

RESEARCH ARTICLE

# Widowhood status, morbidity, and mortality in India: evidence from a follow-up survey

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## Abstract

A known health effect of widowhood is an increased mortality risk among surviving spouses, with gender- and age-specific observations. While morbidity conditions with socio-economic factors may exacerbate the effect of widowhood on mortality, no research has attempted to predict mortality among the widowed over the married population with the presence of morbidity in India. Thus, the present study concurrently examines marital status and health in the Indian setting, bringing substantial empirical evidence to explore the link between marital status, morbidity, and mortality. The study used prospective data from India Human Development Survey (IHDS) wave 1 (2004–2005) and wave 2 (2011–2012). In total, 82,607 individuals aged 25 years and above were considered for the analysis. To present the preliminary findings, descriptive statistics and bivariate analysis were used. Using multivariable logistic regression, the interaction effect of marital status and morbidity status was estimated to predict the likelihood of mortality. Across all socio-economic groups, widowed individuals reporting any morbidity had a higher mortality proportion than married people. Young widowers with any morbidity are more susceptible to increased mortality. Asthma among young widowers and cardiovascular diseases among elderly widowers significantly elevate the probability of mortality. However, older widowed women with diabetes had a lower probability of mortality than older married women with diabetes. The widowers' disadvantage in mortality and morbidity may be attributable to less care-receiving and the greater incidence of unhealthy lifestyle practices during the post-widowhood period, indicating the need for more research.

**Keywords:** widowhood; morbidity–mortality; young widowers; IHDS

## Introduction

Increased mortality risk among surviving spouses is a documented health consequence of widowhood (Boyle *et al.*, 2011; Moon *et al.*, 2011; Schone and Weinick, 1998; Shor *et al.*, 2012). Although the direction and strength of relationships differ among studies and across countries, both the cross-sectional and longitudinal research have shown linkages between widowhood and death, regardless of the cause (Blanner *et al.*, 2020; Mendes de Leon *et al.*, 1993; Moon *et al.*, 2014). Even after correcting for various demographic and socio-economic factors, connections between widowhood and mortality have persisted. Some research has also referred to the higher mortality risk associated with the widowhood phenomenon as the *widowhood effect* (Caputo *et al.*, 2021; Dabergott, 2021a; Kristiansen *et al.*, 2017; Sullivan and Fenelon, 2014).

A considerable discussion exists about the cause of the increased mortality risk among widowed individuals. Previous research examining the mechanisms linking widowhood and mortality has suggested a number of ways in which widowhood and mortality are thought to be related. For instance, some evidence demonstrates that a change in the economic and social role following the death of a spouse may increase the risk of death among the widowed population (Bowling, 1987;

Liu, Jiang, *et al.*, 2020; Liu, Umberson, *et al.*, 2020; Zick and Smith, 1991). Other pioneering research speculated that the stress of caring for a terminally ill spouse might induce the caregiver spouse to neglect his or her own health, which may also increase their early mortality (Sanders, 1982, 1988). At the same time, some of the seminal studies have also suggested that the loss of a spouse, in addition to causing a transition in the socio-economic roles that existed throughout their marriage, may trigger the onset of various diseases and premature death among the widowed population (Smith and Zick, 1994, 1996). While most of the formative research on links between widowhood and mortality has been conducted in high-income countries, the majority of these studies have looked at the different socio-economic dimensions in the link between widowhood and mortality by gender (Hu and Goldman, 1990; Manor and Eisenbach, 2017; Manzoli *et al.*, 2007; Martikainen and Valkonen, 1996; Rendall *et al.*, 2011; Smith and Zick, 1996; Vable *et al.*, 2015). However, with the other component, the epidemiology aspect among widowed people and its relationship to health is one of the most recent developments in the literature of widowhood and health (Elwert and Christakis, 2008; Grundy and Tomassini, 2010; Manor and Eisenbach, 2017; Murphy *et al.*, 2007). As already mentioned, most research has been conducted in high-income countries, and there is an urgent need to examine widowhood and mortality from an epidemiological viewpoint, particularly in low- and middle-income countries.

In general, it has been found that the widowed population reported poorer health and more symptoms than the married population (Aoun *et al.*, 2015; Einiö *et al.*, 2017). Numerous studies have quantified the extent of the increased risk of cardiovascular disease (CVD), elevated systolic blood pressure, major cardiovascular events, cholesterol levels, and chronic pain symptoms following the death of a spouse among widowed ones (Erlangsen *et al.*, 2017; Fagundes *et al.*, 2018; Fagundes and Wu, 2020). However, study findings on widowhood and physical health outcomes were inconsistent and mixed across the study population and countries by gender. In contrast, study findings are significantly gender- and age-specific, focusing on widowhood and mortality (Espinosa and Evans, 2008; Manzoli *et al.*, 2007; Prior *et al.*, 2018; Zivin and Christakis, 2007). It has been observed that men experienced a higher risk of mortality after widowhood than women (Dabergott, 2021a; Liu, Jiang, *et al.*, 2020; Liu, Umberson, *et al.*, 2020; Shor *et al.*, 2012; Smith and Zick, 1996). Existing research indicates that the unexpected loss of a spouse affects men more severely than women, with a 54% increase in mortality risk for men and no increase in risk for women (Sullivan and Fenelon, 2014). Moon *et al.* (2014) found that within 12 months after experiencing the loss of a spouse, men were at higher risk of mortality than women (Moon *et al.*, 2014). While by the cause of the death, men were more likely to experience cardiac problems and increased mortality risk (Vable *et al.*, 2015). However, such a pattern was not observed for women (Dereuddre *et al.*, 2016). Mortality risk had elevated by more than 20% for widowers with chronic obstructive pulmonary disease, diabetes, accidents or significant fractures, and lung cancer and by 10% with colon cancer, heart disease, heart failure, renal disease, stroke, vascular disorders, and other malignancies (Elwert and Christakis, 2008). In this context, Jin and Chrisatakis (2009) concluded that a reduction in service quality, a lack of coordination across the different levels of healthcare, and an inability to advocate and communicate effectively during official medical consultations might also contribute to the rising mortality risk among men due to widowhood (Jin and Chrisatakis, 2009). While, in the post-widowhood phase, many widowers engage in unhealthy risk behaviours such as smoking, alcohol use, and lack of good nutrition, a sleeping disorder accelerates the onset of many lifestyle-related symptoms and chronic morbidities and may raise their pre-mature death compared to married men (Eng *et al.*, 2005; Manor and Eisenbach, 2017).

In India, strong gender norms and traditional kinship structures are observed in contrast to many high-income, egalitarian societies (Singh *et al.*, 2022). The patriarchal social structure is also the cause of the dreaded stage of life among widowed individuals, notably among women (Chakravarti, 1998; Chen and Dreze, 1992, 1995). Traditionally, a woman's primary responsibility was to take care of her husband in India. She lost the fundamental reason for living when she lost her husband. In India, widowhood among women is often a highly fragile stage of life marked by

extreme poverty, a lack of social support, and the inability to remarry (Dasgupta, 2017; Drbze and Srinivasan, 1997). Existing evidence also indicated that women's widowhood status is substantially connected with worse physical and mental health conditions and poor healthcare utilisation compared to men (Lloyd-Sherlock *et al.*, 2015a; Pandey and Jha, 2012; Perkins *et al.*, 2016, 2018; Sreerupa and Rajan, 2010). For instance, Perkins *et al.* (2016) found that recently widowed women and women who had been widowed for an extended period had higher levels of psychiatric distress, lower self-rated health, and hypertension compared to married women, whereas long-term widowed men had a higher risk of developing diabetes when compared to married men (Perkins *et al.*, 2016). Agrawal and Keshri (2014) older widows had a higher prevalence of non-communicable diseases (G. Agrawal and Keshri, 2014). While there are a number of studies reporting that widows had poorer self-reported health and a higher depression level than married women, such a pattern is missing for men (Lloyd-Sherlock *et al.*, 2015; Perkins *et al.*, 2016). Given this background, women experiencing adverse social and economic repercussions of widowhood and also being more susceptible to worse health conditions might also have greater morbidity-related deaths than men in India. The present study aims to assess the widowhood and health in the Indian setting concurrently, bringing substantial empirical evidence to explore the link between widowhood, morbidity, and mortality. Thus, the main objective of this paper is to examine the mortality difference between widowed and married individuals by the morbidity condition across the age group and gender.

To the best of our knowledge, no research has attempted to predict mortality among the widowed over the married population with the presence of morbidity in India. While, except for a few studies, the majority of previous research has also given less consideration to Indian men and more emphasis to the possible health implications of widowhood on women. Thus, the present study contributes to the epidemiological aspect of mortality among widowhood population and also contributes to the widowhood literature highlighting mortality–morbidity dimension from a gender perspective in Indian settings.

## Materials and methods

### Data source

The study used prospective data from India Human Development Survey (IHDS) wave 1 (2004–2005) and wave 2 (2011–2012). The IHDS is a panel survey that provides adequate samples for vital events like birth, marriage, migration, and death, as well as various socio-demographic variables, including education, employment, social-cultural capital, household assets, and family structure (Desai *et al.*, 2005, 2012). IHDS 1 collected information on 41,554 households and 215,754 individuals in 1,503 villages and 971 urban areas across 33 states. In the second wave, 2011–2012, 83 % were re-interviewed. In the second wave, a tracking sheet was also filled out for individuals surveyed in IHDS wave 1 (including migration and death-related information). In addition, the tracking sheet provides specific information on the deaths of people, including the number of years since the individual's death at the time of the second wave, as well as their educational, marital, and job status. This information from the IHDS was used to estimate deaths among adults aged 25 years and above by marital status in the present study.

### Sample

The main interest of this research was in studying the mortality of widowed individuals compared to married ones with chronic morbidity conditions. For this, the main study population was married and widowed adults aged 25 years and above in IHDS-1. The sample size selection started with information on 104,774 individuals aged 25 years and above (out of a total of 215,754 measured) in IHDS-1. Out of these, 98,044 were married or widowed during IHDS 1 (2005–2006).

The IHDS tried to contact these individuals in 2011–2012, for its second wave. Thus, this study ignored individuals (5,947 individuals) whose marital status changed from IHDS 1 to IHDS 2. Another 5,650 individuals were lost to follow-up. Besides, individuals with missing information on their morbidity status and health risk behaviour were further excluded from the final analysis, and 82,607 individuals were part of the final sample in the study.

### **Dependent variable**

The dependent variable in this study was the individuals surveyed in IHDS 1 (2005–2006) and their survival status (alive or dead) by IHDS 2 (2011–2012). As mentioned earlier, the survival status of individuals between the two IHDS rounds was observed in the tracking sheet (Barik *et al.*, 2018).

### **Independent variable**

The main independent variable was marital status (married or widowed) with or without morbidity reported in IHDS-1. This study obtained information from the IHDS on major morbidity to predict the processes by which widowhood status might affect mortality. The IHDS provided information on various major morbidities, while we focused on five particular morbidities: tuberculosis (TB), hypertension, CVDs, diabetes, and asthma. Afterwards, this study constructed a variable with the presence of any of the mentioned morbidity or the absence of any morbidity (Ennis and Majid, 2021; Prior *et al.*, 2018).

### **Covariates**

The present study considered a number of socio-economic characteristics to control by which mortality among currently widowed and married individuals could vary. The age group was divided into two broad age groups, that is, 25–59 years and 60 years and above (Hossain and Sk, 2022). The social group was considered which included higher caste (HC), other backward classes (OBC), scheduled caste (SC) and scheduled tribe (ST) (Gupta and Sudharsanan, 2022). The economic condition was measured using the wealth index. The wealth index was constructed using principal component analysis (PCA) using 23 equally weighted dichotomous items that measured household consumer goods possessions. The wealth index in this study categorised households into three groups: poor, middle, and rich. Education of the individual was categorised as uneducated, up to 5th standard, up to metrics, up to secondary level, and above secondary level. Currently, smoking and alcohol consumption were divided into yes and no.

### **Statistical analysis**

The main empirical strategy relies on a descriptive analysis of deaths reported in IHDS 2 for widowed and married individuals with morbidity reported in IHDS 1. The chi-square test was applied to analyse death differences between married and widowed adults with morbidity conditions. Then morbidity-specific mortality percentage was calculated for married and widowed adults by age group and gender. Further, to determine to what extent the morbidity could explain differences in mortality between widowed and married individuals, a logistic regression framework was applied. The regression coefficients were then used to estimate predictive margins to compare predicted probabilities of mortality by marital status and morbidity conditions. Separate morbidity-adjusted odds of mortality were estimated for widowed individuals over married ones. To understand the influence of morbidity condition (whether individuals suffered any morbidity and specific morbidity), the interaction effect of marital status with the presence of any morbidity condition and specific morbidity condition on the probability of death was estimated. All results were stratified by age group and gender (Smith and Zick, 1996). For better understanding, the specific morbidity was clubbed to two categories. The first broad

category was respiratory ailments including asthma and TB, while the second broad category was non-communicable diseases (NCDs) including hypertension, CVDs, and diabetes. In all the regression analyses, standard errors were clustered at the level of the primary sampling unit. The regressions were also adjusted for social group, wealth index, education level, current smoking, and alcohol consumption. For all of the analyses, IHDS 1 individual weights were applied. All the statistical analysis was done using Stata (version 15) and MS Excel.

## Result

### *Sample characteristics*

Table 1 demonstrates the survival status of the individual samples across selected characteristics followed in the IHDS, 2011–2012, from 2004 to 2005. About 28% of older adults died between waves of the IHDS. Between the two waves, a higher proportion of men (10%) died than women (7%). By marital status, widowed adults had a higher proportion of deaths during the survey period. While socially backward groups like ST and SC had a higher proportion of deaths. Similarly, those with low socio-economic status (SES), that is, those with a low wealth index (8.6%) or who were uneducated (9%), had more deaths. While individuals who smoke (10%) or drink alcohol (9.2%) had a higher share of death than their counterparts. While individuals reporting having any morbidity (TB, hypertension, CVDs, diabetes, and asthma) in IHDS 1 had died more (19%) compared to those who reported no morbidity (7.6%).

### *Deceased individuals with morbidity among married and widowed individuals*

Table 2 depicts the percentage of deceased individuals with any morbidity by their marital status followed in the IHDS, 2011–2012, from 2004 to 2005. Older widowed reported morbidity had a higher percentage of mortality than older married reported morbidity. Compared to married men (around 24%) and women (10%) who had morbidity, widowers (49%) and widows (28%) who reported having morbidity had a higher proportion of deaths. Widowed people with morbidity from other or Muslim groups had a higher percentage share of death. Additionally, compared to other economic categories, the widowed people from the poor wealth index with morbidity (43%) had a greater proportion of death. Although married individuals with morbidity had an advantage in mortality with improved educational levels, there was no consistency in mortality and educational level among widowed individuals with morbidity conditions. In addition, widowed persons reported having morbidity those who smoke (45%) had a higher proportion of deaths.

### *Predicted probabilities of death among widowed over married with the presence of any morbidity by age group and gender*

Figure 1 examines the interaction effect between widowhood and morbidity on the probability of death. The top left panel, for men aged 25–59 years, shows that morbidity status was a greater modifier for young men's mortality after widowhood. Due to the presence of any morbidity, more than 40% increased percentage point (PP) of the probability of death had been found among young widowers than those without reported morbidity. While due to the presence of any morbidity, 8% increased PP of the probability of death had been found among young married men. Among the older men, the presence of any morbidity had 60% increased PP of the probability of death among widowers than 40% increased PP among the married ones. Among women, we did not find evidence of an interaction effect of widowhood and morbidity status on the probability of death. In addition to this, the evidence of the interaction effect of health risk behaviours and widowhood status predicting the probability of mortality was given in Appendix Fig. 1.

**Table 1.** Survival status of individual samples across selected characteristics followed in the India Human Development Survey, 2011–2012, from 2004 to 2005 (N = 82,607)

Characteristics	Survived	Died	Samples
<b>Age group</b>			
25 to 59	96.24	3.76	67505
60 and above	71.55	28.45	15102
<b>Gender</b>			
Men	90.48	9.52	40598
Women	93.00	7.00	42009
<b>Marital status</b>			
Married	93.82	6.18	73849
Widowed	74.82	25.18	8758
<b>Social group</b>			
HC	92.01	7.99	19191
OBC	91.94	8.06	29065
SC	91.42	8.58	16380
ST	90.09	9.91	6359
Muslim	92.56	7.44	8690
Others	91.38	8.62	2922
<b>Wealth index</b>			
Poor	91.37	8.63	27544
Middle	91.67	8.33	27538
Rich	92.42	7.58	27525
<b>Education</b>			
Uneducated	90.91	9.09	14728
Up to 5th standard	91.63	8.37	11421
Up to metric	91.66	8.34	31490
Up to secondary level	92.39	7.61	10411
Above secondary level	92.69	7.31	14557
<b>Currently smoking</b>			
No	92.16	7.84	67645
Yes	89.97	10.03	14962
<b>Currently alcohol consumption</b>			
No	91.88	8.12	74650
Yes	90.71	9.29	7957
<b>Any of five major morbidity conditions</b>			
<b>No</b>	<b>92.40</b>	<b>7.60</b>	<b>78363</b>
<b>Yes</b>	<b>80.76</b>	<b>19.24</b>	<b>4244</b>

Note: Five major morbidity conditions include tuberculosis (TB), hypertension, cardiovascular diseases (CVDs), diabetes, and asthma. HC denotes higher caste, OBC denotes other backward classes, SC denotes scheduled caste, and ST denotes scheduled tribe. IHDS-1 individual weights were applied.

**Table 2.** Percentage of individuals who died between two waves of IHDS reporting the presence of any of the five major morbidity conditions by their marital status at the base wave (2004–2005) in the India Human Development Survey, 2011–2012, from 2004 to 2005 (N = 82,607)

Characteristics	No morbidity			Morbidity		
	Married	Widowed	<i>P</i> value	Married	Widowed	<i>P</i> value
<b>Age group</b>						
25 to 59	3.17	6.17	<0.001	10.18	11.9	0.357
60 and above	23.57	36.17	<0.001	32.76	40.03	<0.001
<b>Gender</b>						
Men	7.71	32.74	<0.001	24.14	49.43	<0.001
Women	3.31	22.25	<0.001	9.82	27.98	<0.001
<b>Social group</b>						
HC	5.27	23.38	<0.001	17	31.77	<0.001
OBC	5.4	24.35	<0.001	17.22	29.41	<0.001
SC	6.27	25	<0.001	20.21	30.99	<0.001
ST	6.98	25.26	<0.001	18.11	37.5	<0.001
Muslim	5.04	24.55	<0.001	16.99	31.03	<0.001
Others	5.25	27	<0.001	12.06	39.53	<0.001
<b>Wealth index</b>						
Poor	6.18	26.64	<0.001	21.2	43.48	<0.001
Middle	5.54	23.94	<0.001	18.23	30.97	<0.001
Rich	5.12	22.34	<0.001	15.52	27.7	<0.001
<b>Education</b>						
Uneducated	6.3	21.41	<0.001	21.85	28.68	0.103
Up to 5th standard	6.04	25.94	<0.001	20.03	34	0.07
Up to metric	5.66	25.2	<0.001	17.69	30.85	<0.001
Up to secondary level	5.28	23.52	<0.001	15.69	37.14	<0.001
Above secondary level	4.78	26.83	<0.001	14.51	30.68	<0.001
<b>Currently smoking</b>						
No	4.83	24.16	<0.001	15.55	30.97	<0.001
Yes	8.94	27.44	<0.001	26.2	45.28	<0.001
<b>Currently alcohol consumption</b>						
No	5.3	24.3	<0.001	17.32	32.19	<0.001
Yes	8.42	28.21	<0.001	19.05	16.67	0.749

Note: Five major morbidity conditions include tuberculosis (TB), hypertension, cardiovascular diseases (CVDs), diabetes, and asthma. *P* values were obtained using the chi-square test. IHDS-1 individual weights were applied.

### **Predicted probabilities of death among widowed over married with specific morbidity by age group and gender**

The probability of mortality among widowed and married by the specific morbidity condition was predicted in Figs. 2 and 3. Fig. 2 shows the predicted probabilities of death by the interaction effect

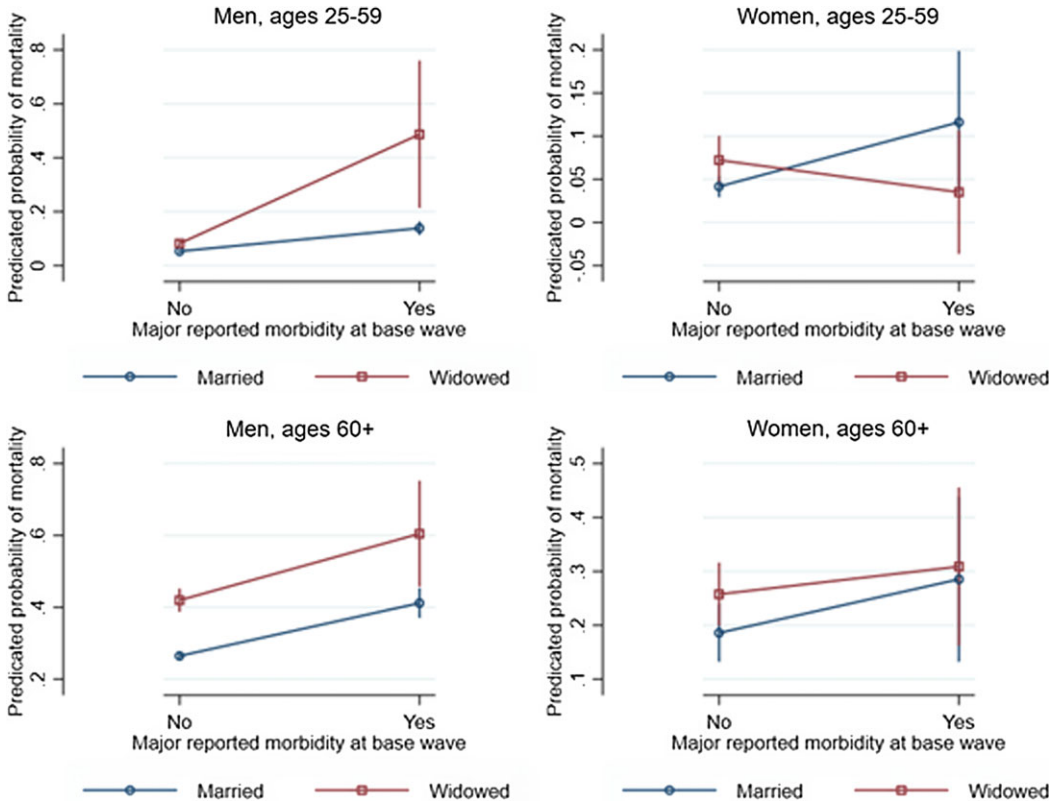


Figure 1. Predicted probabilities of death by marital status, from logistic regression interacting marital status with the presence of any morbidity by gender and age group, IHDS, India.

of marital status and respiratory ailments (asthma and TB). Among the respiratory ailments, young widowers reporting asthma had almost 80% increased PP of the probability of mortality and 20% increased PP of the probability of mortality for married men (Fig. 2). And, no evidence of excess mortality for women with asthma was found. In addition to this, there was no significant evidence of the interaction effect of widowhood and TB predicting mortality across age and gender. Even, no observation was found for young widows with TB in the dataset.

Figure 3, on the other hand, shows the predicted probabilities of death by the interaction effect of marital status and NCD-related ailments (hypertension, CVDs, and diabetes). Among the older men, CVDs had 84% increased PP of the probability of mortality for widowers and 45% increased PP of the probability of mortality for married men. No observation was found for young widowers with CVDs and diabetes in the dataset. Interestingly, older widowed women with diabetes reported a lower probability of mortality than older married women with diabetes. For more information on the specific morbidity-wise mortality among married and widowed adults across socio-economic status, see the supplementary material (Appendix Table A1).

### Discussion

The present research explores the relationship between chronic morbidity and mortality among individuals in the post-widowhood phase compared to married people by age and gender. Across all socio-economic groups, widowed individuals reporting any morbidity had a higher mortality proportion than married people. We found that young men with any morbidity are more



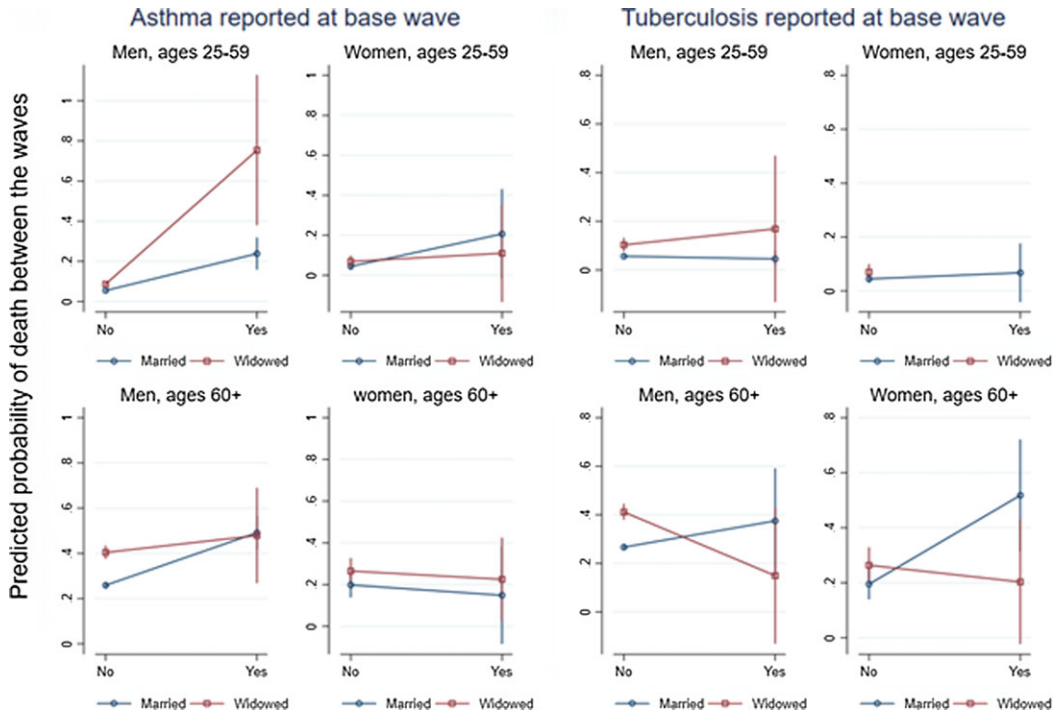


Figure 2. Predicted probabilities of death from 2004–2005 to 2011–2012 by marital status, from logistic regression interacting marital status with the respiratory ailments in 2004–2005 by gender and age group, IHDS, India.

susceptible to increased mortality risk because of their widowhood status. While, by the specific morbidity conditions, asthma among young widowers and CVDs among old widowers increased the probability of death significantly. On the contrary, among women, older widowed women with diabetes had a lower probability of mortality than older married women with diabetes.

The study results indicate that for men, particularly younger ones, the widowhood status with any morbidity significantly predicts increased mortality even after controlling SES and behavioural factors. There is no such pattern of widowhood and morbidity interaction effect on mortality for young women. A potential implication of the higher mortality among young widowers than among young widows with morbidity possibly is that morbidity conditions worsen the health status of young widowers more than young women, despite the fact that men own the resource access and may have more protective qualities of higher SES (Brenn and Ytterstad, 2016; Dabergott, 2021b). On the other hand, widows have worse social and economic consequences after widowhood than widowers, yet widows may be able to cope with the loss of a husband (McCrae and Costa, 1988; Peña-Longobardo *et al.*, 2021). In contrast, the consequences of widowhood among men, such as emotional shock or coping with the lifestyle, have a more significant impact on men’s capacity to cope with loss (Drbze and Srinivasan, 1997; Stroebe *et al.*, 2001), which may onset and develop the morbidity condition (Stroebe *et al.*, 2001, 2007). Further lack of care widowers previously received from the deceased wife worsened their health, increasing the mortality risk among the younger widowers (Chami and Pooley, 2021).

This research also revealed that the predicted mortality for young widowers with asthma is much higher. As marriage represents a crucial institution, it may prevent men from engaging in risky behaviours such as smoking, drinking excessively, and other harmful healthy behaviours, consequently reducing their mortality risk (Schone and Weinick, 1998). With the loss of a spouse, to cope with distress and loneliness, widowers are more likely to engage in unhealthy behaviours

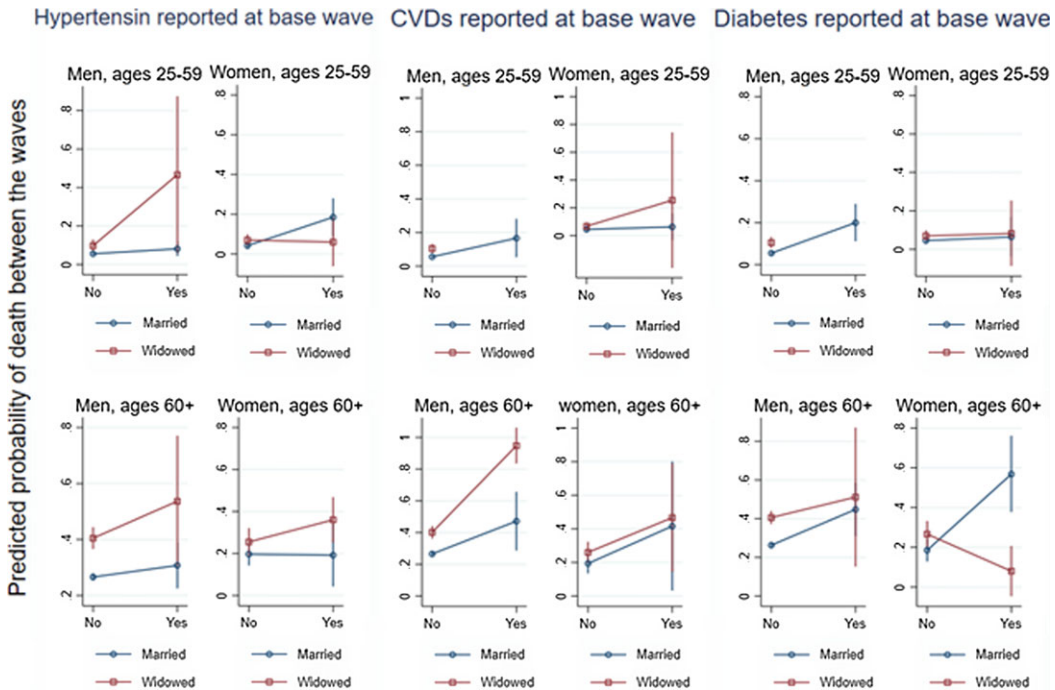


Figure 3. Predicted probabilities of death from 2004–2005 to 2011–2012 by marital status, from logistic regression interacting marital status with the NCDs in 2004–2005 by gender and age group, IHDS, India.

such as smoking, alcohol, and other drug use, which may contribute to the development of lifestyle-based diseases (Umberson, 1992; Williams, 2004). In the Indian set-up, the study by Perkins *et al.* (2018) also found that recently widowed men are 62% and 76% more likely to smoke and have consumed alcohol (Perkins *et al.*, 2018). Thus, this study's findings may imply that the increased risk of death among widowers with asthma is the result of an unhealthy lifestyle. In this study, the findings on the probability of young widower mortality with asthma are also consistent with existing studies (Brenn and Ytterstad, 2016; Ikeda *et al.*, 2007). In addition, results shown in Appendix Fig. 1 also confirm that smoking among young widowers was associated with the increased probability of mortality than young married men.

It is well established that mortality due to CVDs is increasing and that men in India are much more likely than women to die from CVDs (Prabhakaran *et al.*, 2018). However, our survey also suggests that older men with CVDs who are widowers have a greater risk of mortality. This pattern of elevated likelihood of death among older widowers implies that the effect of widowhood may lead to less healthier living style, resulting in increased mortality among the widowers. Johnson *et al.* (2000) also established in their study that a change in the behaviour would lead to higher mortality among the widowers occurring out of anger, frustration, or feeling which may lead to deteriorated health status (Johnson *et al.*, 2000).

However, our finding that widowers with CVDs have a higher death rate than married men with CVDs suggests that older widowers may not seek treatment for their deteriorating health and also fail to get care in the post-widowhood period. In this context, it is theorised that elderly widowers are particularly vulnerable due to their long-standing inability or lack of experience in obtaining emotional assistance outside of the marriage during times of crisis. Previous research on the higher probability of deaths among older widowers suggests that older widowers suffer from greater loneliness and social isolation, and these elements might be the risk factors for CVD events increasing their mortality risk (Valtorta *et al.*, 2016).

Notably, the older widows with diabetes reported a lower probability of mortality than the older married with diabetes. Our study finding is also in line with the existing studies where a significant lower risk of diabetes for widowed women was found compared to married women (Erlangsen *et al.*, 2017; Ramezankhani *et al.*, 2019). Possible explanations include a shift in diet and a lower BMI among widows in India (Agrawal *et al.*, 2021). In India, widowed women, particularly Hindu widows, had to give up their regular dietary choices in order to adhere to the traditions of the Hindu culture, and this meant renouncing the ‘heating foods’ which include onion, garlic, eggs, and so forth (Agrawal *et al.*, 2021). In addition, after the death of the husband, surviving spouses have less influence over home affairs and decisions, which may reduce their consumption leading to undernutrition (Chen and Dreze, 1992). Thus, it may be possible that the differential diet and nutritional level among widows and married women in later ages may explain the probability of mortality among widows.

According to our knowledge, this is the largest nationally representative study of mortality among widowed men and women in India, focusing on the morbidity condition. It is also the first study of its kind to examine widowhood status and morbidity effect on mortality by age and gender. However, there are some limitations in the present study. First, the morbidity considered in the study is self-reported, which may impact the results. Second, the study considers a small number of morbidities to assess the morbidity–widowhood impact on mortality. However, existing studies show that, to examine the morbidity and mortality aspect of marital status, a larger number of morbidities need to be considered (Prior *et al.*, 2018). Third, the duration of the widowhood can be a proximate factor to explain the widowhood–morbidity impact on mortality (Johnson *et al.*, 2000). However, due to data restraints, we failed to adjust the duration of the widowhood in this study.

## Conclusion

Morbidity conditions among widowed adults strongly predicted death. At the same time, the impact of widowhood–morbidity conditions differed by gender and age. Men with morbidity in India are more vulnerable to experiencing the elevated probability of mortality than women due to widowhood status. The increased mortality risk among young or older widowers is a consequence of behavioural risk. In order to lower the mortality risk, additional health-related education and counselling in the post-bereavement period may help protect widowers from various lifestyle-based diseases and reduce excess mortality. While, evidence of the diabetes and marital status predicting mortality for women raises number of questions which need further explanation and detailed research, given the vulnerable stand of women in post-widowhood stages in India.

**Data availability statement.** The dataset utilised in the study is readily accessible in the public domain through the Inter-university Consortium for Political and Social Research (ICPSR). To download the data, please follow the link: <https://ihds.umd.edu/data/data-download>

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## References

- Agrawal A, Laji C, and Pakrashi D (2021). He has gone to a better place, but she has not: health status of Hindu widows in India. *Journal of Development Studies* 57, 5, 750–771. <https://doi.org/10.1080/00220388.2020.1802008>
- Agrawal G, and Keshri K (2014). Morbidity patterns and health care seeking behavior among older widows in India. *PLoS ONE* 9, 4, 1–8. <https://doi.org/10.1371/journal.pone.0094295>
- Aoun SM, Breen LJ, Howting DA, Rumbold B, McNamara B, and Hegney D (2015). Who needs bereavement support? A population based survey of bereavement risk and support need. *PLoS ONE* 10, 3, 1–14. <https://doi.org/10.1371/journal.pone.0121101>
- Barik D, Desai S, and Vanneman R (2018). Economic status and adult mortality in India: is the relationship sensitive to choice of indicators? *World Development* 103, 176–187. <https://doi.org/10.1016/j.worlddev.2017.10.018>
- Blanner C, Mejldal A, Prina AM, Munk-Jørgensen P, Ersbøll AK, and Andersen K (2020). Widowhood and mortality: a Danish nationwide register-based cohort study. *Epidemiology and Psychiatric Sciences*. <https://doi.org/10.1017/S2045796020000591>
- Bowling A (1987). Mortality after bereavement: a review of the literature on survival periods and factors affecting survival. *Social Science and Medicine* 24, 2, 117–124. [https://doi.org/10.1016/0277-9536\(87\)90244-9](https://doi.org/10.1016/0277-9536(87)90244-9)
- Boyle PJ, Feng Z, and Raab GM (2011). Does widowhood increase mortality risk?: testing for selection effects by comparing causes of spousal death. *Epidemiology* 22, 1, 1–5. <https://doi.org/10.1097/EDE.0b013e3181fdcc0b>
- Brenn T, and Ytterstad E (2016). Increased risk of death immediately after losing a spouse: cause-specific mortality following widowhood in Norway. *Preventive Medicine* 89, 251–256. <https://doi.org/10.1016/j.ypmed.2016.06.019>
- Caputo J, Li P, Kühn M, Brønnum-Hansen H, and Oksuzyan A (2021). Immigration background and the widowhood effect on mortality. *Journals of Gerontology – Series B Psychological Sciences and Social Sciences* 76, 10, 2155–2168. <https://doi.org/10.1093/geronb/gbab090>
- Chakravarti U (1998). Gender, caste, and labour: the ideological and material structure of widowhood. *Widows in India: Social Neglect and Public Action* 30, 36, 1–63.
- Chami JM, and Pooley JA (2021). Widowed young: the role of stressors and protective factors for resilience in coping with spousal loss. *Omega (United States)* 2021. <https://doi.org/10.1177/00302228211047088>
- Chen M, and Dreze J (1992). Widows and health in rural north India. *Economic and Political Weekly*, WS81–WS92.
- Chen M, and Dreze J (1995). Recent research on widows in India: Workshop and conference report. *Economic and Political Weekly*, 2435–2450.
- Dabergott F (2021a). The gendered widowhood effect and social mortality gap. *Population Studies* 0, 0, 1–13. <https://doi.org/10.1080/00324728.2021.1892809>
- Dabergott F (2021b). The gendered widowhood effect and social mortality gap. *Population Studies*. <https://doi.org/10.1080/00324728.2021.1892809>
- Dasgupta P (2017). Women alone: the problems and challenges of widows in India. *International Journal of Humanities and Social Sciences (IJHSS)* 6, 6, 35–40.
- Dereuddre R, Van de Velde S, and Bracke P (2016). Gender inequality and the “East-West” divide in contraception: an analysis at the individual, the couple, and the country level. *Social Science and Medicine* 161, 1–12. <https://doi.org/10.1016/j.socscimed.2016.05.030>
- Desai S, Dubey A, Joshi BL, Sen M, Shariff A, Vanneman R, and Codebook H (2005). India human development survey (IHDS). NCAER, India and Inter-university Consortium for Political and Social Research, MI, USA.
- Desai S, Dubey A, Joshi BL, Sen M, Shariff A, Vanneman R, and Codebook H (2012). India Human Development Survey-II (IHDS-II). NCAER, India and Inter-university Consortium for Political and Social Research, MI, USA.
- Drbze J, and Srinivasan PV (1997). Widowhood and poverty in rural India: some inferences from household survey data. *Journal of Development Economics*, 54, 2, 217–234.
- Einiö E, Moustgaard H, Martikainen P, and Leinonen T (2017). Does the risk of hospitalisation for ischaemic heart disease rise already before widowhood? *Journal of Epidemiology and Community Health* 71, 6, 599–605. <https://doi.org/10.1136/jech-2016-207987>
- Elwert F, and Christakis NA (2008). The effect of widowhood on mortality by the causes of death of both spouses. *American Journal of Public Health* 98, 11, 2092–2098. <https://doi.org/10.2105/AJPH.2007.114348>
- Eng PM, Kawachi I, Fitzmaurice G, and Rimm EB (2005). Effects of marital transitions on changes in dietary and other health behaviours in US male health professionals. 1986, 56–62. <https://doi.org/10.1136/jech.2004.020073>
- Ennis J, and Majid U (2021). “Death from a broken heart”: a systematic review of the relationship between spousal bereavement and physical and physiological health outcomes. *Death Studies* 45, 7, 538–551. <https://doi.org/10.1080/07481187.2019.1661884>
- Erlangsen A, Runeson B, Bolton JM, Wilcox HC, Forman JL, Krogh J, Katherine Shear M, Nordentoft M, and Conwell Y (2017). Association between spousal suicide and mental, physical, and social health outcomes a longitudinal and nationwide register-based study. *JAMA Psychiatry* 74, 5, 456–464. <https://doi.org/10.1001/jamapsychiatry.2017.0226>
- Espinosa J, and Evans WN (2008). Heightened mortality after the death of a spouse: marriage protection or marriage selection? *Journal of Health Economics* 27, 5, 1326–1342. <https://doi.org/10.1016/j.jhealeco.2008.04.001>

- Fagundes CP, Murdock KW, LeRoy A, Baameur F, Thayer JF, and Heijnen C (2018). Spousal bereavement is associated with more pronounced ex vivo cytokine production and lower heart rate variability: mechanisms underlying cardiovascular risk? *Psychoneuroendocrinology* **93**, April, 65–71. <https://doi.org/10.1016/j.psyneuen.2018.04.010>
- Fagundes CP, and Wu EL (2020). Matters of the heart: grief, morbidity, and mortality. *Current Directions in Psychological Science* **29**, 3, 235–241. <https://doi.org/10.1177/0963721420917698>
- Grundy EMD, and Tomassini C (2010). Marital history, health and mortality among older men and women in England and Wales. *BMC Public Health* **10**. <https://doi.org/10.1186/1471-2458-10-554>
- Gupta A, and Sudharsanan N (2022). Large and persistent life expectancy disparities between India's social groups. *Population and Development Review*, **48**, 3, 863–882.
- Hossain B, and Sk MIK (2022). Exploring the effects of gender differences and widowhood status on the days spent in poor health: a secondary data analysis from India. *Journal of Cross-Cultural Gerontology*, 221–235. <https://doi.org/10.1007/s10823-022-09454-2>
- Hu Y, and Goldman N (1990). Mortality differentials by marital status: an international comparison. *Demography* **27**, 2, 233–250. <https://doi.org/10.2307/2061451>
- Ikeda A, Iso H, Toyoshima H, Fujino Y, Mizoue T, Yoshimura T, Inaba Y, and Tamakoshi A (2007). Marital status and mortality among Japanese men and women: the Japan collaborative cohort study. *BMC Public Health* **7**, 1–7. <https://doi.org/10.1186/1471-2458-7-73>
- Jin LEI, and Chrisatakis NA (2009). Investigating the mechanism of marital mortality reduction: the transition to widowhood and quality of health care. *Demography*, **46**, 605–625.
- Johnson NJ, Backlund E, Sorlie PD, and Loveless CA (2000). Marital status and mortality: the national longitudinal mortality study. *Annals of Epidemiology* **10**, 4, 224–238. [https://doi.org/10.1016/S1047-2797\(99\)00052-6](https://doi.org/10.1016/S1047-2797(99)00052-6)
- Kristiansen CB, Bojesen AB, Munk-Jorgensen P, Andersen K, Manusheva N, Bajraktarov S, Arsova S, and Vujovic V (2017). The widowhood effect-mortality and adverse health effects when losing a spouse in old Age Case report of treatment issues in the management of dementia with parkinsonism. *European Psychiatry* **41**, S656. <http://dx.doi.org/10.1016/j.eurpsy.2017.01.1100>
- Liu H, Jiang Q, and Feldman MW (2020). Widowhood and mortality risk of older people in rural China: do gender and living arrangement make a difference. *Ageing and Society* **40**, 9, 1939–1955. <https://doi.org/10.1017/S0144686X19000436>
- Liu H, Umberson D, and Xu M (2020). Widowhood and mortality: gender, race/ethnicity, and the role of economic resources. *Annals of Epidemiology* **45**, 69–75.e1. <https://doi.org/10.1016/j.annepidem.2020.02.006>
- Lloyd-Sherlock P, Corso B, and Minicuci N (2015). Widowhood, socio-economic status, health and wellbeing in low and middle-income countries. *Journal of Development Studies* **51**, 10, 1374–1388. <https://doi.org/10.1080/00220388.2015.1066497>
- Manor O, and Eisenbach Z (2017). Mortality after spousal loss: are there socio-demographic differences? *Israel's Destiny: Fertility and Mortality in a Divided Society* **12**, 303–318. <https://doi.org/10.4324/9780203788127-15>
- Manzoli L, Villari P, Pirone GM, and Boccia A (2007). Marital status and mortality in the elderly: a systematic review and meta-analysis. *Social Science and Medicine* **64**, 1, 77–94. <https://doi.org/10.1016/j.socscimed.2006.08.031>
- Martikainen P, and Valkonen T (1996). Mortality after the death of a spouse: rates and causes of death in a large Finnish cohort. *American Journal of Public Health* **86**, 8 I, 1087–1093. [https://doi.org/10.2105/ajph.86.8\\_pt\\_1.1087](https://doi.org/10.2105/ajph.86.8_pt_1.1087)
- McCrae RR, and Costa PT (1988). Psychological resilience among widowed men and women: a 10-year follow-up of a national sample. *Journal of Social Issues* **44**, 3, 129–142. <https://doi.org/10.1111/j.1540-4560.1988.tb02081.x>
- Mendes de Leon CF, Kasl SV, and Jacobs S (1993). Widowhood and mortality risk in a community sample of the elderly: a prospective study. *Journal of Clinical Epidemiology* **46**, 6, 519–527. [https://doi.org/10.1016/0895-4356\(93\)90124-J](https://doi.org/10.1016/0895-4356(93)90124-J)
- Moon JR, Glymour MM, Vable AM, Liu SY, and Subramanian SV (2014). Short- and long-term associations between widowhood and mortality in the United States: longitudinal analyses. *Journal of Public Health (United Kingdom)* **36**, 3, 382–389. <https://doi.org/10.1093/pubmed/fdt101>
- Moon JR, Kondo N, Glymour MM, and Subramanian SV (2011). Widowhood and mortality: a meta-analysis. *PLoS ONE* **6**, 8. <https://doi.org/10.1371/journal.pone.0023465>
- Murphy M, Grundy E, and Klogirou S (2007). The increase in marital status differences in mortality up to the oldest age in seven European countries, 1990–99. *Population Studies* **61**, 3, 287–298. <https://doi.org/10.1080/00324720701524466>
- Pandey MK, and Jha AK (2012). Widowhood and health of elderly in India: examining the role of economic factors using structural equation modeling. *International Review of Applied Economics* **26**, 1, 111–124. <https://doi.org/10.1080/02692171.2011.587109>
- Peña-Longobardo LM, Rodríguez-Sánchez B, and Oliva-Moreno J (2021). The impact of widowhood on wellbeing, health, and care use: a longitudinal analysis across Europe. *Economics and Human Biology* **43**. <https://doi.org/10.1016/j.ehb.2021.101049>
- Perkins JM, Lee H, James KS, Oh J, Krishna A, Heo J, Lee J, and Subramanian SV (2016). Marital status, widowhood duration, gender and health outcomes: a cross-sectional study among older adults in India. *BMC Public Health*, 1–12. <https://doi.org/10.1186/s12889-016-3682-9>

- Perkins JM, Lee HY, Lee JK, Heo J, Krishna A, Choi S, Nam YS, Oh J, and Subramanian SV (2018). Widowhood and alcohol, tobacco, and other drug use among older adults in India. *Journals of Gerontology – Series B Psychological Sciences and Social Sciences* 73, 4, 666–674. <https://doi.org/10.1093/geronb/gbw134>
- Prabhakaran D, Jeemon P, Sharma M, Roth GA, Johnson C, Harikrishnan S, Gupta R, Pandian JD, et al. (2018). The changing patterns of cardiovascular diseases and their risk factors in the states of India: the Global Burden of Disease Study 1990–2016. *The Lancet Global Health* 6, 12, e1339–e1351. [https://doi.org/10.1016/S2214-109X\(18\)30407-8](https://doi.org/10.1016/S2214-109X(18)30407-8)
- Prior A, Fenger-Grøn M, Davydow DS, Olsen J, Li J, Guldin MB, and Vestergaard M (2018). Bereavement, multimorbidity and mortality: a population-based study using bereavement as an indicator of mental stress. *Psychological Medicine* 48, 9, 1437–1443. <https://doi.org/10.1017/S0033291717002380>
- Ramezankhani A, Azizi F, and Hadaegh F (2019). Associations of marital status with diabetes, hypertension, cardiovascular disease and all-cause mortality: a long term follow-up study. *PLoS ONE* 14, 4, 1–15. <https://doi.org/10.1371/journal.pone.0215593>
- Rendall MS, Weden MM, Favreault MM, and Waldron H (2011). The protective effect of marriage for survival: a review and update. *Demography* 48, 2, 481–506. <https://doi.org/10.1007/s13524-011-0032-5>
- Sanders CM (1982). Effects of sudden vs. chronic illness death on bereavement outcome. *Omega* 13, 3, 227–241. <https://doi.org/10.2190/RTPF-M5EA-6N7A-7D0D>
- Sanders CM (1988). Risk factors in bereavement outcome. *Journal of Social Issues* 44, 3, 97–111. <https://doi.org/10.1111/j.1540-4560.1988.tb02079.x>
- Schone BS, and Weinick RM (1998). Health-related behaviors and the benefits of marriage for elderly persons. *Gerontologist* 38, 5, 618–627. <https://doi.org/10.1093/geront/38.5.618>
- Shor E, Roelfs DJ, Curreli M, Clemow L, Burg MM, and Schwartz JE (2012). Widowhood and mortality: a meta-analysis and meta-regression. *Demography* 49, 2, 575–606. <https://doi.org/10.1007/s13524-012-0096-x>
- Singh A, Chokhandre P, Singh AK, Barker KM, Kumar K, McDougal L, James KS, and Raj A (2022). Development of the India patriarchy index: validation and testing of temporal and spatial patterning. *Social Indicators Research* 159, 1, 351–377. <https://doi.org/10.1007/s11205-021-02752-1>
- Smith KR, and Zick CD (1994). Linked lives, dependent demise? Survival analysis of husbands and wives. *Demography* 31, 1, 81–93. <https://doi.org/10.2307/2061909>
- Smith KR, and Zick CD (1996). Risk of mortality following widowhood: age and sex differences by mode of death. *Social Biology* 43, 1–2, 59–71. <https://doi.org/10.1080/19485565.1996.9988913>
- Sreerupa, and Rajan SI (2010). Gender and widowhood: disparity in health status and health care utilization among the aged in India. *Journal of Ethnic and Cultural Diversity in Social Work* 19, 4, 287–304. <https://doi.org/10.1080/15313204.2010.523650>
- Stroebe M, Schut H, and Stroebe W (2007). Health outcomes of bereavement. [Norwegian]. [References]. *The Lancet* 370, 1960–1973.
- Stroebe M, Stroebe W, and Schut H (2001). Gender differences in adjustment to bereavement: an empirical and theoretical review. *Review of General Psychology* 5, 1, 62–83. <https://doi.org/10.1037/1089-2680.5.1.62>
- Sullivan AR, and Fenelon A (2014). Patterns of widowhood mortality. *Journals of Gerontology – Series B Psychological Sciences and Social Sciences* 69, 1, 53–62. <https://doi.org/10.1093/geronb/gbt079>
- Umberson D (1992). Gender, marital status and the social control of health behavior. *Social Science and Medicine* 34, 8, 907–917. [https://doi.org/10.1016/0277-9536\(92\)90259-S](https://doi.org/10.1016/0277-9536(92)90259-S)
- Vable AM, Subramanian SV, Rist PM, and Glymour MM (2015). Does the “widowhood effect” precede spousal bereavement? Results from a nationally representative sample of older adults. *American Journal of Geriatric Psychiatry* 23, 3, 283–292. <https://doi.org/10.1016/j.jagp.2014.05.004>
- Valtorta NK, Kanaan M, Gilbody S, Ronzi S, and Hanratty B (2016). Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *Heart* 102, 1009–1016. <https://doi.org/10.1136/heartjnl-2015-308790>
- Williams K (2004). The transition to widowhood and the social regulation of health: consequences for health and health risk behavior. *Journals of Gerontology – Series B Psychological Sciences and Social Sciences* 59, 6, 343–349. <https://doi.org/10.1093/geronb/59.6.S343>
- Zick CD, and Smith KR (1991). Patterns of economic change surrounding the death of a spouse. *Journals of Gerontology* 46, 6. <https://doi.org/10.1093/geronj/46.6.S310>
- Zivin K, and Christakis NA (2007). The emotional toll of spousal morbidity and mortality. *American Journal of Geriatric Psychiatry* 15, 9, 772–779. <https://doi.org/10.1097/JGP.0b013e318050c9ae>

## Appendix A

**Table A1.** Percentage of deceased individuals' cross-marital status between two waves of the India Human Development Survey, 2011–2012, by specific morbidity condition reported at base wave (2004–2005)

Characteristics	Tuberculosis (N = 459)			Hypertension (N = 2,406)			Cardiovascular diseases (N = 819)			Diabetes (N = 1,285)			Asthma (N = 905)		
	Married	Widowed	P value	Married	Widowed	P value	Married	Widowed	P value	Married	Widowed	P value	Married	Widowed	P value
<b>Social group</b>															
HC	19.7	NA	–	10.98	25.79	<0.001	22.05	35.71	0.038	19.75	34.85	0.185	27.59	48.15	<0.001
OBC	17.27	35	0.061	12.64	27.71	<0.001	15.18	33.33	0.018	21	27.38	0.007	28.24	34.67	0.283
SC	14.66	30.77	0.136	14.29	22.97	0.075	20.39	26.32	0.562	20.8	25.93	0.202	33.57	42.62	0.218
ST	5.41	0	0.736	19.44	40	0.125	10.53	45.6	0.129	28.57	50	0.558	37.04	50	0.557
Muslim	17.5	36.36	0.178	13.58	25	0.023	19.57	44.44	<0.001	20	33.33	0.541	25.53	35.71	0.456
Others	NA	21.2	–	7.95	37.29	<0.001	21.43	46.15	0.08	11.88	39.39	<0.001	16.13	54.55	0.013
<b>Wealth index</b>															
Poor	14.74	61.54	<0.001	16.16	33.77	<0.001	17.31	43.75	0.015	26.5	37.5	0.276	31.68	48.61	0.01
Middle	10.61	13.64	0.675	13.15	28.73	<0.001	20	35.56	0.026	21.94	27.03	0.356	29.22	45	0.009
Rich	22.61	23.81	0.904	10.99	25.09	<0.001	18.64	36.14	<0.001	17.58	33.33	<0.001	25.94	30.43	0.459
<b>Education</b>															
Uneducated	17.43	23.08	0.617	14.29	23.08	0.15	18.64	28.57	0.409	26.09	21.43	0.724	34.01	35.29	0.868
Up to 5th standard	15.38	27.27	0.324	17.82	33.33	0.023	19.74	22.22	0.86	23.94	25	0.937	29.63	38.89	0.302
Up to metric	15.6	27.27	0.177	11	25.99	<0.001	17.86	40.35	<0.001	22.68	33.72	0.033	30.57	42.7	0.036
Up to secondary level	18.92	66.67	0.057	13.67	30.59	<0.001	18.56	52.17	<0.001	16.85	40	<0.001	20	38.89	0.102
Above secondary level	7.89	28.57	0.11	10.87	27.74	<0.001	19.9	29.27	0.185	16.75	28.21	0.018	21.15	55.56	<0.001

Note: IHDS-1 individual weights were applied. P value obtained from the chi-square test.

Those who reported no morbidity were excluded from this table and only those samples reporting any of the selected morbidities in the study were considered.

NA: Not available.

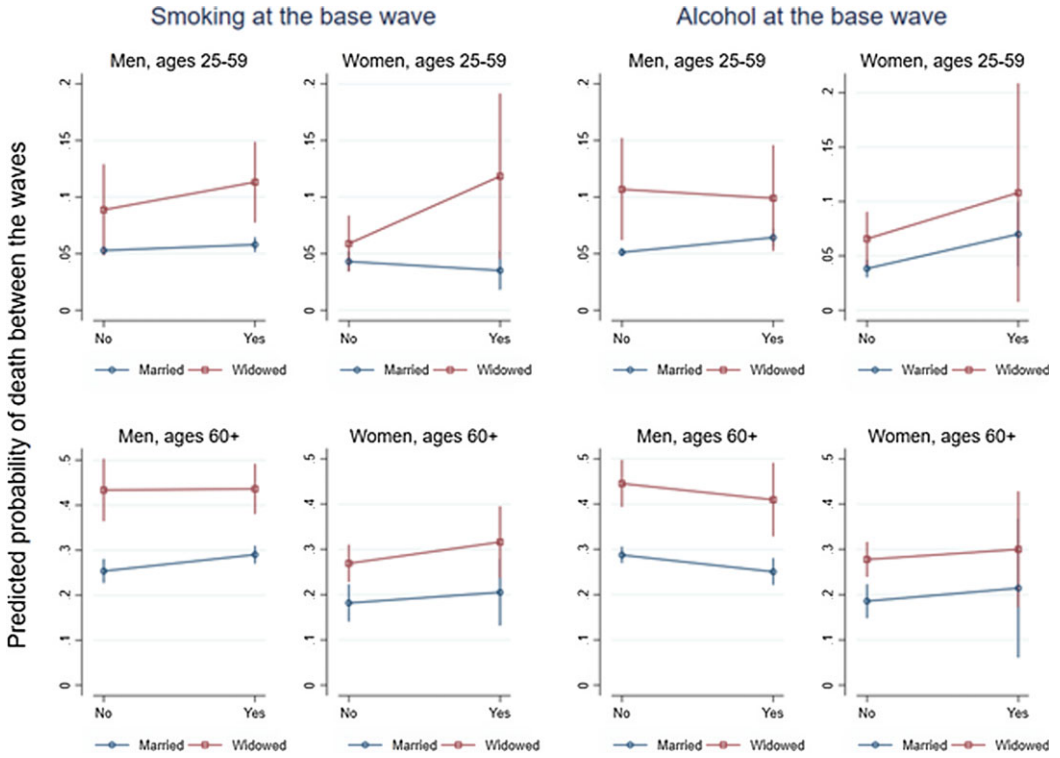


Figure A1. Predicted probabilities of death during 2004–2005 to 2011–2012 by marital status, from logistic regression interacting marital status with the health risk behaviours in 2004–2005 by gender and age group, IHDS, India.