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The mortality divide in India: the differential contributions of gender, caste, and standard of living across the life course

The Mortality Divide in India: The Differential Contributions of Gender, Caste, and Standard of Living Across the Life Course

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Interpreting health inequalities in relation to the socioeconomic circumstances of individuals and populations provides a useful assessment of potentially avoidable inequalities.¹ In particular, socioeconomic inequalities in mortality suggest not only contemporaneous exposure to disadvantaged individual and ecological circumstances but also cumulative exposure to adverse circumstances.² A necessary prerequisite for reducing health disparities, consequently, is to ascertain the socioeconomic distribution of health and mortality.³ Much of the current evidence on socioeconomic inequalities in health and mortality is restricted to developed countries,^{4–10} and there has been little systematic effort to document the different socioeconomic dimensions along which health and mortality are patterned in developing countries.¹¹ Using the most recent nationally representative survey data, the 1998–1999 Indian National Family Health Survey (INFHS), we investigated the different socioeconomic and geographic dimensions along which inequalities in mortality exist in India.

Research on mortality in India has almost exclusively focused on the determinants of infant and child mortality.^{12–14} Given India's high infant and child mortality rates—67 and 93 per 1000, respectively—this emphasis is legitimate and understandable.¹⁵ Furthermore, given that girls have a higher mortality than boys, inequalities in infant and child mortality have mainly been studied from a gender perspective.^{14,16–19} Crucially, most analyses of mortality are based either exclusively on aggregate data, typically at the level of Indian districts or states,¹⁴ or exclusively on individual data.^{16,20} In this study, we extended the current understanding of mortality differentials in India in the following ways.

First, we investigated the differential patterning of mortality across different stages of

Objectives. We investigated the contributions of gender, caste, and standard of living to inequalities in mortality across the life course in India.

Methods. We conducted a multilevel cross-sectional analysis of individual mortality, using the 1998–1999 Indian National Family Health Survey data for 529 321 individuals from 26 states.

Results. Substantial mortality differentials were observed between the lowest and highest standard-of-living quintiles across all age groups, ranging from an odds ratio (OR) of 4.61 (95% confidence interval [CI]=2.98, 7.13) in the age group 2 to 5 years to an OR of 1.97 (95% CI=1.68, 2.32) in the age group 45 to 64 years. Excess mortality for girls was evident only for the age group 2 to 5 years (OR=1.33, 95% CI=1.13, 1.58). Substantial caste differentials were observed at the beginning and end stages of life. Area variation in mortality is partially a result of the compositional effects of household standard of living and caste.

Conclusions. The mortality burden, across the life course in India, falls disproportionately on economically disadvantaged and lower-caste groups. Residual state-level variation in mortality suggests an underlying ecology to the mortality divide in India. (*Am J Public Health.* 2006;96:818–825. doi:10.2105/AJPH.2004.060103)

the life course, from infancy and childhood through adult mortality to mortality at older ages. Second, in addition to gender differences, we examined inequalities in mortality across socioeconomic dimensions to evaluate the independent contributions of gender, caste, and standard of living in shaping patterns of mortality. Such an evaluation, across the life course, is likely to be indicative of the processes that generate health inequalities.²¹ Finally, analyses of exclusively aggregate or exclusively individual data conflate the different sources of variation in mortality.^{22–24} Using a multilevel analytic perspective,^{25,26} we examined the simultaneous contribution of individual, household, and area levels in producing variation in mortality, thus estimating the importance of geographic contexts for individual mortality.

We addressed the following questions about the mortality divide in India:

1. What is the relative importance of gender, of caste, and of standard of living in shaping unequal patterns of mortality?

2. To what extent do unequal patterns of mortality by gender, caste, and standard of living vary across different stages of the life course?
3. What is the extent of geographic variation in mortality at the level of local areas, districts, and states after allowance is made for the effects of individual and household demographic and socioeconomic markers?
4. To what extent does the geographic variation in mortality, at the levels of states, districts, and local areas, vary across different stages of the life course?

METHODS

The outcome measure was a dichotomous variable indicating whether an individual was dead (1) or alive (0).

Data

The analyses are based on the representative cross-sectional INFHS of 529 321 individuals from 92 486 households in 26 Indian states.²⁷ The household data were obtained from face-to-face interviews conducted in the

respondents' homes, which elicited a range of demographic and socioeconomic information on each member of the household. The survey response rate ranged from 89% to almost 100%, with 24 of the 26 states having a rate of more than 94%.²⁷ INFHS interviewers also obtained information on the number of deaths in the household in the 2 years prior to the date of the survey.²⁷

The lowest unit of observation was the individual, and in our analyses we used the data on each household member, including those who had died in the previous 2 years. Information on age and gender was available for both living and dead household members. The household survey provided current information on caste, religion, and standard of living, which was linked to members who were alive at the time of the survey as well as to the deceased members. This linkage assumes that the household members who died in the 2 years prior to the survey had a standard of living, caste, and religion similar to those of household members who were still alive. All households were geocoded to the primary sampling unit, district, and state to which they belonged. The primary sampling units, hereafter called "local areas," were villages or groups of villages in rural areas and wards or municipal localities in urban areas. Table 1 shows the descriptive characteristics of the sample, as well as number and percentage of deaths in the 2 years prior to the survey, by the 6 life stages.

Predictors

Social caste. Social caste was based on the head of household's self-identification as belonging to a scheduled caste, scheduled tribe, other backward class, other caste, or no caste group. Although there is a substantial degree of heterogeneity within each category, these categories are routinely used for population-based monitoring. Scheduled tribes and scheduled castes are the most socially disadvantaged groups and have traditionally been identified by the Indian government as needing affirmative action.²⁷

"Scheduled castes" are the lowest castes in the traditional Hindu caste hierarchy (e.g., "untouchables" or *Dalits*), and as a consequence they experience intense social and economic segregation and disadvantage.^{28,29}

Occupationally, most scheduled castes are landless agricultural laborers or are engaged in what were traditionally considered to be ritually polluting occupations.³⁰

"Scheduled tribes" consist of approximately 700 tribes that tend to be geographically isolated and have limited economic and social interaction with the rest of the population.²⁹ Although they are ethnically distinct, their physical isolation has been the main criterion used to identify communities as scheduled tribes and to treat them as beneficiaries of affirmative action.²⁹

"Other backward class" comprises a diverse collection of "intermediate" castes that were considered low in the traditional caste hierarchy but clearly above scheduled castes.³¹

"Other caste" is thus a default residual group (i.e., persons who do not belong to a scheduled caste, scheduled tribe, or other backward class) that enjoys higher status in the caste hierarchy.

We classified groups for whom caste was not likely to be applicable (e.g., Muslims, Christians, or Buddhists) and participants who did not report any caste affiliation in the survey as "no caste."

Standard of living. Standard of living was measured by household assets and material possessions. Asset ownership indices have been used in many previous studies as a reliable and valid surrogate measure for wealth and standard of living.³²⁻³⁴ We adapted the INFHS standard-of-living index to the "proportionate possession weighting" used in studies of poverty in a number of countries.³⁵⁻³⁷

The INFHS standard-of-living index and the weighted standard-of-living index that we used were correlated to the order of 0.93 ($P < .00001$). The weights for each item were derived on the basis of the proportion of households owning the particular item. Thus, for example, if 40 of 100 households in the sample owned a radio, then a radio would get a weight of 60 ($100 - 40$). Weights for each item were summed into a linear index and households were allocated a final score. Because the standard-of-living index is a constructed measure, it does not have an absolute interpretation. For our analysis, we divided the standard-of-living index into quintiles and placed the population into those quintiles.

Other predictors. Age was grouped into 6 categories to capture the different stages of the life course: infant (aged < 1 year), young children (aged 2–5 years), children to adolescent (aged 6–18 years), young adult (aged 19–44 years), middle-aged (aged 45–64 years), and elderly (aged 65 years and older). Other predictors included religious affiliation of the household head (Hindu, Muslim, Christian, other) and the location of the household (large city, population ≥ 1 million; small city, population 100 000–1 million; town, population ≤ 100 000; village or rural area).

Statistical Analysis

We used multilevel logistic regression³⁸ to model mortality variation at the different analytic levels.^{25,26} The 5-level model, calibrated for each of the age strata, had a binary response (y , dead or not) for individual i living in household j in local area k in district l in state m . Assuming the binary response, y_{ijklm} , to be Bernoulli distributed with probabilities $\pi_{ijklm} : y_{ijklm} \sim \text{Bernoulli}(1, \pi_{ijklm})$, the probabilities, π_{ijklm} , were related to a set of categorical predictors X (gender, caste, standard of living, religion, and urban/rural status), and a random effect for each level, by a logit link function as

$$(1) \quad \text{logit}(\pi_{ijklm}) = \log \left[\frac{\pi_{ijklm}}{(1 - \pi_{ijklm})} \right] \\ = \beta_0 + \beta(X) + u_{ijklm} \\ + v_{oklm} + f_{olm} + g_{om}$$

The linear predictor on the right-hand side of the equation consists of a fixed part ($\beta_0 + \beta(X)$) and 4 random intercepts attributable to households (u_{ijklm}), local areas (v_{oklm}), districts (f_{olm}), and states (g_{om}). The parameter β_0 estimates the log odds of mortality for the reference group, and the parameters β estimate the differential in the log odds of mortality for the different categorical predictors, modeled as contrasted dummy variables. Each of the random effects is assumed to have an independent and identical distribution, such that we have variances estimated for households (σ_u^2), local areas (σ_v^2), districts (σ_f^2), and states (σ_g^2). These variance parameters show the heterogeneity in the log odds of mortality at each level, after taking into account the

TABLE 1—Number and Percentage of Deaths During the 2 Years Before the Survey, by Descriptive Characteristics of the Sample and Life Course Stage: Indian National Family Health Survey, 1998–1999

	Infants (<1 y)			Young Children (2–5 y)			Children/Adolescents (6–18 y)			Young Adults (19–44 y)			Middle-Aged Adults (45–64 y)			Elderly (≥65 years)		
	No. Deaths	n	Deaths, %	No. Deaths	n	Deaths, %	No. Deaths	n	Deaths, %	No. Deaths	n	Deaths, %	No. Deaths	n	Deaths, %	No. Deaths	n	Deaths, %
Gender																		
Men	1 072	13 263	8.08	290	26 059	1.11	350	80 855	0.43	931	97 457	0.96	1 332	36 104	3.69	2 517	16 027	15.70
Women	907	12 043	7.53	356	24 098	1.48	341	76 685	0.44	748	98 727	0.76	972	34 104	2.85	2 011	13 784	14.59
Caste																		
Scheduled caste	414	4 663	8.88	128	8 904	1.44	135	27 454	0.49	297	31 532	0.94	420	11 321	3.71	783	4 502	17.39
Scheduled tribe	344	3 633	9.47	171	7 326	2.33	164	21 727	0.75	327	24 536	1.33	311	8 227	3.78	486	3 188	15.24
Other backward class	583	7 262	8.03	161	14 050	1.15	202	43 791	0.46	460	54 128	0.85	654	19 497	3.35	1 313	8 440	15.56
Other caste	534	8 402	6.36	149	17 135	0.87	158	56 147	0.28	527	76 353	0.69	814	28 067	2.90	1 777	12 477	14.24
No caste	104	1 346	7.73	37	2 742	1.35	32	8 421	0.38	68	9 635	0.71	105	3 096	3.39	169	1 204	14.04
Standard of living index																		
Bottom quintile	658	5 994	10.98	266	12 189	2.18	219	33 387	0.66	470	35 210	1.33	589	13 044	4.52	972	6 011	16.17
Second quintile	532	5 632	9.45	194	11 225	1.73	186	33 599	0.55	350	36 941	0.95	510	13 078	3.90	907	5 367	16.90
Third quintile	387	5 288	7.32	95	10 153	0.94	125	32 351	0.39	340	39 413	0.86	432	13 238	3.26	812	5 398	15.04
Fourth quintile	264	4 533	5.82	62	8 923	0.69	115	31 315	0.37	313	41 275	0.76	385	13 995	2.75	872	5 801	15.03
Top quintile	138	3 859	3.58	29	7 667	0.38	46	26 888	0.17	206	43 345	0.48	388	16 853	2.30	965	7 234	13.34
Religion																		
Hindu	1 519	18 931	8.02	471	37 196	1.27	508	117 253	0.43	1 289	149 510	0.86	1 800	54 739	3.29	3 636	23 256	15.63
Muslim	276	3 724	7.41	92	7 528	1.22	86	22 674	0.38	160	23 958	0.67	234	7 304	3.20	492	2 984	16.49
Christian	114	1 611	7.08	49	3 107	1.58	52	9 621	0.54	113	12 444	0.91	129	4 465	2.89	190	1 797	10.57
Other religion	66	1 011	6.53	33	2 277	1.45	43	7 823	0.55	117	10 085	1.16	140	3 628	3.86	210	1 751	11.99
Missing religion	4	29	13.79	1	49	2.04	2	169	1.18	0	187	0.00	1	72	1.39	0	23	0.00
Urban/rural status																		
Large city	89	2 184	4.08	29	4 505	0.64	39	15 699	0.25	174	26 047	0.67	235	8 899	2.64	428	3 265	13.11
Small city	56	1 289	4.34	24	2 685	0.89	42	9 411	0.45	78	13 193	0.59	133	4 663	2.85	288	1 917	15.02
Town	184	2 944	6.25	41	5 873	0.70	72	20 885	0.34	215	28 048	0.77	278	9 723	2.86	606	3 725	16.27
Village	1 650	18 889	8.74	552	37 094	1.49	538	111 545	0.48	1 212	128 896	0.94	1 658	46 923	3.53	3 206	20 904	15.34
Total	1 979	25 306	7.82	646	50 157	1.29	691	157 540	0.44	1 679	196 184	0.86	2 304	70 208	3.28	4 528	29 811	15.19

Note. We observed 26 states and 440 districts (439 for infants); no. of local areas observed ranged from 3181 to 3215 and no. of households observed ranged from 22 468 to 85 108 across the 6 age strata.

relationship between the log odds of mortality and predictors in the fixed part. Models were calibrated with the quasi-likelihood approximation using the first-order Taylor linearization procedure.³⁹

RESULTS

Table 2 presents the conditional odds ratios (ORs) along with 95% confidence intervals (CIs) derived from 6 age-stratified multivariable multilevel logistic regression models. The reference category in each of the age-stratified models is a Hindu man

living in a large city, who belongs to the “other caste” group and whose household is in the top standard-of-living quintile. For this advantaged group, the predicted mortality rate per 1000 persons across the 6 age groups was 30 (aged <1 y), 2 (aged 2–5 years), 1 (aged 6–18 years), 5 (aged 19–44 years), 20 (aged 45–64 years), and 120 (aged 65 years and older).

Socioeconomic Differentials in Mortality by Age Group

Mortality risk for infants (aged <1 year) in the lowest quintile of standard of living

was greater than that for infants from the highest quintile (OR=2.73, 95% CI=2.18, 3.44); each lower standard-of-living quintile had a greater mortality risk than the quintile above it (Table 2). Gender, caste, and religion differentials in infant mortality were not substantial.

Among young children (aged 2–5 years), differences in mortality were apparent by gender, caste, and standard of living. Mortality risk was higher for girls than for boys (OR=1.33, 95% CI=1.13, 1.58). Although the mortality risks for children from scheduled castes and other backward classes were

TABLE 2—Adjusted Odds Ratios (With 95% Confidence Intervals [CIs]) for Mortality Across Age Groups, Conditional on State-, District-, Local Area-, and Household-Level Random Effects: Indian National Family Health Survey, 1998–1999

	Infants (< 1 y) OR (95 CI)	Young Children (2–5 y) OR (95 CI)	Children/Adolescents (6–18 y) OR (95 CI)	Young Adults (19–44 y) OR (95 CI)	Middle-Aged Adults (45–64 y) OR (95 CI)	Elderly (≥ 65 years) OR (95 CI)
Gender						
Men	1.00	1.00	1.00	1.00	1.00	1.00
Women	0.91 (0.82, 1.01)	1.33 (1.13, 1.58)	1.03 (0.88, 1.20)	0.79 (0.72, 0.87)	0.77 (0.70, 0.83)	0.92 (0.87, 0.99)
Caste						
Other caste	1.00	1.00	1.00	1.00	1.00	1.00
Scheduled caste	1.13 (0.96, 1.32)	1.15 (0.87, 1.52)	1.35 (1.05, 1.74)	1.01 (0.87, 1.18)	1.03 (0.90, 1.18)	1.23 (1.11, 1.37)
Scheduled tribe	1.14 (0.93, 1.38)	1.71 (1.27, 2.30)	1.94 (1.47, 2.57)	1.46 (1.23, 1.73)	1.03 (0.87, 1.22)	1.26 (1.10, 1.44)
Other backward class	1.12 (0.97, 1.30)	0.98 (0.76, 1.27)	1.33 (1.05, 1.67)	1.01 (0.88, 1.16)	0.99 (0.88, 1.12)	1.08 (0.99, 1.18)
No caste	1.22 (0.94, 1.58)	1.32 (0.88, 1.98)	1.15 (0.76, 1.76)	0.98 (0.74, 1.28)	1.08 (0.85, 1.36)	0.99 (0.82, 1.20)
Standard-of-living index						
Top quintile	1.00	1.00	1.00	1.00	1.00	1.00
Fourth quintile	1.58 (1.26, 1.99)	1.77 (1.12, 2.81)	2.03 (1.43, 2.88)	1.67 (1.39, 2.01)	1.22 (1.05, 1.42)	1.09 (0.98, 1.21)
Third quintile	1.96 (1.56, 2.45)	2.17 (1.39, 3.40)	2.01 (1.41, 2.88)	1.91 (1.58, 2.30)	1.44 (1.23, 1.68)	1.07 (0.96, 1.20)
Second quintile	2.38 (1.89, 2.98)	3.84 (2.49, 5.92)	2.81 (1.97, 4.01)	2.09 (1.72, 2.54)	1.69 (1.44, 1.99)	1.17 (1.05, 1.32)
Bottom quintile	2.73 (2.18, 3.44)	4.61 (2.98, 7.13)	3.25 (2.26, 4.66)	2.92 (2.40, 3.55)	1.97 (1.68, 2.32)	1.05 (0.93, 1.18)
Religion						
Hindu	1.00	1.00	1.00	1.00	1.00	1.00
Muslim	1.06 (0.89, 1.26)	1.19 (0.90, 1.59)	1.03 (0.78, 1.36)	0.86 (0.71, 1.03)	0.94 (0.80, 1.11)	1.12 (0.99, 1.27)
Christian	1.02 (0.75, 1.37)	1.08 (0.71, 1.65)	1.08 (0.74, 1.59)	0.83 (0.64, 1.07)	0.99 (0.79, 1.23)	0.73 (0.60, 0.88)
Other religion	0.94 (0.68, 1.30)	1.33 (0.85, 2.07)	1.21 (0.81, 1.79)	1.33 (1.05, 1.68)	1.39 (1.13, 1.71)	0.80 (0.67, 0.96)
Missing religion	2.10 (0.67, 6.54)	1.77 (0.23, 13.85)	2.68 (0.61, 11.74)	...	0.40 (0.05, 3.03)	...
Urban–rural status						
Large city	1.00	1.00	1.00	1.00	1.00	1.00
Small city	0.75 (0.51, 1.11)	1.14 (0.63, 2.05)	1.45 (0.90, 2.34)	0.80 (0.60, 1.09)	0.94 (0.72, 1.22)	1.16 (0.95, 1.41)
Town	1.06 (0.79, 1.43)	0.75 (0.45, 1.27)	1.00 (0.66, 1.53)	0.98 (0.77, 1.24)	0.92 (0.74, 1.15)	1.31 (1.11, 1.54)
Village	1.15 (0.88, 1.51)	1.03 (0.67, 1.59)	0.97 (0.67, 1.42)	0.89 (0.72, 1.09)	0.91 (0.75, 1.12)	1.10 (0.94, 1.28)

not different from those of children from other castes, children from scheduled tribes had a substantially greater mortality risk (OR=1.71, 95% CI=1.27, 2.30). The standard-of-living gradient was stronger for children than for infants, with children from the lowest quintile having an OR of 4.61 (95% CI=2.98, 7.13) compared with those in the top quintile. Children’s odds of mortality increased steadily as household standard of living declined.

Mortality differentials among children and adolescents (aged 6–18 years) were also patterned by social caste and standard of living. Children and adolescents belonging to scheduled tribes had the greatest risk of mortality (OR=1.94, 95% CI=1.47, 2.57), followed by those from scheduled castes (OR=1.35,

95% CI=1.05, 1.74) and other backward classes (OR=1.33, 95% CI=1.05, 1.67), with “other castes” as the reference group. Children and adolescents in the lowest standard-of-living quintile had an OR of 3.25 (95% CI=2.26, 4.66) compared with those in the highest quintile.

Among young adults (aged 19–44 years), there were gender-based mortality differentials; women had a lower mortality risk (OR=0.79, 95% CI=0.72, 0.87). Caste differentials were observed mainly for scheduled tribes (OR=1.46, 95% CI=1.23, 1.73). Standard of living remained a strong predictor of mortality, with the bottom quintile having a mortality OR of 2.92 (95% CI=2.40, 3.55) compared with those in the top quintile.

For middle-aged adults (aged 45–64 years), the gender differentials were similar to those observed for young adults, with a lower mortality risk for women (OR=0.77, 95% CI=0.70, 0.83). Caste differences in mortality were not substantial. Middle-aged adults in the lowest standard-of-living quintile had an OR of 1.97 (95% CI=1.68, 2.32) compared with those in the highest quintile. Although standard-of-living differentials in adult mortality remain, the gradient was considerably weaker compared with the standard-of-living gradients observed at younger ages.

Elderly (aged 65 years and older) women had a lower mortality risk (OR=0.92, 95% CI=0.87, 0.99) than elderly men. The relationship between mortality and household standard of living was not marked in this age

TABLE 3—Unadjusted (UOR) and Adjusted (AOR) Odds Ratios and Percentage Change for Caste and Standard of Living Across Age Groups, Conditional on State-, District-, Local Area-, and Household-Level Random Effects: Indian National Family Health Survey, 1998–1999

	Infants (<1 y)			Young Children (2–5 y)			Children/Adolescents (6–18 y)			Young Adults (19–44 y)			Middle-Aged Adults (45–64 y)			Elderly (≥ 65 y)		
	UOR	AOR	Change ^a	UOR	AOR	Change ^a	UOR	AOR	Change ^a	UOR	AOR	Change ^a	UOR	AOR	Change ^a	UOR	AOR	Change ^a
Caste																		
Other caste	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Scheduled caste	1.36	1.13	64	1.50	1.15	70	1.65	1.35	46	1.29	1.01	97	1.23	1.03	87	1.24	1.23	4
Scheduled tribe	1.44	1.14	68	2.34	1.71	47	2.43	1.94	34	1.87	1.46	47	1.28	1.03	89	1.21	1.26	-24
Other backward class	1.27	1.12	56	1.12	0.98	117	1.48	1.33	31	1.16	1.01	94	1.08	0.99	113	1.10	1.08	20
No caste	1.39	1.22	44	1.70	1.32	54	1.33	1.15	55	1.02	0.98	200	1.14	1.08	43	1.03	0.99	133
Standard-of-living index																		
Top quintile	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Fourth quintile	1.67	1.58	13	1.83	1.77	7	2.09	2.03	6	1.66	1.67	-2	1.19	1.22	-16	1.13	1.09	31
Third quintile	2.13	1.96	15	2.37	2.17	15	2.12	2.01	11	1.91	1.91	0	1.40	1.44	-10	1.12	1.07	42
Second quintile	2.64	2.38	16	4.29	3.84	14	2.96	2.81	8	2.11	2.09	2	1.65	1.69	-6	1.24	1.17	29
Bottom quintile	3.09	2.73	15	5.32	4.61	16	3.51	3.25	10	3.00	2.92	4	1.91	1.97	-7	1.13	1.05	62

^a“Change” is the degree to which the odds ratios were attenuated after adjustment that was calculated according to the formula $\frac{AOR-UOR}{UOR-1} \times 100$.

group. Although the second-lowest standard-of-living quintile had an increased mortality risk (OR=1.17, 95% CI=1.05, 1.32), the risks of the other quintiles were no different from that of the highest quintile. Strong caste differentials in mortality, however, were observed for this age group.

The only clear urban–rural differential in mortality was for the elderly age group, with those living in towns experiencing a higher mortality risk (OR=1.31, 95% CI=1.11, 1.54) than those living in large cities. For religion-based differentials, there were no clear patterns, although for young and middle-aged adults in households whose religious affiliation

was “other,” the mortality risk was 1.33 (95% CI=1.05, 1.68) and 1.39 (95% CI=1.13, 1.71), respectively, compared with Hindus.

Effect of Mutual Adjustment on Mortality Risks Associated With Caste and Standard of Living

Table 3 shows unadjusted and mutually adjusted mortality odds ratios by caste and standard of living. After mutual adjustment for caste and standard of living, we observed greater attenuation in caste-related mortality differentials than in those related to standard-of-living quintiles. For the elderly, however, standard of living showed no independent

association with mortality, nor did it attenuate the substantial caste differentials in mortality.

Mortality Variation Across Local Areas, Districts, and States

Table 4 shows the variance estimates for the different levels before and after adjustment for gender, religion, caste, standard-of-living index, and urban and rural status for the 6 age groups, with larger variance suggesting greater clustering. Clustering of deaths by household was stronger for infants, children, and young adults. Geographic variability was mostly observed at the state level for infants, young children, and the elderly. The

TABLE 4—State, District, Local Area, and Household Variation in Mortality (in Logits) for 6 Age Groups Before and After Adjustment for Individual or Household Demographic and Socioeconomic Markers: Indian National Family Health Survey, 1998–1999

Variance	Infants (<1 y)		Young Children (2–5 y)		Children/Adolescents (6–18 y)		Young Adults (19–44 y)		Middle-Aged Adults (45–64 y)		Elderly (≥ 65 y)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
State (σ_g^2)	0.169*	0.149*	0.169*	0.073	0.176*	0.054	0.059*	0.041*	0.050*	0.025	0.058*	0.045*
District (σ_r^2)	0.088*	0.060*	0.139*	0.075	0.204*	0.123*	0.054*	0.044*	0.077*	0.063*	0.030*	0.020*
Local Areas (σ_v^2)	0.043	0.006	0.278	0.123	0.015	0.000	0.154*	0.119*	0.102*	0.099*	0.071*	0.068*
Household (σ_u^2)	1.457*	1.129*	5.025*	4.176*	1.261*	3.768*	0.000	0.000	0.147	0.246	0.103	0.079

Note. The column “Before” gives the variance estimates at different levels before accounting for individual or household demographic and socioeconomic markers. The column “After” gives the variance estimates at different levels after accounting for individual or household demographic and socioeconomic markers.

*P=.05 for α level on a χ^2 distribution; “Wald-like” tests.^{41,42}

variation attributable to districts, compared with states, was marginally greater for the child and adolescent population and middle-aged adults. The geographic variations, however, were reduced once household socioeconomic markers were taken into account. State- and district-level variations were statistically significant mainly for infants and the elderly. For young adults, variation across all geographic levels was statistically significant.

Table 5 presents the predicted mortality odds ratio for each state (with all of India as the reference) for each of the 6 age groups. These odds ratios quantify the unique risk of living in

a particular state for individuals who otherwise share similar demographic and socioeconomic characteristics. Kerala had the lowest mortality risk for infants (OR=0.53) and the elderly (OR=0.73), whereas Rajasthan and Haryana had the highest risk for infants (both ORs=2.14) and Bihar had the highest risk for the elderly (OR=1.57). Bihar also had high (higher than the Indian average) mortality risks for young children (OR=1.46), the child and adolescent population (OR=1.45), and middle-aged adults (OR=1.21), whereas Rajasthan also had a high (higher than the Indian average) risk for the elderly (OR=1.24). The highest mortal-

ity risk for young children was in Madhya Pradesh (OR=1.72), and the highest mortality risk for children and adolescents was in Arunachal Pradesh (OR=1.59). Haryana was the only state with significantly elevated mortality for young adults (OR=1.33), and Andhra Pradesh had the highest risk (OR=1.33) for middle-aged adults.

DISCUSSION

Our study shows substantial inequalities in mortality across both population subgroups and geographic areas in India. First, disadvantages to girls appeared to matter mainly for young children (aged 2–5 years). This is consistent with the widespread gender differences that have been observed for this age group in nutrition and in intrahousehold distribution of resources, including food, access to medical treatment, and parental care.^{40–43} However, there was not a strong gender differential in infant mortality, a finding consistent with previous work indicating that excess mortality in girls is found primarily in childhood rather than in infancy.⁴⁴ Second, caste differentials in mortality were substantial among children and adolescents (aged 6–18 years) and the elderly, with scheduled tribe members experiencing a greater mortality risk across the life course. Third, standard of living was strongly associated with mortality across the life course, except among the elderly, for whom caste differentials were more marked.

While the standard-of-living gradient was weaker for older age groups, mortality differentials by standard-of-living quintiles were pronounced, with the odds ratios for the lowest quintile ranging between 1.97 and 4.61 across a person’s life course up to age 64 years. A smaller economic differential in mortality among the elderly has also been observed in industrialized countries.⁴⁵ In the Indian context, where there are considerably higher rates of mortality during the early stages of life, there may be stronger selection effects among the groups with the lowest standard of living than would be seen for equivalent age groups in industrialized countries. This might explain the considerable narrowing or even absence of the mortality gradients related to living standards among the elderly; that is, the poorest people may not live long

TABLE 5—Adjusted Odds Ratios (AOR) for Mortality Risk Associated With State of Residence, by Age Group: Indian National Family Health Survey, 1998–1999

State	Infants (< 1 y) AOR	Young Children (2–5 y) AOR	Children/Adolescents (6–18 y) AOR	Young Adults (19–44 y) AOR	Middle-Aged Adults (45–64 y) AOR	Elderly (≥ 65 y) AOR
India (reference)	1.00	1.00	1.00	1.00	1.00	1.00
Andhra Pradesh	0.98	1.05	0.99	1.09	1.33*	1.32*
Arunachal Pradesh	1.40	1.16	1.59*	1.15	1.13	1.13
Assam	0.99	0.84	1.05	0.83	1.08	1.14
Bihar	0.98	1.46*	1.45*	1.20	1.21*	1.57*
Goa	0.72	0.88	0.90	1.17	1.13	1.05
Gujarat	1.04	1.09	1.01	1.02	1.07	1.01
Haryana	2.14*	0.91	1.24	1.33*	0.80	0.99
Himachal Pradesh	0.93	0.97	0.87	0.97	0.91	0.88
Jammu	1.02	0.86	0.89	0.87	1.01	1.03
Karnataka	0.74*	0.91	0.93	0.99	0.87	0.80*
Kerala	0.53*	0.78	0.84	0.68	0.86	0.73*
Madhya Pradesh	1.58*	1.72*	1.01	1.02	1.12	0.86*
Maharashtra	0.78	0.76	0.81	0.81	0.87	0.98
Manipur	0.74	1.03	0.97	1.23	0.91	1.00
Meghalaya	1.56*	1.08	1.13	0.93	0.96	0.82
Mizoram	0.82	1.15	0.94	1.01	0.90	0.80
Nagaland	0.90	0.98	0.94	1.16	0.89	0.72*
New Delhi	0.84	0.93	0.97	1.05	0.99	1.13
Orissa	1.11	0.91	0.87	0.86	0.94	1.14
Punjab	1.43	1.09	1.00	1.28	0.96	0.88
Rajasthan	2.14*	1.29	1.15	0.94	1.03	1.24*
Sikkim	0.70	1.02	0.99	0.91	1.03	1.12
Tamil Nadu	0.72*	0.85	0.95	0.96	0.99	0.95
Tripura	1.08	1.04	0.99	0.96	1.04	0.89
Uttar Pradesh	1.18	0.99	1.08	1.07	1.08	0.99
West Bengal	0.65*	0.75	0.80	0.81	1.04	1.28*

Note. The reference category was all of India. To calculate odds ratios, we used the posterior state-level residuals estimated from a model that adjusted for individual- or household-level demographic and socioeconomic markers and for random effects associated with households, local areas, and districts.

*Statistically significant at P=.05.

enough to become elderly. Finally, we observed state-level heterogeneity in mortality mainly among infants and the elderly, suggesting a possible ecological effect at the state level, resulting in increased or decreased mortality at the beginning and end stages of life.

The findings related to the effect of mutual adjustment of caste and standard of living (Table 3) are potentially useful for reflecting on the processes that generate health inequalities, with respect to the relative importance of material circumstances⁴⁶ and the consequences of social status within the social hierarchy.^{21,47} Except for the elderly, mortality differentials were most strongly patterned by standard of living, and, once standard of living was taken into account, the caste differentials appeared less important. For the elderly group, caste-based mortality differentials were much stronger than the differences based on living standards.

Caste affiliation in India traditionally reflects a person's status within a hierarchical social structure. If status-based position within a social hierarchy influences mortality, then caste might be expected to show a strong association with mortality after control for living standards. Indeed, one might expect the association between standard of living and mortality to be attenuated on adjustment for caste. It is also clear that the public legitimacy of caste in India has been diminishing,⁴⁸ and caste status is changing from being a marker of vertical relative rank to representing some sort of horizontal cultural distinctiveness.⁴⁹ Consequently, one might expect progressive attenuation over time of any adverse health effects because of mechanisms related to occupying a relatively low status within the caste hierarchy. Such attenuation may occur because of a diminishing importance of caste hierarchy in determining social status or it may reflect general improvements in living standards over time—or some combination of both.

The findings, however, are mixed. The attenuation of caste differences, owing to adjustment of living standards, in the working age groups between 19 and 64 years seems to substantiate the view that attenuation is related to the diminishing importance of caste. At the same time, a strong influence of caste in younger age groups (aged younger than 18 years) persists, even after control for standard

of living—a finding that is contrary to the idea of diminishing importance of caste in India over time and between generations.

While these findings provide useful clues to understanding the process that may generate health inequalities, they also highlight the challenges in separating the effects of “status” from the effects of material standards of living. Importantly, distinguishing and measuring the psychosocial and material components in both status and material indicators is extremely complex. It could be argued that with the general decline in the legitimacy of caste-based inequities, one can expect standard of living to be a significant marker of status in a given social hierarchy. Thus, a person's relative status in the hierarchy of material standards of living may generate psychosocial processes that in turn influence health outcomes. Conversely, positions within a caste hierarchy are structural and real. Indeed, the evidence related to the attenuation of caste effects in models that were mutually adjusted for caste and standard of living suggests that caste and standard of living are closely related, with the obvious causal direction of the association going from caste to standard of living. These issues notwithstanding, a straightforward interpretation of our findings is that in the ordering of influences on mortality, material standard of living has the greatest effect, followed by caste, a marker that captures in objective ways one's status within a social hierarchy.

Another finding that merits discussion relates to gender differentials in mortality. Unlike some previous researchers,¹⁴ we found excess mortality in girls only among young children. Indeed, we observed a slight advantage for girls among infants, although it was not statistically significant. Estimates based on the INFHS show a lower disadvantage in mortality for girls at younger ages as compared with estimates provided by the Sample Registration System, a large-scale demographic survey conducted in India that has historically provided the annual estimates of birth rates, death rates, and other fertility and mortality indicators at the national and subnational levels.⁵⁰ The estimated mortality rate for girls in the age group birth to 4 years was 18.5 per 1000 in the INFHS, compared with 24.5 per 1000 in the Sample Registration System. Comparable estimates in the same age group for boys were 18.1 and 21.8,

respectively, from the 2 data sources.²⁷ The differences in estimates from the 2 large-scale surveys clearly warrant further methodological and demographic examination.

We must note that our findings may be influenced by recall bias. Respondents may have reported incorrect data for dead members of the household, including age, because they remembered incorrectly.⁵¹ However, we expect this to be greater concern for analyses stratified by causes of death. Because educational levels were not ascertained for deceased individuals, we could not consider the important influence of education on mortality.^{52,53} The socioeconomic inequalities reported here are restricted to all-cause mortality; it is likely that the socioeconomic and geographic differentials will vary for different causes of death.

Our study provides systematic evidence of socioeconomic and state-based inequalities in mortality across the life course in India, a pattern that has also been noted for health-related behaviors in India.^{54,55} Routine and regular descriptions of such inequalities are critical to creating an evidence base for which population subgroups, at which stages of the life course, and in what geographic areas, are at greatest risk of dying. Currently, the mortality divide in India is sharp, with the burden disproportionately falling on economically disadvantaged and lower-caste population groups. The state-level variation in the relationship between mortality and socioeconomic status highlights an underlying ecology to this mortality divide. ■

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Contributors

S. V. Subramanian originated the study, analyzed and interpreted the data, and wrote and edited the article. S. Nandy, M. Kelly, and D. Gordon contributed to data preparation, interpretation of results, and editing of the article. G. Davey Smith and H. Lambert contributed to the interpretation of results and editing of the article.

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Human Participant Protection

This research is based on a secondary analysis of a public-use data set. No protocol approval was needed.

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