Title: Education or economic status? Comparing their relative effect on prime-age adult mortality in India using longitudinal survey data

Acknowledgments

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Abstract

Introduction: Improvements in the health status of the population are closely related to the level of socio-economic development. Several studies have drawn the link between occupational status, income, wealth and education on the one hand and health outcomes on the other relying on data from developed countries. However, the phenomenon remains largely unexplored in developing countries. This study examines the relative effect of two primary aspects of development, educational attainment and economic resources on prime-age adult mortality in India.

Methods: Relying on nationally representative data from the Indian Human Development Survey (IHDS), we use multi-level mixed-effect logistic regression modeling to estimate the relative effect of educational attainment and economic status on prime-age adult deaths between 2004-05 and 2011-12, controlling for important individual- and community-level covariates, as well as clustering at the community level.

Results: Around 3% of prime-age adults (15-59) in the wave 1 sample died between 2004-05 and 2011-12, with the percentage for men exceeding that for women. Individual educational attainment and household economic status both have a significant effect on mortality, but the decline in the risk of death with increasing education is greater than the decline associated with rising wealth quintile. In addition, community-level education reduces the risk of death among women. Women residing in a community with a higher average level of education seem to be enjoying a protective effect of their social surrounding, whereas average wealth quintile does not appear to be significant at the community level. The interaction of the two socio-economic factors shows that the probability of prime-age adult death declines mostly in response to increasing education. Similar mortality patterns observed across all economic groups among same level educated confirm recent findings on the changing epidemiological environment in India where specific lifestyle-related risk factors are starting to gain importance.

Conclusions: The mortality patterns identified by this study suggest that education should be considered as a major policy priority for improving adult mortality in developing countries like India on the long run. In addition to the direct effects of higher educational attainment for the individual, there seem to be community-level of effects of education that improve the health status especially of women. The lack of significance for the community-level wealth effect raises the question of sustainability of future economic development as expressed in terms of prime-age adult mortality.

1. Introduction

Improvements in the health status of the population are closely related to socio-economic development. Several studies relying on data from developed countries have drawn the link between occupational status, income, wealth and education on the one hand and health outcomes on the other. In addition to early childhood conditions, lifestyle factors with strong socio-economic gradients, such as smoking, alcohol consumption and unhealthy dietary habits, have been found to be positively associated with higher adult mortality (Stringhini et al. 2010; 2011). At the national level, the availability and accessibility of healthcare play an important role. Yet while the priorities in terms of reducing premature mortality among prime-age adults have long been put on a firm scientific basis in developed countries, research seeking to understand the relationship of socio-economic factors with adult mortality in the context of developing countries remains scarce (Allen et al. 2017). The present study is looking at this relationship in India. Using nationally representative, longitudinal data from the Indian Human Development Survey (IHDS), we track individuals over two survey waves and relate their risk of dying to their individual and household socio-economic characteristics, as well as those of their community in a multi-level modeling framework. In particular, we are interested in the relative contributions of two socio-economic risk factors, namely level of educational attainment measured at the individual level and economic status measured at the household level, acting as a fundamental determinant of health by influencing various intermediate factors (Lutz, W. and Skirbekk 2013; Link and Phelan 1995).

The different components of socio-economic development are closely related in determining health outcomes (Bollen, Glanville, and Stecklov 2001; Liberatos, Link, and Kelsey 1988). But for the sake of more targeted intervention in improving population health in a developing country context where resources are scarce, research needs to disentangle their relative contribution to the overall burden of disease (Stringhini et al. 2017; Winkleby et

al. 1992; Geyer et al. 2006). Different risk factors can affect health outcomes independently from each other through various pathways. In order to improve the health situation, these pathways need to be identified, particularly in India which ranks among the biggest contributors to globally premature mortality.

Other studies have documented the strong and negative correlation, both at the individual and the aggregate level, between education and adult mortality controlling for other measures of socio-economic status, such as income and race (Grossman and Kaestner 1997). Using a series of U.S. school reforms, Lleras-Muney (2005) finds that in 1960 an additional year of schooling has been causally linked to an increase in life expectancy at age 35 of 1.7 years (Lleras-Muney 2005). In addition, Montez et al. (2012) show that the reduction in the mortality risk due to education has not been levelling off with education among American adults (Montez, Hummer, and Hayward 2012). Rather, due to technological progress that increased the demand for highly skilled labor, the negative association between educational attainment and adult mortality in the U.S. may have increased over time (Hayward, Hummer, and Sasson 2014). A related study by Montez and Hayward (2014) confirms that educational attainment has been essential in explaining health and mortality differentials among elderly U.S.-Americans in the latter parts of the 20th century after controlling for early life conditions, such as childhood socioeconomic disadvantages and childhood health problems (Montez and Hayward 2014). KC and Lentzner (2010) also found that among all countries at different levels of socio-economic development less educated segment of the adult ages for men and women have higher morbidity and mortality than those who are better educated (KC and Lentzner 2010). An in-depth meta-analysis by Baker et al (2011) showed that less education has been associated consistently with a higher likelihood of premature death. The pooled education effect implies that people with below secondary education had a 46 percent higher probability of dying than people with high school or higher education (Baker et al. 2011).

Educational attainment can affect adult mortality both directly and indirectly. Education affects human health directly by increasing knowledge of potential health threats and by enhancing cognitive skills that affect health-seeking behavior (Brinch and Galloway 2011; Glymour et al. 2008; Cutler and Lleras-Muney 2010). Indirectly, education can affect human health through its poverty-reducing effect, better access to valuable information and healthy lifestyles (Rogers, Hummer, and Everett 2013; House 2002; Marmot and Wilkinson 2001; Lutz, W. and Skirbekk 2013). Moreover, education affects people's social networks and the mobility and portability of important social connections, which have been shown to have positive health effects (Berkman et al. 2000; House, Landis, and Umberson 1988). Quite frequently, though, education affects mortality by enhancing job opportunities. Higher incomes and reduced likelihood of unemployment explain large parts of the effects of economic status on life expectancy. According to Kandel (2007), education changes our cognition, including our perception of the environment, our view of the future, the degree of rationality in our decisions, and ultimately behavior resulting from these mental processes (Kandel 2007). Some empirical studies show that more educated individuals tend to have a longer investment horizon, are more risk-averse and suffer from mental health problems to a lesser degree (Meijer et al. 2009; Lachman et al. 2010; van der Pol 2011). Education also affects psychosocial factors in health, such as sense of control, anxiety, depression, social isolation, and stress (Matthews, Gallo, and Taylor 2010).

The link between economic status and health has been widely documented (Deaton 2002; Preston 1975; Stringhini et al. 2017), with poverty being recognized as one of the major determinants of ill health. Individuals with higher income can afford to live in safer houses and in safer neighborhoods, purchase higher quality food or afford access to gyms and other recreational facilities, as well as better healthcare. Higher incomes are earned in higher-quality jobs that are often safer and more interesting. Higher status occupation comes with greater prestige, which can increase self-esteem and affect health positively. Yet increased stress levels among highly productive individuals might be related to higher risk of cardiovascular disease. Using data from the U.S. social security, Duleep (1989) finds income levels to be strongly associated with mortality risk controlling for other factors such as disability and bad neighborhood characteristics (Duleep 1989, 1989). Krueger and Burgard (2011) estimate the risk of mortality by employment status, type of occupation, and family income based on the 1990 to 2002 U.S (Krueger and Burgard 2011). National Health Interview Survey (NHIS) and find employment to be associated with 35 % lower risk of dying compared to unemployment. Those who are not active in the labor force at all are exposed to a 60 % higher risk of premature death, indicating that in addition to the benefits of earning an income, less healthy people are more likely to drop out of the labor market. Compared to those working full time, adults working overtime have 30 %

higher risk of death. Lower status occupation increases the risk of death for both men and women (Stringhini et al. 2017).

In addition to the individual-level effects of socio-economic status, studies have found important community-level effects on mortality. Most of these studies, though, focus on the relationship of socio-economic characteristics and child health outcomes (Pamuk, Fuchs, and Lutz 2011; Kravdal 2004), as data on infant and child mortality is routinely collected by the Demographic and Health Surveys (DHS). Data on adult mortality, however, are more difficult to obtain, particularly with information on individual and household-level characteristics.

1.1 Limited research on adult mortality in India

Although Indian adult mortality for both men and women continues to be well above the global average and indeed, well above the levels observed in many other countries at similar stages of development like Sri Lanka and Bangladesh (United Nations 2017), only a few studies have investigated the phenomenon more closely. Most existing research on adult mortality in India deals with the levels and trends, as well as gender differentials. Dyson (1984), for example, finds that from the age of 35 Indian men experience much higher death rates than women leading to significantly shorter male life expectancy (Dyson 1984). An analysis of more than a quarter of a million deaths registered across India shows that the risk of dying for men aged 15-69 was about a third greater than for women in the same age group, with the difference being larger in regions experiencing higher mortality (Ram et al. 2015). Saikia et al. (2013) attempt to estimate male adult mortality in India post-independence applying the widowhood method to the census data from 1961-2001 and find that adult life expectancy has been increasing for most of the states of India during the 1949-1960 period. Yet regional variation in adult mortality across India has always been strong (Saikia et al 2011).

Studies on the relative importance of education and economic status in determining the risk of adult death have been scarce even globally. A recent cross-country study by Lutz and Kebede (2018) estimates the relative effects of educational attainment (mean years of schooling) and income (GDP per capita) on life expectancy at birth and child mortality (Lutz and Kebede 2018). Their results suggest that education has been more relevant than income at improving mortality conditions across the globe in the past few decades. However, a systematic investigation addressing this issue in India is lacking so far. A recent study by Saikia et al. (2019) emphasizes the socio-economic disparity in life expectancy at age 15 in India using orphanhood techniques (Saikia, Bora, and Luy 2019). The present study attempts to fill this research gap by explicitly asking for: What matters more for prime-adult mortality in India, education or economic status? Answering this fundamental question will contribute to the ongoing debate on where to direct public health interventions in one of the world's largest emerging markets if growing inequality ought not to express itself further in growing inequalities in the length of life.

2. Data sources

This study is based on the India Human Development Surveys (IHDS) of 2004–2005 and 2011–2012 conducted by researchers from the University of Maryland, USA, and the National Council of Applied Economic Research (NCAER), New Delhi, India. IHDS is the first nationwide panel survey conducted in India with a sample size sufficiently large to study rare events like adult death. Due to its longitudinal design, that allows us to connect individual deaths directly to living conditions at the time of the first survey, IHDS provides a perfect opportunity to examine the relative effects of education and household economic status on prime-age mortality. While socioeconomic characteristics are typically highly correlated at aggregated levels, individual-level correlation is usually much lower.

In IHDS-I (2004-05) 41,554 households were surveyed across 1,503 villages and 971 urban neighborhoods all over India. IHDS-I is a nationally representative survey collecting socio-economic and health data on over 215,754 individuals from 33 Indian states and union territories. Comparison of IHDS data with other reputed nationally representative data sources, such as the data provided by the National Sample Survey Office (NSSO) and the Indian

Demographic and Health Survey (DHS) shows a high degree of congruence in common items (Desai et al. 2010). For example, poverty estimates based on NSSO are very similar to IHDS estimates.

The second round of the survey (IHDS-II) successfully re-interviewed about 83% of the households from IHDS-I, as well as households having split off from the original household but residing in the same locality. For each of the original household members in 2004-05, a tracking sheet had to be filled in order to identify current whereabouts and survival status. For those individuals that had changed residency, household members still residing in their original (i.e., IHDS-I) home were asked to provide information on their current occupations, marital status, and survival status. If the entire household had migrated out or died, interviewers collected demographic characteristics and survival status from their closest relatives or friends, as identified by household members in IHDS-I.

Figure 1 Description of the IHDS sample used for the analysis.

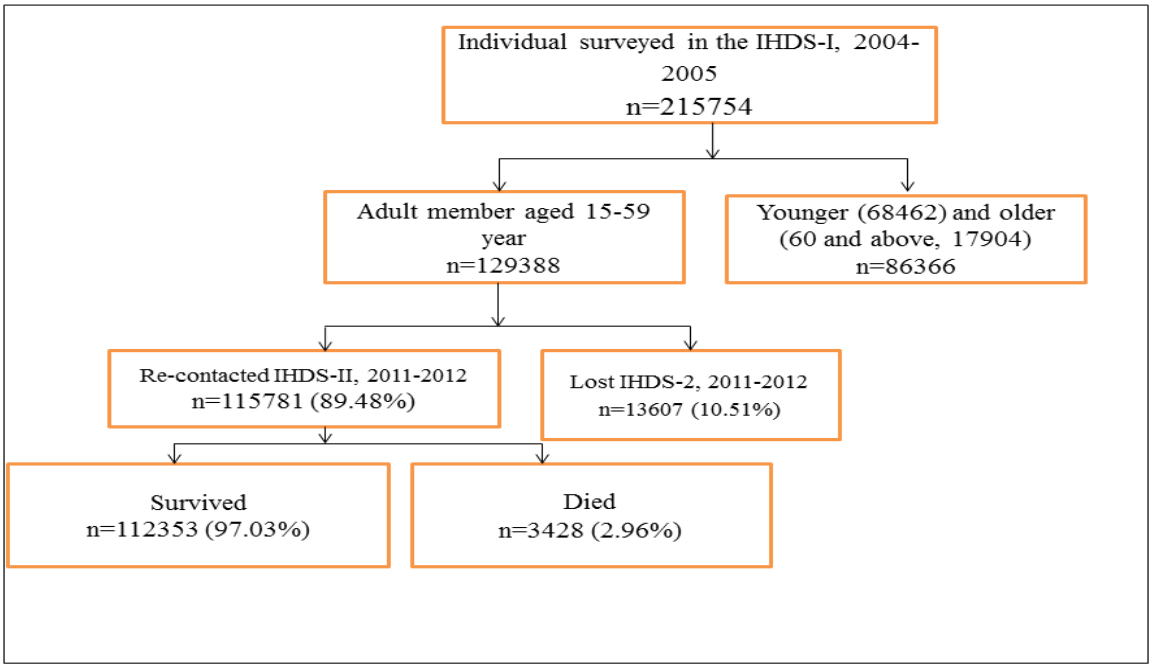


Figure 1 provides a schematic depiction of the survey design, as well as the number of individuals relevant to our study. Since we are interested in prime-age adult death, we restrict our sample to individuals aged 15-59 years in 2004-05. IHDS-I collected information for 215,754 individuals, 129,388 of which were adults aged 15–59 at the time of the survey. Of those 129,388 adults, IHDS-II successfully identified 115781 and 13607 individuals were not identified, these are attrition sample. Out of these successfully identified 115781 individuals, 3428 adults had died between the two survey waves. To check the consistency of the adult death estimates derived from IHDS data, we compared them with those obtained from the Indian Sample Registration System (SRS). As shown in Figure A5 of the appendix, age-specific death rates are almost identical.

2.1 Adjustment of the attrition cases

Like any other long-term follow-up study, the challenge to this analysis came from the sample attrition, of 10 % of the individuals. The analysis of attrition clearly shows that the patterns of lost sample is not random, it is disproportionately concentrated in more affluent households living in urban areas, higher educated and those living in the rental houses. Sample losses usually occurred due to migration—mainly for work, or household split. It may provide a lower bound estimate of the relationship household economic status, educational attainment, and prime-

age adult death. Therefore to avoid bias in the estimates we have done adjustment for the attrition cases in our analysis.

Fundamentally, the attrition is a problem of nonresponse; often researchers ignore attrition cases entirely and use only the available cases for analysis. While enough evidence research shows that some individuals are more likely to drop out than others (e.g., Behr et al., 2005; Olsen, 2005), dropping the attrition cases from the analysis can bias the outcomes. Various procedures have been suggested in the literature over the last several decades to deal with attrition data, the technique of multiple imputation, which originated in early 1970 in application to survey nonresponse (Rubin 1976), has gained popularity increasingly over the years as indicated by literature. We have used multiple imputations (MI) approach for adjustment of the attrition cases; it is a flexible, simulation-based statistical technique for handling missing data. Imputation methods performed by simulating from a Bayesian posterior predictive distribution of the missing data under the conventional prior distribution (Reiter and Raghunathan 2007; Carlin, Galati, and Royston 2008; Royston, Carlin, and White 2009; White, Royston, and Wood 2011; Carpenter & Kenward, 2013). Analysis of the attrition shown in the appendix table A4. We have used these variables, including cluster identification, for the imputation model to correct for attrition bias. The principle aim of using this technique is to avoid any possible bias in the light of extensive nonrandom sample attrition over, to utilize richness of dataset efficiently. Detail explanation of this method given somewhere else (Rubin 1976; Carpenter and Kenward 2013; Stata Corp. 2019). To check the consistency of the results, we have analyzed data for both conditions, with adjustment and without adjustment for the attrition cases. The finding based on in the data without adjusted for attrition cases provided in the Appendix section. Very small difference founded between results based on the data with adjustment and without adjustment for attrition.

The term ‘‘prime-age’’ in this study refers to adults aged between 15 and 59 years of age. This age range was chosen because near 60 is the official age of retirement in the public sector in India. In spite of the increase in life expectancy at birth in India, the reduction in mortality level is lesser in adult age group than under-five death and older age mortality decline, surprisingly, the share of premature death is increased in the adult age group (Chaurasia, 2010; SRS, 2013). However, this is also when most adults in this age group are economically active, biologically reproductive, and assuming responsibility for the support of children and the elderly. We are aware that “prime-age” under this definition can vary by national context (Yamano and Jayne 2004; Chapoto and Jayne 2008).

3. Methods

IHDS survey used hierarchical sample design to select cluster as primary sampling unit (PSU) form rural and urban area then households within the PSU using the stratified random sampling. For the rural area village/settlement and for urban area towns and cities were selected as a unit of PSU selected by probability proportional to population (PPP) in order to obtain a nationally representative probability. We make the use of the hierarchical structure of the IHDS sample, we employed multilevel mixed effect logistic regression model to analyses the probability of dying individuals aged 15-59 year who were interviewed in the 2004–2005 survey died before the second survey was conducted in 2011–2012. This prospective panel allows exploring the link of education level and economic status with prime age adult mortality between two surveys.

3.1 Individual and community level variables

To assess the relative effect of educational attainment and economic status measured at individual and community level on prime-age adult death, the prime adult death is a dependent variable and education and economic variables at individual and community levels are the independent variable. IHDS provide the information on educational attainment of individual (the year of schooling). Education variable categories in the five categories: No education (zero years of schooling), primary (1-5 year of schooling), secondary (5-10 years), higher secondary (11-12 years), graduate and above (13 years and above). The economic status of the household measured by wealth index is a standardized measure of economic status for households. The household wealth score was calculated using a set of 24 variables that measured household possession of basic and durable assets. We generated an asset-based score

using a principal component analysis (PCA) of the household's various assets. PCA is a statistical technique used to reduce the number of variables into a smaller data set. We used information regarding ownership of furniture, electrical devices and appliances, vehicles. We used factor scoring, with each variable from the first principal components as weights, to generate a socioeconomic indicator for each household (Vyas and Kumaranayake, 2006). Community-level variables included in the analysis captured the effect of community level education and economic resources on prime age adult deaths. Community level education was generated average years of education attained by an adult in the clusters or communities. Community level education categories into four categories years of schooling: less than 4, 4 to less than 6, 6 to less than 8, and 8 and above years of schooling. Similarly, the community level wealth index was created from the mean values of the wealth index in the various clusters used for survey. Community level average wealth index were categories into four categories: less than 2, 2 to less than 3.5 and 3.5 and above.

3.2 Health status, Demographic and other social predictors of mortality

We have controlled for the morbidity condition of adult reported in the 2004-05, morbidity condition refers an adult suffering with any of the disease conditions included Diabetes, Cardiovascular disease, Hypertension. Others demographic, social characteristics and locational effect of the adults were controlled in the analysis. These characteristics are founded predictors of mortality in India (Saikia and Ram 2010; Barik, Desai, and Vanneman 2018; Saikia, Bora, and Luy 2019). Demographic characteristics include age (in year), sex (men, women), marital status (married, unmarried/no gona, widowed, separated). Social groups are defined on the basis of affiliation to a particular caste and religion groups. The traditional all Hindu caste or Jati categorized in to five Varnas (translated into English as Castes), Brahmins (priests), Kshatriyas (warriors, royalty), Vaisyas (traders and merchants), and the Sudras (menial job) and Sudras and Dalits (the untouchables, doing lowest of the menial jobs). There are number of sub-castes within these five Castes. However, for the administrative purpose all, the constitution of India classified traditional Caste groups into four broad categories: scheduled castes (SCs), scheduled tribes (STs), other backward castes (OBCs) and general castes (non-disadvantaged castes). The SCs and STs are officially recognized as socially disadvantaged groups. OBCs is another Indian population group recognized as "socially and educationally backward classes," but OBCs have higher status than SCs and STs. Using the religion and caste groups, social groups categorized in the five categories: Hindu forward caste, Hindu OBC, Hindu SC/ST, Muslim and Others. Place of residence is categorized in the rural and urban settlement.

4. Results

4.1 Descriptive analysis

Table 1 shows the survival status of the adults between 2004-05 and 2011-12 by their demographic, socio-economic characteristic and health status in 2004-05. Unadjusted percentage survival status shows that the level of prime age adult deaths quite varied across the demographic, socio-economic characteristics of the individual. Around 3 percent adults died during the period from 2004-05 to 2011-2012; percentage of prime age adult deaths is higher for men's (3.25%) adults compared to women's (2.44%). As expected, percentage of death is higher among the higher age group. By education level of the adults, adult deaths were higher among the adults without any formal education compared to the educated adults. Notably, parentage of adult death declining with increases the level of educational attainment. Percentage of adult death is three times lesser among the graduate and above educated adults compared to no educated adults. Similarly, lower percent of prime age deaths are reported among the adults living in higher educated community. The percentage of deaths is the highest among the adult's belongings to the Hindu SCs/STs social group compared to Others Hindu's and non-Hindu social group. By economic status of the adult, percentage of adult deaths are higher among economically poor adults compared to the economically batter off adults. We observed a distinct downward gradient in the percentage of prime-age adult deaths, as the wealth quintile rises. Percentage of adult deaths is higher in rural areas than their urban counterparts.

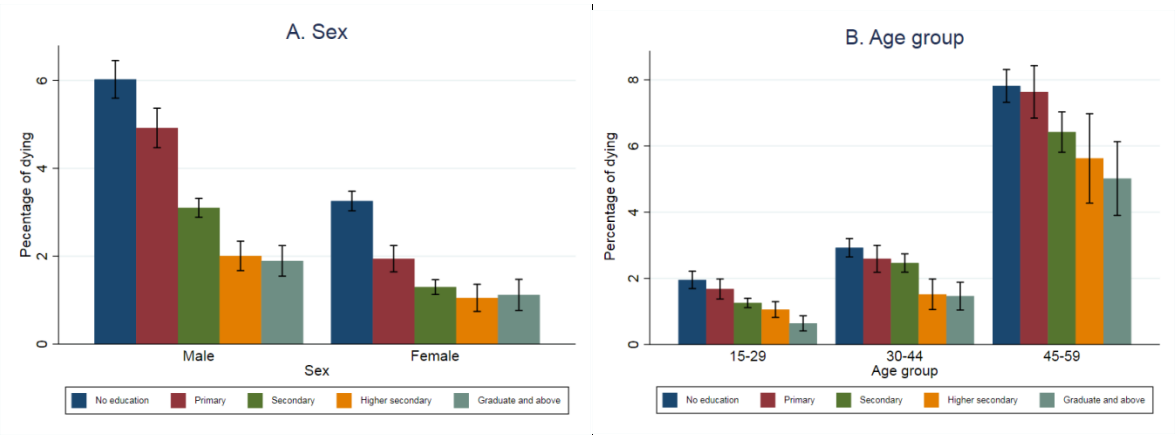
Table 1 Percentage of prime age adult (15-59 years) in 2004-05 dying between 2004-05 and 2011-12 by demographic and socio-economic characteristics, India

Age group	Surviving	Died
Morbidity condition		
No	97.32	2.68
Yes	90.92	9.08
Age group		
15-29	98.46	1.54
30-44	97.38	2.62
45-59	93.91	6.09
Sex		
Male	96.75	3.25
Female	97.56	2.44
Marital status		
Marriage	96.79	3.21
Unmarried/no gona	98.52	1.48
widowed	92.52	7.48
Separated	96.45	3.55
Education level		
No education	95.86	4.14
primary	96.56	3.44
Secondary	97.65	2.35
Higher secondary	98.37	1.63
Graduate and above	98.36	1.64
Social group		
General Hindu	97.5	2.5
OBC Hindu	97.27	2.73
SC/ST Hindu	96.49	3.51
Muslim	97.55	2.45
Others	97.25	2.75
Wealth quintile		
Poorest	96.07	3.93
Poorer	96.85	3.15
Middle	97.08	2.92
Rich	97.44	2.56
Richest	97.79	2.21
Mean year of community schooling		
0-<4	96.67	3.33
4--<6	96.91	3.09
6--<8	97.29	2.71
and max	97.56	2.44
Average community wealth quintile		
0 to less than 2	96.02	3.98
2 to 3.5	96.75	3.25
3.5 and above	97.23	2.77
Place of residence		
Rural	96.99	3.01
Urban	97.36	2.64

Total	97.15	2.85

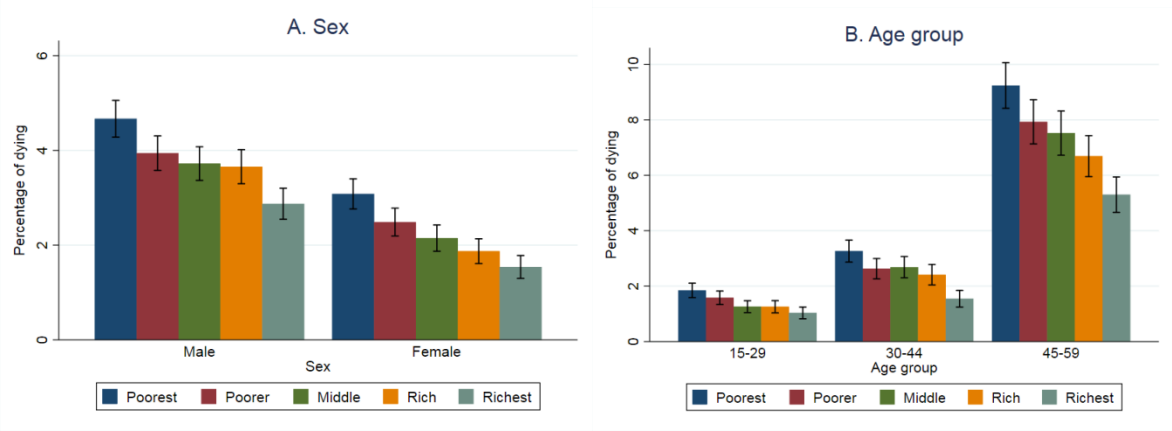
We have analyzed the patters of adults dying by educational attainment; Figure 2 shows the percent of prime-age adult dying between 2004-05 and 2011-12 by sex, age group and their level of education. Panel A of figure 2 show the percentage of adult dying by sex and their level of education in order to understand the association between prime age adult death and educational attainment among men and women. It shows that overall prime age adult mortality is higher among men's compared to women's. However, the percentage of adult dying is decreasing with an increase each level of educational attainment for both men's and women's. Panel B show the percentage of adult dying by age group and education level in order to understand the effect of education among younger (15-29 years), middle (30-44 years) and old (45-59 years) age adults. It is showing that with an improving education level the percentage of deaths decreasing across all adult age groups in India. As expected, the overall percentage of adults dying lesser among the younger adults and percentage of deaths is higher among the older adults.

Figure 2 Percentage of prime age adult dying between 2004-2005 and 2011-2012 by sex and education level (panel A) and age group and education level (panel B).



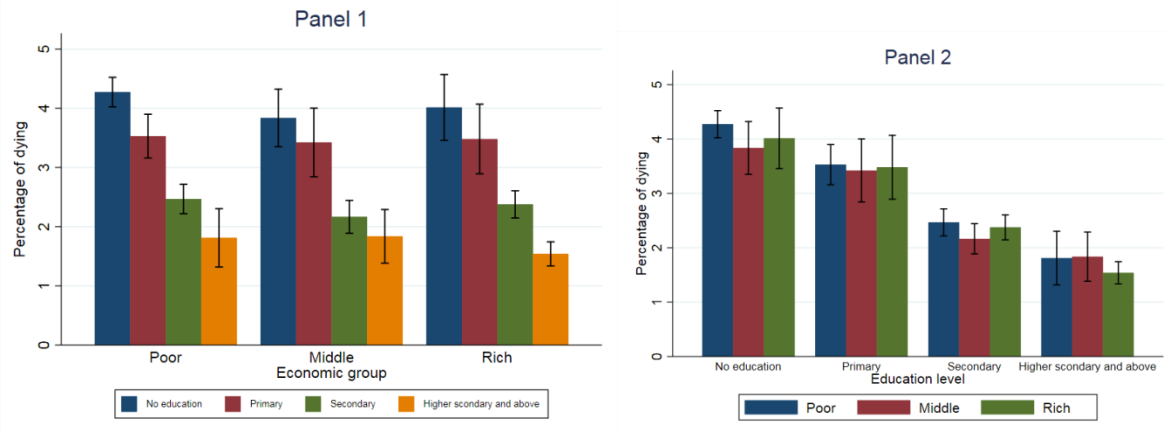
Further we have accessed association between prime age adult death and economic status, figure 3 shows the level of prime age adult dying by sex, age group and economic status to understand the effect of economic status on prime age adult deaths between the two survey periods 2004-05 to 2011-2012. Panel A of the figure 3 showing adult dying by their economic status for both men's and women's. It shows that with improving the economic status of the adults the percent of prime age adult deaths declining for both men's and women's. Further, panel B shows the percentage of prime age adult dying in the broader age group of the adult by their economic status. It reveals that the improving the economics status is conducive to reduce the adult death across the all adult age groups.

Figure 3 Percentage of prime age adult dying between 2004-2005 and 2011-2012 by sex and economic groups level (panel A) and age group and economic groups (panel B).



Above descriptive analysis shows that improving in education attainment and economic status are reduce the deaths for both men's and women's. Further, we accessed effect of educational attainment among the similar economically empowered adults and vice versa. Figure 4 present adult dying in prime age group by their education level and belongs from the same level of economic status and vice versa. Panel A of figure 4 shows adult dying by education level from the similar economic status in order to understand the effect of educational attainment on prime age adult death in the same economic condition. Interestingly, adults are dying lesser with an increasing the level of education belongs from same economic background across all economic groups. Moreover, the pattern is quite similar across the economic groups declining deaths with increasing level of education. The level of prime age adult death is invariably higher among no educated and decline with each level of education irrespective of their economic groups. Also, Chi squire test confirm the significant differences in the prime age adult death by education level across the economic groups. Panel B of figure 4 shows same level of education and belong from different level of economic status to understand the effect of economic status among the similarly educated adults. Notably, increasing economic status does not have significant differences in adult death among the same level of educated adults. No educated adults have higher deaths and pattern is same among poor, middle and rich economic groups, others side, overall higher secondary and above educated adults dying lesser across the poor, middle and rich economic groups. Chi-squire test confirms that there is no significant difference in the prime age adult death by their economic status among the same level of educated adults in India.

Figure 4 Percentage of prime-age dying by educational attainment across economic group and vice versa



4.2 Results of multilevel analysis

Two level mixed effect logistic regression used to predict the role of educational attainment and economic status measured at individual and community level on prime age adult death between 2004-05 and 2011-12 separately for men's and women's. Table 2 shows the likelihood of prime age adult death for men's, first column of the table 2 shows the relationship between each explanatory variable and risk of prime age adult death, adjusting only for unexplained variation at individual and community levels. Founded in the previous literature, the variables included in the study have significant effect on prime age adult death. Risk of adult deaths shows steep increasing in the higher ages. By the marital status of the men's, risk of the prime age adult death is higher among the widowed and separated men's compare to currently married men's.

Compared to no educated adults, the likelihood of prime age adult death decline by 21% for those up to primary educated, by 52% for secondary educated, by 69% lesser for with higher secondary education, and by 71% for graduate and above educated adults. Similarly, the becoming economically empowered adults significantly reduced the odds of the prime age adult death. The odds of prime age adult death is 24 % and 40 % lesser among middle and rich income group, respectively, compared to poorest income group. The unadjusted relationship between education levels, economic status and the likelihood of prime age male adult death also apparent when estimated at community level. Men's living in the communities where average schooling of adults between 4 and 6 years had a risk of prime age death is 12 % lower than the men's those in the communities where the average education attainment is less than four years, while the likelihood of prime age death in the communities with even higher levels of average education level had 15 % lesser risk. Increases in the average wealth quintile score of the community of residence were also associated with decline in the risk of prime age adult death but it is lesser significant than for increasing average years of community schooling. By the place of residence, prime age men's deaths are higher among the rural areas than their urban counterparts.

Model 1 in the table 2 shows the effect of educational attainment on prime age adult death at individual and community level after adjusting effects of demographic, social characteristics of the adults. After controlling for other predictors, the effect of the educational attainment remained significant, increasing in the level of education associated to reduction in the likelihood of prime age adult death at individual level, while the effect of community level education is not remained significant effect on men's prime age adult death. Model 2 shows the effect of economic status on men prime age adult death at individual and community level. The effect of household wealth quintile above than poorest reduced the prime age adult death risk, but the community level economic status does not have any significant effect men adult deaths.

Model 3 shows independent effect of educational attainment and economic resources measured at individual and community level after controlling simultaneously for each other, and demographic and social characteristics. Result shows that education level of the adults have significant effect on prime adult's death after controlling for economic status and other characteristics of the adult. Risk of men's prime age deaths is significantly declined among secondary, higher secondary and graduated adults, While, community level educational attainment does not have any significant on men's prime age deaths. Further, the effect of economic status of the individual and community level wealth score after controlling for education and other characteristics of the adult. The effect of household wealth score is significant to reduce the risk of adult death. Risk of adult death decline with increase in the wealth index of the household, but the increase in the average wealth index with in the community does not have significant effect on adult deaths.

Table 2 Multilevel model results: Odds ratio for the probability of men prime age adult death between 2004-05 and 2011-12, India,

Variables	Bivariate	Model 1	Model 2	Model 3
Individual variable				
Morbidity	4.29***(0.41)	2.54***(0.26)	2.45***(0.25)	2.54***(0.26)
Age squire (in log scale)	2.94***(0.1)	3.2***(0.15)	3.48***(0.16)	3.28***(0.16)
Marital status				

Marriage (reference)				
Unmarried/no gona	0.36***(0.02)	1.8***(0.15)	1.79***(0.15)	1.85***(0.15)
widowed	2.99***(0.36)	1.81***(0.22)	1.89***(0.24)	1.81***(0.23)
Separated	1.62**(0.36)	1.95***(0.44)	1.85***(0.43)	1.82***(0.42)
Education level				
No education (reference)				
primary	0.79***(0.05)	0.9 (0.06)		0.92 (0.06)
Secondary	0.49***(0.03)	0.71***(0.04)		0.74***(0.05)
Higher secondary	0.31***(0.03)	0.49***(0.05)		0.52***(0.06)
Graduate and above	0.3***(0.03)	0.35***(0.04)		0.41***(0.05)
Social group				
General (reference)				
OBC	1.15**(0.07)	1.07 (0.07)	1.11 (0.08)	1.05 (0.07)
SC/ST	1.5***(0.09)	1.36***(0.09)	1.43***(0.1)	1.31***(0.09)
Muslim	0.88 (0.08)	0.84*(0.08)	0.95 (0.09)	0.85*(0.08)
Others	1.31**(0.17)	1.21 (0.16)	1.34**(0.18)	1.24 (0.17)
Household wealth quintile				
Poorest (reference)				
Poorer	0.82***(0.05)		0.82***(0.06)	0.87*(0.06)
Middle	0.76***(0.05)		0.77***(0.06)	0.85**(0.07)
Rich	0.73***(0.05)		0.68***(0.06)	0.83**(0.07)
Richest	0.58***(0.04)		0.49***(0.04)	0.69***(0.07)
Community level variables				
Mean year of community schooling				
0-<4 (reference)				
4--<6	0.96 (0.06)	1.04 (0.07)		1.03 (0.07)
6--<8	0.86**(0.06)	0.98 (0.07)		1 (0.08)
8 and max	0.83***(0.06)	1.01 (0.09)		1.04 (0.1)
Average community wealth quintile				
0 to less than 2 (reference)				
2 to 3.5	0.85 (0.13)		0.89 (0.14)	0.91 (0.14)
3.5 and above	0.76*(0.11)		1.05 (0.16)	1.06 (0.16)
Place of residence				
Rural (reference)				
Urban	0.87***(0.04)	1.04 (0.06)	1.06 (0.06)	1.11*(0.07)
Random effects				
Level 2 (Community)		0.11(0.03)	0.09(0.04)	0.08(0.03)

Note: *p < = .05, **p < = .01, ***p < = .001, Standard error in parenthesis

Table 3 presents the results obtained from two-level mixed effect logistic models to estimate the effect on prime age women's death. Similarly estimated in the table 2 for men's, the first column of the table 3 shows the bivariate relationship between each explanatory variable and likelihood of women's prime age adult death. The relation between demographic, social characteristics and women's prime age adult death is similar as men's prime age adult death. Education level of the women is significantly associated to decline the likelihood of their prime age adult mortality, compared to no educated women's, risk of women's mortality decline by 37 % for those with only primary educated, by 58 % for secondary and higher secondary completed schools. Similarly, the risk of women's prime age adult death decline significantly with higher order of wealth quintile. Relationship between educational attainment, economic status and women prime age death also significant at community level. Women living in the communities where the average year of schooling is 4 to 6 years had a risk of death 13% lower than those living in

communities where the average educational attainment is lesser than 4 years, while the odds of women prime age death is 32 % lesser for the women's living in the higher educated communities. Increases in the mean average wealth quintile score of the community of residence were also associated to decline in likelihood of women's prime age mortality.

Model 1 shows the effect of education at individual and community level on women prime age adult deaths with adjusting for other predictors. The effect of education at individual and community level, as expected, reduced by adjustment of education at other level. However, the increasing the level of women's education is significantly reduces the risk of prime age deaths among women's. Similarly, for the community level education, except for the increasing from average less than 4 year of schooling to average 4 to less than 6 years, increasing in the education continue to be associated with a substantial and statistically significant reduction in the risk of women's death. Model 2 include the economic status at individual and community level to understand their effect with controlling for other predictors. Economic status of the household increasing from poorest to middle and higher economic status significantly contributed to reduce the likelihood of women's' prime age deaths. Similarly, for the community level, comparing to the average low wealth quintile, community with higher average wealth quintile is significantly reduced the risk of women's death in prime age. Overall increasing educational attainment is more significantly contributed to reduce the likelihood of women's prime age death compared to economic resources at both individual and community level.

Model 3 shows the independent effect of educational attainment and economic resources measured at individual and community. Simultaneous adjustment for education level and economic status along with other predictors are reduces the effect of both at individual and community level. However, the effect increases in the household economic status reduced more than the effect of increases educational attainment. Risk of the women's death declined significantly with an increasing each level of educational attainment. Similarly, likelihood of prime age adult death is significantly lesser among the women's from the rich and richest wealth quintile compared to the women's from poorest wealth quintile. Unlike for men's, women residing in a community with higher average level of education remains independently associated with a significant reduction in the risk of prime age mortality, but the increasing in the average wealth quintile with in the community no longer have significant effect to reduce the risk of women's prime age mortality.

Table 3 Multilevel model results: Odds ratio for the probability of women prime age adult death between 2004-05 and 2011-12, India,

Variables	Bivariate	Model 1	Model 2	Model 3
Individual variable				
Morbidity	3.04***(2.45-3.77)	2.09***(0.24)	2.16***(0.25)	2.21***(0.26)
Age squire (in log scale)	2.35***(2.16-2.55)	2.23***(0.13)	2.35***(0.13)	2.24***(0.13)
Marital status				

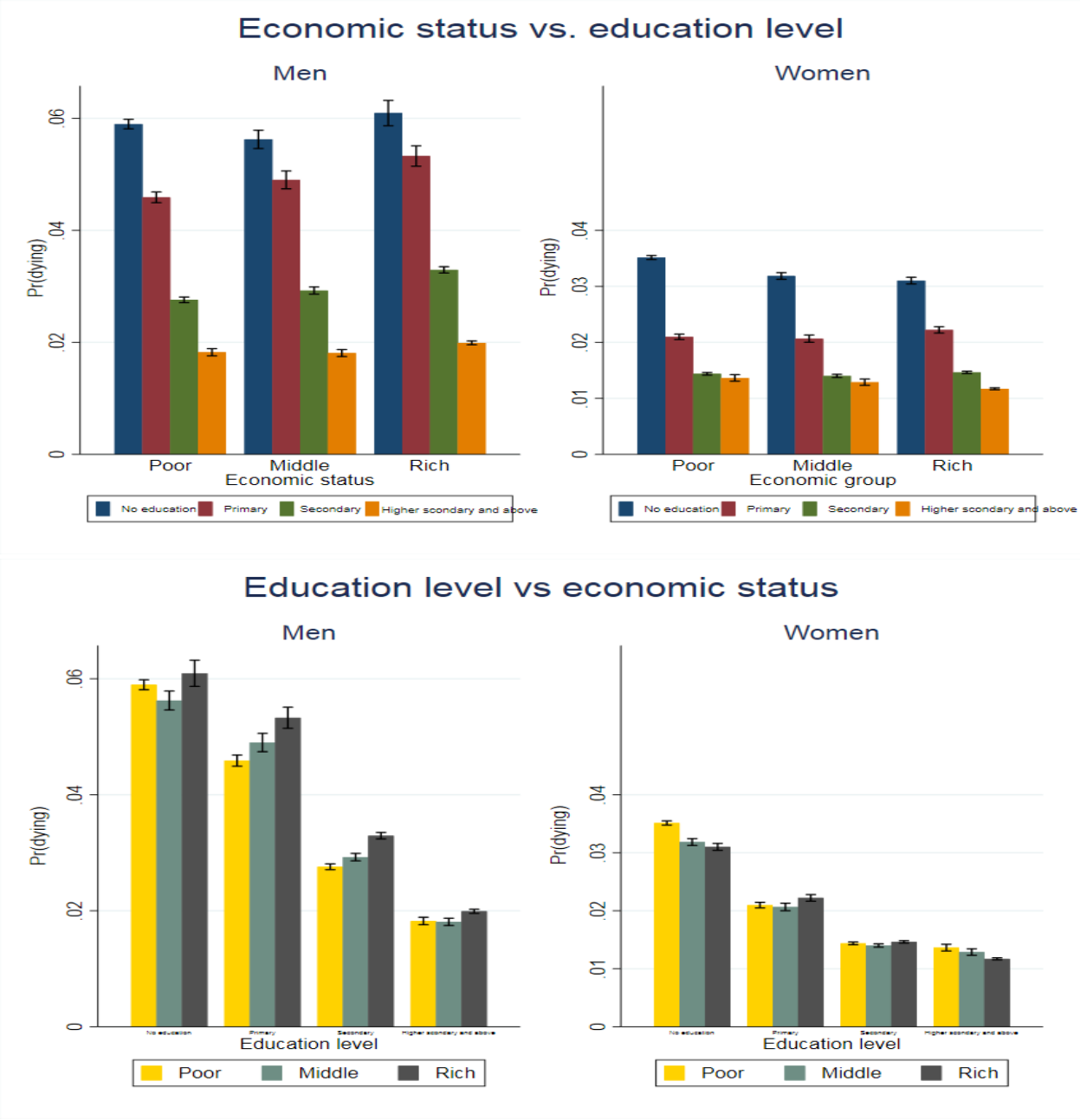
Marriage (reference)				
Unmarried/no gona	0.61***(0.05)	2.19***(0.24)	1.92***(0.22)	2.14***(0.25)
widowed	3.17***(0.26)	1.87***(0.16)	1.88***(0.17)	1.85***(0.17)
Separated	1.26 (0.21)	1.47**(0.24)	1.43**(0.25)	1.47**(0.26)
Education level				
No education (reference)				
primary	0.63***(0.05)	0.78***(0.07)		0.8**(0.08)
Secondary	0.42***(0.03)	0.66***(0.06)		0.7***(0.06)
Higher secondary	0.33***(0.05)	0.56***(0.09)		0.67**(0.12)
Graduate and above	0.34***(0.06)	0.5***(0.1)		0.54***(0.11)
Social group				
General (reference)				
OBC	1.04 (0.08)	0.93 (0.08)	0.96 (0.08)	0.9 (0.08)
SC/ST	1.46***(0.12)	1.27***(0.11)	1.3***(0.11)	1.19**(0.1)
Muslim	1.17 (0.12)	1.01 (0.11)	1.13 (0.13)	0.99 (0.11)
Others	0.73 (0.17)	0.75 (0.18)	0.74 (0.19)	0.77 (0.2)
Household wealth quintile				
Poorest (reference)				
Poorer	0.81**(0.07)		0.87 (0.08)	0.92 (0.08)
Middle	0.71***(0.06)		0.77***(0.08)	0.84*(0.08)
Rich	0.61***(0.06)		0.63***(0.07)	0.76**(0.08)
Richest	0.51***(0.06)		0.51***(0.06)	0.68***(0.09)
Community level variables				
Mean year of community schooling				
0-<4 (reference)				
4--<6	0.87*(0.06)	0.91 (0.07)		0.96 (0.08)
6--<8	0.68***(0.06)	0.74***(0.07)		0.81**(0.08)
8 and max	0.62***(0.05)	0.72***(0.08)		0.79*(0.1)
Average community wealth quintile				
0 to less than 2 (reference)				
2 to 3.5	0.7**(0.12)		0.76*(0.13)	0.77 (0.13)
3.5 and above	0.55***(0.09)		0.75*(0.12)	0.81 (0.14)
Place of residence				
Rural (reference)				
Urban	0.85**(0.75-0.97)	1.11 (0.08)	1.08 (0.09)	1.2**(0.1)
Random effects				
Level 2 (Community)		0.08(0.03)	0.09(0.05)	0.06(0.03)

Note: *p < = .05, **p < = .01, ***p < = .001, Standard error in parenthesis

Finally, we predicted the risk of prime age death using the parameter estimates form model 3 to understand the effect of an increasing level of educational attainment among similar economic group and the effect of increasing level of economic status among the similar level of educated adults for both men's and women's. It clearly shows that increasing each level of educational attainment reduce the risk of prime age adult death across all economic group of the adults for both men and women. For example: In poor economic setting, the likelihood of prime age death decline with increasing each level education as similar in the rich economic setting. While, when we see the effect of economic status across the same level of education group to understand the effect of economic status at

different level of education, it shows that improving economic status does not shows positive effect on prime age adult death for both men and women. Surprisingly, the risk of adult death is increase among the economically richer group in case of men adults.

Figure 5 Predicated probabilities of adult dying in prime age across economic group by their education level and vise-versa.



Others social factors also found their significant effect on adult mortality for both men's and women's in India. Marital status also has significant effect on adult mortality in India. Marriage is a universal social practice in India, risk of prime age adult death is higher among unmarried, widowed divorced compared to the currently married adults. By social groups of the adults, adult belong from Hindu SCs/STs have significantly high likelihood of prime age adult deaths camper to the adults belongs from upper Hindu caste. Place of residence also found the significant

predictors of prime age adult mortality in India. Adults living in the urban areas have high risk of prime age adult mortality compared to their rural counterparts. Meanwhile bivariate analysis shows that the risk of prime age adult death is lesser among the urban area then to rural inhabitants, while adjustment for the education and economic status the patter is appears to higher risk of prime age adult deaths in urban area. The possible explanation of higher risk of adult death in urban area is that people living in the urban areas are more exposed to pollution and higher level of road accidents compared to less level exposed of pollution and less chance of accidental death in rural areas of India.

5. Discussion

Factors leading to adult mortality in developing countries have explored considerably less than those leading to child mortality due to a lack of data availability. Data on infant and child mortality by their socio-economic status are regularly collected in the demographic and health surveys, while data on adult mortality are very limited to come by these characteristics. Individual level study of adult mortality is much more difficult from the cross-sectional data because there is not consistent data on adult death by education, economic status and other important characteristics. Using the data from the India Human Development Survey is a first India nationally representation panel data of first round was conducted in 2004-05 and second round in 2011-12, this study analysis the relative effect of educational attainment and economic status on prime age adult deaths between 2004-05 and 2011-12 in India. Advantage of panel survey over cross sectional data is that the adult surveyed in 2004-05 reported education level, wealth status and health status, following the same individual in the second round in 2011-12, the survival status of these individuals was analyzed by their educational attainment and wealth status reported in 2004-05 before their death. Understanding the complete picture of the relative effect of education attainment and economic resources is important for informing policy choices aimed at sustainable improvement in the survival and health of the adult in India where higher share of premature death due to non-communicable disease, accidental and injuries deaths.

Descriptive analysis shows that around 3% adults were dying in prime age group between 2004-05 and 2011-12, while the percentage of men dying in prime age is higher compared to their women counterparts. A study analysis based on 0.27 million nationally surveyed deaths shows that men aged 15-69 years had had higher risk mortality than women in the same age group and while this difference become higher in the high mortality areas (Ram et al. 2015). Dyson founds the reverse pattern of child mortality among the adult, mortality is considerably higher among men's (Dyson 1984). Prime age adult mortality is lesser among the educated adults compared to no educated adults across the all age groups for both men and women. It indicates that educational attainment is conducive to reduce prime age adult death across younger and older adult. Similarly, prime age adult deaths are lower among the economically better off compared to poorest and poorer economic groups.

Primary purpose of this analysis is to examine the independent effect of two primary aspects of development, educational attainment and economic resources on prime age adult mortality in more comprehensive way than has been done before. Using the two-level mixed effect logistic regression model accounting clustering with in the communities, we have estimated the relative effect of education attainment and economic resources measured at individual and community level on prime age adult mortality. The inclusion of community effect allows us to understand the extent of independent effect of the community level education level and economic recourses on the risk of prime age adult death. As bivariate analysis shows the differences in the prime age adult mortality between men's and women's, to consider the possibility of different pattern for the determinants of prime age adult mortality by sex, we carried out the analysis separately for men and women. Analyzing separately by sex allows us to understand the differences in extent of this effect on prime age adult mortality at individual and community level between men and women.

Further, analysis of this study emphasized to understand the extent to which the individual and community level effect of educational attainment and economic resources changes when these two factors considered simultaneously. Compared to the model examined the effect of education with controlling for other predictors, adjustment for the economic resources slightly reduced the effect of education for both men and women. Reduction in the community level education is also noted very small in case of women's, while community level education does not show the any

significant effect on prime age adult mortality in case of men's. In contrast, adjustment for education, effect of wealth status decline on likelihood of prime age adult death with increasing the wealth quintile for both men's-women's. Thus, these results shows that adults educational attainment up to secondary school have similar risk of death to adults are living in the in richest wealth quintile in India. Our finding also suggests that a women's residing in a community where average adult's year of schooling is 6 to less than 8 years, and 8 and above years of schooling are remains independently associated with a significant reduction in the risk of prime age adult mortality for women's. In contrast, we did not found any significant effect of effect of average community wealth quintile on likelihood of prime age adult death.

Examining the relative effect of education attainment and economic status in this analysis revealed a pattern to that founded in the previous study; the decline in the average likelihood of the death in prime age with increasing educational attainment is greater that the decline associated with increasing wealth quintile. Results are consistent with other studies shows that educational attainment is stronger associated to reduce the risk of infant death. A study base on 43 low–middle income countries shows that impact of mother education on infant death is stronger than household wealth quintile, women residing in a more educated community reduce risk of infant death (Pamuk, Fuchs, and Lutz 2011).

Recently, some studies examined impact of community level effect education and economic resources, and other factors analyzed within community level variation in indicator of child health outcome. There are sufficient evidences of child health outcomes shows that community level educational and economic development is associated to child nutritional status and child mortality. Recently, some studies taken advantage of hierarchical survey in developing countries to understand weather women living in the higher educated community getting additional child health advantage over the effect mother own education (Fuchs, Pamuk, and Lutz 2010). Community level characteristics can added numerous impact, including an imitative effect where less educated men's and women's would benefit from the generally higher level learn from educated adults and model the health behaviors of the broader community as well as a positive effect on women autonomy more generally (Pamuk, Fuchs, and Lutz 2011; Kravdal 2004). A review of community level intervention to reduce maternal death suggested that community level characteristics, education, prenatal care are important factors to reduce women death in reproductive age group (Kidney et al. 2009) (Kidney et al 2009). But the possible importance of community education and economic status on adult mortality has been ignored in the literature, limited studies examined impact of community level education, economic resources, and other factors analyzed within community level variation in indicator of adult health outcomes using individual level analysis in developing countries.

Our finding shows that community-level education appears with additional independent effect to reduce risk of prime-age adult death for women's, while average household wealth quintile at community level shows less impact but it is not significant. However, community-level education and economic resources do not associated to reduce the risk of death among men's. Previous studies also shows that risk of infant death is lower among the women residing in the more educated community, and average community wealth score shows little indication of had any impact on risk of infant mortality in low-middle income countries (Pamuk, Fuchs, and Lutz 2011). A study by Kravdal (2004) show found that community-level education is among women operates to a certain extend through the same pathway as individual level through the same of the mother, that is, by increasing autonomy and the utilization of healthcare services (Kravdal 2004).

Female labour force participation is lowest in India, a substantially high proportion of females are engaged into domestic duties only. In the Indian context, norms of female seclusion limit women's mobility in the public sphere, constraining their learning opportunities by limiting their choices of work location and their ability to interact outside of the community. Women most of the time spends within the community, at the same time females need to take permission other members to go outside from the household and community. Therefore the residing community-level characteristics are important for getting information, learning, and exposure for their cognitive development in the context of low female education level in India. While, Men's are mainly participating in the economic activity outside from the community and the exposure higher in the outside of the communities as well, therefore learning exposure is not limited within the same community characteristics.

Another important strength of this study is that we have accessed the relative effect of educational attainment among the same level of economically empowered adults and, similarly, relative effect of economic status on death among similar level of educated educational attainment group. Our analysis reveal that increasing level of the educational attainment is significantly reducing the risk of the prime-age adult death among the similar level of economically empowered adults across economic group, while the improving the economic status of the household does not evident to reduce the likelihood of adult death among the same level of educated adults across the education level after adjustment for other predictors. It clearly indicates that becoming wealthier without human capital development does not show positive effect on the health status of the adults. Yet no one study analyses the relative effect of educational attainment and economics status at the similar level of economic status and in the same level of education group.

Unanticipated, adult living economically richer households are on the higher risk of prime-age adult death for men's among the same level of educated adults. Yet while the evidence on the association between economic status and health collected from western countries is mostly unambiguous, rising income with healthy lifestyle, consumption of more diversified food, emerging research from India and other parts of the developing world suggests that rising income may be associated with both positive (Saikia and Ram 2010) as well as negative effects on adult mortality (Ramachandran 2015). Economically wealthy people in India typically tend to engage in non-manual work related to less physical activity, which may reduce the caloric needs (Desai et al. 2010). On the other hand, gains in income lead to higher food intake which can in turn lead to obesity, as well as an increased risk of diabetes and cardiovascular disease (Barik, Desai, and Vanneman 2018; Subramanian et al. 2013). Cardiovascular diseases are the biggest causes of death in 30-69 years age group accounting almost every third death (Sample Registration System, 2015). Increasing consumption of restaurant food by higher-income Indians (Nationally Sample Survey, 2012) may also increase the risk of obesity. In the development agenda of United Nation under the Sustainable Development Goals, target 3.4 and 3.6 of gals 3 emphasized on reduction by one-third premature mortality from non-communicable disease by 2030 and halve the number of deaths from road traffic accidents by 2020. India has the largest share into global premature adult death; any worldwide reduction of premature adult death will depend on the progress in India. Understanding the relative effect of educational attainment and economic resources on prime-age adult death is important to policy guidance aimed at sustained improvement in the adult health of India which has higher burden of non-communicable diseases and higher level of adult death than global average.

6. Conclusion

The present study tried to address for the first time in a more comprehensive way to the important strategic question whether education or economic resources is more important factor for preventing premature adult death in India using the individual-level analysis. Women residing in a community with a higher average level of education seem to be enjoying a protective effect of their social surrounding, whereas average wealth quintile does not appear to be significant at the community level. The interaction of the two socio-economic factors shows that the probability of prime-age adult death declines mostly in response to increasing education. Similar mortality patterns observed across all economic groups among same level educated confirm recent findings on the changing epidemiological environment in India where specific lifestyle-related risk factors are starting to gain importance.

Finding come out from the systematic analysis shows that education turns out to be more important factor than economic resources in reducing the risk of death in the prime age group for both men and women in India. The mortality patterns identified by this study suggest that education should be considered as a major policy priority for improving adult mortality in developing countries like India on the long run. In addition to the direct effects of higher educational attainment for the individual, there seem to be community-level of effects of education that

improve the health status especially of women. The lack of significance for the community-level wealth effect raises the question of sustainability of future economic development as expressed in terms of prime-age adult mortality.

It is important, the policies crafted with health goals by expansion of secondary education for both men's and women's. In case of India, women education level is lower than men's, women education is more important, it not only impact their own health but also can affect other family member health status. Mother education affect health child, nutritional, therefor improving in the early childhood condition status of children can reduce the risk of mortality in prime age group. The global time-series analysis of national data clearly suggest that positive association between health and economic status mediated by education attainment, increasing education to contributes economic growth by empowering men and women to better healthcare their families and increase the chance to get employment that will bring them out of poverty by their own means (Lutz, Crespo Cuaresma, and Sanderson 2008; Cohen and Soto 2007).

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8. Appendix

(without adjusted for attrition cases)

Table A1 1 Percentage of prime age adult (15-59 years) in 2004-05 dying between 2004-05 and 2011-12 by demographic and socio-economic characteristics, India

Variables	Surviving	Died	N
Age group			
15-29	98.58	1.42	52,868
30-44	97.51	2.49	37,812
45-59	92.6	7.4	24,473
Sex			
Men	96.3	3.7	57,692
Women	97.62	2.38	57,461
Marital status			
Marriage	96.63	3.37	78,352
Unmarried/no gona	98.5	1.5	31,069
widowed	91.65	8.35	3,677
Separated	95.86	4.14	2,055
Education level			
No education	95.64	4.36	38,627
primary	96.58	3.42	17,865
Secondary	97.72	2.28	40,344
Higher secondary	98.43	1.57	18,317
Graduate and above			
Social group			
General Hindu	97.42	2.58	23,859
OBC Hindu	97.02	2.98	41,250
SC/ST Hindu	96.28	3.72	33,733
Muslim	97.53	2.47	13,456
Others	97.53	2.47	2,856
Wealth quintile			
Poorest	96.07	3.93	34,388
Poorer	96.67	3.33	25,065
Middle	97.16	2.84	22,860
Rich	97.12	2.88	15,488
Richest	97.8	2.2	17,353
Mean year of community schooling			
0-<4	96.48	3.52	31,147
4--<6	96.8	3.2	36,361
6--<8	97.21	2.79	26,254
and max	97.61	2.39	21,392
Average community wealth quintile			
0 to less than 2	96.6	3.4	2,394
2 to 3.5	96.97	3.03	20,197
3.5 and above	97.22	2.78	92,562
Place of residence			
Rural	96.83	3.17	84,389
Urban	97.3	2.7	30,764

Total	96.96	3.04	**115,153**

Figure A1 Percentage of prime age adult dying between 2004-2005 and 2011-2012 by sex and education level (panel A) and age group and education level (panel B).

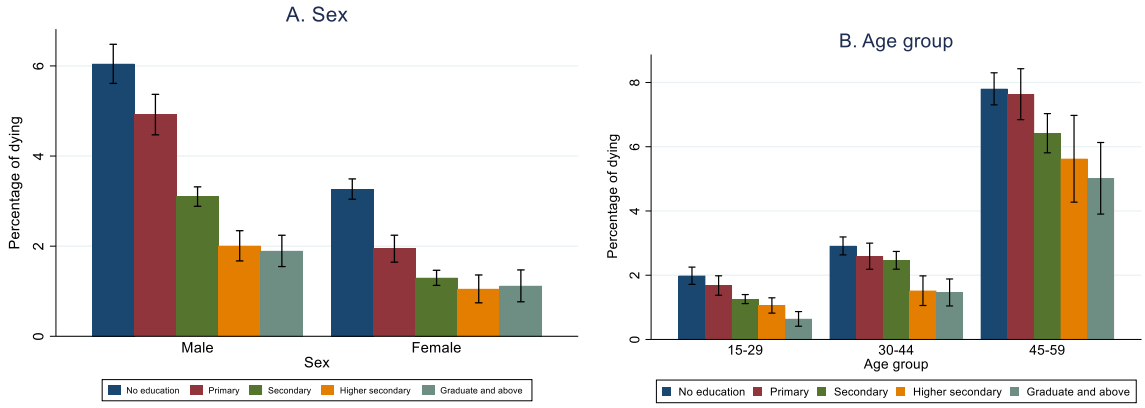


Figure A2 Percentage of prime age adult dying between 2004-2005 and 2011-2012 by sex and economic groups level (panel A) and age group and economic groups (panel B).

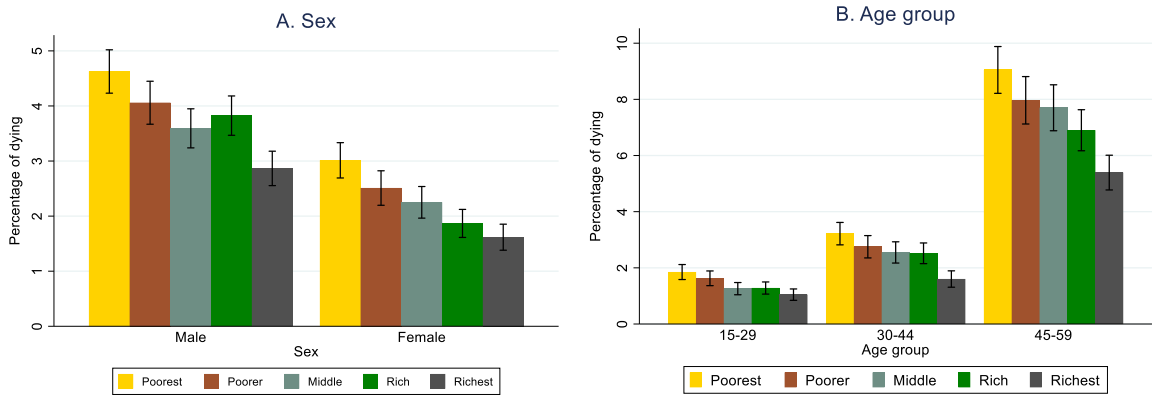
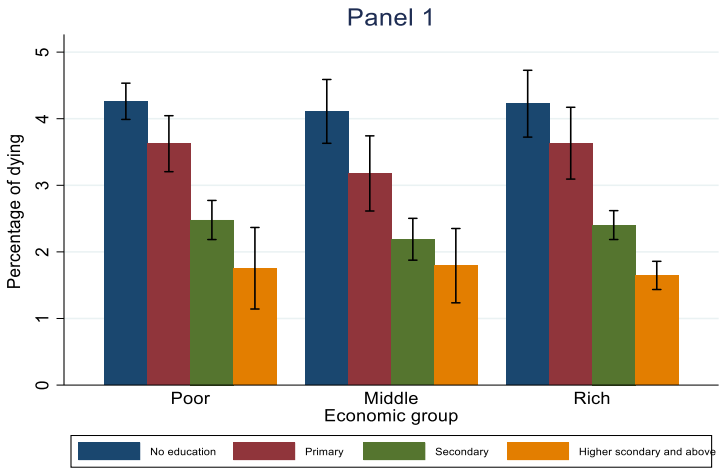


Figure A3 Percentage of prime-age dying by educational attainment across economic group and vice versa



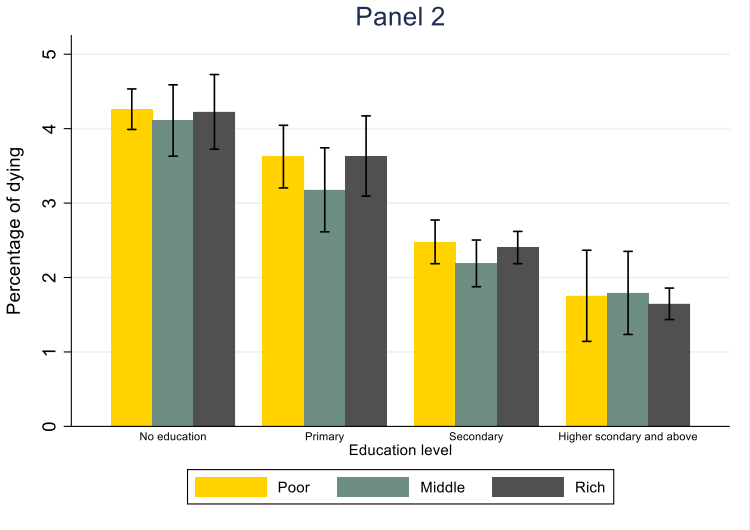


Table A2 Multilevel model results: Odds ratio for the probability of men prime age adult death between 2004-05 and 2011-12, India,

Variables	Bivariate	Model 1	Model 2	Model 3
Individual variable				
Morbidity	4.39***(3.66-5.28)	2.54***(2.09-3.07)	2.46***(2.02-3)	2.54***(2.08-3.09)
Age squire (in log scale)	3.08***(2.88-3.31)	3.46***(3.15-3.81)	3.75***(3.4-4.13)	3.55***(3.22-3.91)
Marital status				
Marriage (reference)				
Unmarried/no gona	0.35***(0.31-0.39)	1.96***(1.66-2.31)	1.93***(1.63-2.29)	2***(1.69-2.37)
widowed	2.9***(2.28-3.68)	1.74***(1.36-2.23)	1.84***(1.44-2.36)	1.77***(1.38-2.26)

Separated	1.71**(1.11-2.63)	2.15***(1.38-3.34)	2.04***(1.28-3.24)	2.03***(1.28-3.22)
Education level				
No education (reference)				
primary	0.79***(0.7-0.9)	0.91 (0.8-1.04)		0.93 (0.82-1.06)
Secondary	0.48***(0.44-0.54)	0.72***(0.64-0.82)		0.76***(0.66-0.86)
Higher secondary	0.31***(0.26-0.37)	0.5***(0.41-0.61)		0.53***(0.43-0.67)
Graduate and above	0.29***(0.24-0.36)	0.36***(0.29-0.45)		0.41***(0.32-0.52)
Social group				
General (reference)				
OBC	1.16**(1.02-1.32)	1.08 (0.95-1.23)	1.13*(0.98-1.29)	1.06 (0.92-1.22)
SC/ST	1.51***(1.33-1.71)	1.38***(1.21-1.58)	1.47***(1.28-1.69)	1.34***(1.17-1.55)
Muslim	0.87 (0.73-1.04)	0.83**(0.68-1)	0.94 (0.78-1.14)	0.83*(0.68-1.01)
Others	1.33**(1.03-1.71)	1.21 (0.94-1.57)	1.36**(1.05-1.78)	1.26*(0.97-1.65)
Household wealth quintile				
Poorest (reference)				
Poorer	0.87**(0.76-1)		0.88*(0.76-1.01)	0.92 (0.8-1.07)
Middle	0.76***(0.66-0.88)		0.76***(0.65-0.89)	0.84**(0.72-0.98)
Rich	0.81***(0.71-0.93)		0.75***(0.64-0.88)	0.89 (0.76-1.05)
Richest	0.6***(0.52-0.69)		0.5***(0.42-0.6)	0.69***(0.57-0.84)
Community level variables				
Mean year of community schooling				
0-<4 (reference)				
4--<6	0.97 (0.86-1.1)	1.03 (0.9-1.17)		1.02 (0.89-1.16)
6--<8	0.88**(0.77-1)	0.97 (0.84-1.12)		0.98 (0.83-1.15)
8 and max	0.85**(0.74-0.98)	0.98 (0.82-1.16)		1 (0.83-1.21)
Average community wealth quintile				
0 to less than 2 (reference)				
2 to 3.5	0.84 (0.62-1.14)		0.88 (0.64-1.2)	0.9 (0.66-1.23)
3.5 and above	0.78*(0.58-1.03)		1.05 (0.78-1.42)	1.07 (0.78-1.46)
Place of residence				
Rural (reference)				
Urban	0.9**(0.82-1.00)	1.08 (0.96-1.21)	1.09 (0.98-1.23)	1.15**(1.02-1.3)
Random effects				
Level 2 (Community)		0.11(0.06-0.21)	0.08(0.04-0.20)	0.07(0.03-0.19)

Note: *p < = .05, **p < = .01, ***p < = .001, Confidence interval in parenthesis

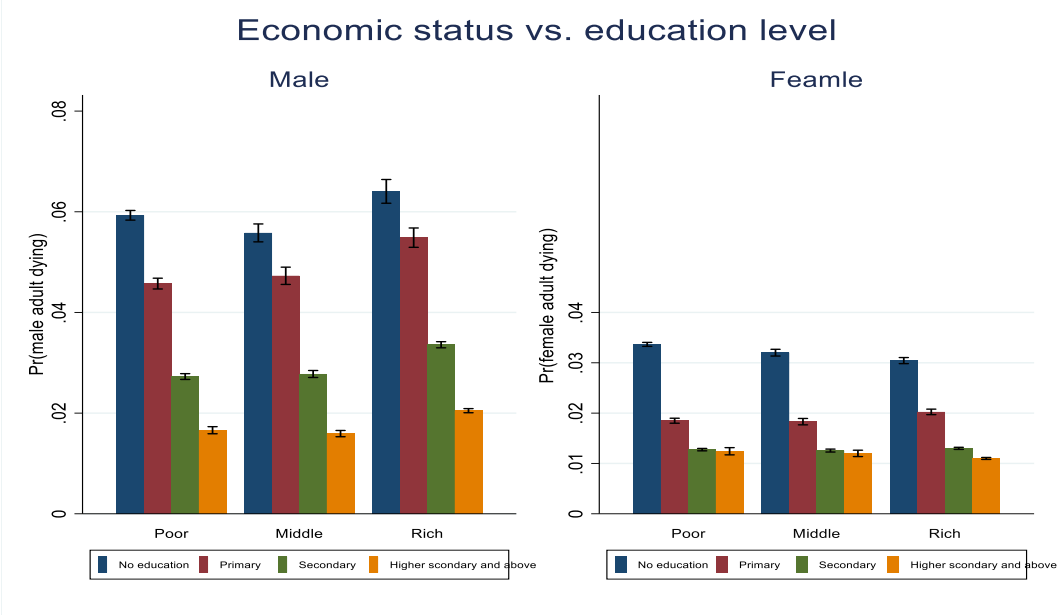
Table A3 Multilevel model results: Odds ratio for the probability of women prime age adult death between 2004-05 and 2011-12, India,

Variables	Bivariate	Model 1	Model 2	Model 3
Individual variable				
Morbidity	3.04***(2.45-3.77)	2.04***(1.63-2.56)	2.07***(1.65-2.6)	2.15***(1.71-2.7)
Age squire (in log	2.35***(2.16-2.55)	2.49***(2.22-2.78)	2.63***(2.35-2.95)	2.49***(2.21-2.79)

scale)				
Marital status				
Marriage (reference)				
Unmarried/no gona	0.64***(0.54-0.75)	2.71***(2.15-3.4)	2.35***(1.86-2.96)	2.66***(2.1-3.37)
widowed	3.35***(2.85-3.94)	1.89***(1.6-2.24)	1.91***(1.61-2.28)	1.88***(1.58-2.24)
Separated	1.31 (0.95-1.8)	1.58***(1.14-2.19)	1.54***(1.11-2.15)	1.6***(1.15-2.23)
Education level				
No education (reference)				
primary				
Secondary	0.59***(0.49-0.7)	0.75***(0.63-0.9)		0.76***(0.63-0.92)
Higher secondary	0.39***(0.33-0.45)	0.64***(0.54-0.77)		0.66***(0.55-0.81)
Graduate and above	0.31***(0.23-0.43)	0.57***(0.4-0.79)		0.66**(0.46-0.94)
Social group	0.33***(0.24-0.46)	0.5***(0.35-0.72)		0.52***(0.35-0.78)
General (reference)				
OBC	1.04 (0.88-1.22)	0.92 (0.77-1.08)	0.96 (0.81-1.15)	0.89 (0.75-1.07)
SC/ST	1.49***(1.27-1.75)	1.27***(1.07-1.5)	1.34***(1.12-1.6)	1.21**(1.01-1.45)
Muslim	1.21*(0.98-1.49)	1.02 (0.82-1.27)	1.17 (0.94-1.46)	1 (0.8-1.25)
Others	0.68*(0.44-1.04)	0.69*(0.45-1.06)	0.69*(0.44-1.07)	0.72 (0.47-1.12)
Household wealth quintile				
Poorest (reference)				
Poorer	0.83**(0.7-0.98)		0.9 (0.75-1.08)	0.95 (0.8-1.14)
Middle	0.74***(0.62-0.88)		0.82**(0.68-1)	0.9 (0.74-1.09)
Rich	0.61***(0.51-0.73)		0.67***(0.54-0.82)	0.8**(0.65-0.98)
Richest	0.53***(0.44-0.64)		0.55***(0.44-0.69)	0.76**(0.59-0.97)
Community level variables				
Mean year of community schooling				
0-<4 (reference)				
4--<6	0.86**(0.74-1)	0.9 (0.78-1.05)		0.95 (0.8-1.11)
6--<8	0.66***(0.56-0.78)	0.73***(0.61-0.87)		0.8**(0.65-0.97)
8 and max	0.58***(0.49-0.69)	0.68***(0.54-0.85)		0.73**(0.57-0.94)
Average community wealth quintile				
0 to less than 2 (reference)				
2 to 3.5	0.69**(0.49-0.96)		0.76 (0.54-1.06)	0.78 (0.56-1.1)
3.5 and above	0.54***(0.4-0.73)		0.74*(0.53-1.03)	0.81 (0.58-1.14)
Place of residence				
Rural (reference)				
Urban	0.85**(0.75-0.97)	1.08 (0.93-1.25)	1.01 (0.87-1.17)	1.14*(0.98-1.34)
Random effects				
Level 2 (Community)		0.03(0.00-0.81)	0.05(0.01-0.45)	0.04(0.00-0.83)

Note: *p < = .05, **p < = .01, ***p < = .001, Confidence interval in parenthesis

Figure A4 Predicated probabilities of adult dying in prime age across economic group by their education level and vise-versa.



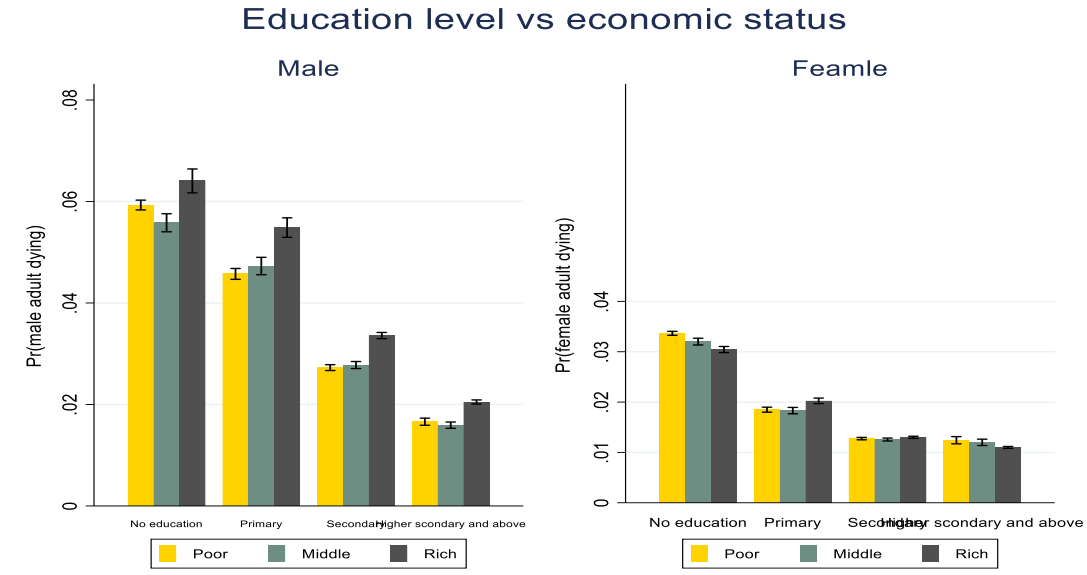
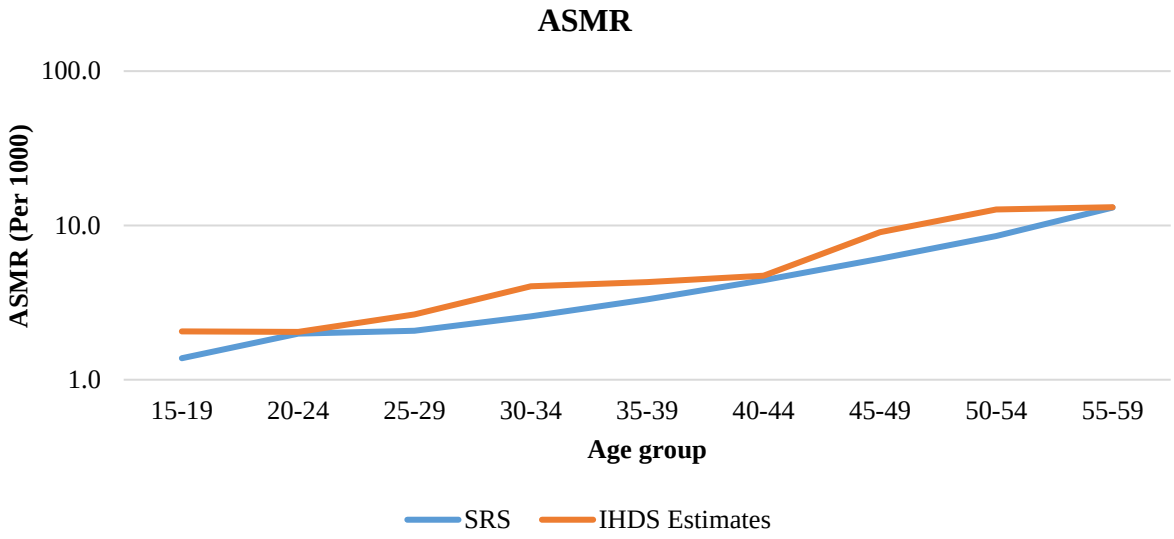


Table A4 Attrition in India Human Development Survey between 2004-05 and 2011-12 for adult 15-59 age group.

Variables	Re-identified	Attrition
Individual variable		
15-29	89.44	10.56
30-44	89.39	10.61
45-59	89.71	10.29
Sex		
Men	89.50	10.50
Women	89.47	10.53
Marital status		
Marriage	89.82	10.18
Unmarried/no gona	88.51	11.49

widowed	89.75	10.25
Separated	92.42	7.58
Education level		
No education	92.64	7.36
primary	90.45	9.55
Secondary	88.89	11.11
Higher secondary	86.87	13.13
Graduate and above	82.42	17.58
Social group		
General	87.64	12.36
OBC	90.46	9.54
SC/ST	91.12	8.88
Muslim	87.04	12.96
Others	87.64	12.36
Household wealth quintile		
Poorest	94.84	5.16
Poorer	90.74	9.26
Middle	90.30	9.70
Rich	87.09	12.91
Richest	83.85	16.15
Community level variables		
Mean year of community schooling		
0-<4	94.13	5.87
4--<6	92.74	7.26
6--<8	89.78	10.22
8 and max	81.30	18.70
Average community wealth quintile		
0 to less than 2	95.31	4.69
2 to 3.5	94.90	5.10
3.5 and above	88.55	11.45
Place of residence		
Rural	93.86	6.14
Urban	81.64	18.36
Ownership of household		
Own household	91.42	8.58
Rental house	69.60	30.40
Work status		
No	86.61	13.39
Yes	91.28	8.72
Total	89.49	10.51

Figure A5 Comparison of IHDS and SRS estimates, 2008


ASMR
100.0
10.0
1.0
ASMR (Per 1000)
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
Age group
SRS
IHDS Estimates