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SOCIOECONOMIC PATTERNS AND DETERMINANTS OF ADULT MORTALITY DUE TO EXTERNAL-CAUSES IN INDIA: ANALYSIS OF NATIONALLY-REPRESENTATIVE, POPULATION-BASED SURVEY DATA

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Abstract

The objective of this study is to analyze the pattern and risk factors of all-cause and external-cause mortality among adults in India. Using a nationally-representative, population-based survey, known as the National Family Health Survey, 2015-2016, we calculate age-specific death rates among adults aged 15-64 for all causes and external causes in the three years before the survey. We estimate external cause-deleted life expectancy by sex and apply logistic regression to investigate the socioeconomic determinants of all-cause and external-cause mortality in India. The male disadvantage in external-cause mortality is higher than in all-cause mortality. For all-cause mortality, caste and household wealth quintile (WQ) are significant predictors for both sexes. For external-cause mortality, Hindu adults experience a higher risk than adults from other religious groups. Moreover, the risk of death from external causes is negatively associated with household WQ. Our study demonstrates that people belonging to lower socioeconomic strata disproportionately carry the burden of death from external causes.

Keywords

Adult mortality, external-causes, socioeconomic status, India, NFHS

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Socioeconomic patterns and determinants of adult mortality due to external-causes in India: Analysis of nationally-representative, population-based survey data

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1. Introduction

External causes of death (also known as deaths due to injuries) primarily comprise of deaths due to accidents, intentional self-harm or suicide, and assault or homicide (WHO 2014). Despite ninety percent of global deaths owing to external causes occurring in low and middle-income countries (LMICs) (Hofman et al. 2005), studies on deaths due to the same in these countries are almost non-existent, primarily because of the lack of robust cause-of-death statistics (Gosselin et al. 2009). Limited evidence shows that deaths due to external causes are not evenly distributed across countries Chandran, Hyder and Peek-Asa 2010) or by socioeconomic characteristics (Birken & MacArthur 2004). Despite the larger share of deaths due to external causes, it is a neglected public health issue in LMICs because of a relatively higher mortality rate resulting from communicable and non-communicable diseases.

According to Goesselin et al. (2009), in developing countries, roughly as many people die from external causes as HIV/AIDS, Malaria, and tuberculosis combined. Studies based on verbal autopsy and reported causes of deaths to find that people from lower socioeconomic backgrounds have a higher risk of death due to external causes in several low-income countries (Chasimpha et al. 2015; Hossain et al. 2017). Injuries can happen at any age but have a particular impact on young people and people of prime working ages. Between the age of 15 and 29, injury-related causes are among the top five (WHO 2014). A study in rural Malawi finds that external-cause mortality is the highest among the 45 and older age group (Chasimpha et al. 2015). Men experience four to five times higher risk of death due to external causes than women in Southern Brazil and rural Malawi (D'Agostini et al. 2009; Chasimpha et al. 2015). A cross-country study (Streatfield et al. 2014) using data on registered deaths in 20 longitudinal surveillance sites of the IN-DEPTH Network across Africa and Asia demonstrates that transport-related deaths ranktop among all deaths from external causesexcept for Bangladesh where drowning of young children is the leading external cause of death.

Mortality from external causes is an under-researched subject in India. Since the cause-of-death statistics in India are either incomplete or unavailable for researchers (Saikia and Kulkarni 2016), few studies address deaths due to external causes in India. The primary source of data on deaths from accidents and suicide in India is the annual report published by the National Crime Records Bureau (NCRB), based on police records (Ministry of Home

Affairs, 2016). A recent study based on NCRB data shows that adults aged 30-59, particularly males, are more likely to die in road traffic accidents. The fatality rate varies across cities and states and is higher during extreme weather (Singh 2017). However, these data suffer serious bias due to underreporting and misclassification (Dandona et al. 2008; Sanghavi, Bhalla, and Das 2009; Gururaj et al. 2008). Another limitation of cause-of-death statistics in India is that they do not provide socioeconomic characteristics of the deceased individuals. Jagnoor et al. (2012) show that unintentional injury mortality contributed 7 percent of total deaths during 2001-2003. Unintentional injury mortality rates are found higher among males than females and in rural areas. In another study, Jagnoor et al. (2011) conclude that unintentional injuries are the sixth leading cause of death among children under five years of age in India, with a higher prevalence among rural children compared to urban children.

A few studies examine all external causes of deaths in a nationally non-representative sample (Streatfield et al. 2014) or a particular external cause of death, e.g., road accidents (Dandona et al. 2008; Gururaj et al. 2008) or unintentional falls (Krishnaswamy and Usha 2006). Streatfield et al. (2014) compare the patterns of mortality from external causes at twenty IN-DEPTH Network sites across Africa and Asia. They find that transport, falls, and suicide contribute a significant share to the external cause of death in India. Ballabgarh was ranked the fourth-highest in age-sex-time standardized mortality rates among all twenty study sitesin IN-DEPTH Network. However, the small sample size of the Ballabgarh surveillance site represents only the study area . Such small-scale studies cannot help to infer on the burden of deaths due to external causesin the entire country.The objective of the present study is to investigate the patterns and risk factors for deaths from external causes in India using a recent, nationally-representative survey. We identify similarities and differences between risk factors associated with all-cause and external-cause mortality among Indian adults. To the best of our knowledge, this is the first study to provide mortality rates due to external causes of deaths by demographic and socioeconomic characteristics of the deceased.

2. Data and Methods

2.1. Data

We analyzed the number of deaths in the households surveyed in the fourth round of Demographic and Health Survey (DHS) for India, also known as National Family Health Survey-4 (NFHS-4) conducted in 2015-2016 (IIPS and ICF 2017). The NFHS provides state- and national-level information on fertility, family planning, infant and child morbidity and mortality, maternal and reproductive health, nutritional status of women and children, and the quality of health services (IIPS and ICF 2017). These data are publicly available on the DHS website. The survey includes 425,563 households from rural and 175,946 households from urban areas. About 699,686 women aged 15-49 were interviewed with a response rate of 97 percent. The sample size for the NFHS-4 was decided to produce indicators at district, state/union territory (UT). The sample was selected through a two-stage sample design, for

rural with villages as the Primary Sampling Units (PSUs) at the first stage (selected with probability proportional to size), and for urban with Census Enumeration Blocks (CEB) followed by a random selection of 22 households in each PSU and each CEB, respectively, at the second stage. In both urban and rural areas, at the second stage, households were selected after conducting a complete mapping and household listing operation in the selected first-stage units.

The NFHS-4 collected information on the 'household's deaths that occurred since January 2013. If any death occurred from January 2013 to the time of the survey, the survey collected information on sex, age at death, month, and year of death of the deceased persons. The survey asked whether death was due to an accident, violence, poisoning, homicide, or suicide. For all these questions, the respondent was either the head of the household or any other adult member capable of answering the survey questions. For the details of the questions asked, see Appendix 1. Following the definition of ICD-10, we defined "external causes of death"as a non-homogeneous collection of deaths, including the three major categories of accidental death, suicide, and homicide (Sonderman et al. 2014).

2.2. Measures

Following the methodology described in the UN technical paper on mortality estimates from major sample surveys (United Nations, 2011), we estimated the all-cause age-specific death rates (ASDR) based on the average annual number of deaths that occurred to usual residents of the household in the three years preceding the survey. The denominator of the ASDR can be calculated in several ways. Typically, mortality rates are calculated,taking person-years of exposure as the denominator. If the period of exposure is as short as one year, the person-years exposed can be well approximated by the age-distribution of the population at the time of the survey. However, while calculating the ADSR over the three years before the survey, an adjustment in the age distribution of the population at the time of the survey is needed. Person-year exposure at age x for three years preceding the survey would be half of a person-year at age x, one whole person-year at age x-1, one whole year at age x-2 and one half at age x-3. Thus, person-years lived for the individuals at age x preceding three years of the survey can be derived following

$$PY_x = (n_x)*0.5 + (n_{x-1})*1 + (n_{x-2})*1 + (n_{x-3})*0.5 \ldots\ldots (1)$$

where

PY_x is thperson year of exposure at age x,

n_x denotes the number of individuals at age x

The numerator of the age-specific mortality rate is the number of deaths that occurred at age x during the three years preceding the survey.

Age-specific mortality rates are calculated using the following formula

$$nM_x = \frac{nDx}{nPx} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where

nD_x= Number of deaths from age x to x+n

nP_x= Person years lived in x to x+n

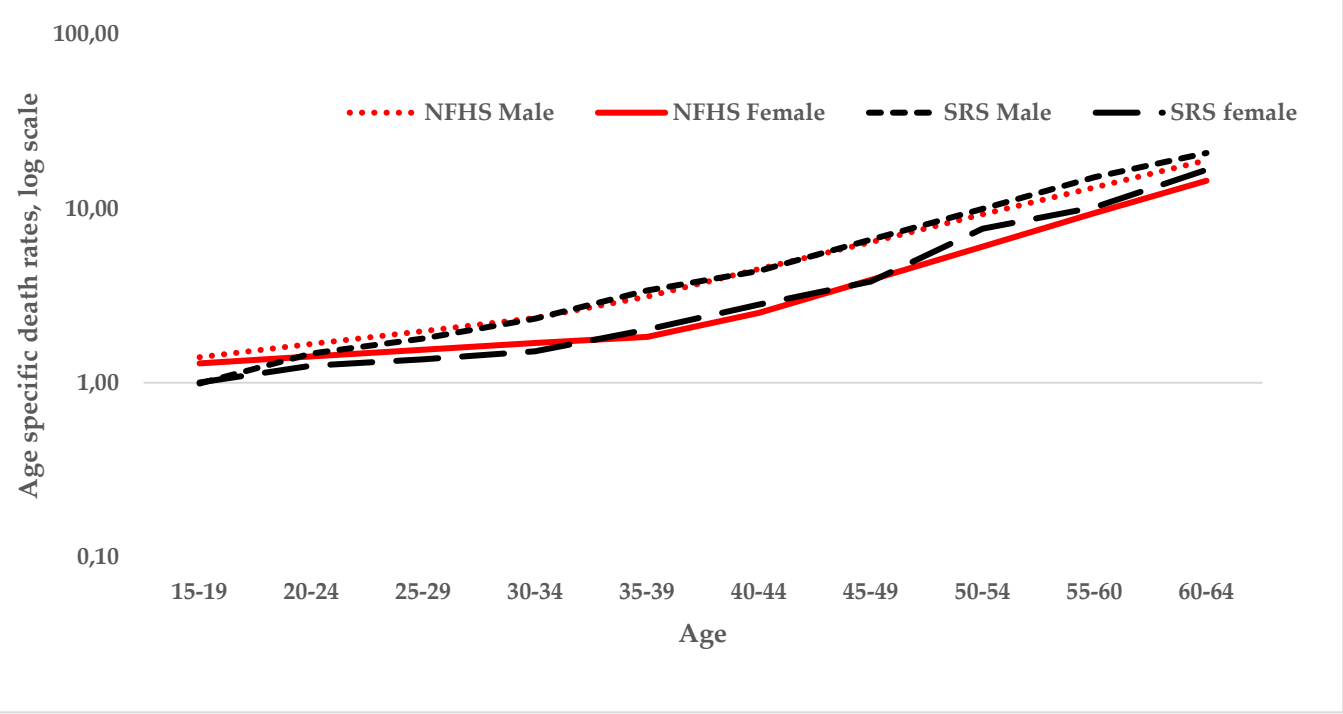
$$nMx^i = \frac{nDx^i}{nPx} \quad \text{.....(3)}$$

where

nDx^i = Number of deaths from cause i in age group x to x+n

In order to evaluate the accuracy of the mortality information in the NFHS, we compared all-cause ASDR obtained from that of India's official statistics, the Sample Registration System (SRS), for the corresponding period (see Figure 1). We observed a high level of concordance of the ASDRs for the age group 15-64 obtained from both sources.

Figure 1: Comparison of all-cause age-specific death rates, National Family Health Survey (NFHS) and Sample Registration System (SRS), India, 2013-2015



Source: 'Author's calculation using the NFHS 2015-2016 data and Sample Registration System Reports, 2013-2015

We estimated all-cause and external-cause mortality rates by sex (male, female), caste (Scheduled Castes or SCs, Scheduled Tribes or STs, Other Backward Castes or OBCs, and General Castes), religion (Hindu, Muslim, and Others combing Christian, Sikh, Buddhists, Jain, and all others); place of residence (Rural and Urban) and household wealth quintile

(WQ) (Poorest, Poorer, Middle, Richer and Richest). Also, to ensure comparability of estimates across socioeconomic strata, we calculated age-standardized mortality rates using age-weights from the European Standard Population (European Commission 2013).

We employed an associated single-decrement life table technique to construct cause-deleted life expectancy at various ages in order to assess the contribution of external causes of death in adult life expectancy (Preston, Heuveline, and Guillot 2001; Kintner 2004). Cause-deleted life expectancy allows us to quantify the hypothetical gains in life expectancy resulting from the elimination of deaths due to external causes.

2.3. Statistical Analysis

Statistical analyses were performed using STATA 15.0 for Windows. We carried out individual-level logistic regression analysis to investigate the association between the probability of dying (from all causes combined and external-causes only) and socioeconomic characteristics of the deceased adults by sex, where the deceased is coded as one and alive as zero. Model 1 reports odds ratio (with 95 percent confidence intervals) of each independent variable adjusted only for the individual's age. Model 2 reports adjusted odds ratios (AOR) adjusted for all other independent variables.

3. Results

Male mortality is higher than female mortality (Table 1 and Figure 2) at all adult ages. However, the male disadvantage is more pronounced in external-cause mortality than in all-cause mortality, as male external-cause mortality is about 2.24 fold higher than that of female (male:10.10 Vs. female:4.50 per 10,000 of thepopulation).

Table1: All-cause mortality rates and external-cause mortality rates (per 10,000 population) among adults aged 15-64, India, 2013-2015

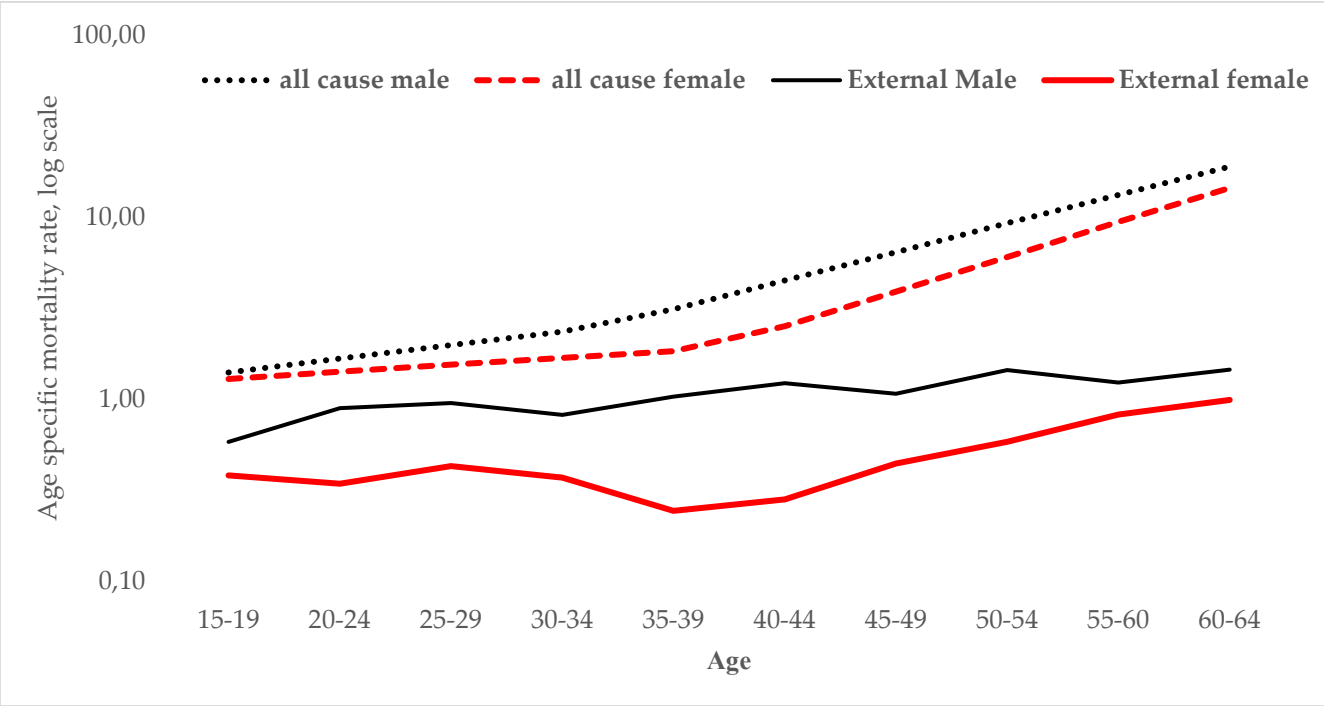
	All-cause mortality rates		External-cause mortality rates	
Age	Ma le	Female	Male	Female
15-19	14.00	12.90	5.80	3.80
20-24	16.70	14.20	8.90	3.40
25-29	19.80	15.50	9.50	4.30
30-34	23.50	16.90	8.20	3.70
35-39	31.30	18.30	10.30	2.40
40-44	45.00	25.20	12.20	2.80
45-49	64.10	39.00	10.70	4.40
50-54	92.70	60.40	14.50	5.80
55-60	132.60	94.20	12.40	8.20

60-64	189.30	144.60	14.50	9.90
15-64	49.00	33.70	10.10	4.50

Source: Author's calculation using the NFHS 2015-2016 data.

Secondly, all-cause mortality increases as age increases. However, the age pattern of external-cause mortality is not linear, particularly for adult females. Eliminating external-cause mortality leads to a gain of 2.7 and 1.6 years in life expectancy at birth for males and females, respectively (Table 2). This gain is the largest in adulthood (male: 77.7 percent and female: 75.0 percent of total gain), indicating that the majority of deaths from the external causes occur during adulthood.

Figure 2: All-cause mortality rates and external-cause mortality rates among adults aged 15-64, India, 2013-2015



Source: Author's calculation using the NFHS 2015-2016 data.

Table 2: Life expectancy and external-cause mortality eliminated life expectancy at various ages by sex, India, 2015-2016

Age	Overall Life Expectancy		External-cause eliminated Life Expectancy		Gain in Life Expectancy years (%)	
	Male	Female	Male	Female	Male	Female
0	67.4	70.6	70.1	72.2	2.7 (100%)	1.6 (100%)
15	56.0	59.8	58.2	61.0	2.1(78%)	1.2 (75%)

60	17.9	19.4	18.4	19.9	0.6(22%)	0.6 (25%)

Source: Author's calculation using the NFHS

Table 3 presents the age-standardized all-cause and external-cause mortality by sex for socioeconomic subgroups. Female adults experience lower mortality rates for all causes and external-cause mortality than male adults across socioeconomic groups. After controlling for age, SC male and female adults experience the highest mortality rates followed by ST adults. Mortality due to external causes is higher among Hindu females than the rest of the women, while all causes of mortality is higher for the Muslim females.Muslim males experience the lowest mortality rates; rural adults experience higher all-cause and external-cause mortality rates than their urban counterparts irrespective of sex (Table 3). Except for deaths from external causes among males, a clear downward slope in mortality rates is visible as household WQ increases from the lowest to the highest.

Table 3: Age-standardized all-cause and external-cause mortality rates for 15-64 adults by socioeconomic characteristics, India, 2013-2015 (per 10,000 of the population).

Caste	**Male external – cause Mortality**	**Female external - cause Mortality**	**Male all-cause Mortality**	**Female all-cause Mortality**
SC	13.59	4.85	68.30	41.24
ST	12.92	4.98	73.76	40.15
OBC	11.22	4.19	55.64	35.23
Others	10.02	4.05	48.82	29.53
Religion				
Hindu	11.84	4.46	58.52	35.45
Muslim	9.76	3.96	53.87	36.32
Other	11.59	4.03	57.72	31.84
Place of Residence				
Urban	10.34	3.81	56.59	31.43
Rural	12.30	4.64	58.69	37.29
Wealth quintile				
Poorest	15.79	4.63	74.52	44.38
Poorer	12.36	5.34	64.00	41.71
Middle	11.42	4.99	60.32	38.53
Richer	12.06	4.15	57.33	30.19
Richest	7.60	2.90	39.63	24.71
Total	11.58	4.35	57.89	35.28

Source: Author's calculation using the NFHS 2015-2016 data.

Table 4 presents the percent share of all-cause and external-deaths out of the surveyed population at age 15-64 by sex. It also presents the percent of external cause deaths out of total deaths. The highest proportion of deaths occur among adults belonging to SCs, STs, and the poorest WQ. It is noteworthy that of the 21,135 adult deaths documented in the survey, 4,026 were due to external causes. This corresponds to 22 percent of total male deaths and 14 percent of total female deaths. For both sexes combined, external causes account for almost one-fifth of the overall number of deaths.

Table 4: Percent of deaths by socioeconomic characteristics, 15-64 aged adults, 2013-2015, India

Socioeconomic characteristics	% Of the deaths due to external causes		% Of the deaths from all causes		Population surveyed at age 15-64		Share of deaths due to external causes out of all deaths	
Caste	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
SC	0.37	0.13	1.62	0.99	186021	188157	22.74	13.28
ST	0.35	0.15	1.75	0.99	81692	84452	19.75	14.59
OBC	0.31	0.12	1.38	0.87	383765	395371	21.83	13.29
Others	0.28	0.11	1.25	0.76	249727	252111	22.42	14.96
Religion								
Hindu	0.33	0.13	1.46	0.89	735133	746436	22.18	14.14
Muslim	0.26	0.09	1.21	0.79	119036	126095	21.38	11.7
Others	0.31	0.11	1.47	0.83	53680	53934	21.11	12.94
Place of residence								
Urban	0.28	0.1	1.34	0.74	327319	318049	20.62	13.47
Rural	0.34	0.13	1.48	0.94	580530	608417	22.75	13.9
Wealth quintile								
Poorest	0.44	0.13	1.9	1.15	152728	165288	22.59	11.46
Poorer	0.34	0.16	1.54	1.03	174685	179616	21.58	15.00
Middle	0.31	0.13	1.42	0.92	186432	187408	21.47	14.50
Richer	0.33	0.11	1.37	0.71	192678	193399	23.64	15.69
Richest	0.21	0.08	1.03	0.62	201326	200756	20.49	12.40
Total	**0.32**	**0.12**	**1.43**	**0.88**	**907849**	**926466**	**22.03**	**13.78**

Source: Author's calculation using the NFHS 2015-2016 data.

Table 5: Logistic regression results for the relationship between all-cause mortality and socio-demographic variables, 15-64 adults, India, 2013-2015

	Males		Females	
	Model 1	Model 2	Model 1	Model 2
Caste				
Other Backward				
Scheduled	**1.26** (1.18-	**1.11** (1.03-1.19)	**1.12** (1.03-1.22)	1.00 (0.92-1.09)
Scheduled Castes	**1.22** (1.16-	**1.14** (1.08-1.21)	**1.17** (1.09-1.25)	**1.11** (1.04-1.19)
General Castes	**0.83** (0.79-	**0.91** (0.86-0.97)	**0.83** (0.77-0.89)	**0.90** (0.83-0.97)
Religion				
Muslim (ref.)	1.00	1.00	1.00	1.00
Hindu	**1.10** (1.02-	1.05 (0.97-1.13)	0.99 (0.91-1.07)	0.93 (0.86-1.01
Other	1.01 (0.91-	1.06 (0.94-1.19)	**0.82** (0.71-0.94)	**0.85** (0.74-0.98)
Type of residence				
Urban (ref.)	1.00	1.00	1.00	1.00
Rural	**1.12** (1.06-	**0.80** (0.76-0.85)	**1.26** (1.18-1.34)	0.94 (0.87-1.02)
Wealth Quintile				
Richest	1.00	1.00	1.00	1.00
Richer	**1.46** (1.35-	**1.51** (1.39-1.64)	**1.29** (1.16-1.42)	**1.27** (1.14-1.41)
Middle	**1.57** (1.46-	**1.68** (1.55-1.83)	**1.66** (1.50-1.83)	**1.64** (1.47-1.83)
Poorer	**1.72** (1.60-	**1.87** (1.72-2.04)	**1.80** (1.64-1.98)	**1.78** (1.60-1.98
Poorest	**2.05** (1.90-	**2.21** (2.03-2.41)	**1.93** (1.76-2.11)	**1.89** (1.70-2.11)

Source: Author's calculation using the NFHS 2015-2016 data.

Notes: 1) Outcome variable: dead from all cause =1; alive=0

2) Model 1 – adjusted for age only; Model 2 – adjusted for all variables.

3) Statistically significant ($p \leq 0.05$) odds ratios are marked in bold. Confidence intervals are reported in brackets.

Table 5 presents logistic regression results for the relationship between all-cause mortality and socio-demographic variables, 15-64 adults, India, 2013-2015. For both sexes, model 1 and model 2 present the unadjusted and the adjusted effects of independent variables, respectively. The caste and household WQ are significant determinants of all-cause mortality for both sexes; the SC male and female adults experience higher odds of dying than the rest. Also, male members of the STs have higher odds of dying compared to males from OBCs or General Castes. Religion is not a significant determinant of all-cause male mortality in the adjusted model. Women from other religions experience lower odds of dying than the reference group. Similarly, the place of residence is not a significant determinant of all-cause mortality in the adjusted model. Finally, for both sexes, the lower the household WQ, the higher the odds of dying.

Table 6: Logistic regression results for the relationship between external-cause mortality and socio-demographic variables, 15-64 adults, India, 2013-2015.

	Males		Females	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Caste				
Other Backward Classes (OBC) (ref.)	1.00	1.00	1.00	1.00
Scheduled Tribes(ST)	1.13 (0.96-1.32)	0.95 (0.80-1.12)	1.17 (0.92-1.48)	1.05 (0.82-1.36)
Scheduled Casts (SC)	**1.25** (1.11-1.42)	**1.15** (1.01-1.30)	1.16 (0.95-1.41)	1.08 (0.88-1.32)
General Castes	0.91 (0.80-1.03)	1.01 (0.88-1.16)	0.97 (0.79-1.19)	1.10 (0.89-1.35)
Religion				
Muslim (ref.)	1.00	1.00	1.00	1.00
Hindu	**1.25** (1.04-1.50)	**1.21** (1.00-1.46)	**1.35** (1.04-1.77)	**1.35** (1.02-1.78)
Other	1.21 (0.93-1.57)	1.29 (0.97-1.70)	0.97 (0.62-1.52)	1.06 (0.66-1.69)
Urban-rural residence				
Urban (ref.)	1.00	1.00	1.00	1.00
Rural	**1.25** (1.11-1.41)	0.95 (0.83-1.09)	**1.35** (1.11-1.64)	1.02 (0.82-1.28)
Household wealth				
Richest	1.00	1.00	1.00	1.00
Richer	**1.60** (1.33-1.92)	**1.62** (1.34-1.96)	**1.64** (1.22-2.21)	**1.64** (1.21-2.23)
Middle	**1.59** (1.33-1.90)	**1.61** (1.33-1.96)	**1.96** (1.48-2.61)	**1.94** (1.42-2.65)
Poorer	**1.75** (1.47-2.08)	**1.79** (1.46-2.18)	**2.14** (1.62-2.83)	**2.10** (1.53-2.87)
Poorest	**2.18** (1.83-2.59)	**2.24** (1.82-2.75)	**1.89** (1.43-2.49)	**1.84** (1.34-2.54)

Source: 'Author's calculation using the NFHS 2015-2016 data.

Notes: 1) Outcome variable: dead from external cause =1; alive=0

2) Model 1 – adjusted for age only; Model 2 – adjusted for all variables.

3) Statistically significant ($p \leq 0.05$) odds ratios are marked in bold. Confidence intervals are reported in brackets.

Table 6 shows the odds ratios for external-cause mortality. Contrary to all cause-mortality, caste is not a significant determinant of external-cause mortality except for SC males (Table 6), who face a higher risk of dying from external causes. In the unadjusted model, Hindus, rural adults, and adults from lower WQ experience a higher likelihood of external-cause mortality. After controlling for socioeconomic characteristics, however, there is no statistically significant association between place of residence and external-cause mortality, whereas Hindu adults still experience a higher risk of death than the rest. With regard to household WQ, our results suggest the same relationship with the risk of dying from external causes as in the case of all causes: households from higher WQ face a lower risk of dying.

4. Discussion

Given the dearth of empirical studies in LMICs on external causes of deaths, our study makes a crucial contribution to the knowledge about deaths from external causes among adults in India. Previous studies documented that economic development in LMICs has brought an increasing number of vehicles with an associated rise in deaths due to external causes through traffic-related crashes in countries with non-existent preventive efforts and unprepared health systems (Gosselin et al. 2009). India, an economically emerging and demographically large country, is no exception from that rule, yet there is limited scientific evidence and a lack ofpoliciesaddressing to prevent deaths due to external causes. Our study is the first to demonstrate the burden of suchdeaths among adults by population subgroups in contemporary India.

Our study finds that, in 2015, about 0.62 million adult deaths[1]occurred due to external causes in India, constituting nearly one-fifth of the total number of deaths among adults aged 15-64. This figure is much higher than that obtained from the NCRB for 2015, which recorded a total of 0.41 million deaths for all age groups (Ministry of Home Affairs 2016). Underreporting of deaths due to external causes in NCRB data is discussed earlier (Patel et 2012;Singh et al. 2018). Our figures cannot be directly compared with the findings from the previous studies (Jagnoor et al. 2011; Jagnoor et al. 2012), as they examinedonly one

[1]We obtained this figure by imposing external-cause mortality rate of this study to India's projected population in 2015 by UN 2017 (United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, custom data acquired via website).

component (that is, unintentional injury mortality) of external-cause mortality rate. Also,their focusis not on the adult age group.While Jagnoor et al. (2012) found that unintentional injuries (deaths excluding self-inflicted injuries and suicide, violence and war as defined by WHO 2008) contribute only 7% of all deaths in all age groups, our study shows that total external-cause deaths contributed 19% of total deaths occurred in the age group 15-64 in India in 2013-2015. A study by Palanivel et al. (2013) shows the external causes account for around 15% of total deaths from2002 to 2007. The results of our study arealso in the line of a study conducted in Africa (say, male adult mortality rate 100.7 in rural Malawi against 115.4 in India, per 100,000 populations) (Chasimpha et al. 2015). It is noteworthy that adult mortality rates due to external causes in India are about 2.9 and 4.5 fold higher than those observed in Europe for males and females, respectively (Oortwijn et al. 2011).

Our findings of male excess mortality due to external causes corroborate previous studies on India (Palanivel, 2013; Singh 2016), as well as studies in other national settings (Chasimpha et al. 2015; Pison et al. 2018). Using previous rounds of the NFHS and other national surveys, earlier studies documented the socioeconomic disparity in adult mortality in India (Subramanian et al. 2006; Po and Subramanian 2011; Saikia and Ram 2010). The present study reconfirms a similar pattern of disparity by castes and household WQ (Subramanian et al. 2006; Po and Subramanian 2011; Saikia and Ram 2010). The mortality disadvantage among adults from deprived castes may be linked to higher prevalence of substance abuse (Saikia and Debbarma 2019), or economic and social discrimination (Banerjee and Knight 1985; Sil & Dhillon, 2017, Ira, Sen and Yun, 2012). Previous studies also discussed the advantage of survival of the Muslim population in India. It is discussed that place of residence, water source, toilet facility, mother's diet, and mother's place of work may endow Muslims with an advantage with respect to mortality (Guillot and Allendorf 2010).

The strength of the present study is the analysis of the nature and extent of disparity in external-cause mortality by adults' socioeconomic characteristics. Our study reveals that the socioeconomic disparity in external-cause mortality does not necessarily coincide with that of all-cause mortality among adults. For instance, both adult Hindu males and females have a higher chance of death due to external causes compared to non-Hindu or non-Muslim adult females. The burden of deaths due to external causes falls disproportionately onpoor households. Contrary to previous studies, there is no statistically significant difference between rural and urban residents in the risk of deaths due to external causes, once we control for socioeconomic factors.

Our study has a few limitations. First, reporting external causes of death, according to a recent study (Pison et al. 2018), is complicated, in an African setting. Although survey respondents more frequently list the deaths of their adult siblings who died of external causes than the deaths of those who die from natural causes, they underreport or misclassify stigmatized causes of death, such as suicide and homicide. Also, the quality of reported information seems to differ by population sub-groups, with more problems occurring in the rural population (Pison et al. 2018). The NFHS data records all external-causes of death together, which may minimize the error related to stigmatized causes of death, as people are not asked to reveal the actual cause. However, we do not have any previous evidence of how reporting of all-cause or external-cause mortality differs by population sub-groups. Under-reporting of such deaths can be a subject of future investigation. Secondly, unlike registry data, survey data like the NFHS has the limitation of underreporting of deaths in the case of one-person households. However,this affect on mortality estimates will be rather small as one-person householdsmake for less than four percent of total households in the most recent census and surveys (Dommaraju 2015). Finally, the NFHS does not provide information on the educational attainment of thedeceased individuals, which keeps from deeper investigating differences in mortality by socioeconomic characteristics.

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