Rising challenge of multiple morbidities among the rural poor in India—a case of the Sundarbans in West Bengal

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Abstract

Background: Multimorbidity or multiple chronic conditions increase with age and imply complicated clinical management and lower quality of life that is compounded by poverty. Yet, there is a serious dearth of evidence on this issue.

Objective: To explore the burden and predictors of multiple morbidities in the Sundarbans of West Bengal.

Materials and Methods: A cross-sectional survey of respondents aged older than 40 years was carried out in the remote islands of Sundarbans in India. A clinical algorithm was used to assess the burden of six chronic conditions, along with the risk factors. Partial proportional odds regression was used to analyze the differentials of multimorbidity.

Result: The crude prevalence of multimorbidity was 44.05%, and it was higher among women. The adjusted odds of showing multimorbidity increased with age and BMI in both the genders. Increase in education (OR: 0.48; 95% CI: 0.27–0.85), employment (OR: 0.33; 95% CI: 0.16–0.67), and sufficient vegetable intake (OR: 0.53; 95% CI: 0.28–1.00) were significant predictors among the rural male population.

Conclusion: The study provides evidence on an often ignored aspect of noncommunicable diseases in India. The evidence underlines the immediate need for attention to the issue of multiple morbidities in a fast aging population of the country's rural poor.

KEY WORDS: Chronic disease, health-care disparities, socioeconomic factors, risk factors, rural health, morbidity

Introduction

By 2020, noncommunicable diseases (NCDs) in the context of India are estimated to contribute to almost 67% of the deaths and to majority of the disability adjusted life years lost.[1] Morbidity attributable to diseases such as ischemic heart disease, cancer, chronic obstructive pulmonary disorder, musculoskeletal problems, and stroke rose from 1990 to 2010 in India.[2] Risk factors such as smoking, household pollution,

and lack of nutrition have been found to be the major contributors to these diseases. The economic implications of these diseases are complex through catastrophic expenditures for the cost of treatment and loss of output and quality of life, especially in the poor households.[3] Although known as the diseases of the wealthy, recent studies show that these NCDs are also prevalent among the poor and the vulnerable. NCDs among the rural and poor population in the country pose a complex public health challenge of bridging the widening inequities in health and health care. The complication is further worsened in the case of multiple chronic diseases, which is also known as multiple morbidities.

Multimorbidity or multiple chronic conditions are defined as two or more chronic diseases occurring in an individual at the same point in time without any reference to an index disease.[4] Two specific reasons mandate this discussion: (a) multiple chronic conditions are known to increase with age. They imply specialized clinical management and greater financial expenditure.[5] With the geriatric population set to account for

more than 10% of the total population by 2026 in India, multi-morbidities require serious consideration and[6] (b) evidence clearly points at the increasing prevalence of chronic diseases in rural areas. Studies have extensively researched the burden and implication of these diseases individually, while a few studies have focused on the graver issue of comorbidities—mostly in the area of psychiatry and mental illnesses.[7]

Although recent literature from across the globe points at the rising burden of multimorbidities and its implications on the geriatric population, yet very little evidence exists in the context of the rural poor in India.[8] In this article, we present evidence on the burden of multimorbidity in the remote rural islands of the Sundarbans of West Bengal in India. Sundarbans, a vast spread of forest islands, belong to the most backward regions in West Bengal. They are an epitome of poverty and vulnerability owing to climate and geographical challenges.[9] Similar to many rural regions of the country, quality health care is often inaccessible. This study focuses on the issue of multimorbidity or multiple chronic conditions in the rural population of West Bengal. We assessed the burden and determinants of multimorbidity in a rural setting such as the Sundarbans as a pretext to the wider debate on the issue of NCDs and the need for equitable solutions.

Materials and Methods

Study Area

The Sundarbans delta, cluster of more than 100 islands in the extreme south of the state of West Bengal in India, is one of the world heritage sites.[10] It comprises of a unique biosphere of reserve forests that are intersected by many tidal rivers, lakes, and estuaries and paint a very formidable terrain. The area outside this reserve forest is equally hostile, comprising of 54 islands spread across 19 administrative blocks—with a population of around 4.5 million, the Sundarbans is the epitome of poverty, deprivation, and an acute livelihood struggle against climatic and geographical challenges.[11]

In 2009, the Sundarbans witnessed the cyclone Aila that wiped out a large portion of river embankments, caused thousands of villages to disappear under water, killed hundreds of people, and rendered more than 400,000 homeless.[12] As a consequence of these frequent climatic shocks and the remote nature of these islands, the health status of the people in Sundarbans is in a deplorable state. Research in the Sundarbans has underlined the poor state of maternal and child health along with many additional emerging public health challenges.[13]

Study Design

The design of the study has been explained in another publication by the authors.[14] A household survey was conducted in 2009 in 19 blocks of the Sundarbans in West Bengal, India. A two-stage random sampling procedure was used with 57 primary sampling units (PSUs) selected in the first stage, that is, three PSUs being randomly selected from each block. The second stage included the selection of 1,141 households that included 10% oversampling to adjust for nonresponse. One

respondent aged 40 years or older was randomly selected from the sampled households and interviewed for information on NCDs. The survey instrument was based on the instrument used in World Health Survey.[15] A total of 831 households that were interviewed had at least one member aged older than age of 40. After data cleaning, 815 cases were used in the analysis. The study has adhered to the ethical guidelines for biomedical research on human subjects and is approved by the institutional review board of the institute. A verbal consent was obtained from the respondents before administering the survey instrument. Every respondent was read their right to voluntary participation and details of the risks and benefits; the right to refusal was outlined.

Multiple Morbidities

We defined multiple morbidities as the presence of two or more chronic conditions in a person at the time of survey. We have defined the presence of a chronic condition as "self-reported diagnosis or from symptoms highly suggestive of such a condition." The respondents were asked if they were diagnosed with angina, arthritis, asthma, hypertension/high blood pressure, diabetes/high blood sugar, and cataract specifically, from any health provider. Only these diseases were considered given their burden in the Indian context. A reference period of 3 months was taken for the above-mentioned diseases.

We used a clinical algorithm for categorizing respondents as highly probable cases based on the criteria outlined by Levesque et al.[16] using symptoms for chronic conditions [Table 1]. There are no typical symptoms that characterize hypertension and diabetes; hence self-reported diagnosis was used as a criterion. We used a clinical algorithm to improve the identification of cases with chronic conditions in the rural setting. Self-reported diagnosis alone can in a rural context risks under estimation of the actual burden of disease owing to illiteracy, lack of common knowledge and understanding of health and diseases, and lack of access to quality care to appropriately lead all symptomatic cases to treatment.

Sociodemographic Variables

Information on background characteristics including age, location, education, caste, and perceived poverty was gathered. Education was classified into three categories—"Illiterate/literate without formal education," "primary education," and "secondary or higher education." The respondents were classified into general, other backward castes (OBC), and scheduled caste (SC)/scheduled tribes (STs) castes. The study area was classified into remote and nonremote zones based on the proximity of the blocks with the city.[13] We classified the respondents into three categories for perceived poverty—"always had deficit of income," "had occasional deficit," and "rare or no deficit."

Risk Factors

Smoking exposure was defined as the minimum pack years of exposure to smoking based on the definition provided

Table 1: Criteria for the assessment of NCDs

Conditions (reference period is last 3 months)

Angina

[Have been diagnosed with angina by any provider in the past]

OR

[Have pain or discomfort in the chest when you walk uphill or hurry in the last 3 months? AND Pain or discomfort in your chest when you walk at an ordinary pace on level ground in the last 3 months?]

Arthritis

[Have been diagnosed with arthritis in the past]

OR

[Has pain, aching, stiffness, or swelling in or around the joint [like arms, hands, legs, or feet], which were not related to an injury and lasted for more than a month? AND A feeling of stiffness in the joint in the morning after getting up from bed, or after a long rest of the joint without movement that occurred regularly? AND Stiffness for more than 30 min.

Asthma

[Have been diagnosed with asthma in the past]

OR

[Has attacks of wheezing or whistling breathing in the last 3 months? AND [Has had an attack of shortness of breath that came on without obvious cause when you were not exercising or doing some physical activity in the last 3 months? OR A feeling of tightness in the chest OR Attacks of wheezing after exertion /exercise OR Waking up with a feeling of tightness in the chest]

Cataract

[Have been diagnosed with cataract in the past]

OR

[Has blurry and cloudy vision AND experiences vision problems with light such as glare and brightness]

Hypertension

[Have got their blood pressure measured using an instrument in the past 3 months] AND [Have been told that they have got "High" blood pressure]

Diabetes

[Have been diagnosed with "Sugar" or "Diabetes" by any provider in the past]

by Lee et al.[17] We calculated the minimum pack years of exposure based on the minimum number of cigarettes that the respondent smoked in a day and the number of years since he/she has been smoking tobacco, to approximate the pack years of exposure to smoking. The respondents were classified as consuming sufficient amount of vegetables if they consumed more than five servings a day.[18] "Servings" was defined as the number of items with vegetables multiplied by number of meals per day. Body Mass Index (BMI) was calculated using weight and height measurements taken from the respondents using a standard tape and weighing machine.

Statistical Analysis

The outcome variable under consideration is multiple morbidities among the respondents. We first did an exploratory analysis of the prevalence of multiple morbidities in the study area against background characteristics using STATA Version 11.0 software. The outcome variables of interest being ordinal in nature, we chose a Partial Proportional Odds (PPO) Model for the above-mentioned set of predictors. Gender segregated analysis was done to control for the influence of gender on the outcome variables. For the model, initially, only those predictors that were significant in the univariate model were entered, followed by all hypothesized predictors. The goodness of fit of these two nested models was compared using log likelihood ratio test. We checked if the predictors in the final model met the assumption that the odds are identical for the predictors through the various cut points (ordinal categories in the outcome variable-1) of the outcome variable through the Wald statistic. A final PPO model was built for multimorbidity, constraining all predictors that met the proportional odds assumption, while the predictors that did not meet the assumption were left unconstrained.

Result

A total of 815 respondents were included in the analysis after data cleaning, of which there were 397 female and 418 male respondents. The average age of the respondents was 54.90 years. Table 2 shows the demographic composition of the study sample.

The prevalence of multiple morbidities was found to be 44.05% (CI 95%: 40.60–47.53). The crude overall prevalence of individual chronic conditions was 21.96% (CI 95%: 19.16–24.96) for angina, 46.38% (CI 95%: 42.91–49.87 for arthritis, 22.94% (CI 95%: 20.09–25.98) for asthma, 39.38% (CI 95%: 36.01–42.83) for cataract, 8.95% (CI 95%: 7.08–11.13 for diabetes, and 8.71% (CI 95%: 6.86–10.86) for hypertension. The prevalence of multiple morbidities by age and gender are shown in Figure 1. The prevalence rates are found to increase with age in both male and female respondents of the study population with a greater increase among the female respondents.

The disease-wise segregation of multimorbidity shows that at least 70% of all respondents presenting any chronic conditions such as angina, hypertension, diabetes, cataract, and asthma showed multiple chronic conditions [Figure 2].

The odds ratios of the predictors in the PPO model are illustrated in Table 3. The results show that age, education, employment status, BMI, vegetable intake, and smoking were significant predictors of the multimorbidity among men. Age was also a significant predictor of multiple chronic conditions among women. The odds of multiple morbidities when compared with single or no condition was 4.64 times (CI 95%: 1.74–12.33) among respondents older than 70 years, while the odds of one or more conditions was significant for respondents aged 60–69 years. The odds of single or multiple chronic conditions decreased with increasing education among both men and women. Men with primary or secondary education and employed men were found to be less likely to report chronic multiple conditions. The odds of single or multiple

Table 2: Sociodemographic composition of the respondents

Sociodemographic factors	Males, *(N* = 418)	Females, *(N* = 397)	Total, *(N* = 815)
	Mean ± SD	Mean ± SD	Mean ± SD
Age (years)	54.90 ± 10.77	54.85 ± 10.66	54.87 ± 10.71
BMI (kg/m²)	19.92 ± 3.02	20.37 ± 3.75	20.14 ± 3.41
Caste (%)			
General	49.52	45.09	47.36
OBC	4.78	4.28	4.54
Scheduled caste	45.69	50.63	48.10
Perceived poverty (%)			
Always deficit	41.11	39.69	40.42
Occasional deficit	42.31	39.44	40.91
Rare or no deficit	16.59	20.87	18.67
Education (%)			
Illiterate or literate without formal education	25.12	62.72	43.44
Primary	60.29	34.51	47.73
Secondary or higher	14.59	2.77	8.33
Marital status (%)			
Married	91.15	64.48	78.17
Widowed/separated/unmarried	8.85	35.52	21.84
Location (%)			
Remote Sundarbans	41.15	47.10	44.05
Nonremote Sundarbans	58.85	52.90	55.95
Occupational groups (%)			
Employed	79.19	35.01	42.33
Unemployed	20.81	64.99	57.67
Smoking (%)			
Nonsmokers	39.90	74.68	57.09
Light smokers	47.47	24.55	36.14
Moderate to heavy smokers	12.63	0.78	6.77
Vegetable intake (%)			
Insufficient	84.84	89.75	87.25
Sufficient	15.16	10.25	12.75

SD, standard deviation.

chronic conditions is found to increase with smoking exposure. However, the odds are found to be higher among heavy/moderate smokers when compared with light smokers. A unit increase in BMI contributed to a marginal increase in the likelihood of the outcome. BMI showed a marginal impact on the outcome variable of interest with a unit increase in BMI among women. Men with sufficient vegetable consumption were half as likely to report multiple morbidities when compared with the reference group, while women were more likely to report multiple chronic conditions.

Discussion

Our study shows that 44.05% of the population older than 40 years of age has multiple morbidities. Estimates from the cross-sectional study by Banjare & Pradhan et.al based on self report for adults older than 60 years of age also showed an overall prevalence of 56.80% in Odisha in India.[19] But, our estimates are very high when compared with the multimorbidity prevalence reported from the Lasi-Pilot Study in 4 states in India.[20] These differences in the estimates are probably due to differences in the operational definitions of multimorbidity and the age groups considered. Our estimates were also lower than prevalence figures from other cross-sectional studies that were facility based or drew data from health and patient records, probably, because reports from patients at hospitals are more likely to capture more chronic conditions.[21]

Age and gender have been found to be strong predictors of multimorbidity. We found a steady increase in the prevalence of multimorbidity with age among both men and women. This trend of increasing prevalence of multimorbidity with age is

Table 3: Odds ratios for multiple morbidities by background characteristics and risk factors—results from PPO model

	Males				Females			
	Single or multimorbidity vs. no chronic condition		Multimorbidity vs. no chronic condition or single chronic condition		Single or multimorbidity vs. no chronic condition		Multimorbidity vs. no chronic condition or single chronic condition	
	Odds ratio	CI 95%	Odds ratio	CI 95%	Odds ratio	CI 95%	Odds ratio	CI 95%
Age (years)								
40–49 (ref.)								
50–59	1.29	0.73–2.28	1.29	0.73–2.28	2.56	1.39–4.72	2.56	1.39–4.72
60–69	3.51	1.49–8.29	1.53	0.72–3.25	2.78	1.44–5.37	2.78	1.44–5.37
>70	2.09	0.75–5.85	4.64	1.74–12.33	4.77	1.89–12.06	4.77	1.89–12.06
Education								
Illiterate (ref.)								
Primary	0.48	0.27–0.85	0.48	0.27–0.85	1.26	0.76–2.09	1.26	0.76–2.09
>Secondary	0.40	0.17–0.93	0.87	0.37–2.01	0.84	0.24–2.90	0.84	0.24–2.90
Marital status								
Married (ref.)								
Unmarried/single/widowed	0.54	0.23–1.25	0.54	0.23–1.25	1.38	0.79–2.42	1.38	0.79–2.42
Perceived poverty								
No deficit (ref.)								
Always deficit	1.32	0.66–2.64	1.32	0.66–2.64	1.65	0.86–3.14	1.65	0.86–3.14
Occasional deficit	1.08	0.54–2.12	1.08	0.54–2.12	1.16	0.61–2.22	1.16	0.61–2.22
Caste								
General (ref.)								
OBC	1.17	0.40–3.42	1.17	0.40–3.42	0.56	0.19–1.64	0.56	0.19–1.64
SC/ST	1.23	0.75–2.00	1.23	0.75–2.00	0.87	0.54–1.42	0.87	0.54–1.42
Occupation								
Unemployed (ref.)								
Employed	0.33	0.16–0.67	0.33	0.16–0.67	1.47	0.89–2.42	1.47	0.89–2.42
Location								
Nonremote (ref.)								
Remote	0.75	0.46–1.22	0.75	0.46–1.22	1.32	0.81–2.15	1.32	0.81–2.15
BMI continuous	1.14	1.05–1.23	1.14	1.05–1.23	1.07	1.00–1.15	1.07	1.00–1.15
Smoking								
Nonsmokers (ref.)								
Light smokers	1.68	1.00–2.81	1.68	1.00–2.81	0.92	0.53–1.60	0.92	0.53–1.60
Moderate to heavy smokers	1.38	0.66–2.86	1.38	0.66–2.86	1.06	0.08–13.31	1.06	0.08–13.31
Vegetable intake								
Insufficient (ref.)								
Sufficient	0.53	0.28–1.00	0.53	0.28–1.00	1.92	0.87–4.24	1.92	0.87–4.24

CI, confidence interval.

in consonance with morbidity trends shown in other studies. Evidences from cross-sectional studies in the general population have shown a higher odds of multiple chronic conditions among the older age groups.[22] Our study findings show that the prevalence of multiple chronic conditions were visibly higher among women and is confirmed by evidence from both India and other countries on gender differences in individual chronic conditions.[23,24] The odds of multiple chronic conditions were slightly higher for female respondents aged older than 70 years when compared with male respondents. Our study shows that both men and women exhibit a greater chance of multiple chronic conditions with age even though the burden is higher among women. This differs from the results reported by Rizza et al.[25] that showed that the burden
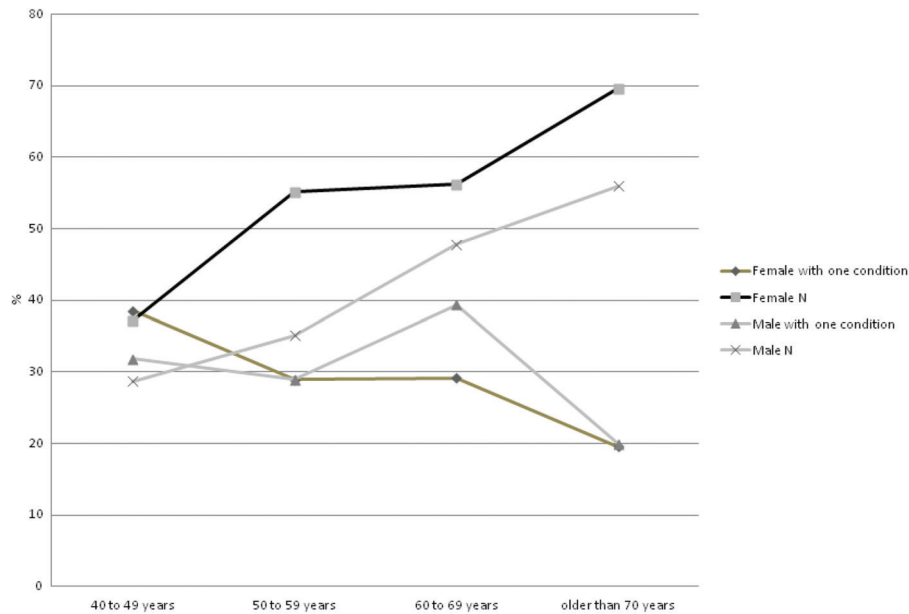
Figure 1: Gender segregated prevalence of multiple morbidities by age.
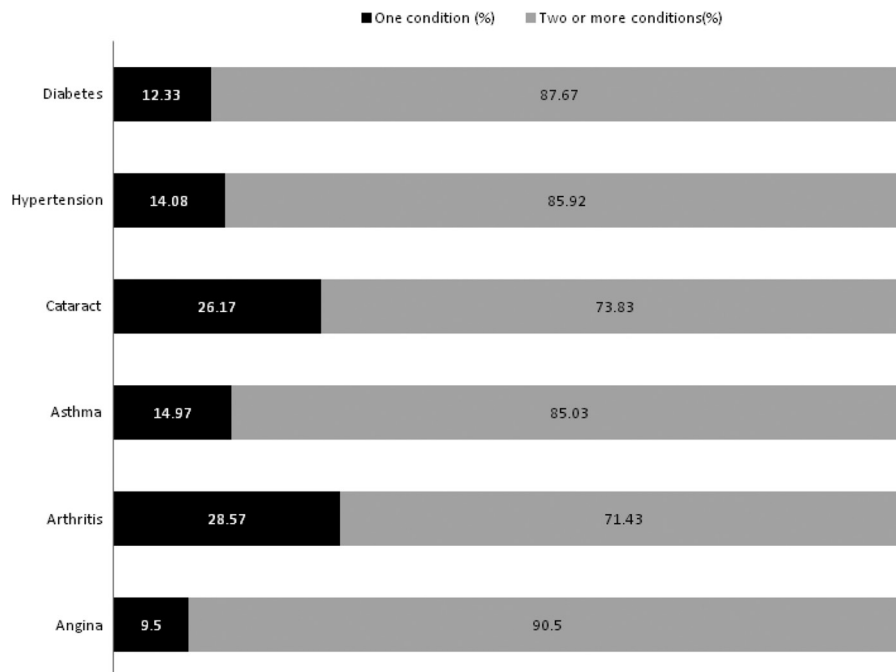

Figure 2: Disease-wise segregation of single and multiple chronic conditions (%).

of multiple morbidities was slightly lower among women with increase in age.[25]

Education has been found to have a negative association with multiple chronic conditions. This is supported by evidence from studies that have also shown a similar negative associ- ation between multimorbidity and educational status.[26] The

probable explanation can be that education improves an individual's ability to access health care and awareness that contributes to better health outcomes. It is interesting to note that education shows no significant association with the out- come among women, probably owing to their backward social and familial position that affects their health seeking behavior

and awareness. Risk factors such as BMI were found to be positively associated with multimorbidity prevalence among both the genders. This confirms the association of high BMI with multimorbidity reported in a cross-sectional study of the general population in Quebec.[27]

We found a positive association for smoking with multiple morbidities among men. This corresponds to results from a study by Fortin et al[27] on lifestyle behaviors and multimorbidity where smoking was associated with the outcome among men. However, studies on multimorbidity in Sweden and South Africa have shown no significant impact of smoking behaviors on the prevalence of multimorbidity in the study population.[26,28] The odds for multimorbidity was positive for moderate smoking. The decrease in odds among heavy smokers was probably owing to under perception of disease risks and severity among heavy smokers.[29] Vegetable consumption showed a negative association with multimorbidity among men and positive association among women.[30] Our results are in line with the study done by Fortin et al.[27] among men and women in Quebec, Canada, wherein the odds of multimorbidity were higher among women (when compared with men) who had sufficient fruit and vegetable intake.[27]

Strengths and Limitations

The study has tried to estimate the burden of multiple chronic conditions by using an operational definition to circumvent the limitations of self-reported disease by including highly symptomatic cases. It differs from popular literature in the area of NCDs by using a symptomatic assessment of burden in rural areas such as the Sundarbans.

Conclusion

The study provides evidence on an often ignored aspect of NCDs in India. Multimorbidity is an emerging public health challenge even in the rural regions of India. The increasing burden of multiple chronic conditions with age implies reduced quality of life, disability, and vulnerability. The results show that the prevalence of multimorbidity is significant even in the remote rural regions such as the Sundarbans that fare poorly on many socioeconomic and development indicators. The evidence serves as a case, to bring to light the immediate need for attention to the issue with responsive systems to monitor and cater to the rising burden among the fast aging population of the country's rural poor.

Acknowledgments

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