Hindu women, a 24% differential (Census of India 2001) and they have shorter birth intervals than Hindus (Bhalotra and van Soest 2008). The Sachar Committee Report commissioned by the Indian Prime Minister documents their relatively weak social, economic and educational status (Government of India 2006, henceforth GOI). Muslims are poorer than upper caste Hindus, especially in urban areas (GOI). They have been less educated than upper caste Hindus for decades and while Muslim women have exhibited some catch-up, Muslim men have not (Deolalikar *forthcoming*). The educational deprivation of Muslims has been shown to drive their disadvantage in the labour market (Bhaumik and Chakrabarty 2006). Their political representation is small relative to their population share and the areas in which they are concentrated receive poorer public services (GOI). Overall, the SES of Muslims is not much better than that of low caste Hindus. Yet, although there are reserved places for the low castes in higher education, in public sector jobs and in state legislatures, there is no similar positive discrimination in favour of Muslims. These facts all make their relative success in averting child mortality quite remarkable.[1]

To investigate the mortality differential, we stack three rounds of the National Family Health Survey of India (NFHS) conducted in 1992/3, 1998/9, and 2005/06 (see

[1] In this paper, low caste Hindus refers to scheduled castes and tribes (SC, ST). There are also castes within the Muslim community but they do not have the same history as the Hindu lower castes and do not qualify for positive discrimination.

IIPS 1995, IIPS and ORC Macro 2000, and IIPS and Macro International 2007). These surveys interviewed women aged 15-49 (13-49 in NFHS-1) at the time of the survey and obtained complete fertility histories, including the dates of live births and of any child deaths. The surveys contain information on relevant individual and household characteristics, and the first two rounds also include information on village characteristics including health infrastructure. Births in the original sample occur during 1954-2006. We restrict the sample to mothers who are normal residents in the dwelling in which they are interviewed. We drop children born before 1960 (0.08% of the sample), as the sample sizes are very small for these years. We right-truncate the sample to ensure that all children analysed have full exposure to the relevant mortality risk; for instance, for under-5 mortality, we remove children less than 60 months old at the time of interview (17.43% of births). We drop mothers who have ever had a multiple birth (3.11% of births)[2] and mothers for whom information on caste is missing (0.38% of all births). We also drop the 11.49% of births in the survey that occur in households of religions other than Muslim or Hindu, and from now on refer to the mortality differential between Muslim and Hindus as *the religion-differential*.[3] The largest sample analysed (for children fully exposed to neonatal risk) has 653,496 live births of 197,952 mothers.

The large samples generated by using the full history of births are an advantage given that mortality is a rare event and Muslims are a minority group. A potential problem with these data is recall bias in dates of birth and death, which is expected to be greater the further back in time the event occurred. To the extent that any recall error is similar across communities this will not matter much for our results. Moreover, Beckett et al. (2001) find that recall error in fertility histories is not a big problem, except for some age heaping. We allow for age heaping by defining indicators of mortality (e.g. under-5) to include deaths in the last month (e.g. 60th). A second possible issue is that the further back one goes in time, the more scarce and the less representative of the complete cohorts of children in these birth years is the sample of births in the birth-history data because only mothers younger than 50 were interviewed. This results in the early years

[2] It is standard practice in the demographic literature to restrict the analysis to singletons as death risks are many times higher for multiple births and can skew the statistics. Amongst Muslims 1.48% of live births are multiple (twin, triplet etc) and amongst Hindus the corresponding figure is 1.29%.

[3] Due to sampling design, the non-weighted share of births in households of religions other than Muslim or Hindu is much larger than their share in the total population. When the number of births is corrected for sampling design, the share of the other religions is closer to figures from the population census: 4.2% of births compared to 6.1% of the population of all ages in 2001.

including a disproportionate share of children born to young mothers.[4] These mothers are likely to be poorer and have higher fertility than the average mother of children born at the same time. We account for this triangular nature of the data structure since we condition on mother's age at birth.

A potential drawback of our data is that variables are measured at the time of the survey and not at the time of birth of the index child. This creates no problems for variables like parental education which do not change between the index child's birth and the survey date. Migration is not a problem for the religion variable because the mother carries her religion with her. However, village infrastructure changes over time and the family's rural/urban status can change on account of migration. We overcome this problem by conducting the analysis for shorter samples of recent births whenever time-varying variables are included as regressors. If it were an important source of bias then the shorter samples would alter the story (suffering much less from this bias) but they do not.

The heights and weights of children are indicators of the child's net nutritional status (e.g. Micklewright and Ismail 2001). These are measured by surveyors at the time of the survey rather than reported by the mother. They are only available for children born 3-5 years before the survey. To render the samples in the three rounds comparable, we restrict attention to height and weight of children aged 0-3 and exclude the states Andhra Pradesh, Madhya Pradesh, Tamil Nadu, West Bengal, and Himachal Pradesh. The anthropometric data are standardized by age and gender and reported as z-scores.

Sample weights included in the surveys are used to obtain summary statistics that are representative for the all India population of mothers aged 15-49 at the time of the survey and their children. Regressions are also weighted using these weights. The sample we analyse changes because, for example, we drop births in the last month for the analysis of neonatal mortality but we drop births in the last five years when we investigate under-5 mortality. Alternatively, we are restricted to a shorter sample once we incorporate variables like child height and weight or village infrastructure. All descriptive statistics are, unless otherwise stated, for the largest sample analysed, which is the sample of children fully exposed to neonatal mortality risk in the pooled sample.

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[4] For example, in the 1998 round, births that occur near the survey date will come representatively from mothers aged 15 to 49. However, births in earlier years, for example 1968, come disproportionately from women who gave birth early. This is because older mothers, for instance age 25 in 1968, were 55 in 1998 and so excluded from the sample by design.

3. A Profile of the Religion Differential

This section describes the religion differential in mortality and the way in which it varies with caste, age, gender, birth order, birth year, rural/urban and state location. We further consider whether there is a similar religion differential in height- and weight-based indicators of nutritional status. This section also summarises religion differences in some of the explanatory variables used in the analysis.

3.1. Religion differentials in mortality

Neonatal, infant and under-5 mortality are defined as the risk of dying between birth and the age of one month, one year, and five years, respectively. After dropping other religions, the sample of children analysed in this paper contains 84.58% Hindus and 14.42% Muslims. Across births in the data, which span the period 1960-2006, average *under-5* mortality is 15.93% amongst low caste Hindus, 12.59% amongst high caste Hindus, and 11.29% amongst Muslims; see Table 1. Muslims have an advantage of 2.31% points (17% of baseline mortality risk) over all Hindus. Their advantage over low caste Hindus, at 4.64%-points (29.14%) is, unsurprisingly, greater than their advantage over high caste Hindus, which is 1.30%-points (10.34%). The latter is the real puzzle since upper caste Hindus are clearly better off than Muslims, whereas lower caste Hindus are, by many indicators, worse off (Government of India 2006). For *neonatal* [*infant*] mortality, the raw differential is 1.72 [3.06] %-points relative to low caste Hindus and 0.90 [1.31] %-points relative to high caste Hindus.

Table 1 goes about here.

The religion mortality differential by age of exposure, gender and birth order

In proportional terms, the mortality advantage with respect to high caste Hindus is decreasing with *age of exposure* (Table 1): 70% of the difference between Muslims and high caste Hindus is established within the first month after birth, and the difference remains constant from infancy up until age five. In contrast, the Muslim advantage with respect to low caste Hindus is increasing in age of exposure, consistent with the higher SES of Muslims as compared with the lower castes.

Table 2 goes about here.

Averaging across the three religion groups, the under-5 survival advantage of *boys over girls* is 0.30%-points. This is entirely driven by high caste Hindus amongst whom the differential is 0.53%-points (Table 2). The Muslim advantage over upper caste Hindus is greater for girl survival, even though Muslims also show an advantage in boy survival. At birth, girls are, by nature, endowed with lower mortality risks than boys and their advantage is eroded with age (e.g. Waldron 1983). While the Muslim advantage over low caste Hindus increases with age for both boys and girls, the Muslim advantage over high caste Hindus only increases with age for girls. By age five, there is no gender difference in mortality rates amongst low caste Hindus, and girls exhibit an *advantage* of 0.08%-points amongst Muslims. In Section 5.1 we shall see that these patterns persist after conditioning on other covariates. These facts are striking and consistent with previous studies suggesting that higher caste Hindus exhibit greater son preference than lower caste Hindus (e.g. Drèze and Sen 1997). Our data indicate that they exhibit greater son preference than Muslims too. A lower degree of son-preference amongst Muslims than among Hindus has been noted in other contexts in India. Muslims exhibit lower sex ratios (boys /girls) at birth (e.g. Barooah and Iyer 2005), a smaller female deficit in educational enrolment (e.g. Bhalotra and Zamora *forthcoming*) and a smaller gender gap in height growth (Bhalotra 2008). A lower degree of son preference amongst Muslims can illuminate the “puzzle” of interest in two ways. First, greater investments in girls in childhood result in better maternal health in later life and this is advantageous for the survival of both boys and girls. Second, if girls face better survival chances in Muslim families than in Hindu families then, at any given level of maternal health, this will tend to contribute to the overall advantage of Muslims.

Table 3 goes about here.

The Muslim/high caste differential increases monotonically with *birth-order*, whereas the Muslim/low caste differential is nonlinear in birth order (Table 3). In addition, high caste Hindus have fewer children than Muslims (Appendix Table 1),[5] and Muslim women use contraceptive methods less often than Hindus (37% versus 49.2% in NFHS-2, IIPS and ORS Macro 2000, and 45.7% versus 57.8% in NFHS-3, IIPS and Macro International 2007). Taken together, these patterns are consistent with Muslims having a higher taste for fertility than high caste Hindus.

Figure 1 goes about here.

[5] The appendix is available on the first author’s web site.

The religion mortality differential across time, sector and state

The Muslim advantage is not a recent phenomenon, being apparent early in the sample period: see Figure 1 and Bhat and Zavier (2005).[6] Annual averages of religion-specific mortality rates in our survey data are subject to considerable sampling variation, but this is smoothed when comparing decadal averages. We find a Muslim under-5 survival advantage over all Hindus of 1.91%-points (8.9% of the Hindu under-5 mortality rate) for births occurring during 1960-70 which decreased in absolute but not in proportional terms to 1.64%-pts (16.24%) in 1990-2001.

Table 4 goes about here.

Although the Muslim advantage over low caste Hindus is observed in both rural and urban sectors, disaggregation by sector reveals that Muslims only do significantly better than upper caste Hindus in rural areas (Table 4). For this reason, we investigate the religion differential for all-India as well as for the rural sample only. The Muslim advantage is not driven by special circumstances in one region; it is apparent in 11 of 26 states for high caste Hindus and in 19 of 26 states for low caste Hindus (see Appendix Table 3). It is notable given our observations regarding religion differences in son preference that the Muslim advantage is least visible in the East and the Northeast, where Hindus have more matriarchal societies.

3.2. Religion differentials in nutritional status

Stunting and wasting are commonly used indicators of nutritional status for children under the age of five. The first refers to height-for-age and indicates cumulative retardation of growth, and the second refers to weight-for-height, which reflects contemporaneous insults to health (e.g. Martorell and Habicht 1986). Following WHO conventions, both indicators are defined as equal to one if the child is more than two standard deviations below the NCHS reference population median.[7] Stunting and wasting have been shown to predict mortality at the individual level (e.g. Katz et al. 1989)

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[6] Their Table 6, p.389 reports the relevant means from the National Sample Surveys of 1963/4 and 1965/6, the Sample Registration Survey of 1979, Census 1981 and 1991, and the National Family Health Surveys (NFHS) of 1992/3 and 1998/9. In this paper, we use the NFHS surveys for 1992/3, 1998/9, and 2005/6, which contain information on births and child deaths over a span of 42 years. While data on mortality from surveys such as the NFHS can be subject to large sampling errors, SRS and Census data are not likely to suffer from this problem. The religion difference investigated here is apparent in these other data sets.

[7] The U.S. National Center for Health Statistics (NCHS) standard, recommended by the World Health Organization (WHO) until recently, was the standard used to produce the z-scores provided in the first two NFHS waves.

although, at the population level, we may see low nutritional status coexist with high mortality (e.g. Klasen 2003).

Table 5 goes about here.

The average child's height-for-age and weight-for-height is below the reference population median in each of the three communities (Table 5). Height outcomes are particularly poor: the average low caste Hindu child is stunted, the average Muslim child is almost so, and even the average high caste Hindu child is 1.8 standard deviations below the reference median. Stunting rates are 52.0%, 46.7%, and 43.9% respectively. Indian children fare better in terms of weight for height, with wasting rates at 20.3%, 16.9% and 17.3%. The ranking of the three communities by stunting is consistent with their SES ranking. Muslims exhibit slightly lower wasting rates but the differential with respect to high caste Hindus is small.[8] Overall, we do not see a clear Muslim advantage in nutritional status the way we do in survival. Disaggregation by gender reveals no boy-girl differences amongst Muslims and low caste Hindus (Table 6). However, amongst high caste Hindu, girls are shorter than boys. This is a further indication of son preference being most marked in this relatively well-off group. The findings here suggest that mortality is not systematically related to other indicators of health. In particular, although the incidence of malnutrition by a cumulative indicator (height) *is* lower amongst children in the higher SES group (Hindus), they are nevertheless more likely to die by the age of five. This echoes the contrary patterns of malnutrition and mortality in comparisons of sub-Saharan Africa and South Asia (e.g. Klasen 2003).

Table 6 goes about here.

To summarise, variation in community differences in survival by age of exposure suggests that they may be related to maternal health, and community differences in survival by birth order and gender indicate that at least some of the high caste Hindu disadvantage may stem from their stronger preference for sons. Moreover, the Hindu disadvantage increases with the child's birth order and is particularly large for children of birth order four or more. Community differences in nutritional status are much smaller than community differences in survival. Muslims have no advantage with respect to stunting (height) and only a small advantage with respect to wasting (weight).

[8] Regressions of disease probabilities on parental education and indicators for caste and religion suggest that Muslim children are significantly more prone to fever and, in urban areas, also to diarrhoea (in the two weeks before the survey) than are Hindu children; see Bhalotra (2009).

3.3. Religion differences in the independent variables

All-India means of variables used in the analysis by religion are in Appendix Table 1. Some relevant religion differences are summarised here. The sex ratio (male/female) at birth is lowest amongst Muslims, and this difference is marginally statistically significant in relation to high caste Hindus. High caste Hindu mothers and fathers tend to be the most educated. Muslims are more educated than low caste Hindus. Muslims are more urbanised than (all) Hindus and (not shown in these descriptive statistics) their poverty rate relative to Hindus is higher within urban areas than within rural areas (GOI, p. 153). In this way, inequality in SES between Muslims and Hindus appears to be lower in rural areas. The higher fertility of Muslims has the consequence that the average child is of higher birth order but it also exerts compositional effects associated with Muslim children being born, on average, to older mothers and later in (calendar) time. Overall, the standard (socioeconomic) predictors of mortality risk do not favour Muslims even if some compositional effects do.

Since Muslims are unevenly distributed across the Indian states, we considered the state-level relationship of religion and mortality. States with a higher proportion of Muslims appear to have lower under-5 mortality, although this may be a composition effect, with the lower mortality risks of Muslims driving the state average (Appendix Figure 1). The analysis to follow allows for compositional effects by including state fixed effects and trends.

4. Methods

Using individual data on more than half a million births, we estimate a religion effect conditional upon child characteristics, family socioeconomic status (SES), state fixed effects, cohort fixed effects and state-specific trends.[9] For this purpose, we use religion and caste specific logit models of the form:

(1) $M_i^* = \boldsymbol{X_i}' \theta^J + u_i;$

$M_i = 1 \text{ if } M_i^* > 0 \text{ and } M_i = 0 \text{ if } M_i^* \leq 0$

M_i is an indicator that takes the value 1 if child i dies before the reference age and 0 otherwise. The reference age is either one month (neonatal mortality), 12 months (infant mortality), or five years (under-5 mortality). The vector $\boldsymbol{X_i}$ contains gender, birth order (whether born second, third, or fourth or above), birth month and birth year of the child,

[9] Alternative specifications with, for example, neighbourhood effects are discussed in Section 6.

categories for the age of the mother at the birth year of the child,[10] rural/urban location of the household, dummies indicating the educational levels of the mother and father, birth cohort dummies, state dummies, and state specific linear time trends. The latter variables will pick up trends in medical technology and information concerning health and health behaviour. The *u* term denotes errors, assumed to be logistic, independent of the covariates, and independent for children in different neighbourhoods (but not necessarily for children in the same neighbourhood); θ^J are three vector of parameters to be estimated – we allow for separate parameters for each of the three groups (J = Muslims, High caste Hindus, or Low caste Hindus). This way, we allow for the effects of characteristics on mortality to be different by community.

The Hindu-Muslim gap is then decomposed to isolate the share due to differences in the independent variables across communities and this is done separately for low and high caste Hindus. In the baseline model, SES is captured by the education of both parents, mother's age at birth which also indicates the stage of the lifecycle; birth order which will also capture differences in risk exposure due to biological factors or fertility preferences, and the extent of sibling competition for resources; and rural location.

Since the essence of the paradox is that mortality rates by religion exhibit an "SES-reversal", it is important that we control sufficiently well for SES. We therefore will also present extensions that incorporate family assets and health infrastructure at the village and state level (Section 6). Since the religion effect persists, we attempt to identify which of some candidate attitudes or behaviours might drive it by including proxies for these in the model. To check if the Muslim advantage evident for child survival also shows up for indicators of nutritional status, we estimate similar models replacing the indicator for mortality with indicators for stunting and wasting (Section 7).

The decomposition uses an extension of the Blinder-Oaxaca technique that is appropriate for binary models (Fairlie 2006, Jann 2006).[11] The average difference in the

[10] Maternal age at birth and birth year are potentially endogenous if fertility is endogenous. Bhalotra and van Soest (2008) estimate a structural model for neonatal mortality that endogenises these variables. We also estimated their structural model (for the case of neonatal mortality), and found similar results to those presented here. In addition, we found that in our under-5 mortality baseline model, removing maternal age at birth from the regression makes no substantial difference to the size of the religion differential or to its persistence in the decomposition analysis.

[11] Despite the popularity of the Blinder-Oaxaca approach, there are few decomposition exercises for non-linear models; exceptions include Fairlie (2006) and Bauer et al. (2007).

child mortality rate of the Hindu community H and the Muslim community M can be expressed as:

$$(2) \quad \bar{Y}^H - \bar{Y}^M = \left[\sum_{i=1}^{N^H} \frac{F\left(X_i^H \hat{\theta}^H\right)}{N^H} - \sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\theta}^H\right)}{N^M} \right] + \left[\sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\theta}^H\right)}{N^M} - \sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\theta}^M\right)}{N^M} \right]$$

with H indexing Hindus (either low- or high caste) and M indexing Muslims. $\bar{Y}^J$ ($J=H,M$) is the average probability of child death at the relevant age, X_i^J is the row vector of independent variables of observation i in group J, $\hat{\theta}^J$ is a vector of logit coefficient estimates including an intercept and N^J is the number of observations in group J. The first term in Eq. (2) is the mortality differential which we would see given the different characteristics of the two groups if Muslims behaved like Hindus (i.e. with parameters set equal to $\hat{\theta}^H$ for both groups). It is an estimate of the extent to which the gap would close if Hindus were assigned the characteristics of Muslims. We could just as well estimate this term forcing the responses of the two groups to be represented or "benchmarked" by the parameters of the Muslim equation, $\hat{\theta}^M$. We present both estimates. The second term in equation (2) picks up the residual or "unexplained" variation in mortality between the two groups. This may be interpreted as reflecting group-specific cultural norms, information, discount rates, attitudes or indeed any omitted variables.

The characteristics effect can be further decomposed into contributions of (groups of) covariates. For this purpose, it is necessary to match observations from both groups to obtain samples of similar sizes. Since decomposition results are potentially sensitive to the matching procedure, 100 low- or high caste Hindu samples were drawn randomly to be matched with the (smaller) Muslim sample, and the reported results are means across simulations. Moreover, for the contribution of each variable, the order of regressors in the equation matters since the contribution of each characteristic is calculated conditional on the contribution of the previous ones (Fairlie 2006, p.4). This potential arbitrariness is minimised by randomising the ordering of the independent variables in each replication and reporting the average results thus obtained.[12] The detailed decomposition is not

[12] The total characteristics effect is neither sensitive to the choice of sample to be matched with the smaller group, nor to the order of covariates. We have experimented with different matched samples and orders of covariates to check the robustness of our baseline results to these two sources of arbitrariness. Using different subsamples of the larger group has almost no effect on the detailed decomposition results. Changing the order of covariates affects the results of *single*

sensitive to the choice of the omitted category for dummies included in the model (Oaxaca and Ransom 1999).

5. Results

5.1. Religion differences in the parameters of the mortality equation

Logit estimates for under-5 mortality are in Appendix Table 5 and the corresponding estimates for neonatal and infant mortality are in Appendix Table 4. Consistent with the biological advantage of newborn girls, they have a significant neonatal survival advantage in all three communities, which is smallest amongst high caste Hindus. By the age of five, the advantage of girls is eroded in every community and amongst high caste Hindus it changes into a significant disadvantage. Under-5 mortality odds tend to be lowest for first-borns and then to increase with birth order, though less steeply for Muslims. This is different for neonatal and infant mortality; particularly for neonatal mortality, the mortality chances are lower for the second and third child than for the first child. Note that the estimated birth order effects are purged of the (correlated) effects of maternal age at birth since this is included in the equation. Results for gender and birth order tie in with long-standing evidence of greater son-preference and lower desired fertility amongst high caste Hindus, confirming findings reported in Section 3.1.

Mortality risk tends to decrease monotonically with mother's age at birth until age 25 (for high caste Hindus) or later. Children born in March and October/November, when temperatures are more moderate, tend to have better survival chances. These effects are strongest in the low caste group, possibly indicating that vulnerability to the epidemiological environment is positively associated with poverty. The beneficial effects of parents' education increase with child age, consistent with an increasing role for environment and care in the survival technology. In general, the effects of paternal and maternal education are similar across the three groups. As is commonly found, the coefficients on mother's education are somewhat larger than on fathers' education, possibly because mothers are the principal care-givers.[13]

The disadvantage associated with living in a rural area is similar across communities although it is a bit smaller amongst high caste Hindus. State of residence is a more significant determinant of mortality amongst Hindus than amongst Muslims. The

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decompositions. However, when averaging over 100 replications, as we do in this paper, there is very little difference over 10 different sets of 100 replications (details available upon request).

[13] An alternative explanation with our sample design might be measurement error in the education of the father, since this information is obtained from the interview with the mother.

year dummy coefficients, which are jointly significant in all regressions, suggest that low caste Hindus have experienced the smallest improvement in survival over time, and Muslims the largest. State-specific linear trends are jointly significant for the two Hindu groups at any reference age, but they are only significant for under-5 mortality amongst Muslims. Overall, there is significant between-community variation in state-level fixed effects and state-specific trends.

5.2. Baseline Decomposition Results

In this section, we present decompositions of the mortality differentials between Muslims and high- and low caste Hindus for each mortality indicator. Estimates for under-5 mortality are in Table 7 (whole sample) and Appendix Table 8 (rural sample). Estimates for neonatal and infant mortality are in Appendix Tables 6 and 7, respectively. The discussion will mostly focus on under-5 mortality where the paradox is most pronounced, but the essential conclusions are similar for neonatal and infant mortality. Results are benchmarked first on one parameter set (the Hindu sample estimates $\hat{\theta}^{H}$) and then on the other (the Muslim sample estimates $\hat{\theta}^{M}$). Some of the results are sensitive to the choice of benchmark, but the overall conclusions of the analysis are not.

Table 7 goes about here.

Muslims versus high caste Hindus

Differences in average characteristics between the communities predict a Muslim *dis*advantage relative to high caste Hindus of 0.36%-points, explaining *none* of the 1.34% points advantage that Muslims exhibit. The characteristics that drive the predicted advantage of Hindus are their better parental education and the direct effect of their lower fertility, expressed as lower average birth order. Muslims gain some advantage over Hindus on account of their greater urbanisation and two indirect effects of their higher fertility. First, the average Muslim child is born later in calendar time, which means she benefits from secular improvements in medical technology and institutional quality, and second, Muslim mothers are, on average, older at birth. State-specific trends also show some favour for Muslims.[14]

Overall, the decomposition shows that compositional advantages of Muslims on account of their location or their higher fertility are overwhelmed by the effects of their

[14] This is for the case where high caste Hindus are the reference group. This result reverses when Muslims are the reference group; the other results remain similar; see Table 7.

lower levels of education. The substantial survival advantage that they exhibit therefore remains a puzzle with the current (conventional) specification.

Muslims versus low caste Hindus

So as to detach omitted variables correlated with SES from religion and gain a better understanding of the role of SES versus religion (i.e. unobservables associated with religion), we also compare Muslims with low caste Hindus. As discussed earlier, high caste Hindus are distinctly better off than Muslims but Muslims are, by many indicators, better off than low caste Hindus (Government of India 2006). The decomposition shows that only about a third of the Muslim advantage over low caste Hindus can be explained by the more favourable characteristics of Muslims.[15] This is consistent with the hypothesis that Muslims have an unobservable trait that is heath-improving.

Isolating the rural sample

Although the all-India decomposition showed that their greater urbanisation confers an advantage upon Muslims, we observed earlier that the Muslim advantage over high caste Hindus is only significant in the rural sample (Section 3). We therefore repeat the decomposition isolating rural households. In general, characteristics again completely fail to explain the Muslim advantage. The closest we get is that in the comparison with high caste Hindus that uses $\hat{\theta}^H$ rather than $\hat{\theta}^M$, birth-year, state effects and state trends are able to explain 10.6% of the Muslim advantage (Appendix Table 8).

6. Extensions

The previous section shows that upper caste Hindus suffer lower survival rates for their children despite having better (for survival) characteristics and this suggests omitted variables correlated with religion. We now extend the covariates in the hope of identifying relevant omitted variables. Is the religion effect an effect of the family's religion or is it an effect that operates through the local community? Might the controls for family SES used so far be insufficient? Might Muslims live in states or villages with

[15] In contrast, about 56% of the high caste Hindu advantage over low caste Hindus is explained by differences in the same covariates (results are available upon request). Two points are worth noting. First, covariates explain more of the high/low caste differential than of the Hindu/Muslim differential, reinforcing other indications that Muslims have some advantage in survival that is unobservable in our data. Second, covariates do not completely explain the caste differential. This is consistent with unmeasured differences in SES between the high and low castes but discrimination against low caste households may also contribute. Indian folklore is rich with tales of low caste households being denied access to the village well and it is entirely plausible that low caste households have more limited access to health services.

better public health facilities? What behaviours might Muslims have that favour survival? In the next section, we consider whether there is any similar unexplained variation in community differences in anthropometric indicators that favours Muslims.

6.1 Neighbourhood Effects

There is a growing recognition of the importance of neighbourhood or local community in determining individual outcomes conditions (e.g., Madise et al. 1999, Diez Roux 2001, Kabir et al. 2003). Child health, for example, may be influenced by neighbourhood through common cultural beliefs and practices regarding food and hygiene for mothers and children, differential access to infrastructure or health services, or exposure to different environmental. To investigate the possible conflation of religion and neighbourhood effects, we estimate a model with neighbourhood fixed effects. Incorporating such effects is possible because the data are stratified into local clusters; they contain 8620 clusters with within-cluster variation in under-5 mortality; 1274 clusters had no variation. The average cluster has 52 children. The fixed effects logit model is estimated using the conditional maximum likelihood estimator of Chamberlain (1980). This estimator requires a large number of clusters but remains consistent if the number of children per cluster does not tend to infinity, which is important in our case since the number of children in many clusters is quite small. The estimator does not give consistent estimates of the separate local neighbourhood effects and can therefore not be used for the decompositions. We therefore only consider models for the pooled sample with first order religion/caste effects, not separate models for the three groups.

Detailed results are in Appendix Table 9, for otherwise identical models with and without neighbourhood effects. Conditional upon the covariates listed above, relative to high caste Hindus, the odds of a Muslim child dying before the age of five are 0.848 (t-value on the corresponding coefficient: -7.77) and 0.850 (t-value -5.93) in the models without and with neighbourhood effects, while the odds of a low caste Hindu child dying are 1.128 (t-value 7.82) without and 1.166 (t-value 8.91) with cluster effects. It is striking how insensitive this conditional distribution of risk across communities is to controlling for cluster effects. This implies that the religion effects we find are effects of the religion of the family and not indirect effects of factors correlated with the share of Muslims in the local community.[16]

6.2 Household wealth

So far we have controlled for socioeconomic status using father's and mother's education (and the mother's age at birth and birth order, which proxy the stage of the lifecycle and the number of dependents). This may be insufficient if Muslims are systematically wealthier than Hindus for a given educational level, for instance, because they own more physical capital. We therefore control for ownership of assets.[17] Wealth is endogenous if omitted regressors such as ability and social connections influence both wealth and mortality or if mortality, by influencing investments in children, determines investments in physical capital. This is why we did not include it in our baseline models. The NFHS contains information on a range of assets owned by households *at the time of the survey* only. We therefore restrict the estimation sample to children born no more than 10 years before each survey. The equation is estimated for under-5 mortality risk, so the sample is further restricted to remove children who have not yet been exposed to this risk for the full five years. [18] Following the method popularised by Filmer and Pritchett (2001), we use the first principal component of a set of assets to create an indicator of wealth and include in the model dummies for the quintile of the wealth distribution that the individual household falls into.[19]

Children face significantly lower odds of dying as they move beyond the second quintile of the distribution. The extended decomposition shows that wealth contributes to explaining the Muslim survival advantage over low-caste Hindus but makes *no* contribution to the Muslim-High caste mortality differential. In this smaller, more recent

[16] Indian women sometimes migrate to their maternal home for a few months to give birth. This will lead to local community being measured with error. However, the measurement error would have to be systematically different between Muslims and Hindus to deliver a bias. For example, if migrating Muslim women systematically moved at birth to areas with better facilities and/or Hindu women systematically moved at birth to areas with worse facilities than in the areas they live in at the time of the survey, then the Muslim advantage in child survival could be an artefact of the data. We feel this is not very plausible.

[17] Assets and income appear in reduced form models of health (Strauss and Thomas 1995).

[18] We also considered the contribution of wealth to explaining the Muslim advantage in neonatal mortality amongst children born no more than five years before each survey. Wealth does not explain any part of this differential. Results are available upon request.

[19] Specifically, we use a PCA index based on dummies for ownership of a radio, fridge, bicycle, motorbike, car, television, and whether the household has electricity, flush toilet, or pit toilet.

sample, the overall contribution of characteristics to explaining the Muslim advantage is even more negative than in the full sample (Appendix Tables 10A and 10B).

6.3 Public services

The baseline decomposition (Table 7) showed that (later) year of birth favour Muslim children relative to high caste Hindus. It seems plausible that this reflects secular improvements in survival associated with the quality and spread of medical facilities, health awareness and overall prosperity. These same factors may also explain the higher mortality risk associated with rural areas, and some of the inter-state variation in intercepts which we capture with state dummies. We investigate this for under-5 mortality by looking at the effects of (log) real per capita state expenditure on health and development projects, controlling for (log) real state income per capita and for rural and urban income inequality using Gini coefficients.[20] We add to equation (1), for under-5 mortality, a vector of these state-level variables. These data are only available for the 15 larger Indian states, which account for more than 95% of India's population, but result in a loss of about 15.5% of observations because women in smaller states are over-sampled in the NFHS design. We find that state expenditure and income are insignificant but that rural inequality increases child mortality amongst Muslims and high caste Hindus. Together, the state-level variables make no significant contribution to explaining the mortality differential (see Appendix Tables 11A and 11B).

Since public expenditure may not be evenly distributed across villages and increases in expenditure do not directly translate into effective improvement in services, we also consider indicators of the availability of health facilities at the village level. This information was only collected for rural areas in the first two rounds of the survey. Since the data in these two rounds are not to be strictly comparable,[21] we use only NFHS-2 for this exercise. As facilities are recorded only at the time of the survey, we keep children born no more than six years before the interview. This makes it hard to analyse under-5 mortality and allow 5 years exposure and so this analysis is conducted only for neonatal and infant mortality (Appendix Tables 12A, 12B and 12C). Given the short time-span and some fairly small state-specific samples, we drop the state-specific time trends but,

[20] The effects of these variables are identified because the model includes state specific trends rather than interactions of state and time dummies.
[21] For example, some unexpected patterns appear when comparing these data, such as a seeming reduction in the percentage of villages with a hospital or a clinic between NFHS-1 and NFHS-2.

otherwise, the estimated model is as in equation (1), with added village-level regressors. In this sample, the Muslim survival advantage over high caste Hindus is not significant in the raw data. However, even equal survival chances of these groups represent a "puzzle" because differences in the characteristics of the two groups predict a Muslim disadvantage of up to 0.77%-points (column 7, Appendix Table 12B).

The added village variables are the log of the village population, indicators for an all-weather road, a pharmacy, a *mahilamandal* (women's council), an *anganwadi* (community childcare centre), a primary health centre, a primary health sub-centre, a hospital, and dispensary or clinic.[22] The contributions of the village variables to explaining the differential are insignificant even if some are large in magnitude. This was anticipated by our estimates with fixed village effects on the pooled sample; see section 6.1. Using more aggregated variables that are comparable in NFHS-1 and NFHS-2, and thus using both datasets, we similarly found no systematic evidence of differential access to health services after controlling for village size in Bhalotra et al. (*forthcoming*).

6.4. Maternal health, diet, preferences, behaviours, kinship

We observed in section 3 that more than two-thirds of the survival advantage of Muslims over high-caste Hindus is realized in the first month of life. This suggests that explanations of the differential may be related to customs, attitudes, behaviours, maternal health, delivery and early feeding practices. In this section, we attempt to incorporate these variables in the analysis. We describe the rich set of indicators used, then explain why they are relevant, present descriptive statistics, discuss the limitations of the data, describe the specifications employed and then proceed to summarise the results.

We use indicators for whether the mother completed antenatal care (i.e., whether she had at least three antenatal checks, one anti-tetanus injection, and one course of iron tablets); gave birth at home, a private facility or a public facility; whether she ever breastfed and if she did, whether she initiated breastfeeding within two or 24 hours;

[22] For neonatal mortality, these variables are only jointly significant in the Muslim regression. For infant mortality, the only individually significant variables are the presence of a *mahilamandal*, which is correlated with *higher* infant mortality amongst low caste Hindus, most likely due to reverse causality going from higher mortality to the establishment of this type of centre, and the availability of an *anganwadi*, which is correlated with lower mortality amongst Muslims. At face value, this suggests that health facilities do not help much in preventing mortality. Alternative explanations for our findings are that the presence of facilities measures actual access to health services with error (e.g., because of poor quality or social exclusion, or high costs) and that reverse causality biases the estimated coefficients downwards.

whether she has low BMI (<18.5)[23]; her (log) height; whether vegetarian; her employment at the time of the survey and whether any employment is outside the home; indicators for endogamy (whether married to a relative and whether to a blood relative) as a proxy for kin networks; and her degree of son preference derived from her reported ideal family composition - our index for son preference in fertility is the deviation of the reported ideal sex ratio of births (male/total children) from the sample average of the ideal sex ratio reported by families with the same number of children.

Antenatal care, place of delivery and breastfeeding are established inputs to child health. There is evidence of intergenerational health transmission so that mothers who have low BMI or short stature are more likely to have children with a poor health predisposition (e.g. Osmani and Sen 2003, Bhalotra and Rawlings 2009). In general it does not seem likely that a vegetarian diet of the mother is harmful to child health but maternal anemia is highly prevalent in India and impacts upon the child. It is relevant to the fact that high caste Hindus are much more likely than Muslims to be vegetarian. Mother's employment suggests itself because Hindu women are more likely to do non-domestic work than Muslim women. Mother's time is an important input to child health as time away from the labour market can be spent, for example, seeking antenatal care, reacting quickly to symptoms of infection, taking children to faraway clinics. Bhalotra (2009) finds that mother's employment (in agriculture or informal work) is associated with less healthy behaviours and an increase in infant mortality. If Muslims practice greater endogamy and have stronger kin networks then they may be better placed to avoid child death in difficult times. Endogamy is associated with lower marriage payments and the perception of the girl child as less of a burden, as well as with the availability of extended care for the mother and the newborn child from the natal family (e.g. Robinson 2007). It may also make for better information sharing amongst women, and stronger insurance networks.

In section 3, we provided evidence suggesting that Hindus exhibit greater son preference than Muslims in India. This can influence mortality risk in two ways. If son preference is associated with excess girl mortality, this will exert a compositional effect upon the average mortality rate. Son preference may also have a causal effect on infant mortality that operates through maternal health. If son preference is a persistent community trait then the neglect of girl children a generation ago may explain poor

[23] The indicator for low BMI is interacted with an indicator for being pregnant at the time of the interview since BMI clearly tends to rise through pregnancy.

maternal health today. Basant (2007) suggests that the Muslim advantage may be due to household allocations to girls and boys being more equal, and more favourable to pregnant mothers in Muslim than in Hindu households. Given evidence that adult height is predominantly influenced by childhood conditions (Bozzoli et al. *forthcoming*), trends in adult height for birth cohorts 1956-86 in India are also consistent with this assertion. Over this period, Muslim women gained height significantly faster than Hindu women, while Muslim men grew more slowly than Hindu men (Bhalotra 2008).

The means of the variables capturing maternal health, diet, preferences, behaviours, and kinship in our extensions are reported in Appendix Table 1. Comparing the means across the three groups shows why these variables may be useful in explaining the religion differentials. Compared with Hindu women, Muslim women in India tend to be taller, are less likely to have low-BMI (with respect to low caste Hindus), more likely to have a non-vegetarian diet, less likely to work, and especially so for work outside the home, more likely to be married to relatives and to express lower son preference.[24]

Incorporating these variables has the following limitations. First, some of them are potentially endogenous, for example, mother's employment and breastfeeding, making it difficult to interpret their coefficients. Second, some vary over time and therefore across siblings but are only recorded at the time of the survey, forcing us to limit the sample to recent births, thus limiting the precision with which their effects can be estimated. The variables that are or can be assumed time-invariant are mother's height, vegetarianism, son preference and endogamy and, for these, we use the full birth histories.[25] Third, our indicators for variables like son preference and endogamy are at best partial representations of the underlying variable that we would like to model. With these caveats in mind, we proceed to investigate whether one or more of these variables hold the key to the Muslim advantage.

Using the full sample of births and pooling NFHS2 and NFHS3, we include the time/sibling invariant variables, height, vegetarianism and son preference along with the standard regressors in the baseline model (Appendix Tables 13A and 13B).[26] We then restrict the sample to the latest birth of the respondent if this precedes NFHS2 by at most

[24] Some of these variables are analysed in detail in Bhalotra et al. (*forthcoming*) where we use just the first two rounds of the NFHS.
[25] Subjective son preference measures may be rationalised ex post and so vary within mother by parity. However, our measure is expressed in deviations from the parity-specific sample average.
[26] Ideal sex ratio is missing for 17% of observations. We replace missing values with the parity-specific community average (implying the deviation from the ideal ratio is set to zero).

3 years or NFHS3 by at most 5 years, and estimate the effects of sibling-varying antenatal care, delivery, breastfeeding, BMI, and mother's employment (Appendix Tables 14A and 14B). We do not use NFHS1 because it has no data on height, vegetarianism or BMI. However information on endogamy was *only* gathered in NFHS1, forcing us to estimate its effects separately, using all births in this one round. For the long samples, we use under-5 mortality and, for the sample of latest births, neonatal mortality. As discussed earlier, we cannot model under-5 mortality on a 3 to 5 year sample and adequately allow for full exposure to the risk of under-5 mortality.

We find some evidence, in some communities, that childhood mortality risk is elevated when the mother has a vegetarian diet, had low BMI when pregnant at the time of the survey, is of short stature, has employment outside the home, exhibits failure to complete antenatal care, or did not breastfeed the index child. In addition, we find that the mortality risk for a female child is higher than for a male child when their mother exhibits higher son preference. Place of delivery and timing of breastfeeding have insignificant or unexpected effects that suggest an omitted variable bias. The sample of births for which antenatal care, breastfeeding and place of delivery variables were collected is comparatively small and, probably for this reason, most of the contributions calculated in the corresponding decomposition have low significance. Therefore, we do not put too much weight on these findings. Indeed, the variables included in this specification can only account for up to 12% [44%] of the Muslim advantage over high [low] castes. However, a significant contribution of maternal work emerges when considering the Muslim advantage over low-caste Hindus, and breastfeeding practices appear to play a significant role in accounting for the Muslim advantage over high castes. Maternal height and vegetarian diet contribute significantly to explaining the Muslim advantage in under-5 mortality, especially with respect to high caste Hindus. Our measure of son preference tends to reinforce the puzzle because, although it contributes to lower female mortality amongst Muslims, it contributes even more to lower male mortality amongst Hindus. All in all, including maternal height, diet, and son preference in the analysis allows us to account for up to 46% [52%] of the Muslim advantage over high [low] castes.[27]

The data confirm that Muslims marry relatives more often (see Appendix Table 1), but children of marriages between relatives tend to suffer higher death risks (see Appendix Table 15A), so that taking endogamy into account reinforces the puzzle (see

[27] We also estimated a specification including indicators for the mother consuming alcohol and tobacco. These variables do not contribute to the differential.

Appendix Table 15B). This is not surprising, since endogamy may be capturing much more than close kinship. Consanguinity is often found to be positively correlated with higher child mortality, although the evidence is mixed and little is known about the respective role of genetic, socio-demographic, and economic factors when a correlation is observed (Dorsten et al. 1999). The data needed to identify stronger support networks amongst Muslims are not available to us but this would be a fruitful avenue for future research. A recent study finds some evidence of separate social interactions amongst Muslims and Hindus in rural Bangladesh (Munshi and Myaux 2006).

To summarise, *except* for maternal vegetarian diet and height, controlling for household wealth, access to health services and public infrastructure, and a range of more unconventional variables pertaining to the mother's health, attitudes and behaviours makes, if at all, a small contribution to understanding the puzzle of why mortality among children of Muslims is lower than among children of high caste Hindus. To some extent this is no doubt because the proxies available for health, attitudes and behaviours are partial and not immune to endogeneity issues. We expect that the real weight of these variables is considerably greater than we estimate.

7. Nutritional Status: Stunting and Wasting

Community differences in anthropometric deficits were described in section 3. The set of regressors is as in equation (1) although we do not include state-specific trends because this sample is relatively short, consisting of three years for each of the three survey rounds. The logit estimates are in Appendix Table 16, and decomposition results in Tables 8 and 9 below. For stunting, the ranking of communities is consistent with their SES. The decomposition shows that between 75 and 94% of the high caste Hindu advantage over Muslims is due to differences in characteristics (Table 8).

Table 8 goes about here.

The characteristics that favour high caste Hindus are parental education, birth order, and month of birth, and their advantage is only partly offset by a Muslim advantage on account of urbanisation, birth year, and state of residence. The Muslim advantage over low caste Hindus is more enigmatic: only 29% of the differential in stunting is explained by differences in characteristics. Mother's education, age at birth and birth year disadvantage lower caste Hindus and overwhelm factors that disadvantage Muslims, namely, higher birth order, distribution of month of birth and father's education.[28] Thus there appear to be omitted variables specific to Muslim children that favour their height performance relative to low caste Hindus. When Muslims do worse, as is the case compared with high caste Hindus, then most of their disadvantage is explained. However, when they do better, as is the case relative to low caste Hindus, their advantage is unexplained. This is consistent with our earlier finding that the Muslim community has some unobservable traits that favour health.

Table 9 goes about here.

Now consider wasting, the indicator on which Muslims do relatively well. Although wasting amongst Muslims is lower by 0.40%-points, differences in characteristics suggest it should be higher by up to 0.56%-points, compared with high caste Hindus, who are favoured again by better parental education and lower birth order. Muslims do better than the low caste group but at most 20% of their advantage is explained by characteristics and this rests upon unobservables captured by the state dummies (Table 9). So Muslims show an unexplained advantage relative to both castes of Hindus in avoiding low weight-for-age just as they do in avoiding mortality.

8. Conclusions

Our main purpose in this paper has been to highlight, describe and analyse the hitherto neglected fact that Muslims in India have better health outcomes than Hindus. This religion differential is much larger than the more widely recognised gender differential in child survival in India and it appears to have persisted for decades. We have estimated a range of specifications and identified some factors that endow Muslims with an advantage in health and survival but their lower SES and, in particular, education, tends to dominate so that conventional variables can explain none of the Muslim advantage over high caste Hindus and, typically, less than half of their advantage over low caste Hindus (see Table 10). We show that the religion differential is unchanged if we control comprehensively for characteristics of the villages or towns in which households of different religions live. Of all the more unusual variables we have experimented with, non-vegetarian diet and height alone appear to be significant

[28] In this short sample, Muslim fathers are less educated than low caste Hindus. This is a reflection of the more rapid educational progress of low caste as compared with Muslim men over time. In contrast, Muslim women have advanced fairly rapidly (see Deolalikar, *forthcoming*).

contributors to the Muslim advantage over high-caste Hindus, with non-vegetarian diet explaining over a third of their advantage in under-5 mortality.

Table 10 goes about here.

Potential explanations of the Muslim advantage include their stronger social networks, which may be accounted for by their marriage culture and their minority status in India; their healthier behaviours, some of which are associated with religion; and their lower son preference which, amongst other things, may explain the better health of Muslim mothers. Personal hygiene amongst Muslims is dictated by the requirement to wash before prayer combined with the rigour of praying five times a day and while we do not have the data to analyse this, historical records suggest the importance of simple hygiene in lowering mortality when mortality is primarily caused by infectious disease (e.g. Miller 2008). Muslims appear to enjoy closer kinship than Hindus, of which endogamy is but one expression. Stronger kinship tends to result in better social networks that may influence child mortality through, for example, the sharing of information or child care amongst women (e.g. Robinson 2007). The data at hand allow us to investigate the role of several aspects of behaviours around birth (antenatal care, place of delivery, and breastfeeding practices), one aspect of marriage culture (endogamy), and of one proxy for son preference based on the self-reported ideal sons to total children ratio. These do not shed more light on the puzzle at hand, but further research is needed to rule out the possibility that this lack of evidence is due to data limitations.

In particular, we find indirect evidence that lower son preference amongst Muslims may be part of the explanation. Indeed, we find that, in a plain logit model of neonatal or infant mortality, the survival advantage of the female child is higher amongst Muslims than high-caste Hindus, whilst, in a logit model explaining under-5 mortality, the risk associated with being a girl is only significant amongst high castes. Furthermore, the sex-ratio at birth is higher amongst high-caste Hindus,. Finally, Muslim women are found to have higher stature, which in part captures better health.

The evidence points to the importance of early life factors - factors that influence child health by the first month of life. It is therefore plausible that Muslims not only have (observed) better survival chances of newborn children but that they experience, for the same reasons, (unobserved) lower risks of foetal death. This would contribute to explaining the higher fertility of Muslim women which, so far, has been explained in terms of higher desired fertility and greater aversion to the use of contraception. However, selection may turn this around. If poverty (SES) dominates in the risk of foetal loss and Muslims are in fact more likely than upper caste Hindus to suffer it then, assuming that it is the frailest children who die *in utero*; the average live birth amongst Muslims will tend to be less frail and more likely to survive. This may contribute to explaining the higher survival chances of Muslim children given that survival rates are conventionally measured as a fraction of live births. The potential for differences between communities in maternal health and in attitudes to pregnancy to create differences in foetal death risk, with consequences for observed differences in both childhood mortality and fertility, has not been investigated in the literature.

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Tables

Table 1: Mortality Rates and Differentials by Community

	(1) *Low Caste* *%*	*(2)* *Differential* *LC-M* *%-points* *(as % of (1))*	*(3)* *High Caste* *%*	*(4)* *Differential* *HC-M* *%-points* *(as % of (3))*	*(5)* *Muslim* *%*
Neonatal	6.79	1.72 (25.30)	5.98	0.90 (15.12)	5.08
Infant	11.03	3.06 (27.69)	9.29	1.31 (14.08)	7.98
Under-5	15.93	4.64 (29.14)	12.59	1.30 (10.34)	11.29

LC is low-caste Hindu (SC and ST), HC is high-caste Hindu, and M is Muslim. Sample of children fully exposed to the relevant mortality risk and for whom caste status is known (N = 653,496 for neonates, N = 629,058 for infants, N = 522,377 for under5s). All differentials are significant at the 1% level.

Table 2: Mortality Rates by Community and Gender

		Neonatal	*Infant*	*Under-5*
Male	Low Caste	7.41	11.33	15.93
	High Caste	6.40	9.42	12.34
	Muslim	5.60	8.26	11.33
Female	Low Caste	6.13	10.71	15.94
	High Caste	5.52	9.15	12.87
	Muslim	4.51	7.68	11.25

See notes to Table 1. For neonates, the female sample size is 313,461 and the male sample size is 340,035.

Table 3: Mortality Rates by Community and Birth Order

Birth order		*Neonatal*	*Infant*	*Under-5*
1	Low Caste	8.63	12.64	16.67
	High Caste	7.14	9.94	11.74
	Muslim	6.62	9.19	11.21
2	Low Caste	6.24	10.44	15.36
	High Caste	5.11	7.98	10.25
	Muslim	4.53	7.20	9.78
3	Low Caste	5.43	9.38	14.64
	High Caste	4.96	8.01	10.58
	Muslim	4.24	6.82	9.31
>=4	Low Caste	6.36	11.01	16.50
	High Caste	6.18	10.40	14.45
	Muslim	4.70	7.92	11.42

See notes to Table 1. For neonates, sample sizes are, respectively, 197,952; 166,382; 117,490 and 171,672 for first-, second-, third- and fourth and above birth order. All differentials are significant at the 1% level, except for the high-caste Hindu differential for first-born children (p-value=0.0226).

Table 4: Mortality Rates by Community and Rural/Urban Location

		Neonatal	*Infant*	*Under-5*
Urban	Low Caste	5.13	8.25	11.48
	High Caste	4.32	6.54	8.51
	Muslim	3.97	6.40	8.84
Rural	Low Caste	7.13	11.61	16.86
	High Caste	6.55	10.24	14.03
	Muslim	5.68	8.84	12.66

See notes to Table 1. For neonates, sample sizes are 209,999 for urban areas and 443,497 for rural areas. All differentials are significant at the 1% level or below except for the Muslim/high-caste differentials in urban areas, which are not significant at any usual level.

Table 5: Malnutrition Rates by Community

	Low-caste Hindu		p-value of Wald test LC-M	High-caste Hindu		p-value of Wald test HC-M	Muslim	
	mean	s.d.		mean	s.d.		mean	s.d.
Height-for-age:								
s.d. from the reference median (z)	-2.054	1.588	0.0003	-1.788	1.566	0.0000	-1.927	1.650
% stunted (z < 2 s.d. below median)	52.0		0.0000	43.9		0.0030	46.7	
Weight-for-height:								
s.d. from the reference median (z)	-1.101	1.120	0.0000	-1.002	1.094	0.8192	-0.998	1.091
% wasted (z< 2 s.d. below median)	20.3		0.0000	17.3		0.5316	16.9	
Number of children	10485			25114			7613	

LC is low-caste Hindu (SC and ST), HC is high-caste Hindu, and M is Muslim. Sample consists of children no more than 36 months old for states where height and weight were measured in all NFHS rounds, i.e., all states except Andhra Pradesh, Madhya Pradesh, Tamil Nadu, West Bengal, and Himachal Pradesh. Top percentile of height-for-age and weight-for-height distributions dropped to remove outliers. Reference population is the National Center for Health Statistics (NCHS) standard.

Table 6: Malnutrition Rates by Community and Gender

		Height-for-age	*Weight-for-height*
Boys	Low Caste	-2.062	-1.120
		[0.005]	[0.0001]
	High Caste	-1.768	-1.008
		[0.000]	[0.808]
	Muslim	-1.937	-1.001
Girls	Low Caste	-2.045	-1.082
		[0.007]	[0.005]
	High Caste	-1.811	-0.996
		[0.014]	[0.922]
	Muslim	-1.917	-0.993

These are z-scores defined as standard deviations from the median of the reference population. See also notes to Table 5. P-values of a Wald test for the significance of the difference compared to Muslim children are in brackets.

Table 7: Decomposition of the Hindu-Muslim Under-5 Mortality Differential, Whole Sample.

	Low-caste/Muslim						*High-caste/Muslim*					
Benchmark	LC			M			HC			M		
	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat
$\overline{Y}^H - \overline{Y}^M$	4.65	100.00		4.65	100.00		1.34	100.00		1.34	100.00	
Explained[a]	1.56	33.62		1.25	26.83		-0.36	-26.67		-0.37	-27.86	
Unexplained[b]	3.09	66.38		3.40	73.17		1.70	126.67		1.71	127.86	
Detailed contributions												
Gender	0.00	0.00	-0.06	0.00	0.00	0.00	0.00	-0.14	-1.66	0.00	-0.01	-0.10
Birth order	-0.22	-4.71	-5.59	-0.15	-3.17	-3.14	-0.36	-26.75	-10.81	-0.24	-18.02	-4.27
Birth month	0.00	-0.05	-0.26	0.01	0.18	0.64	-0.01	-0.70	-1.27	0.00	0.32	0.29
Mother's age at birth	0.43	9.25	8.08	0.28	6.00	4.76	0.09	6.65	2.69	0.01	0.90	0.23
Father's education	0.16	3.48	6.81	0.14	3.02	4.95	-0.57	-42.57	-14.59	-0.39	-29.01	-5.52
Mother's education	0.30	6.53	6.71	0.30	6.44	6.36	-0.34	-25.34	-14.19	-0.32	-23.83	-5.47
Rural	0.56	12.09	7.14	0.43	9.34	5.54	0.25	18.62	8.24	0.24	17.90	5.25
Birth year	0.05	1.07	0.71	0.04	0.94	0.13	0.43	31.85	4.66	0.70	52.00	1.80
State	-1.06	-22.88	-2.29	-0.90	-19.28	-1.33	-0.05	-3.85	-0.24	0.01	0.66	0.02
State trends	1.34	28.86	2.99	1.09	23.37	1.47	0.21	15.72	0.86	-0.38	-28.65	-0.62

LC is low-caste Hindus, HC is high-caste Hindus and M is Muslim. $\overline{Y}^H - \overline{Y}^M$ is the difference in the mortality rate of the Hindu community H and the Muslim community M.

[a] $\sum_{i=1}^{N^H} \frac{F\left(X_i^H \hat{\theta}^J\right)}{N^H} - \sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\theta}^J\right)}{N^M}$, where J is the group used as benchmark, is the sum of the contributions of each variable. In words, this is the differential that would be predicted based on differences in characteristics. [b] $\left[\overline{Y}^H - \overline{Y}^M\right] - \left[\sum_{i=1}^{N^H} \frac{F\left(X_i^H \hat{\theta}^J\right)}{N^H} - \sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\theta}^J\right)}{N^M}\right]$ is the difference between the actual and predicted differentials. The left-hand side panel shows the decomposition of the differential between low caste Hindus and Muslims while the panel in the right-hand side pertains to high caste Hindus and Muslims. Within each panel, we present two sets of estimates, one for each benchmark (refer p.14). The first cell in each panel shows the total differential. For example. low caste Hindus have a mortality risk that is 4.65% points higher than that of Muslims. The first column shows the %-point difference explained overall and by each covariate (or set of covariates). The second column casts this in % terms, and the third column presents the z-statistic. A value of the z-statistic larger than 1.96 in absolute terms denotes a statistically significant contribution.

Table 8: Decomposition of the Hindu-Muslim Stunting Differential

	Low-caste/Muslim						*High-caste/Muslim*					
benchmark	LC			M			HC			M		
	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat
$\overline{Y}^H - \overline{Y}^M$	5.25	100.0		5.25	100.0		-2.81	100.00		-2.81	100.00	
Explained[a]	1.53	29.15		1.23	23.43		-2.63	93.60		-2.11	75.25	
Unexplained[b]	3.72	70.85		4.02	76.57		-0.18	6.40		-0.70	24.75	
Detailed contributions[c]												
Gender	0.00	0.00	-0.02	0.00	0.08	0.33	-0.01	0.53	-1.80	-0.01	0.18	-0.45
Birth order	-0.28	-5.26	-2.75	-0.28	-5.41	-2.21	-1.04	37.07	-6.03	-0.68	24.05	-2.22
Birth month	-0.22	-4.10	-2.72	-0.57	-10.87	-5.89	-0.22	7.79	-4.11	-0.47	16.70	-4.86
Mother’s age at birth	0.32	6.14	2.36	0.36	6.79	2.07	0.31	-10.96	3.19	0.26	-9.19	1.69
Father’s education	-0.10	-1.97	-1.52	-0.24	-4.61	-2.90	-1.57	55.88	-7.00	-1.63	58.00	-3.89
Mother’s education	0.71	13.60	4.99	0.51	9.65	3.16	-1.58	56.32	-11.01	-0.97	34.52	-3.03
Rural	0.42	7.99	1.36	0.79	15.10	2.65	0.28	-10.11	2.50	0.46	-16.24	2.63
Birth year	0.58	11.11	6.06	0.54	10.33	4.13	0.73	-26.10	9.51	0.90	-31.90	7.16
State	0.08	1.45	0.19	0.11	2.16	0.18	0.48	-17.21	2.62	0.04	-1.27	0.09

Children no more than 36 months old for states where height and weight were measured in all NFHS rounds, i.e., all states except Andhra Pradesh, Madhya Pradesh, Tamil Nadu, West Bengal, and Himachal Pradesh. See also notes to Table 7.

Table 9: Decomposition of the Hindu-Muslim Wasting Differential

	Low-caste/Muslim						*High-caste/Muslim*					
benchmark	LC			M			HC			M		
	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat	%-point	% of $\overline{Y}^H - \overline{Y}^M$	z-stat
$\overline{Y}^H - \overline{Y}^M$	3.43	100.0		3.43	100.0		0.40	100.0		0.40	100.0	
Explained[a]	0.70	20.44		0.31	8.94		-0.56	-138.8		-0.27	-66.67	
Unexplained[b]	2.73	79.56		3.13	91.06		0.96	238.8		0.67	166.7	
Detailed contributions[c]												
Gender	-0.01	-0.17	-0.39	0.00	-0.10	-0.19	0.01	2.89	1.24	0.02	3.82	0.77
Birth order	0.01	0.27	0.11	-0.07	-2.02	-0.66	-0.28	-70.20	-2.02	-0.11	-27.75	-0.46
Birth month	-0.19	-5.58	-2.70	-0.06	-1.88	-0.75	-0.03	-7.64	-0.70	-0.07	-18.43	-0.91
Mother's age at birth	-0.10	-2.84	-0.80	-0.06	-1.76	-0.42	0.02	4.56	0.22	-0.07	-16.60	-0.48
Father's education	-0.02	-0.55	-0.35	-0.04	-1.21	-0.63	-0.40	-98.75	-2.29	-0.23	-55.83	-0.70
Mother's education	0.19	5.55	1.48	0.25	7.37	1.66	-0.39	-96.80	-3.36	-0.52	-127.7	-2.09
Rural	0.30	8.67	1.14	0.16	4.76	0.65	0.08	20.69	0.93	0.10	24.63	0.65
Birth year	-0.03	-0.84	-0.26	-0.14	-3.99	-1.19	0.08	18.83	1.29	0.20	50.01	2.02
State	0.53	15.55	1.70	0.26	7.44	0.55	0.36	88.20	2.44	0.41	102.0	1.38

Children no more than 36 months old for states where height and weight were measured in all NFHS rounds, i.e., all states except Andhra Pradesh, Madhya Pradesh, Tamil Nadu, West Bengal, and Himachal Pradesh. See also notes to Table 7.

Table 10: Summary of Decomposition Results

	Explained variable	Specification details	Sample size		Low caste		High caste	
				Benchmark	LC	M	HC	M
(1)	Under 5 Mortality	Standard set of regressors.	518585	Differential	4.65	4.65	1.34	1.34
				Explained[a]	1.56	1.25	-0.36	-0.37
(2)		Rural sample. Standard set of regressors except rural indicator.	349662	Differential	4.25	4.25	1.44	1.44
				Explained[a]	1.28	0.54	0.15	-0.56
(3)		Children born no more than 10 years before the survey. Standard set of regressors plus wealth quintile.	151068	Differential	3.87	3.87	1.02	1.02
				Explained[a]	1.48	0.67	-0.62	-0.89
(4)		15 largest Indian states only. Standard set of regressors plus state macroeconomic variables.	436151	Differential	4.75	4.75	1.41	1.41
				Explained[a]	1.55	1.24	-0.36	-0.38
(5)		NFHS-2 and NFHS-3. Standard set of regressors plus mother height, diet, and self-reported son preference.	284479	Differential	4.77	4.77	1.30	1.30
				Explained[a]	2.30	2.50	0.41	0.60
(6)		NFHS-1. Standard set of regressors plus endogamy variables.	175829	Differential	4.89	4.89	1.16	1.16
				Explained[a]	0.89	0.08	-1.55	-1.37
(7)	Neonatal Mortality	Standard set of regressors.	648615	Differential	1.72	1.72	0.92	0.92
				Explained[a]	0.62	0.56	0.00	0.01
(8)		NFHS-2. Children born no more than 6 years before the survey. Rural sample.	36382	Differential	1.47	1.47	0.60	0.60
		Standard set of regressors except state-specific linear trends, plus village characteristics.		Explained[a]	0.62	-0.45	-0.77	-0.47
(9)		NFHS-2 and NFHS-3. Latest births if occurred to the respondent no more than 3 years before NFHS-2 and no more than 5 years before NFHS-3.	44462	Differential	0.78	0.78	0.35	0.35
		Standard set of regressors except state-specific linear trends, plus antenatal, delivery, breastfeeding, maternal work and maternal BMI dummies.		Explained[a]	0.34	0.26	-0.25	0.04
(10)	Infant Mortality	Standard set of regressors.	624444	Differential	3.06	3.06	1.33	1.33
				Explained[a]	1.18	0.87	-0.07	-0.12

(11)		As in specification (7)	31204	Differential Explained[a]	2.31 1.04	2.31 0.13	0.41 -0.72	0.41 -0.43
(12)	Stunting	Children up to 36 months old. 5 states excluded for consistency across rounds.	43192	Differential	5.25	5.25	-2.81	-2.81
				Explained[a]	1.53	1.23	-2.63	-2.11
(13)	Wasting	As in specification (12)	43354	Differential Explained[a]	3.43 0.70	3.43 0.31	0.40 -0.56	0.40 -0.27

All samples include only children fully exposed to the relevant mortality risk. Unless specified otherwise, all samples are drawn from pooled NFHS-1, NFHS-2 and NFHS-3 data. The standard set of regressors includes indicators for gender, birth order, birth month, mother's age at birth, father's education, mother's education, rural location, year of birth of the child, state of residence, and state-specific linear time trends. The sample size reported here is the sum of all observations in community-specific logits. LC is low-caste Hindus, HC is high-caste Hindus and M is Muslim. [a] $\sum_{i=1}^{N^H} \frac{F\left(X_i^H \hat{\theta}^J\right)}{N^H} - \sum_{i=1}^{N^M} \frac{F\left(X_i^M \hat{\theta}^J\right)}{N^M}$, where J is the group used as benchmark.

Figure

Figure 1