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Research Article

Evidences of Reporting Heterogeneity Among the Senior Citizens of India

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Abstract

The perception of health differs between people and regions. This paper focuses on whether there is reporting homogeneity between two elderly whose true health status is similar. True health status of an elderly is measured using three objective measures of health: grip-strength, body mass index and whether the elderly is suffering from a chronic disease. The reporting of their health is checked using the simplest subjective measure of health: self-assessed health. Using the sixty plus population from Study on global AGEing and adult health (SAGE) - Wave 1, 2007-10reporting heterogeneity is checked by ordered probit regression. The methodology by *Lindeboom and Doorslaer (2004)* has been applied to locate sub-populations where reporting heterogeneity exists among the elderly population. Older females, elderly belonging to Scheduled Caste, higher age groups has a higher tendency of reporting their health as bad. Evidences of reporting heterogeneity among elderly whose true health status was similar was observed for various states, caste groups proving that cultural, social and economic background affects reporting behavior among the older population. If both objective and subjective measures are not included to conduct health research, the policies framed and programs initiated will not render any effective result in improving their health scenario.

Background

Health status of a country is often used for measuring economic prosperity and social status of a country. Health is multi-dimensional and complicated (Ahn, 2002). Hence, most large-scale surveys make sincere attempt to capture the health scenario of a nation to determine various policy formulation, medical strategies, resource allocation patterns and locating target population whose needs are required to be kept in the nation’s priority list. Thus, it can be stated, with confidence, that the quality of data measuring health that are collected by large scale surveys in both developed and developing countries are of paramount importance as they play a pivotal role in ascertaining the country’s administrative and political attention. The most common health indicator on which data is collected is self-assessed health which involves questions like “In general, how would you rate your health today?” with options “very good, good, moderate, bad, very bad”. This data that is collected to understand the health status of a population based on the respondent’s perception and reporting of their own health is often looked upon with skepticism by many researchers. The reliability of these data is not thoroughly trusted by many researchers.

Self-assessed health (SAH) has been widely used as a proxy indicator for true overall health of an individual (Carro & Traferri, 2014; Terza, 1987). Research in the field of public health is mainly based on self-assessed health of individuals. Although self-reported health is considered to be one of the good predictors of health outcomes such as medical care and mortality but some literature suggests that self-rated health can have problems in inter population comparisons such as ‘state-dependent reporting bias’ (Kerkhofs & Lindeboom, 1995), ‘scale of reference bias’ (Groot, 2000),

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‘response category cut-point shift’(Sadana, Mathers, Lopez, Murray, & Iburg, 2002), ‘reporting heterogeneity’ (Shmueli, 2003), ‘differential item functioning’ (Hays, Morales, & Reise, 2000). Many health research aims to measure health inequality. It has been found in numerous literature that health inequality is heavily affected by heterogeneity in reporting behavior (Ziebarth, 2010).Complications in the evaluation of health states arises from the fact that an individual’s own understanding of his/her health does not match with the judgment passed on his/her health by a medical expert. He suggested that the data on self-reported morbidities were misleading public policy designed for health care and medical strategies designed for betterment of the health sector, especially in India. Therefore, although self-assessed health data is privileged with many interior information it is still deficient in many other ways and cannot be completely relied upon(Sen, 2002). Literature claim that subjective measures of health are prone to reporting errors as thresholds for health might vary from an individual to another. Hence, two individuals, despite of having similar status of true health might report their health differently(Crossley & Kennedy, 2002; Currie & Madrian, 1999; Jones, Rice, d’Uva, & Balia, 2013; Lindeboom, 2006).

This study aims to assess the deviation of self-assessed health from true health status. True health status cannot be completely measured. It can be expressed in terms of various subjective and objective health measures. Objective health measures are usually free of perception error. In the present study, we have used three such variables as the proxy for true health status: grip-strength, body mass index and suffering from one or more chronic diseases available in SAGE-Wave 1. The variable for self-assessed health is readily available in the data. We attempt to observe how differently individuals report their health despite having the same true health status expressed in terms of various objective measures of health. This has been done using a framework for individual reporting behaviour that allows to test whether differences in responses to health questions are the true reflection of health variations or reporting behaviour. The health report model further helps in distinguishing between two types of reporting heterogeneity: cut-point shift and index shift. Index shift is said to occur when the reporting thresholds shift in parallel without affecting the shape of the distribution of self-assessed health.

Cut-point shift occurs when the thresholds vary within a sub-group of population and results in change in the shape of the distribution of self-assessed health. The rationale behind developing this method was that different groups of people speaking different languages and belonging to different cultural and socio-economic background tend to perceive their own health differently and hence use different reference points to categorize their health (Lindeboom & Van Doorslaer, 2004). Using this methodology on the 52nd round of National Sample Survey it was found that there existed reporting heterogeneity among the older women across various regions of India.

There was no evidence of gender-wise or within region educational qualification-wise disparity in reporting behaviour(Chen & Mahal, 2010). However, the present study makes an attempt to apply this method on the elderly population whose percentage has been on the rise in India. In the previous literature self-reported measures like disability, hospitalization and chronic morbidities were used for creating true health status(Chen & Mahal, 2010). In this study, we have constructed the true health status on strictly objective measures of health which are considered to be free from perception bias.

The central idea is to address the question: *Which population sub-groups gives rise to reporting heterogeneity and is this heterogeneity a result of cut-point shift or index shift in the reporting behaviour?* In some cases true health of two sections of population may actually be different, but in most cases people’s perception about their own health differs due to their cultural, social, economic and individual living style variation. Hence, it is of utmost need to check whether reporting homogeneity is maintained among individuals belonging to two or more sub-groups with similar true health status. As life expectancy is on the rise in India, elderly health has become a concerned matter. Hence, it is of top-most priority to analyze whether the self-reported health data is homogeneous in nature. Evidences of reporting heterogeneity will simply wrong portrayal of elderly health status among various sub-populations of the sample selected.

Data Source

The data for the present study has been borrowed from Study on global AGEing and adult health (SAGE)- Wave 1, 2007-2010 sampled from six states, Rajasthan, Uttar Pradesh, West Bengal, Assam, Maharashtra and Karnataka. India is a country of 28 states and seven union territories out of which 19 states covering 96% of the population has been used to form the sampling design. The states are divided into six National Sample Survey (NSS) regions and six levels of development. A composite index of the level of development was created by giving equal weightage to four development indicators: infant mortality rate, female literacy rate, percentage of safe deliveries and per capita income. SAGE Wave 1 surveyed 375 rural and urban PSUs from which 10,424 households were selected. A total of 12,198 individuals were interviewed out of which 4,349 were male and 6,881 were female respondent above the age of 18years.

Methodology

At the outset, a simple ordered probit regression has been run and partial effects on the probability of reporting a certain category of SAH has been checked by various background characteristics.

To identify reporting heterogeneity among the senior citizens, the methodology developed by Lindeboom and Doorslaer, 2004 is used. Let the true latent health variable be H^* and H^s be the reported subjective measure of health. Since true health cannot be observed we have used three objective measures of health as proxy of the true health status: BMI, whether the person is suffering from any chronic disease or not and grip-strength. Let the objective measures be defined by H^0. Mathematically,

$$H^s = f_1 (H^*, X_1, \varepsilon_1; \beta_1) \text{ ---(i)}$$

$$H^* = f_2 (H^0, X_2, \varepsilon_2; \beta_2) \text{ --(ii)}$$

Here, ε_1 andε_2 are random variables and f_1 (.) , f_2 (.) are functions that describe reporting behaviour and the relationship between true health and its determinants respectively. X_1 andX_2 are the pure reporting behaviour and the correction for dissimilarity between H^0 and H^*. H^s is often measured as a ordered categorical variable.

$$H^s = i \leftrightarrow c_{i-1} < H^* < c_i \text{ , } i=1,..,n \text{ --(iii)}$$

Where c_i's are the cut-points and n are the number of response category. The cut-points are allowed to vary with different X_1's. Therefore, we get:

$$c_i = g_i (X_1; \beta_{1i}) \text{ , } i=1,..,n-1, \; c_0= -\infty, \; c_n= \infty \text{ ----------------------------------(iv)}$$

The function g_i (.) captures the differential responses on H^s for individuals with similar level of true health (H^*). Since, latent true health is unobserved we may rewrite equation (ii) as,

$$H^* = f (H^0; \alpha) + X'_2\beta_2 + \varepsilon_2 \text{ --(v)}$$

Thus replacing equation (iii) with equation (iv) and (v) we finally get H^s in terms of H^0:

$$H^s = i \leftrightarrow g_{i-1} (X_1; \beta_{1i-1}) - X'_2\beta_2 < f (H^0; \alpha) + \varepsilon_2 < g_i (X_1; \beta_{1i}) - X'_2\beta_2 \text{ -------(vi)}$$

An ordered probit regression can be used to estimate equation (vi).

The empirical strategy to separate the objective health effects from the true health effect is to grill down the population into fine sub-groups so that we may say any differences in the true health can be solely accredited as the difference in objective health measure. Reporting heterogeneity can either affect the mean or the shape of the distribution function of self-assessed health, the former called cut-point shift and the latter called index shift. So, in order to check reporting heterogeneity, the restriction β_{1i}'s are equal for all i's is considered and a restricted model is thus estimated. Rejection of the null hypothesis suggests differential effects of X_1 on the reporting thresholds: a non-parallel reporting shift (cut-point shift) or a parallel shift (index shift). To check for which kind of shift has occurred in the sub-group the second restriction holds the α^k constant for all k sub-groups and estimates a semi-restricted model.

- Restriction 1: β_{1i}'s are equal for all i's (Restricted model)
- Restriction 2: α^k constant for all k sub-groups (Semi-restricted model)

The test for differential response behaviour is carried across various sub-groups using a straightforward likelihood test. A chi-squared value for the likelihood ratio test of the nested models will be determined for both the null hypotheses.

$$\chi^2 \text{ statistic} = -2*(\text{log likelihood of the null model - log likelihood of the alternative model})$$

If the chi-squared is significant we reject the null hypothesis of reporting homogeneity. The degrees of freedom for the chi-squared value in each case will be the difference in the number of parameters being estimated in the null versus alternative model.

Variable Description

We have used two types of health variables in this study: Reported health variable: Self-Assessed Health of the individual and Objective health variables: grip-strength, BMI, suffering from chronic diseases.

Reported Health Variable

(i) **Self-Assessed Health:** Self-Assessed Health (SAH) has been used as the dependent variable to check the reporting heterogeneity for the various sub-groups of elderly population. It is re-coded in three categories as "poor", "moderate" and "good" by clubbing "very good/good" in "good" and "bad/ very bad" into "bad".

Objective Health Variables

(i) **Grip-strength:** Grip strength has been measured for both the hands twice and it has been recorded by using the Smedley hand dynamometer. Many literatures have evidences that grip strength has a high predictive power of measuring many health outcomes (Metter, Talbot, Schrager, & Conwit 2002; Giampaoli et al. 1999; Rantanen et al. 1999, 2000). Since cut-offs for ages were not available in the SAGE manual, an average of the cut-offs for males and females aged 60+ has been borrowed from the Camry hand dynamometer, which is similar to the device used in SAGE-Wave1. The cut-offs are given below in Table 1.

Table 1: Description of health variables used for testing reporting heterogeneity

Health variables	Number of categories	Description		
Reported health variable				
Self -Assessed Health	3	0= Poor	1= Moderate	2= Good
Objective Health variables		Categories		Cut-offs
Grip Strength (in kgs)	3	Weak	Males	<23.64
			Females	<15.17
		Normal	Males	23.64-38.33
			Females	15.17-25.86
		Strong	Males	>38.33
			Females	>25.86
Body Mass Index (in kg/mts^2)	3	Underweight		<18.5
		Normal		18.5-25
		Overweight		>25
Suffering from chronic disease	2	Does not have		0
		Has one or more		1

(i) **Body Mass Index:** Body mass index is calculated as the ratio of weight in kilograms and the square of height in meters. The cut-offs have been provided in Table 1.

(ii) **Suffering from one or more chronic illness:** In SAGE-Wave 1 whether a person has been suffering from any of the chronic diseases such as arthritis, stroke, angina or angina pectoris, diabetes, chronic lung disease (emphysema, bronchitis, COPD), asthma, depression, high blood pressure (hypertension), cataract diagnosed in the last 5 years and any injuries in the last 12 months has been asked. This variable has been constructed using this information. If a person aged 60 plus had been diagnosed with any of these chronic diseases by a medical expert then the person has been given the code 1 else 0.

Results

Distribution of self-assessed health by background

In Table 2 the percentages of elderly reporting various categories of reported and objective measures of health are given. It can be noted that 48% elderly reported their SAH as "moderate". Around 43% of the 60 plus population were found to be underweight with a BMI of 18.5 kg/mt^2 or below. Approximately 52% elderly were medically diagnosed with one or more of the above mentioned chronic illnesses. When an average of grip strength for aged men and women were categorized in three groups, only 7% elderly had a strong grip-strength.

Table 2: Descriptive tables showing percentages of people belonging to various categories of self-assessed health, BMI, Chronic diseases and grip strength; SAGE-Wave1 (2007-10)

HEALTH MEASURE	PERCENTAGE	SAMPLE SIZE (N)
Self-Assessed health		
Poor	27.94	934
Moderate	48.01	1,867
Better	24.05	816
Body Mass Index		
Overweight or normal	56.10	2,109
Underweight	43.90	1,379
Chronic Diseases		
No disease	48.27	1,887
One or more diseases	51.73	2,081
Grip Strength		
Weak	46.95	1,505
Average	46.32	1,703
Strong	6.73	215
TOTAL		**3,968**

Table 3 shows the percentages of reporting various categories of health by elderly belonging to different backgrounds. The highest percentage of reporting poor health was by individuals form West Bengal, where 41% elderly reported their health as poor. Only 14% elderly reported their health as poor in Karnataka. Around 59% older adults reported their health as moderate in Karnataka and Rajasthan. The highest percentage of elderly who reported their health as good belonged to Uttar Pradesh, around 30%. A higher percentage of older females, 30% reported their health as poor and a higher percentage, 26% older males reported their health as good. In rural India, 29% elderly reported to be feeling poor on the day of interview whereas 32% urban elderly reported to be feeling good on the interview day. Compared to the other caste groups, most Scheduled Tribes rated their health as poor (42%) but individuals belonging to others category rated their health as good maximum number of times (25%). Maximum individuals belonging to the middle category in wealth quintile reported their health as poor (34%) whereas maximum people belonging to the rich quintile rated their health as moderate (50%) and good (28%). The elderly who were underweight (35%), suffering from one or more chronic diseases (33%) and with weak grip strength (34%) reported their health as poor.

Since SAH is an ordered variable we have used a simple ordered probit regression to check the effect of various background characteristics on reporting various categories of SAH. The partial effects on the probabilities of rating one's health has also been calculated to see which group of individual have a higher tendency of reporting a particular category of SAH. The qualitative interpretation of the beta coefficients is that a positive coefficient implies a positive effect on the latent health index.

Table 3: Percentages of population with various background characteristics reporting different categories of Self-Assessed Health; SAGE-Wave1 (2007-10) Partial effect on probabilities of reporting different categories of self-assessed health

Background variables	Self-assessed Health			
	Poor (%)	Moderate (%)	Better (%)	Sample size (N)
Regions				
Assam	38.39	41.52	20.09	350
Karnataka	13.86	59.54	26.6	552
Maharashtra	24.05	54.39	21.56	591
Rajasthan	20.55	59.37	20.08	791
Uttar Pradesh	29.94	40.43	29.63	719
West Bengal	41.46	40.09	18.46	614
Sex				
Male	26.19	47.68	26.13	1,919
Female	29.72	48.35	21.93	1,698
Place of residence				
Rural	29.42	50.14	20.44	2,701
Urban	24.47	43.02	32.51	916
Social groups				
ST	41.94	43.72	14.34	188
SC	32.21	47.19	20.6	612
others	26.15	48.46	25.39	2,817
Wealth quintile				
Poor	31.49	48.44	20.07	1,307
Middle	34.27	42.5	23.23	672
Richer	21.54	50.15	28.3	1,620
Body Mass Index (Measured)				
Underweight/severely	34.89	44.75	20.36	1,379
Normal	21.68	52.43	25.9	1,696
Overweight/obese	21.24	48.4	30.35	413
Chronic disease status				
No disease	21.69	48.99	29.32	1,536
One or more chronic diseases	32.68	47.27	20.05	2,081
Grip Strength				
Weak	34.32	44.07	21.61	1,505
Average	20.85	52.78	26.36	1,703
Strong	15.61	53.3	31.09	215
Total				**3,968**

Thus, a positive coefficient will indicate a higher probability of reporting a higher category of SAH among the particular sub-population. From the Table 4 we can infer that an older female had lesser chance of rating her health as "good". To be precise, from the partial effect on probability column we may say that being an older female decreases the probability of reporting one's health as good by -0.035 (for older females: β= -0.12, dy/dx = -0.035, $p<0.10$). The advancement of age decreases the probability of reporting a better category of SAH (β= -0.01, dy/dx = -0.004, $p<0.01$). If the older respondent belongs to Scheduled Caste the probability of reporting his/her health as better decreased by -0.015 whereas it increased by 0.022 if he/she belonged to "others" category. An aged person residing in urban area had a better chance of reporting a higher category of health than an aged staying in the rural areas. Education plays a significant role in reporting of SAH. With increase in education an elderly had a better chance of reporting his/her health in the higher category of SAH. The probability of an elderly with higher secondary or secondary education reported their health as a higher category increased by 0.067, $p<0.01$ and for elderlies with more than 12 years of education the probability increased by 0.136, $p<0.01$. Compared to the individuals belonging to the poorest category of wealth quintile, the aged belonging to the middle or richer quintile showed higher probability of reporting a better category of SAH. From Table 4, we can see that if an aged individual belonged to a rich quintile household his/ her probability of reporting his/ her health as good increases by 0.056, $p<0.05$. If an aged individual was classified to have a normal BMI his/her probability of rating his/her health in the better category increases by 0.08, $p<0.01$. Among those suffering from one or more chronic diseases the probability of reporting a better category of SAH decreased significantly by -0.124 at $p<0.01$. Increase in grip-strength improves the rating category of SAH. If an elderly had average grip strength then his/her probability of reporting a better category of SAH rises by 0.08 at $p<0.01$.

Table 4: Table showing beta coefficients and partial effect on probabilities for various background characteristics for Self-assessed health; SAGE-Wave1 (2007-10)

BACKGROUND CHARACTERISTICS	Beta co-efficient	Partial effects on probabilities(dy/dx)
SEX (Reference: Males)		
Females	-0.12** (-0.27, 0.02)	-0.035
AGE		
Age above 60years	-0.01*** (-0.02, 0.00)	-0.004
SOCIAL GROUPS (Reference: Scheduled Tribe)		
SC	-0.05 (-0.39, 0.29)	-0.015
Others	0.07 (-0.23, 0.38)	0.022
PLACE OF RESIDENCE (Reference: Rural)		
Urban	0.08 (-0.05, 0.21)	0.023
EDUCATIONAL ATTAINMENT (Reference: Primary or below education)		
Secondary or higher secondary education	0.21*** (0.08, 0.34)	0.067
Higher education	0.40*** (0.19, 0.62)	0.136
WEALTH QUINTILE (Reference: Poor)		
Middle	0.08 (-0.11, 0.28)	0.025
Rich	0.17** (0.02, 0.33)	0.056
MEASURED BMI (Reference: underweight)		
Normal	0.24*** (0.11, 0.38)	0.079
Overweight	0.20** (0.02, 0.40)	0.065
CHRONIC DISEASES (Reference: does not have any disease)		
Has one or more chronic diseases	-0.42*** (0.30, 0.54)	-0.124
GRIP STRENGTH (Reference: Weak)		
Average	0.24*** (0.12, 0.37)	0.078
Strong	0.10 (-0.15, 0.35)	0.030
ESTIMATED CUT-POINTS		
Cut point 1	-0.56 (-1.31, 0.19)	
Cut point 2	0.89 (0.15, 1.64)	

Cut-point and index shift in reporting behaviour for various strata of elderly population

Attempt has been made to locate the population that demonstrates heterogeneous reporting behaviour. For this purpose, we have stratified the sample in various ways to make the groups homogeneous so that we can assume these strata to have similar true health status. Based on these homogeneous strata we have used the methodology developed by *Lindeboom and Doorslaer* in *2004* to test the null hypothesis on reporting homogeneity across various sub-groups. The figures for the cut-points for different strata where reporting heterogeneity was noted has been included in the later sections to understand the general reporting behaviour of these strata.

Test for reporting heterogeneity by states for place of residence and sex:

Six states were surveyed in SAGE-Wave1, to use these to form regions of India would not be representative. Hence, in Table 5 test of reporting differentials by six states of India has been carried out for males and females of urban and rural areas. The hypothesis of reporting homogeneity was rejected for all the four strata: urban males, urban females, rural males and rural females. Out of the four strata urban males displayed both cut-point and index shift whereas the other three strata had cut-point shift in their reporting behaviour. It can be noted from Figure 1, 2, 3 and 4 that despite having similar measures of objective health, the urban males of Assam, Maharashtra and West Bengal had a higher cut-point 1 implying that their tendency of reporting their health as poor was higher than the urban males of Assam and Uttar Pradesh. The urban males residing in Karnataka and Rajasthan had very low cut-point 1 hence, we may say that the urban males in these states, given a choice between poor and moderate health status would choose "moderate" to report their health. For the urban females of Assam, the tendency to choose "moderate" to describe their health status was very low. The cut-point 2 for the urban females of Assam, Karnataka, Maharashtra, Rajasthan and West Bengal was relatively lower than Uttar Pradesh implying when older urban women with similar latent true health were asked to rate their health, they preferred giving their response as either good or excellent. Among the rural males of Assam and West Bengal cut-point 1 was quite high, implying given a choice between "moderate" and "poor" the rural 60+ males of these areas rate their health as poor. The cut-point 2 for Uttar Pradesh rural males was the lowest indicating that rural males of U.P had the tendency of rating their health as good rather than moderate. In Maharashtra, Karnataka and Rajasthan the distance between cut-point 1 and cut-point 2 was quite large indicating a larger tendency of rural men to rate their health as moderate. The cut-point 1 of rural females of Assam, West Bengal was high signifying tendency of rural females to rate their health as poor. The cut-point 2 for rural females in U.P was low indicating greater tendency of rating their health as good. The rural aged women of Karnataka and Rajasthan had highest cut-point 2 representing their tendency of rating their health as "moderate" given a choice between "moderate" and "good".

Table 5: Test for differential by states; SAGE-Wave1 (2007-10)

States	Urban		Rural	
	Males	Females	Males	Females
Log likelihood: Assam	-37.35	-41.03	-158.13	-92.21
Log likelihood: Karnataka	-70.23	-72.36	-156.99	-132.51
Log likelihood: Maharashtra	-101.25	-105.18	-151.10	-145.65
Log likelihood: Rajasthan	-45.14	-55.78	-279.04	-268.14
Log likelihood: Uttar Pradesh	-53.11	-41.94	-351.70	-238.77
Log likelihood: West Bengal	-94.25	-81.14	-220.34	-164.34
Log likelihood: Sum	-401.33	-397.43	-1317.29	-1041.63
Log likelihood: Restricted	-422.42	-413.14	-1362.34	-1079.60
$\chi2$ statistic (1st stage)= $-2*(L^R-L^U)$	42.18	31.43	90.09	75.94
P-value (20 d.f)	***0.00***	***0.05***	***0.00***	***0.00***
Log likelihood: Semi-Restricted	-409.64	-402.86	-1356.21	-1069.67
$\chi2$ statistic (Cut-point differences) = $-2*(L^{R\alpha}-L^U)$	16.62	10.87	77.84	56.07
P-value (5 d.f)	***0.01***	***0.05***	***0.00***	***0.00***
$\chi2$ statistic (Index shift)= $-2*(L^R-L^{R\alpha})$	25.55	20.55	12.25	19.86
P-value (15 d.f)	***0.04***	0.15	0.66	0.18

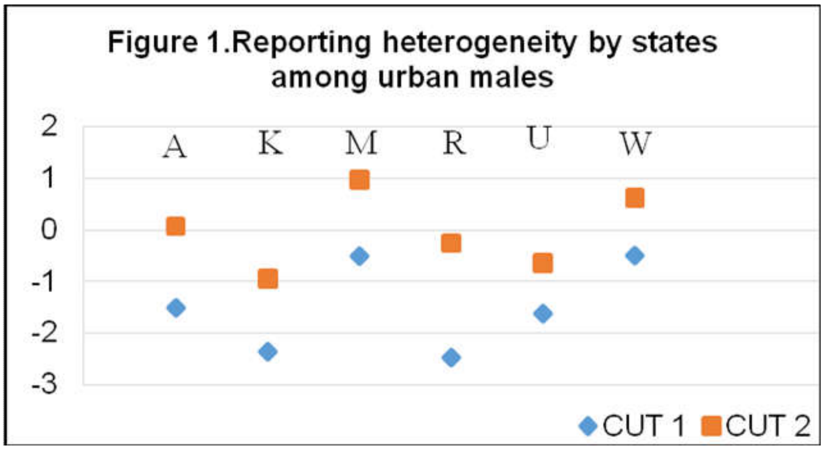


Figure 1.Reporting heterogeneity by states among urban males

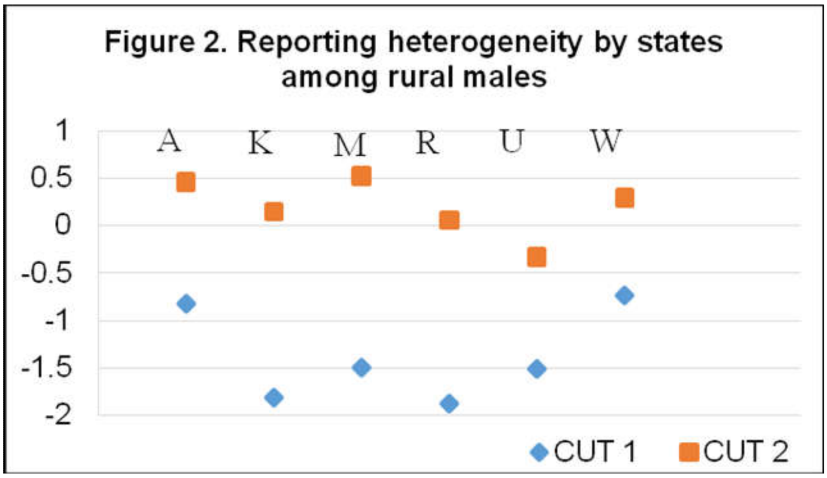


Figure 2. Reporting heterogeneity by states among rural males

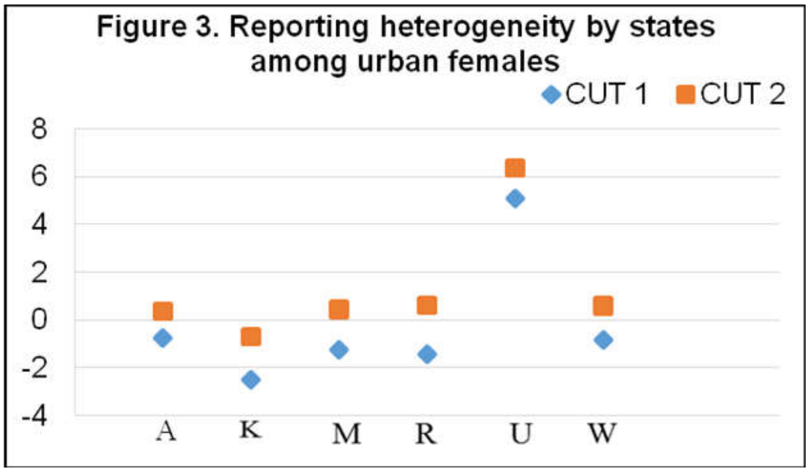
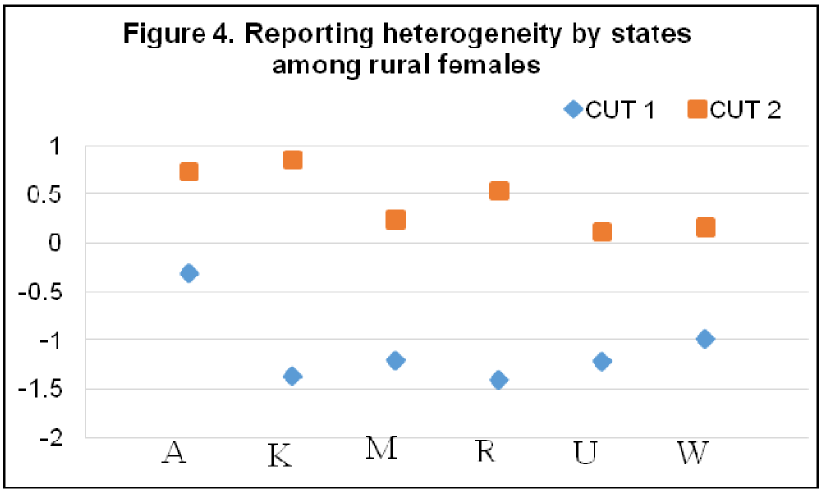


Figure 3. Reporting heterogeneity by states among urban females



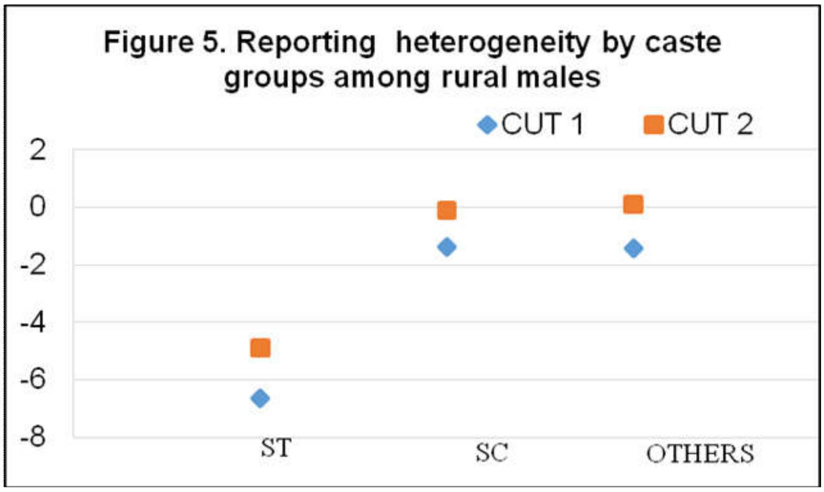
Note: Figure 1, 2, 3 and 4: A=Assam; K=Karnataka; M=Maharashtra; R=Rajasthan; U=Uttar Pradesh; W=West Bengal

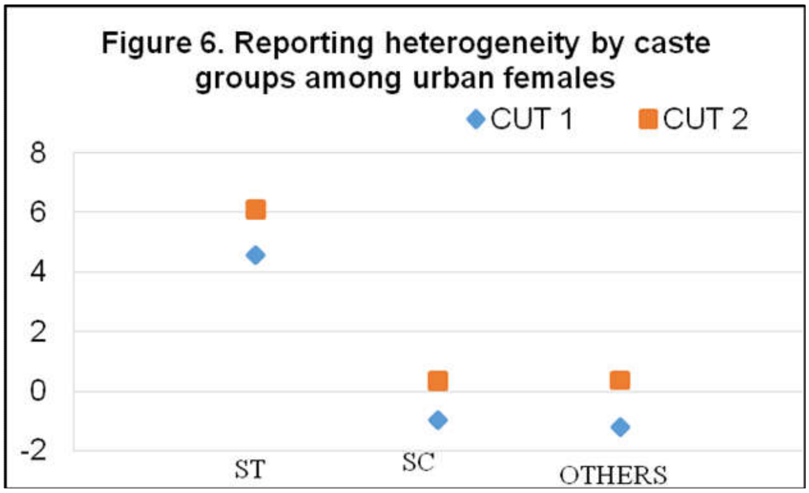
Test for reporting heterogeneity by caste groups for place of residence and sex:

In Table 6, test for differential reporting by different caste groups: Scheduled Tribe, Scheduled Caste and Others was performed for the same four strata. The hypothesis of reporting homogeneity was rejected for urban females and rural males. On further testing a significant cut-point shift was observed among the rural males and significant index shift was observed for both urban females and rural males. In fact from Figure 5 and 6, rural males belonging to ST category had a higher tendency of reporting their health as "good" or "moderate" than those belonging to SC or others category. Given similar levels of latent true health urban females belonging to ST category reported their health as poor whereas those belonging to SC or others category reported their health as "good".

Table 6: Test for differential by caste-groups; SAGE-Wave1 (2007-10)

Caste Groups	Urban		Rural	
	Males	Females	Males	Females
Log likelihood: Scheduled Tribe	-7.68205	-5.69513	-87.3356	-59.3286
Log likelihood: Scheduled Caste	-47.9742	-40.2288	-272.268	-217.753
Log likelihood: Others	-364.072	-367.421	-1005.39	-827.27
Log likelihood: Sum (L^U)	-419.728	-413.345	-1365	-1104.35
Log likelihood: Restricted (L^R)	-422.274	-423.333	-1375.65	-1107.14
χ2 statistic (1st stage)= -2*(L^R -L^U)	5.090761	19.97457	21.29834	5.57
P-value (8 d.f)	0.75	***0.01***	***0.006***	0.7
Log likelihood: Semi-Restricted ($L^{R\alpha}$)	n.a	-413.777	-1368.23	n.a
χ2 statistic (Cut-point differences) =-2*($L^{R\alpha}$-L^U)	n.a	0.86	6.47	n.a
P-value (2 d.f)	n.a	0.65	***0.04***	n.a
χ2 statistic (Index shift) =-2*(L^R-$L^{R\alpha}$)	n.a	19.11	14.83	n.a
P-value (6 d.f)	n.a	***0.004***	***0.02***	n.a





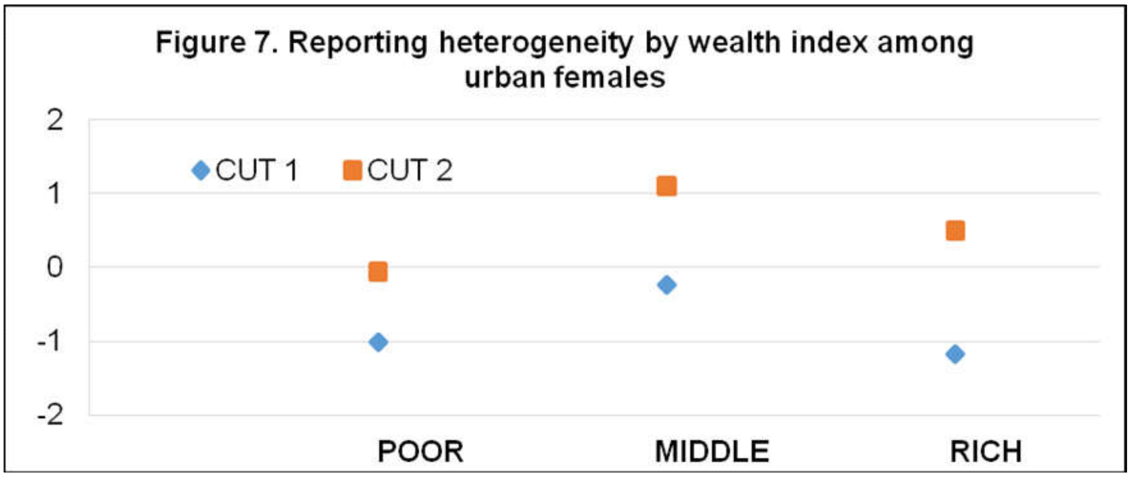
Test for reporting heterogeneity by wealth quintile for place of residence and sex:

Table 7 tests reporting homogeneity by wealth quintile. The null hypothesis of reporting homogeneity was rejected among urban females. Statistically significant cut-point shift was observed for this stratum. Referring to Figure 7 if three urban elderly females belonging to poor, middle and rich wealth quintile were interviewed and they had similar level of true health, then the female belonging to the middle wealth quintile would rate her health as "poor" or "moderate" whereas an older female belonging to the poor wealth quintile would rate her health as "good". The rich female would rate her health as moderate majority of times.

Table 7: Test for differential response by wealth quintile; SAGE-Wave1 (2007-10)

Wealth quintile	Urban		Rural	
	Males	Females	Males	Females
Log likelihood: Poor	-48.5322	-63.4003	-574.324	-500.897
Log likelihood: Middle	-62.903	-88.4724	-274.301	-198.3
Log likelihood: Rich	-302.834	-266.869	-503.815	-392.427
Log likelihood: Sum (L^U)	-414.27	-418.74	-1352.44	-1091.62
Log likelihood: Restricted (L^R)	-418.698	-425.778	-1357.05	-1098.02
χ2 statistic (1st stage)= -2*(L^R -L^U)	8.86	14.07	9.23	12.80
P-value (8 d.f)	0.35	***0.07***	0.32	0.12
Log likelihood: Semi-Restricted ($L^{R\alpha}$)	n.a	-424.27	n.a	n.a
χ2 statistic (Cut-point differences)	n.a	11.06	n.a	n.a

= $-2*(L^{R\alpha}-L^{U})$				
P-value (2 d.f)	n.a	***0.00***	n.a	n.a
χ2 statistic (Index shift)= $-2*(L^{R}-L^{R\alpha})$	n.a	3.02	n.a	n.a
P-value (6 d.f)	n.a	0.81	n.a	n.a



Test for reporting heterogeneity by sex for caste-groups, place of residence and wealth quintiles:

Reporting homogeneity was tested by sex in Tables 8 and 9 and it was rejected for the others category of social group and rural non-poor population. The males and females in these strata responded differently to SAH question inspite of having similar level of true health. In case of others social group there was a significant index shift in response behaviour for the males and females. Among the rural non-poor strata there was both cut-point shift and index shift for males and females. In general, the female respondent would rate her health lower than the older male respondent as per Figure 8 and 9.

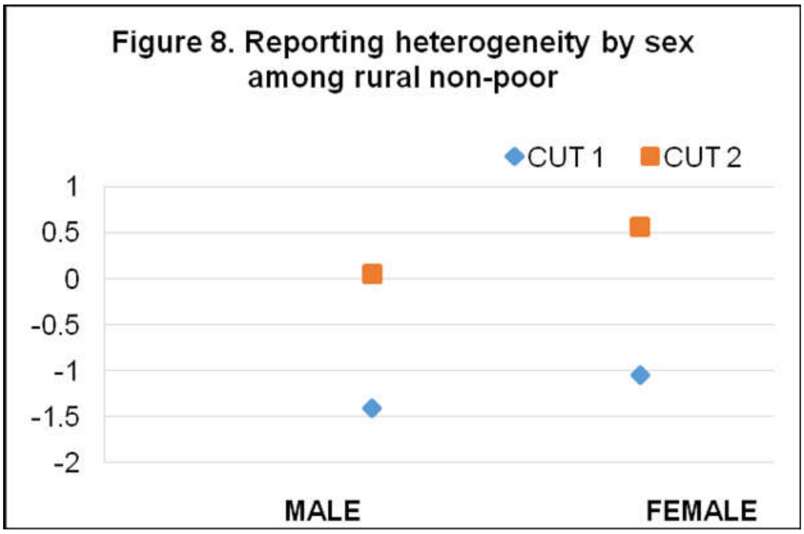
Table 8: Test for differential by sex; SAGE-Wave1 (2007-10)

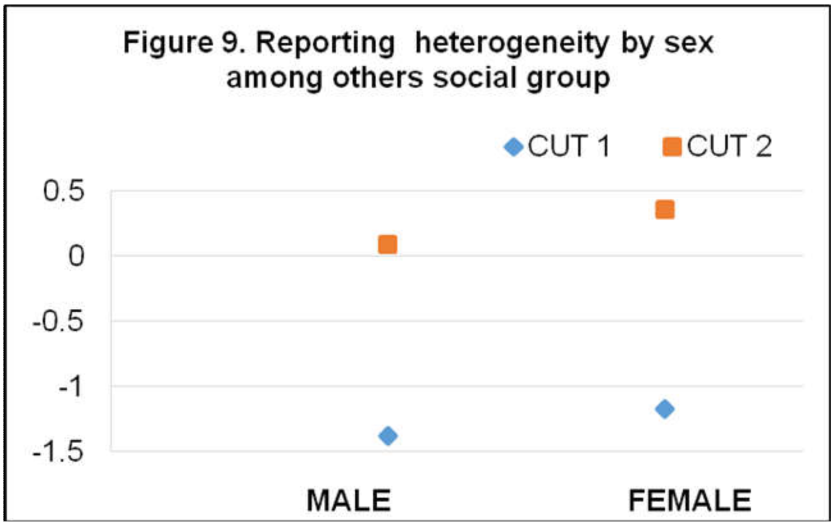
Sex	Scheduled Tribe	Scheduled Caste	Others
Log-likelihood:Male	-97.403256	-323.07935	-1379.8498
Log-likelihood:Female	-71.381059	-261.17947	-1203.2638
Log-likelihood:Sum	-168.784315	-584.25882	-2583.1136
Log-likelihood:Restricted	-172.05346	-585.43304	-2587.4648
χ2 statistic (1st stage)= $-2*(L^{R}-L^{U})$	6.5382809	2.35	8.7
P-value (4 d.f)	0.16	0.67	***0.07***
Log-likelihood:Semi-restricted	n.a	n.a	-2583.6323
χ2 statistic (Cut-point differences) = $-2*(L^{R\alpha}-L^{U})$	n.a	n.a	1.04
P-value (1 d.f)	n.a	n.a	0.3
χ2 statistic (Index shift)= $-2*(L^{R}-L^{R\alpha})$	n.a	n.a	7.66
P-value (3d.f)	n.a	n.a	***0.05***

Table 9: Test for differential by Sex; SAGE-Wave1 (2007-10)

Sex	Urban		Rural	
	Poor	Non-poor	Poor	Non-poor
Log-likelihood:Male	-48.5322	-368.533	-574.324	-786.626
Log-likelihood:Female	-63.4003	-357.434	-500.897	-593.4
Log-likelihood:Sum	-111.933	-725.967	-1075.22	-1380.03
Log-likelihood:Restricted	-115.194	-729.076	-1075.98	-1385.04
χ2 statistic (1st stage)= $-2*(L^{R}-L^{U})$	6.523718	6.21718	1.51442	10.03352
P-value (4 d.f)	0.16	0.18	0.82	0.04

Log-likelihood:Semi-restricted	n.a	n.a	n.a	-1381.47
χ2 statistic (Cut-point differences) $=-2*(L^{R\alpha}-L^{U})$	n.a	n.a	n.a	2.9
P-value (1 d.f)	n.a	n.a	n.a	***0.08***
χ2 statistic (Index shift) $=-2*(L^{R}-L^{R\alpha})$	n.a	n.a	n.a	7.14
P-value (3d.f)	n.a	n.a	n.a	***0.06***





Discussions

Self-assessed health is the most widely used health indicator collected in various surveys. However, from this study an evident and obvious gap can be seen in the true health status and reported health among the elderly population surveyed in SAGE-Wave 1, 2007-2010. It is observed that older females suffering from one or more chronic ailments, the underweight elderly with less grip strength had higher probability of rating their general health as poor. Whether there is a true difference in the health of various sub-groups or is the differential reporting due to different perception of one's own health is then checked using simple likelihood tests. It was seen that reporting heterogeneity existed across the six sample states of India. This might be due to the difference in culture, language and socio-economic levels of these states. The state-wise results show that inspite of having similar level of true health the urban males of Assam, Maharashtra and West

Bengal reported their health as moderate or poor compared to their counterparts in Karnataka, Rajasthan and Uttar Pradesh. The heterogeneity is observed in both cut-point and index shift indicating any differences between these states in SAH for the urban male population tends to understate the true differences as reflected by the three objective measures: BMI, chronic diseases and grip strength taken as a proxy for true health in the present study.

By conducting the reporting heterogeneity test we may reach the conclusion health reporting behaviour among the urban males and rural females according to caste groups; urban males and rural males as well as females by wealth index; scheduled tribe and scheduled caste by sex and urban non-poor as well as poor and rural non-poor by sex are homogenous indicating the difference in their reporting behaviour as an actual reflection of the difference in their true health status as measured by the objective measures of health. In general, in the sub-populations where the hypothesis of reporting homogeneity is accepted, their rating of self-assessed health can be taken as the true reflection of their actual health status provided the objective measures taken in the study are assumed as good proxy of true health. However, the findings of this study is limited to the sample population and the period of time when the data is collected. Research in any field is subjected to limitations. The data availability in India has taken an epic leap. However, there is room for improvement in order to allow researchers to apply various methodologies to analyze the data. Some of the limitation of the present study are: the study has divided the population into many sub-groups to locate reporting heterogeneity. However, there still lies scope of drilling the population into finer sub-categories, which is difficult as that will decrease the sample size to a great extent; no set of objective health measure can exhaustively define the underlying true health status of an individual. Hence, the gap between objective measure of health and true health exists.

Conclusion

The greying section of the population usually is the one that suffers from higher percentage of morbidity. They are vulnerable to both physical and mental illness. With the advancement in medical sciences, the proportion of the aged has started to increase in India. Hence, their health status stands as one of the topmost priorities to the Government of India. The policies regarding health care are framed based on the research conducted in the field of health of the elderly population. Budget and other resource allocation is done after identification of the target population whose health status is found to be lower than the fellow citizens.

This study gives evidence on various heterogeneity that set in the data due to reporting behaviour of the respondent. The heterogeneity may arise due to interviewer bias also. But the present study deals with measurement error that arises in the health data due to the respondent. The present study makes an effort to locate the sections of the elderly population which contributes to the heterogeneity arising in the health data. If there is differential or biased health reporting, the health measures based on the reporting of health may not give a true scenario of the health status. This may result in wrongly prioritized policies and misallocation of resources which is not economically beneficial for the Nation. Analyzing health scenario by taking only self-rated health as a measure can become quite risky. Policy formulation and health programmes initiated based on health report given by an individual alone might not be cost-effective. Moreover, proxy response may add to the biasedness of reported health data.

However, Self-Assessed Health is a valuable measure. A person's own perspective about his/her health is an important issue and cannot be ignored. Proxy response is also unavoidable as it is unjust to leave the portion of the aged population who are not capable of giving responses. However, many a times interviewers ask proxy to respond on behalf of the respondent to avoid wastage of time in call back interviews or opt for a substitute in case the respondent is absent at the time of interview. This gives rise to unnecessary biasedness due to proxy. Surveys must frame questions in such a way that it bears the same meaning even if asked repeatedly. Collecting objective measures of health in surveys is important. Health research must be based not only on subjective but also objective measures of health. Numbers form the backbone of most policy formulation and programme initiation. If these numbers themselves are not consistent then it will only lead to false policy formulation and erroneous resource allocation. Hence, self-rated measure, no matter how rich information is provided by it, should be coupled with a few objective measures of health to give a better picture of the health of the sub-population.

A good alternative is to develop an interview form consisting of battery of items that include both subjective and objective measures of health. Clinical measures of health is often not a liable option in a large-scale survey. However, questions regarding whether the person was hospitalized for a particular disease or not, medical prescriptions, medications taken by the individual for different diseases, measuring height, weight, blood pressure and blood sugar level of the individual, grip strength, timed walk does not need highly qualified medical experts. These certain objective measures can be easily collected in an ongoing survey without any extra financial burden. If the research conducted in the field of health can be based on mix measures of health, i.e., both subjective and objective measures will give a more appropriate health scenario. This will help in efficient policy formulation, effectuve resource utilization and a wholesome comprehension of the population that needs to be listed as high priority.

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