SELF-RATED HEALTH AND MORTALITY AMONG THE ELDERLY IN MATLAB, BANGLADESH*

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1. Introduction

Self-reported health status has been well established in industrialized settings as a valid and reliable measure that fairly accurately predicts mortality[5]. In developing countries, however, the validity of self-reported health has been questioned. Sen in his commentary, points to the deficiencies of self-reported measures. Citing the incongruity between life expectancy and self-perceived health status in the Indian states of Kerala and Bihar as examples, he argues that people's assessment of their own health status is limited by their social experience. In the state of Bihar, life expectancy is low but people report lower rates of morbidity. In Kerala, on the other hand, life expectancy is higher, but self-reported rates of morbidity are also higher. He reasons that in Bihar, people have low perception of illness because literacy level is low and medical infrastructure is poor, but the actual disease burden may be high. Therefore, he concludes, self-reported morbidity can be a misleading.[15]

While Sen may be correct in that one's perception of own health status is limited by social experience, what remains unclear is what these social experiences may be that colors one's perception of health, how they work, and how self reports of health may predict own mortality in developing country settings.

In his example, Sen cites low literacy as a reason for low health perception. However, a number of studies from developing countries contradicts this perception. A study in India observed that people with no education showed the highest odds of reporting poor health compared to those with the highest level of education among the elderly. [16] Similarly, in Bangladesh, people with no formal education were significantly more likely to report poor health compared to those with more than six years of education. Furthermore, those who were in the lowest three socioeconomic quintiles were more likely to report bad or very bad health. [14] In Malaysia, those who were illiterate were more likely to report worse health status, but only in the Chinese population. [18] In addition, both higher education and greater household assets

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increased the probability of reporting good health in the Philippines, Thailand, and Taiwan. [20]

A couple of studies from Africa show no relationship between education and poor self-reported health. In the Khanasa-Nankana District of Ghana, having some formal education showed no significant relationship to self-reported health after functional ability was taken into account, although those in the lowest two socioeconomic quintiles were more likely to report poor health. [2] Among adolescents in Nairobi's slums, years of schooling was not associated with self-reported health status after controlling for unobserved characteristics.[9]

Furthermore, some evidence exists that show that self-reported health measures in developing countries are highly correlated with physical performance, functional limitations, and presence of chronic diseases, adding credibility to the measure. In Bangladesh, Rahman and Barsky [11] found that among the elderly population aged 50 years and older, self-reported health status was significantly associated with objective measures of physical performance. In fact, differences in physical performance, ADL limitations, and reports of chronic and acute morbidity explained the differences in self-reported health between men and women. Kuhn et al. [6], extending the analysis to adults over age 15, found the multiple correlation between self-reported health and a set of observed and self-reported measures was about .5. Similarly, the number of functional limitations and presence of specific chronic diseases decreased the probability of reporting good health in the Philippines, Thailand and Taiwan.[20] Wu and Rudkin's study also show a strong relationship between functional status and self-reported health in Malaysia. [18]

The relationship between self-reported health and subsequent mortality has been shown in a growing number of studies. In Shanghai, China, Yu et al. [19] showed that self-reported "poor" health among 65-74 year olds increased the adjusted relative risk of dying by 1.93 compared to those who reported "excellent/good" health during five years of follow-up. Those who reported "fair" health had 2.16 times the risk of dying. Among the elderly aged 75 years and older, those who reported "poor" health had 1.34 times the risk and those who reported "fair" health had 1.14 times the risk of dying, but the results were not statistically significant. These results were confirmed by a study of the oldest old in China[1]. Similar associations between self rated health and mortality were found in Taiwan across ethnic groups[17] and socioeconomic status[10].

A study in Indonesia showed that self-reported health was highly predictive of mortality regardless of gender, socioeconomic status, or education level among those aged 50 and above.[8] These results confirm the findings from an earlier study which used three waves of panel data to show that individuals who reported poor health

were more likely to die in the subsequent follow-up periods. [3] The results were consistent across several time periods, for both men and women, and despite inclusion of various indicators of socioeconomic status, height and body mass index, physical functioning, symptoms of poor physical health, symptoms of depression, and physical health assessments.

Self-reported health of men and women aged 50 years and above was also predictive of mortality in the Vadu Health and Demographic Surveillance Site in Pune District of India, independent of age, sex, socioeconomic status, education, spousal support, and family size. [4] Furthermore, self rated health was shown to be as good a predictor of mortality as objective measures of health in Bambuí, Brazil. [7]

Two studies from Matlab, Bangladesh also show self-reported health as a predictor of mortality. In a two year follow-up study, Razzaque et al. [13] reports that self-reported health of elderly aged 50 years and above was predictive of subsequent mortality. Those who reported as having bad or very bad health showed higher relative risk of dying compared to those who reported as having good or very good health for both sexes and even after controlling for socioeconomic factors. For women, those reporting moderate health also showed increased risk of dying. An earlier study in the same area showed similar results for both a younger group aged less than 50 and an older group aged 50 and above for a five year follow-up period. [6]

While the relationship between self-rated health and mortality is well established in industrialized country settings[5], the evidence from developing countries is still sparse. This study seeks to further our understanding of the relationship between self-rated health, sociodemographic factors, and subsequent mortality in a developing country setting. To accomplish this aim, it takes advantage of two unique datasets: the Matlab Health and Socioeconomic Survey and the Matlab Health and Demographic Surveillance System. It builds upon earlier studies in Bangladesh [6, 11, 13, 14] by more closely examining the relationship between self-rated health, sociodemographic factors and mortality. Further, while previous studies have a short follow-up period of five years or less, this study is unique in following respondents for fifteen years.

The study seeks to answer the following research questions:

(1) What are the correlates of self-rated health?

(2) What is the relationship between self-rated health and subsequent mortality? How does the relationship change over time?

(3) What are the relationships between other self-reported health measures, such self-reported chronic morbidity, self-reported functional disability and self-reported general health and subsequent mortality?

2. Research Design and Methods

2.1. **Study area.** The data for this study will come from Matlab, a rural area of Bangladesh about 55 km from the capital city of Dhaka. The International Centre for Diarroeal Research, Bangladesh (icddr,b) has been maintaining a Health and Demographic Surveillance System (HDSS) in this site since 1966. The HDSS registers all births, deaths, marriage, and migration events occurring in the area. The HDSS data are collected prospectively on a regular basis.

2.2. **Data.** The study uses data from the HDSS and the Matlab Health and Socioeconomic Survey (MHSS). The first round (MHSS1) was conducted in 1996 and covered 4,364 households. The questions included self-rated health, activities of daily living (ADL), and self-reported chronic morbidity. The data also contain sociodemographic measures such as marital status, religion, and education level. The dataset is described in detail elsewhere. [12] A unique feature of the MHSS is that the data can be linked to the HDSS. Mortality subsequent to 1996 will be obtained from the HDSS dataset to determine survival rates.

2.3. **Study Variables.**

2.3.1. *Self-Reported Health.* The main variable of interest is taken from the question in MHSS: "What is your current health status?: healthy, fairly healthy, and unhealthy/sick." If the respondent answered "fairly healthy", the questionnaire asked, "What do you mean by fairly healthy?: Better than average health, Worse than average health." Since there were no significant differences in outcomes between those who reported better than average health and worse than average health and there were no differences in outcomes between the healthy and fairly healthy groups, the self-reported health responses were combined to form a dummy variable coded '1' if the respondent had reported unhealthy/sick and '0' if the respondent had reported healthy or fairly healthy.

In addition, MHSS included other measures of self-reported health: reports of functional limitations with regard to activities of daily living (ADLs) and whether the respondent has specific chronic diseases. For measuring ADL limitations, the respondents were asked if they had to do an activity, could they do it. To which they responded "easily", "have trouble", or "unable to do it". I categorized the ADLs

according to Rahman and Barsky's [11] groupings. The first cluster contained personal care activities of 1) bathing; 2) dressing; 3) getting up and out of bed; and 4) using the toilet. The second cluster consisted of activities that define range of motion: 1) carrying 10 kg weight for 20 yards; 2) using hand pump for water; 3) standing up from a squatting position; 4) sitting in a squatting position; 5) getting up from a sitting position in char or stool; and 6) crouching/stooping. If the respondent reported limitations in conducting any of the personal care activities in the first cluster, he/she was categorized as having a major ADL limitation. If the respondent only reported limitations in the second cluster, then he/she was classified as having a minor ADL limitation.

Finally, self-reported measures of chronic morbidity were used. These included 14 conditions as in Rahman and Barsky [11]: anemia, arthritis, broken bones, cataracts, vision problems, asthma, other breathing problems, diabetes, pain or burning on urination, paralysis, tuberculosis, gastric or ulcer problems, edema, and a residual category called "other conditions". Unlike the earlier study, the variable for chronic morbidity is a continuous variable that represents the sum of all morbidities reported by the individual.

2.3.2. *Mortality.* The main outcome variable of interest is the time to death or censoring recorded in days. Dates of deaths were obtained from the HDSS. Censoring means moving out of the HDSS area or the final date of observation. The out migration dates are from the HDSS and the final date of observation for this analysis was December 31, 2011. All cause mortality was used in the analysis. Injuries and accidents constituted a small portion of the deaths. These were included in the analysis because among the elderly, overall frailty can lead to injuries and accidents. Furthermore, I kept deaths from infectious diseases in the analysis because the category included those that could lead to chronic conditions such as tuberculosis and those who are in poorer general health may be more susceptible to infections.

2.3.3. *Sociodemographic Characteristics.* Age, sex, education, marital status, and religion are added as controls. Age at the time of MHSS is categorized into three groups: 1) 50-59 years old; 2) 60-69 years old; and 3) 70 years and older. Education is a dummy variable with no schooling (reference group) and attended some school. Further classification of education levels was not possible due to the small number of women who attained high levels of education. Marital status is a dummy variable based on marital status at the time of the MHSS, with "1" for unmarried (which includes never married, divorced, separated, or widowed) and "0" for married (reference group). Religion is coded as either Muslim (reference group) or Hindu.

2.3.4. *icddr,b Treatment Area.* A variable for icddr,b treatment area was included to see if there were any differences between areas that received services from icddr,b and the government service areas. To the extent that access to health care may inform your life span prospects, those residing in icddr,b service areas may be more knowledgeable about their true health status. A total of 137 out of the 142 villages in the HDSS were included in the sample. Of these, 65 were in the treatment areas and 72 were in the comparison areas.

2.4. **Statistical Analysis.** Before launching into the examination of self-reported health and mortality, a better understanding of the determinants of self-reported poor health is necessary. Therefore, I begin my analysis by using logistic regression to see which sociodemographic and other self-reported health factors are associated with reporting poor health. Then, to examine the relationship between self-reported health and mortality, I use Kaplan-Meier estimates to look at the unadjusted relationship between self-rated health and mortality. Next, I use Cox proportional hazards regression to examine the survival time between the 1996 MHSS survey and death for individuals aged 50 and above. The analysis is first stratified by sex, then by sex and follow-up time. Follow-up time is categorized into the first five years and five to fifteen years. Individual weights from MHSS are used in the analysis. The weights are described in detail elsewhere [12]. Six models are estimated. The base model contains the self-reported health variable plus sex and age as controls. Model 2 introduces the sociodemographic variables in a block. The third model examines the addition of the icddr,b treatment area. Model 4 adds the Activity of Daily Living variable and Model 5, the self-reported chronic morbidity variable. The full model is presented in Model 6.

3. Results

Table 1 shows weighted summary statistics for all variables for the entire sample and for whose who died during the follow-up period by sex. The table shows the percentage distribution of self-reported health status (SRH), sex, age, education, marital status, religion, comparison and treatment areas, and ADL. Chronic morbidities are reported as the mean number reported by the respondent.

3.1. **Correlates of Self-Reported Health.** The odds ratios of reporting poor health status are shown in Table 2. Model 1 shows that women are 1.72 times more likely report poor health status than men. Further, the odds of reporting poor health status increases with age. Those in the 60-69 year old age group are 1.54

TABLE 1. Weighted Summary Statistics for Self-Reported Health and Sociodemographic Characteristics of Adults 50 years and Older in 1996 by Sex and Mortality Status, Matlab HDSS Area, Bangladesh

	Total		Male		Female	
	Entire Sample	Deaths	Entire Sample	Deaths	Entire Sample	Deaths
SRH						
Healthy (ref.)	62.92	51.86	67.73	58.77	58.41	42.93
Unhealthy	37.08	48.14	32.27	41.23	41.59	57.07
Sex						
Male (ref.)	48.41	56.43	100.00	100.00	0.00	0.00
Female	51.59	43.57	0.00	0.00	100.00	100.00
Age						
50-59 (ref.)	48.12	26.20	39.43	23.69	56.27	29.44
60-69	36.57	44.53	41.80	45.76	31.66	42.93
70+	15.31	29.28	18.77	30.55	12.06	27.63
Education						
No schooling	33.00	34.10	51.19	49.86	15.93	13.69
Some schooling (ref.)	67.00	65.90	48.81	50.14	84.07	86.31
Marital Status						
Married (ref.)	74.58	68.44	94.61	92.30	55.78	37.54
Unmarried	25.42	31.56	5.39	7.70	44.22	62.46
Religion						
Muslim (ref.)	87.24	84.54	88.97	87.64	85.62	80.52
Hindu	12.76	15.46	11.03	12.36	14.38	19.48
Areas						
Comparison (ref.)	49.50	49.19	48.49	50.22	50.45	47.86
Treatment	50.50	50.81	51.51	49.78	49.55	52.14
ADL						
None (ref.)	44.73	33.78	61.63	48.37	28.87	14.90
Minor	40.24	43.17	28.70	36.94	51.07	51.23
Major	15.03	23.05	9.67	14.69	20.06	33.87
Chronic Morbidity (mean)	2.17	2.29	1.83	2.07	2.49	2.58

times more likely to report poor health compared to the 50-59 year olds, while those 70 years and older are 3.10 times more likely to report poor health status.

When sociodemographic variables are added to the model (Model 2), sex is no longer significantly associated with self-reported poor health. Age associations remain. Having had some schooling reduces the odds of reporting poor health status, being unmarried in 1996 increases the odds, and religion is not significantly associated with self-reported health. Living in the iccdr,b treatment area shows no relationship to self-reported health in Model 3.

Models 4 and 5 show that other self-reported health measures are highly associated with general self-reported health. In Model 4, those with major ADL limitations were

TABLE 2. Odds Ratios of Reporting Poor Health Status: Men and Women Aged 50 and Above, Matlab HDSS Area, Bangladesh, 1996-2011

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	0.31^{***}	0.25^{***}	0.31^{***}	0.21^{***}	0.18^{***}	0.11^{***}
Female	1.72^{***}	1.18	1.72^{***}	0.88	1.40^{***}	0.54^{***}
Age 60-69	1.54^{***}	1.43^{***}	1.54^{***}	0.98	1.46^{***}	0.92
Age 70+	3.10^{***}	2.59^{***}	3.10^{***}	1.27	2.81^{***}	1.08
No schooling		1.69^{***}				1.76^{***}
Unmarried		1.53^{***}				1.61^{***}
Hindu religion		1.16				1.13
Treatment area			1.00			1.08
ADL, major				10.44^{***}		7.82^{***}
ADL, minor				4.40^{***}		3.77^{***}
Chronic morbidity					1.38^{***}	1.27^{***}
Deviance	37830.60	37312.43	37830.60	34161.13	36312.83	33062.62
Num. obs.	2050	2050	2050	2050	2050	2050

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\cdot}p < 0.1$

ten times more likely to report poor health status than those with no limitations. Those with minor ADL limitations were four times more likely to say that they were unhealthy. Further, when ADL covariates were added to the model, women have reduced odds of reporting poor health but the relationship is not statistically significant. In Model 5, one additional report of a chronic morbidity condition increased the odds of reporting poor health by a factor of 1.38.

Finally, in the final model, the odds of women reporting poor health is about 50 percent lower than those of the men. The odds of reporting poor health are higher for those who were unmarried in MHSS, Hindus, those who report major and minor ADL limitations, and with one additional chronic morbidity reported. The association between ADL measures and SRH is strong. Those with major ADL limitations have about 7.82 and with minor ADL limitations 3.77 times the odds of reporting poor health compared to those with no ADL limitations. Furthermore, an additional report of a chronic condition increases the odds of reporting poor health by 27 percent.

3.2. **Self-Reported Health and Mortality.** Figure 1 shows the Kaplan-Meier survival curves for self-rated health by sex and age groups, not controlling for potential confounders. The figures show that across all age groups, those who self-report as being healthy have higher survival probabilities compared to those who report as unhealthy. This is consistent among both men and women. Furthermore, in all

age groups, women have higher survival probabilities than men regardless of their self-reported health status.

3.3. **Stratified Analysis by Sex.** Table 3 presents the hazard ratios of mortality for men ages 50 and above. In the base model which only controls for age reporting as unhealthy more than doubles the daily hazard of death. Being aged 60-69 and 70 and above increase the daily hazard of death by a factor of 2.49 and 3.90 respectively. However, for 60-69 year olds who reported poor health, the increase in the hazards of death are not as great compared to their healthy counterparts; while for 70 years and older adults who reported poor health, the increase in the hazards are even greater than that of their healthy peers.

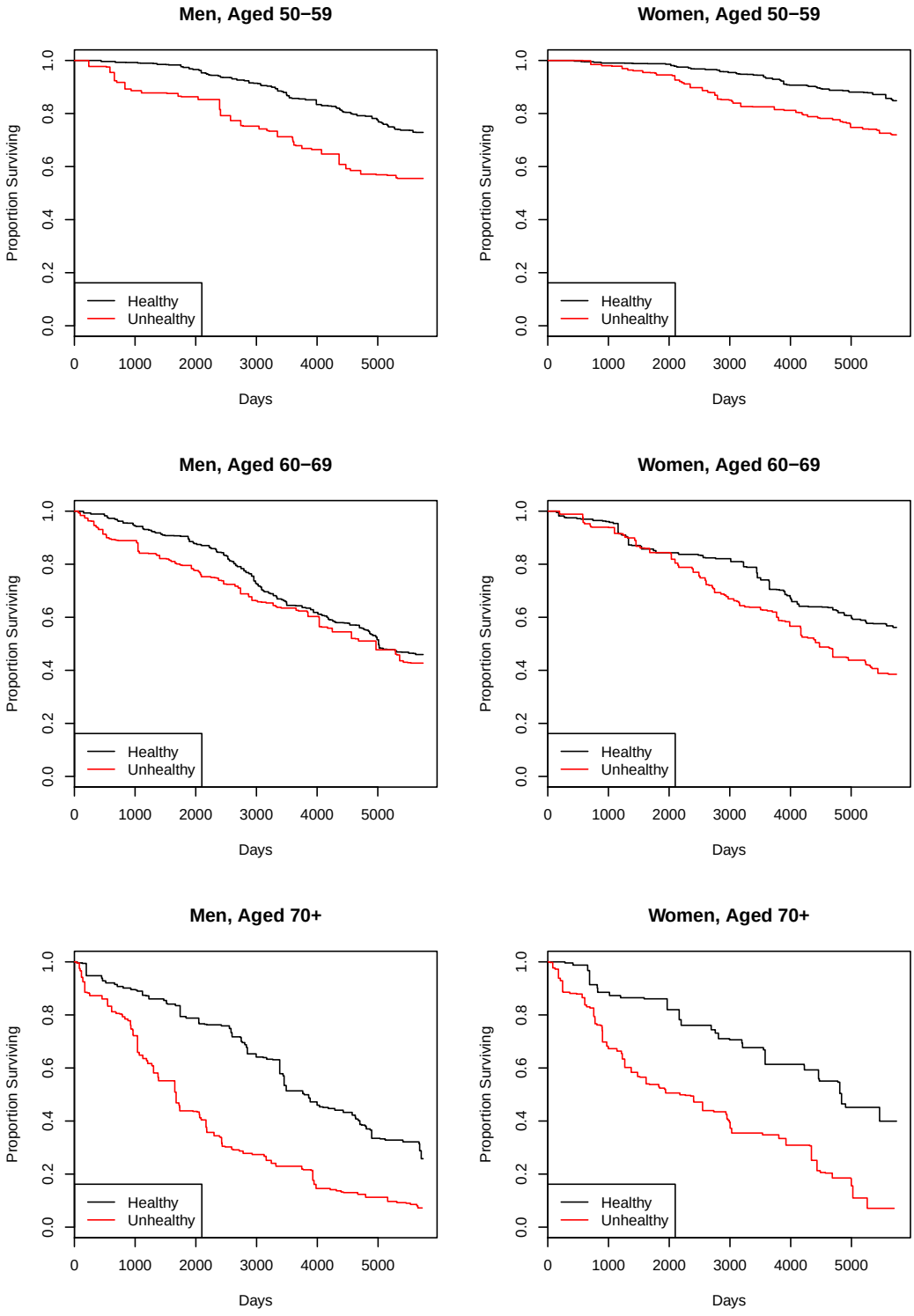
Addition of the sociodemographic variables in Model 2 does not alter the relationship between self-reported health and mortality; neither does the inclusion of icddr,b treatment area indictor in Model 3.

Models 4 and 5 introduce other self-reported health indicators to the model: ADL and chronic morbidity. While addition of ADL reduces the magnitude of the association between self-reported health and mortality, a strong relationship remains with a daily hazard ratio of 1.75. Further, reports of a major ADL increases the daily hazards of death by 87 percent while reports of a minor ADL increases the hazards by 67 percent. Report of one additional chronic morbidity condition decreases the hazards slightly by 9 percent.

The full model (Model 6) shows slightly weaker association between self-reported health and mortality compared to the other models, but the association between self-reported health and mortality remains strong with the daily hazards ratio of 1.70. Reporting as unhealthy increases the daily hazard of death by a factor of 1.96. Furthermore, reports of both major and minor ADL significantly increases the hazard of death by factors of 1.77 and 1.60 respectively. All other covariates except education show statistically significant relationship with mortality.

The results for women are shown in Table 4. The base model for this age group shows that the daily hazards of death associated with self-reported health status is similar in magnitude as the men. As with the men, age increases the hazards of death. The association with age and mortality are higher for women than men. The 60-69 and 70 and above age group show increased hazards of death by factors of 3.74 and 5.75 respectively. As with the men, the interaction terms between SRH and age groups show that women in their 60s who report poor health have lower increase in the hazards of death than their healthy peers and women who are 70 years or older and report poor health have an even higher increase in the hazards of death than their healthy counterparts.

FIGURE 1. Kaplan-Meier Survival Curves for Self-Reported Health by Sex and Age Groups, Matlab HDSS Area, Bangladesh, 1996-2011



Similar to the men, including the sociodemographic variables and the indicator for icddr,b treatment area does not change the association between self-reported health and mortality considerably (Models 2 and 3).

Furthermore, as with the men, the addition of ADL to the base model reduces the magnitude of the association between self-reported health and the daily hazard of death (Models 4). However, the association remains strong, with reports of being unhealthy increasing the daily hazard of death by factors of 1.89. Reports of at least one major ADL limitation increases the hazard of death by 88 percent, while reports of a minor ADL limitation raises the hazard of death by 30 percent.

Unlike the men, the addition of the chronic morbidity covariate slightly increases the hazards of death associated with self-reported health. The hazards of death associated with one additional report of chronic morbidity decreases hazards of death by 2 percent. This finding is counterintuitive and raises questions regarding women's awareness of own specific chronic disease conditions.

The full model for women shows that those who report as being unhealthy has an increased daily hazard of death by a factor of 1.96 (Model 6). The interaction term between poor self-reported health and age 70 and above is no longer significant. All other covariates are statistically significant.

Table 5 shows the hazards ratios for self-reported health status, age, and sex, taking into account the interaction terms. This table reveals that for the most part, SRH and age interact in expected ways. Those who report poor SRH have higher daily hazards of death and the older age groups have higher hazards than the younger age groups. One exception is among 60-69 year old males. In this age group, those who report good SRH have higher daily hazards of death than those who report poor health status, after controlling for functional limitations. Additionally, 60-69 year old women who report poor health have higher hazards of death than women in the oldest age group who report good health.

3.4. **Stratified Analysis by Sex and Follow-Up Time.** To examine how mortality prediction by self-reported health holds over time, in the next set of analysis, I stratify by sex and follow-up time. As expected, the results show that the daily hazards of death for people who report poor health is considerably higher during the first five years of follow-up than after five years. Results were consistent for both men and women (Tables 6, 7, 9, and 10)

During the first five years of follow-up since the interview, the daily hazards of death for men who report poor health increase by a factor of 5.68 in the base model (Table 6). The hazards ratios are about the same in other models but are reduced

TABLE 3. Hazards Ratios of Mortality by Self-Reported Health Status and Other Variables: Men Aged 50 and Above, Matlab HDSS Area, Bangladesh, 1996-2011

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poor SRH	2.02***	2.01***	2.03***	1.75***	1.90***	1.70***
Age 60-69	2.49***	2.45***	2.50***	2.37***	2.44***	2.32***
Age 70+	3.90***	3.81***	3.89***	3.07***	3.67***	2.95***
Poor SRH x Age 60-69	0.57***	0.58***	0.57***	0.51***	0.57***	0.52***
Poor SRH x Age 70+	1.28***	1.28***	1.27***	1.29***	1.34***	1.32***
No schooling		1.02				1.02
Unmarried		1.23***				1.21***
Hindu religion		1.31***				1.35***
Treatment area			0.92***			0.93**
ADL, major				1.87***		1.77***
ADL, minor				1.67***		1.60***
Chronic morbidity					1.09***	1.05***
AIC	125557.92	125493.54	125547.94	125186.88	125462.78	125093.27
Num. events	521	521	521	521	521	521
Num. obs.	1044	1044	1044	1044	1044	1044
PH test	0.87	0.97	0.93	0.88	0.93	0.99

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\cdot}p < 0.1$

TABLE 4. Hazards Ratios of Mortality by Self-Reported Health Status and Other Variables: Women Aged 50 and Above, Matlab HDSS Area, Bangladesh, 1996-2011

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poor SRH	2.10***	2.10***	2.11***	1.89***	2.14***	1.96***
Age 60-69	3.74***	3.57***	3.72***	3.39***	3.74***	3.21***
Age 70+	5.75***	5.11***	5.93***	4.74***	5.78***	4.30***
Poor SRH x Age 60-69	0.77***	0.73***	0.79***	0.76***	0.77***	0.73***
Poor SRH x Age 70+	1.30***	1.18*	1.24**	1.27**	1.28**	1.14
No schooling		0.89**				0.83***
Unmarried		1.32***				1.30***
Hindu religion		1.32***				1.36***
Treatment area			1.16***			1.07*
ADL, major				1.88***		1.97***
ADL, minor				1.30***		1.32***
Chronic morbidity					0.98*	0.96***
AIC	97013.38	96862.76	96987.29	96816.47	97010.07	96620.32
Num. events	366	366	366	366	366	366
Num. obs.	1006	1006	1006	1006	1006	1006
PH test	0.99	1.00	1.00	1.00	0.99	1.00

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\cdot}p < 0.1$

TABLE 5. Hazards Ratios of Mortality by Self-Reported Health Status, Age Groups, and Sex, Matlab HDSS Area, Bangladesh, 1996-2011

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Males						
Good SRH, 50-59 years old	1.00	1.00	1.00	1.00	1.00	1.00
Poor SRH, 50-59 years old	2.02	2.01	2.03	1.75	1.90	1.70
Good SRH, 60-69 years old	2.49	2.45	2.50	2.37	2.44	2.32
Poor SRH, 60-69 years old	2.88	2.87	2.89	2.09	2.65	2.04
Good SRH, 70 years and older	3.90	3.81	3.89	3.07	3.67	2.95
Poor SRH, 70 years and older	10.06	9.79	10.00	6.90	9.35	6.65
Females						
Good SRH, 50-59 years old	1.00	1.00	1.00	1.00	1.00	1.00
Poor SRH, 50-59 years old	2.10	2.10	2.11	1.89	2.14	1.96
Good SRH, 60-69 years old	3.74	3.57	3.72	3.39	3.74	3.21
Poor SRH, 60-69 years old	6.06	5.50	6.17	4.88	6.17	4.61
Good SRH, 70 years and older	5.75	5.11	5.93	4.74	5.78	4.30
Poor SRH, 70 years and older	15.63	12.64	15.52	11.43	15.88	9.58

considerably when ADL limitation variables are added to the model. However, the hazards remain statistically significant at 4.30 (Model 4) and 4.05 in the full model (Model 6). In the full model, having major ADL limitations increases the hazards of death by a factor of 3.24 and minor ADL limitations by a factor of 1.82. An additional report of a chronic condition does not increase the daily hazards significantly when controlling for other sociodemographic and self-reported health measures. Further, for men, having had no schooling raises the hazards by a factor of 35 percent. Other covariates that increases the hazards of deaths are marital status and religion. Report of a chronic condition show no change to the hazards of death.

For women in the five year follow-up period, the hazards ratio for those who report poor health status is 4.51 in the base model (Table 7). As with the men, the hazards do not fluctuate much with the addition of sociodemographic, icddr,b treatment area, or chronic morbidity variables. However, when ADL limitations are added to the model, the hazards ratios are reduced to 3.39 in Model 4 and 3.71 in Model 6. Interestingly for the women, the hazards ratio for 60-69 year olds are higher than that for those 70 years or older once controls are introduced in Models 2-6. Furthermore, unlike the men, women with no schooling show reduced hazards of death. The hazards of death for women with no schooling show that their hazards are reduced by 25 percent in Model 2 and 33 percent in Model 6. Having a major or minor ADL limitation increases the hazards of death, by 5.69 and 2.27 respectively in the full model. Further, one additional chronic condition reported decreases the hazards of death by 5 to 9 percent. This points to the questionable validity of self-reported chronic conditions among women.

TABLE 6. Hazards Ratios of Mortality by Self-Reported Health Status and Other Variables: Men Aged 50 and Above, Matlab HDSS Area, Bangladesh, 0-5 Years Follow-Up (1996-2001)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poor SRH	5.68***	5.43***	5.70***	4.30***	5.42***	4.05***
Age 60-69	3.81***	3.61***	3.81***	3.35***	3.73***	3.17***
Age 70+	8.75***	7.65***	8.68***	5.97***	8.38***	5.26***
Poor SRH x Age 60-69	0.41***	0.42***	0.41***	0.37***	0.41***	0.39***
Poor SRH x Age 70+	0.60***	0.63**	0.60***	0.58***	0.62***	0.61***
No schooling		1.33***				1.35***
Unmarried		1.98***				1.97***
Hindu religion		1.30***				1.34***
Treatment area			0.88**			0.95
ADL, major				3.20***		3.24***
ADL, minor				1.89***		1.82***
Chronic morbidity					1.06***	1.00
AIC	37518.81	37371.33	37512.73	37233.65	37503.09	37082.30
Num. events	159	159	159	159	159	159
Num. obs.	1044	1044	1044	1044	1044	1044
PH test	0.99	1.00	1.00	1.00	1.00	1.00

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\cdot}p < 0.1$

When hazards ratios that incorporates the interaction terms between self-reported health status and age are examined for the five year follow-up period in Table 8, the results reveal that for 50-59 year old men, having reported poor health has higher hazards of death than those who report good health in the 60-69 year age group. For women in their 60s, once controlling for ADL limitations, those who report poor health have lower hazards ratio than those who report good health. This raises questions regarding the validity of the self-reported heath measure among women in this age group. Self-reported ADL limitations may be better predictors of mortality than self-reported health.

We now turn to the longer range analysis looking at the 5-15 year follow-up period. For both men and women, the hazards ratios associated with reporting poor health status is much smaller than those seen in the shorter follow-up period: 1.42 for men and 1.80 for women in the full model (Tables 9 and 10). However, the results are highly significant. For men, reporting poor health increases the hazards of death by 59 percent in the base model. The addition of sociodemographic or icddr,b treatment area variables to the model does not change the hazards by much. However, the addition of ADL limitations and chronic morbidity reports slightly reduces the hazards

TABLE 7. Hazards Ratios of Mortality by Self-Reported Health Status and Other Variables: Women Aged 50 and Above, Matlab HDSS Area, Bangladesh, 0-5 Years Follow-Up (1996-2001)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poor SRH	4.51***	4.57***	4.52***	3.39***	4.71***	3.71***
Age 60-69	13.65***	13.10***	13.59***	9.99***	13.68***	9.44***
Age 70+	12.49***	11.70***	12.74***	7.62***	12.72***	7.50***
Poor SRH x Age 60-69	0.22***	0.22***	0.22***	0.22***	0.22***	0.22***
Poor SRH x Age 70+	0.93	0.92	0.90	0.90	0.90	0.84
No schooling		0.75***				0.67***
Unmarried		1.18*				1.09
Hindu religion		1.08				1.22**
Treatment area			1.11*			0.97
ADL, major				5.21***		5.69***
ADL, minor				2.22***		2.27***
Chronic morbidity					0.95***	0.91***
AIC	28892.36	28876.27	28889.73	28543.93	28883.27	28485.22
Num. events	112	112	112	112	112	112
Num. obs.	1006	1006	1006	1006	1006	1006
PH test	0.99	1.00	1.00	1.00	0.99	1.00

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\cdot}p < 0.1$

TABLE 8. Hazards Ratios of Mortality by Self-Reported Health Status, Age Groups, and Sex, Matlab HDSS Area, Bangladesh, 0-5 Years Follow-Up (1996-2001)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Males						
Good SRH, 50-59 years old	1.00	1.00	1.00	1.00	1.00	1.00
Poor SRH, 50-59 years old	5.68	5.43	5.70	4.30	5.42	4.05
Good SRH, 60-69 years old	3.81	3.61	3.81	3.35	3.73	3.17
Poor SRH, 60-69 years old	8.87	8.23	8.92	5.39	8.29	5.05
Good SRH, 70 years and older	8.75	7.65	8.68	5.97	8.38	5.26
Poor SRH, 70 years and older	30.01	26.32	29.91	14.75	28.05	13.07
Females						
Good SRH, 50-59 years old	1.00	1.00	1.00	1.00	1.00	1.00
Poor SRH, 50-59 years old	4.51	4.57	4.52	3.39	4.71	3.71
Good SRH, 60-69 years old	13.65	13.10	13.59	9.99	13.68	9.44
Poor SRH, 60-69 years old	13.63	13.18	13.80	7.30	14.25	7.56
Good SRH, 70 years and older	12.49	11.70	12.74	7.62	12.72	7.50
Poor SRH, 70 years and older	52.25	49.11	51.90	23.14	54.12	23.41

associated with poor self-reported health. During this follow-up time, reports of major ADL limitations show lower hazards of mortality compared to reports of minor ADL limitations. This is counter-intuitive and raises questions about reports of ADL limitations in predicting mortality during longer term follow-up. In the full model, hazards of reported a major ADL limitation is not statistically significant. Report of an additional chronic morbidity increases the hazards of death by 8 percent in the full model. Unlike in the five year follow-up, having no formal schooling reduces the hazards of death by 8 percent.

For women during the 5-15 year follow-up period, the hazards ratios associated with reporting poor health is higher than those of the men. Reporting poor health increases the hazards of death by a facto of 1.88 percent in the base model. This relationship does not change much with the addition of other covariates. As with the men, when ADL limitations are added to the model, the hazards of self-reported poor health are less (Model 4) than in the other models. In the full model, self-reported poor health is associated with increased hazards of death by a factor of 1.8. The interaction terms between poor SRH and age are no longer statistically significant for women in the 5-15 year follow-up period. Hazards of death associated with major or minor ADL limitations continue to show significance. Those who report having major or minor ADL limitation have increased hazards by 35 percent and 19 percent respectively after controlling for other covariates (Model 6).

When hazards ratios of self-reported health status are examined with the age interaction terms by sex for the 5-15 year follow-up period (Table 11), results show that generally, hazards for those who report poor health status are higher than those who report good health for the same age group. However, for men in their 60s, those who report good health have slightly higher hazards of death than those who report poor health. Therefore, the SRH indicator may not be a valid indicator for men in this age group.

4. Discussion

Despite questions regarding the validity of the self-reported health measure in developing countries, this study presents further evidence that self-reported health is a fairly good indicator of overall health status both in the short and longer term. The logistic regression analysis has confirmed earlier findings in Bangladesh by Rahman and Barsky[11] that SRH is highly correlated with ADL limitations and self reports of chronic morbidity. This was true even after controlling for sociodemographic variables which were not included in Rahman and Barsky's study.

TABLE 9. Hazards Ratios of Mortality by Self-Reported Health Status and Other Variables: Men Aged 50 and Above, Matlab HDSS Area, Bangladesh, 5-15 Years Follow-Up (2001-2011)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poor SRH	1.59***	1.61***	1.60***	1.45***	1.50***	1.42***
Age 60-69	2.40***	2.41***	2.41***	2.31***	2.35***	2.31***
Age 70+	3.35***	3.49***	3.35***	2.87***	3.14***	2.96***
Poor SRH x Age 60-69	0.56***	0.57***	0.56***	0.50***	0.56***	0.50***
Poor SRH x Age 70+	1.16.	1.17.	1.15	1.22*	1.24*	1.30**
No schooling		0.93*				0.92**
Unmarried		0.82**				0.72***
Hindu religion		1.25***				1.33***
Treatment area			0.92**			0.91**
ADL, major				1.21**		1.02
ADL, minor				1.64***		1.57***
Chronic morbidity					1.09***	1.08***
AIC	87677.84	87643.23	87671.10	87477.70	87610.62	87370.86
Num. events	362	362	362	362	362	362
Num. obs.	863	863	863	863	863	863
PH test	0.99	1.00	1.00	1.00	1.00	1.00

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, .$p < 0.1$

TABLE 10. Hazards Ratios of Mortality by Self-Reported Health Status and Other Variables: Women Aged 50 and Above, Matlab HDSS Area, Bangladesh, 5-15 Years Follow-Up (2001-2011)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Poor SRH	1.88***	1.88***	1.89***	1.78***	1.89***	1.80***
Age 60-69	2.71***	2.59***	2.70***	2.59***	2.72***	2.45***
Age 70+	5.19***	4.57***	5.38***	4.71***	5.19***	4.19***
Poor SRH x Age 60-69	1.07	1.00	1.10	1.08	1.07	1.02
Poor SRH x Age 70+	1.09	0.95	1.04	1.12	1.09	0.95
No schooling		0.95				0.92.
Unmarried		1.37***				1.38***
Hindu religion		1.45***				1.42***
Treatment area			1.17***			1.10**
ADL, major				1.32***		1.35***
ADL, minor				1.19***		1.19***
Chronic morbidity					1.00	0.99
AIC	67712.03	67557.68	67691.50	67691.61	67713.96	67527.61
Num. events	253	253	253	253	253	253
Num. obs.	870	870	870	870	870	870
PH test	1.00	1.00	1.00	1.00	1.00	1.00

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, .$p < 0.1$

TABLE 11. Hazards Ratios of Mortality by Self-Reported Health Status, Age Groups, and Sex, Matlab HDSS Area, Bangladesh, 5-10 Years Follow-Up (2001-2011)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Males						
Good SRH, 50-59 years old	1.00	1.00	1.00	1.00	1.00	1.00
Poor SRH, 50-59 years old	1.59	1.61	1.60	1.45	1.50	1.42
Good SRH, 60-69 years old	2.40	2.41	2.41	2.31	2.35	2.31
Poor SRH, 60-69 years old	2.15	2.20	2.15	1.67	1.98	1.65
Good SRH, 70 years and older	3.35	3.49	3.35	2.87	3.14	2.96
Poor SRH, 70 years and older	6.21	6.55	6.15	5.10	5.84	5.49
Females						
Good SRH, 50-59 years old	1.00	1.00	1.00	1.00	1.00	1.00
Poor SRH, 50-59 years old	1.88	1.88	1.89	1.78	1.89	1.80
Good SRH, 60-69 years old	2.71	2.59	2.70	2.59	2.72	2.45
Poor SRH, 60-69 years old	5.47	4.88	5.59	4.97	5.49	4.50
Good SRH, 70 years and older	5.19	4.57	5.38	4.71	5.19	4.19
Poor SRH, 70 years and older	10.69	8.13	10.61	9.35	10.71	7.14

The analysis also sheds some light on what sociodemographic 'lens' may influence assessment of own health status, thus confirming Sen's argument [15], that people's self assessment of health is rooted in their own social experience. My study shows that women are more likely to report poor health status but not after accounting for functional limitations. However, unlike Sen's reasoning, those with no schooling are more likely to report poor health status. Also, unmarried persons are more likely to report poor health status. Religion is not associated with higher odds of reporting poor health status; neither is icddr,b treatment area. The use of icddr,b treatment area may not be an accurate reflection of access to health information for this age group. Services provided by icddr,b are maternal and child health related and do not concern elderly health care.

Finally, the results of this study is consistent with the growing body of literature that shows that self-reported health is a fairly good predictor of mortality and confirms earlier findings in Bangladesh by Kuhn et. al [6] and Razzaque et al [13]. It however, does not provide support for Sen's misgivings about the measure's validity in low income settings. My findings indicate that for both men and women, across most age groups, reporting poor health status significantly increases the hazards of death throughout 15 years of follow-up.

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