

# Mapping the Multidimensionality of Medical Care related Catastrophe on Households: A Study of Four Blocks in Birbhum District, West Bengal

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## Research

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## Abstract

# Background

Medical care related catastrophe is generally identified by healthcare expenses crossing a certain percentage of household's resources (Wagstaff and van Doorslaer, 2003). This paper attempts to examine medical care related 'catastrophe' by going beyond the threshold-oriented approach of catastrophic medical expenditure and include multiple indicators which seeks to explore the catastrophe from a multidimensional perspective.

## Methods

Drawing from multidimensional vulnerability to poverty approach (Alkire and Foster, 2008), we provide a measure which incorporates multiple indicators that might put households in medical care related catastrophic situation. Our study uses data from a cross-sectional household survey conducted by the Society for Health and Demographic Surveillance (SHDS) of the Government of West Bengal in 2012. Using negative binomial and logistic regression, the study also attempts to find the correlates of healthcare utilization, incurring catastrophic health expenditure for both 10 per cent of household consumption expenditure and 40 per cent of non-food expenditure as well as resorting to distress financing and availing low quality/ no care despite chronic illness.

## Results

Estimates show that illness, presence of elderly members, hospitalization and outpatient visits increases the risk of incurring catastrophic health expenditure and healthcare utilization counts. In addition, households belonging to backward socio-religious categories and having members engaged as casual labourers face higher odds of distressed financing and availing informal/ no healthcare. In contrast to Wagstaff and van Doorslaer's measure of catastrophic medical expenses, the multidimensional measure shows a lower medical care catastrophe for the upper economic classes and forward caste groups and vice versa which is more realistic and convincing.

## Conclusions

The evidence generated from the multidimensional analysis presents a more convincing and reliable picture of vulnerability imparted due to health shocks as compared to identifying households with catastrophic medical expenditure by Wagstaff and van Doorslaer's method. However, this study has its limitations as it has given equal weightage to all the dimensions and restricted itself to headcount measures. However, extension and refinement of this approach can provide more insightful findings.

## Background

In many developing countries, households' out-of-pocket (OOP) payments are the principal source of financing medical care [1]. A household is considered to have incurred catastrophic medical expenses (CME) when its OOP medical expenses exceeds a certain percentage of its capacity to pay, often proxied by income, total consumption expenditure or non-food expenditure [2]. The thresholds represent a pre-defined percentage of household income or expenditure which varies from 5 to 40 [3, 4]. Also, lower thresholds are used when total income or expenditure values are considered as the denominator, while higher thresholds are used when net food expenditure is subtracted from the denominator, reflecting the capacity to pay of the household [5]. The underlying assumption of the latter approach is that food and

health expenditure are not substitutes [6]. When OOP medical payments becomes catastrophic, they force households, especially the poor ones, to borrow money, sale assets, take help from relatives and friends or compromise its consumption of basic necessities in order to spend for health care [1, 2, 7, 8].

A large number of studies using data from different settings estimated the extent of CME and identified a number of factors which contribute to household's catastrophic medical payments. Among such factors coverage of household by medical insurance, type of medical care utilized (inpatient/outpatient, public/private), economic conditions and occupational type of the households, socio-demographic and other characteristics of the household (e.g. place of residence, presence of chronically ill members, presence of elderly, presence of children, household size etc.) are found influential [9–15]. Not only the reasons behind medical catastrophe for households are multiple, a situation of catastrophe gets revealed through multiple observable outcomes at the household level. For example, large out-of-pocket medical expenses may force households to depend on a financing mechanism which may reduce its long-term well-being [16–18]. Also, when a household is forced to sell its productive assets or borrow money at high rates of interest or spends from savings which was kept for productive investment – all for meeting out-of-pocket medical expenses, it is bound to reduce a household's long-term well-being [19–20]. There would also be sections of the population lacking the capacity to mobilize finance for meeting out-of-pocket medical expenses and they may resort to measure like avoiding or delaying medical care or seeking medical care from less expensive private options such as quack or unqualified medical practitioners.

The Wagstaff and van Doorslaer approach, despite their ease of interpretation and popularity, has several limitations. The first and foremost limitation of the Wagstaff and van Doorslaer approach is that the entire exercise of analyzing the intensity and incidence of CME among the households is a money-centric measure calculated when the ratio between household's health expenditure and its disposable income exceeds a threshold. It ignores the other aspects of households and individuals as well as health seeking behavior which are important for capturing a holistic picture. Second, exceeding the threshold may imply different situation for a poor and non-poor household since we do not often have information about household's savings. In this regard, it must be noted that households which have gone beyond their capacity to pay for medical expenses could possibly do it because of its assets, capacity to borrow and social capital. Therefore, it is also important to look at how the out-of-pocket medical expenses are financed. Third, poor households, however lack capacity to mobilize additional money for medical care and they may delay health care, avoid health care, and even go to less expensive unqualified health care. The measure proposed by Wagstaff and van Doorslaer does not incorporate these households. Against this backdrop, this paper attempts to identify households with medical care related catastrophe by looking at multiple dimensions and compare it with estimates obtained by using Wagstaff and van Doorslaer's approach.

## Methods

### Data Source

The paper uses data from a cross-sectional household survey conducted by the Society for Health and Demographic Surveillance (SHDS) which was created by the Department of Health and Family Welfare, Government of West Bengal in 2008. The survey was conducted in four community development blocks of Birbhum district in West Bengal. Birbhum is one of the 19 districts of West Bengal which account for 5.12 per cent of the land area and 3.76 per cent of the total population in the state. As per the latest Census (2011) [21], the district has a sex ratio of 956 females per 1000 males and literacy rate is 70.7 per cent. Also, the percentages of Schedule Castes (SC) and Scheduled Tribes (ST) in total population are 29.5 and 6.9 per cent respectively. The survey covered 12557 households (54,585 individuals) living in 351 villages in four community development blocks, namely, Suri-I, Sainthia, Rajnagar and Muhammad

Bazaar. The survey collected information on household and individual member level socioeconomic and demographic information, self-reported general ailments and chronic ailments, utilization of inpatient and outpatient health care, expenditure on health care and sources of financing the health care expenses. The recall period for collecting outpatient and inpatient care utilization and expenditure were 15 days and 365 days respectively. The survey also collected health care utilization information which was not related to any ailment but preventive and childbirth related in nature.

## Methodology

In order to get a holistic picture of a household's catastrophe due to illness and associated high OOP medical care expenditure and its ability to cope up with the situation, we consider a measure which considers various characteristics of the households. In other words, we look at multiple indicators observed at the household level to get a more complete picture of the shock that a medical care need imposes on the household. In doing so, we draw upon the conceptualization of multidimensional poverty [22], to identify the healthcare related catastrophe based on demographic characteristics, healthcare utilization indicators and inability to cope factors. Following their approach, we first identify a set of indicators which could capture to a great extent a household's vulnerability due to illness shock. In the second stage, we set threshold for each of the chosen indicator to identify if a household is vulnerable to medical care induced catastrophe with regard to the particular indicator. Thus, for each of the nineteen indicators, one knows if a particular household is vulnerable in that particular indicator. This allows us to generate a catastrophe score for each household depending upon the number of indicators it is vulnerable to. In the final stage, we select a threshold for the vulnerability score and compare it with the Wagstaff and van Doorslaer catastrophic approach, where the percentage of households who are multidimensionally vulnerable or having catastrophic health expenditure are almost equal. A comparative analysis of both the approaches has been conducted across socio-religious category and income groups. The socio-religious categories are ST, SC, Muslim and Others (General and Other backward caste households). The income groups have been generated using information collected by the survey on consumption expenditure which includes both homegrown and purchases from the market for each individual. We used per capita consumption expenditure (PCCE) as proxy for a household's economic status and the 2011-12 poverty line for rural West Bengal (Rs 783) determined by the Planning Commission, to categorize sample households into economic groups [23]. Using this technique, households with PCCE less than Rs 783 have been classified as poor and those having PCCE equal or higher than Rs 783 but lesser than twice the poverty line (Rs1566) have been considered as lower-middle class. Likewise, households with PCCE equal to Rs 3132 (greater than Rs 1566 but lower than four times the poverty line) are the middle-class households and those with PCCE greater or equal to Rs 3132 have been categorised to be upper-middle class or rich households.

## Study variables

The lists of all the indicators and variables used to construct those indicators are provided in Table 1 (also refer to Additional File 1). These indicators have been chosen considering their frequency of mention in the existing empirical literature. The higher values of the indicators imply an increase in the probability of medical care induced catastrophe for the household. For example, higher number of elderly, children, chronically ill persons, female members in the reproductive age group and members reporting acute illness in a household may increase the need for more medical care and may require more financial resource for meeting medical care need. An increase in demand for medical care may increase the household's OOP medical expenses if not covered by insurance or similar protection mechanism. The higher OOP medical expenses may have many unintended consequences on the households. First, it may force the household to compromise its consumption of basic necessities such as food and nutrition, education for the children. Second, it may force household to sell productive assets (such as land, cattle) which may reduce their long run earning

capacity. Third, fearing high medical expenses, many households might avoid or delay seeking health care, avoid seeking health care or may go to less expensive low quality care, even under-consume health care (by not fully taking the required medicines and not getting the suggested diagnostic tests done). When monetary budget allocated for medical care get rationed or curtailed, girl children, women and elderly often bear most of the discrimination.

Table 1  
Household level indicators and their threshold values

Indicators	Threshold for vulnerability
Household size	$\geq 6$
Number of elderly persons	$\geq 1$
Number of children (0–5 years)	$\geq 3$
Number of chronically ill persons	$\geq 1$
Number of persons reporting acute illness	$\geq 1$
Number of women belonging to reproductive age group (15–49 years)	$\geq 1$
Number of hospitalization cases	$\geq 1$
Number of hospitalization at private facilities	$\geq 1$
Number of hospitalization outside the district	$\geq 1$
Number of outpatient visits	$\geq 2$
Number of outpatient visits at private facilities	$\geq 2$
Number of outpatient visit outside the district	$\geq 1$
Per capita consumption expenditure (PCCE)	Poor households (households with less than Rs. 783 PCCE)
Occupational type of the household	Casual labour households
Number of members having insurance coverage	More than half of the members not having insurance coverage
Out-of-pocket health expenditure as a percentage of total consumption expenditure	$\geq 10$ per cent
Out-of-pocket health expenditure as a percentage of total non-food expenditure	$\geq 40$ per cent
Type of finance for meeting out-of-pocket expenditure	Borrowing/contribution and selling/mortgaging any asset
Low quality care or no healthcare	No healthcare / informal care for severe illnesses
Source: Estimated from Birbhum Population Project Survey data (2012)	

## Data analysis

Like multidimensional poverty measure, our unit of analysis is household. To analyze the utilization of medical care services, negative binomial regressions have been estimated as it is an appropriate method which allows a better fit for over-dispersed count outcome variables and offers more precise results than other count data regression models [24].

For Negative Binomial regressions the following count data dependent variables are considered: (i) number of hospitalization; (ii) number of hospitalization in private facilities; (iii) number of hospitalization outside the district; (iv) number of outpatient (OP) visits; (v) number of outpatient (OP) visits to private facilities and (vi) number of outpatient (OP) visits outside the district.

To examine the household correlates of CME (conventional measures/Wagstaff van Doorslaer method), distress financing and no or low-quality medical care, logistic regressions have been conducted. For catastrophic medical expenditure as per the conventional measures, we have considered two binary dependent variables: (i) households with OOP health expenditure exceeding 10 per cent of its total consumption expenditure (TCE) taking on value 1 and 0 otherwise; and (ii) households spending more than 40 per cent of its non-food expenditure (nFE) on health care can take on value 1 and 0 otherwise. For the convenience of presentation, we refer the first one as Threshold 1 and the second one as Threshold 2. A household is considered to have resorted to distress financing for meeting medical expenses if it depended on sale/mortgaging of physical assets, borrowing and contributions from friends and relatives (value 1) or not (value 0). No or low quality of medical care is defined if at least one member of the household remained without medical care in case of a severe illness (illness which restricted usual activity or made the person confined to bed at least for a day) or went to seek medical care from a quack (value 1), otherwise 0. The statistical analysis has been carried out using Stata 14.

## Results

The household level indicators along with their threshold values are presented in Table 1. Table 2 presents the mean and 95 per cent confidence intervals of the indicators. The average household size is approximately 5. For every 100 households 39 elderly people, 46 children, 284 women of reproductive age group, 64 persons reporting illness with 19 reporting chronic illness are found. The average monthly PCCE of the household is ₹1371.17. About 26 per cent of the household members in the sample are covered by some form of health insurance scheme or other. As far as households' occupation is concerned, the casual labour households constitute more than half of the sample households (54 per cent), followed by self-employed (26 per cent) and regular wage/salaried (14 per cent).

Table 2  
Household level summary statistics of the indicators

Variables/Indicators	Mean (95% Confidence Intervals)
Average household size	5.02 (4.98,5.06)
Average number of elderly members	0.39 (0.38,0.40)
Average number of children	0.46 (0.45,0.47)
Average number of chronically ill members	0.19 (0.18,0.20)
Average number of acute ill persons	0.64 (0.62,0.65)
Average number of females in the reproductive age	2.84 (2.82,2.87)
Average per capita consumption expenditure (Rs)	1371.17 (1347.12,1395.22)
Proportion of households members with insurance coverage	0.26 (0.25,0.26)
Proportion of self-employed households	0.26 (0.26,0.27)
Proportion of regular wage/salaried households	0.14 (0.14,0.15)
Proportion of casual labour households	0.54 (0.53,0.55)
Proportion of households engaged in <i>other</i> or no occupations	0.06(0.05,0.06)
Average number of hospitalizations	0.24 (0.23,0.25)
Average number of hospitalizations at private facilities	0.008 (0.006,0.009)
Average number of hospitalizations outside district	0.012 (0.009,0.014)
Average number of outpatient visits	0.87 (0.85,0.89)
Average number of outpatient visits outside district	0.005 (0.004,0.007)
Average number of outpatient visits in private facilities	0.34(0.33,0.36)
Average 'out-of-pocket health expenditure as a percentage of total consumption expenditure'	10.51 (9.67,11.34)
Average 'out-of-pocket health expenditure as a percentage of total non-food consumption expenditure'	68.03 (61.58, 74.48)
Proportion of households reporting contribution/donation/borrowing from friends/relatives/neighbours and/or selling/mortgaging of assets to as major source to finance health care	0.30 (0.29,0.31)
Proportion of households with no care/low quality care despite chronic/acute illness	0.42 (0.41,0.43)
Source: Estimated from Birbhum Population Project Survey data (2012)	

For every 100 households, 24 episodes of hospitalization and 87 OP visits have been reported. The private facilities accounts for almost 34 per cent of the total OP visits and less than 1 per cent of OP visits happened outside the district. On an average a household spends little more than 10 per cent of its total consumption expenditure and 68 percent of its total non-food expenditure on medical care. As high as almost 30 per cent of the households resort to borrowing money, seeking contribution from friends and relatives, selling or mortgaging assets as a major source of

finance for meeting their OOP medical care expenditure. The proportion of household with no medical care or care from low quality healthcare provider (such as quack) is also as high as 42 per cent.

Table 3 presents the results of negative binomial regression for 6 healthcare utilization variables. The values of the Incidence Rate Ratio (IRR) suggest that demographic and illness related variables at the household level are positively related to the rate of healthcare utilization variables, especially hospitalization and OP visit to private facilities. The rate of hospitalization is expected to be higher for households with higher household size, elderly members, children, chronically and acute ill members, females in the reproductive age as well as for SC and Muslim households. Having an insurance coverage increases hospitalization at private facilities for a household. Belonging to disadvantaged socio-religious groups reduces the rate of health care utilization as is observed from the significant IRR values for hospitalization in private facilities and OP visits in private facilities. Also being economically backward reduces a household's count in most of the health care utilization variables though it is insignificant for number of OP visits and number of OP visits outside district. It however holds significant for poor households travelling outside district for OP care.

Table 3  
Results of the Negative Binomial regressions

Variables	Hospitalization	Hospitalization in private facilities	Hospitalization outside district	Outpatient visits	Outpatient visits in private facilities	Outpatient visits outside district
	IRR	IRR	IRR	IRR	IRR	IRR
Household size	1.04***	1.43*	1.42*	1.02	1.05*	1.12
Number of elderly members	1.12*	1.19	0.93	0.99	0.96	1.48***
Number of children	1.42*	1.04	1.08	1.01	1.10*	0.94
Number of chronically ill members	1.15*	0.97	1.05	2.12*	1.66*	4.22*
Number of members with acute illness	1.04***	0.95	0.90	1.99*	1.17*	1.13
Number of women in the reproductive age group	1.06**	0.79***	0.84	1.04	1.03	0.96
Number of members having insurance coverage	1.01	1.13***	0.99	1.02	0.93*	0.94
Type of household (Ref: Self-employed/regular wage or salaried/other households)						
<i>Casual Labour households</i>	1.03	0.803	0.81	1.01	0.90*	1.14
Socio-religious categories (Ref: Others)						
<i>Scheduled Tribes</i>	0.80**	0.36	0.80	0.97	0.48*	0.40
<i>Scheduled Caste</i>	1.26*	0.50**	0.90	1.01	0.77*	1.37
<i>Muslim</i>	1.44*	0.58***	0.92	0.99	0.83*	1.81
Economic Class (Ref: Upper Middle)						
<i>Poor</i>	0.425*	0.033*	0.01*	0.96	0.41*	0.28***
<i>Lower Middle</i>	0.591*	0.105*	0.14*	0.99	0.66*	0.61
<i>Mid-Middle</i>	0.844***	0.341*	0.45*	0.94	0.93	2.09

Note: \*, \*\* and \*\*\* indicate 1%, 5% and 10% level of significance respectively.

Source: Estimated from Birbhum Population Project Survey data (2012)

Variables	Hospitalization	Hospitalization in private facilities	Hospitalization outside district	Outpatient visits	Outpatient visits in private facilities	Outpatient visits outside district
	IRR	IRR	IRR	IRR	IRR	IRR
Constant	0.164*	0.018*	0.02*	0.38*	0.33*	0.01*
Note: *, ** and *** indicate 1%, 5% and 10% level of significance respectively.						
Source: Estimated from Birbhum Population Project Survey data (2012)						

The results of the logistic regressions exploring the household level correlates of catastrophe medical expenses, distressed financing and no medical care or low-quality medical care are presented in Table 4. Among the control variables, the significant correlates of incurring CHE using 10 per cent of TCE as threshold (Threshold 1) are presence of elderly and chronically ill members, hospitalization events and OP visits (both in private facilities and outside district). On the other, the significant controlling variables for incurrance of CHE, using 40 per cent of nFE as threshold (Threshold 2) are presence of children, chronically ill members, hospitalization events and OP visits (both in private facilities and outside district) and belonging to poor, lower middle and upper middle income groups.

Table 4  
Results of the logistic regressions

Variables	Catastrophe		Distress Financing	Low quality/no care for severe illness
	Threshold1	Threshold2		
	Odds Ratio	Odds Ratio	Odds Ratio	Odds Ratio
Household size	0.78*	0.60*	0.70*	0.97
Presence of an elderly member	1.63*	1.67*	1.17**	0.96
Presence of a child	0.57**	1.06	0.69	1.40**
Presence of an acute ill member	0.82*	0.97	1.44*	35.75*
Presence of a chronically ill member	1.63*	1.76*	2.13*	11.98*
Presence of a woman in the reproductive age group	0.91*	0.64*	0.85**	0.94
Number of hospitalization event	5.448*	4.24*	11.05*	-
Number of hospitalizations at private facilities	3.314*	2.56*	0.95	-
Number of hospitalizations outside the district	1.939**	2.36*	1.02	-
Number of OP visit	1.07	1.01	1.16*	-
Number of OP visit to private facility	1.91*	1.75*	1.76*	-
Number of OP visit outside the district	2.35*	2.31*	1.31	-
<i>Occupation type (Ref:Others)</i>				
Casual labour households	0.94	1.03	1.72*	1.22*
Number of members having insurance coverage	0.92	0.88*	0.75*	0.94
<i>Socio-religious categories (Ref: Others)</i>				
Scheduled Tribes	0.48*	0.62*	1.05	1.78*
Scheduled Caste	0.91	0.87*	1.84*	1.13***
Muslim	1.01	1.02	1.74*	1.24*
<i>Economic Class (Ref: Upper Middle)</i>				
Poor	0.42*	7.64*	2.48*	1.30**
Lower Middle	0.49*	4.61*	1.92*	1.15

Notes: Definitions of dependent variables – **Threshold1** = 1 if a household's out-of-pocket health expenditure is more than 10% of its consumption expenditure, = 0 otherwise; **Threshold2** = 1 if a household's out-of-pocket health expenditure is more than 40% of its non-food expenditure, = 0 otherwise; **Distress financing** = 1 if household resorts to selling/mortgaging of assets, borrowing and contribution from others to finance health care, = 0 otherwise; **Low quality/no care for any illness** = 1 if at least one ill member of the household does not seek health care even when ill, = 0 at least resort healthcare in spite of chronic illness (at least one case); =0. \*, \*\* and \*\*\* indicate 1%, 5% and 10% level of significance respectively.

Source: Estimated from Birbhum Population Project Survey data (2012).

Variables	Catastrophe		Distress Financing	Low quality/no care for severe illness
	Threshold1	Threshold2		
	Odds Ratio	Odds Ratio	Odds Ratio	Odds Ratio
Mid-Middle	0.86	3.26*	1.88*	0.89
Constant	0.32*	0.09*	0.02*	0.03*
Notes: Definitions of dependent variables – <b>Threshold1</b> = 1 if a household's out-of-pocket health expenditure is more than 10% of its consumption expenditure, = 0 otherwise; <b>Threshold2</b> = 1 if a household's out-of-pocket health expenditure is more than 40% of its non-food expenditure, = 0 otherwise; <b>Distress financing</b> = 1 if household resorts to selling/mortgaging of assets, borrowing and contribution from others to finance health care, = 0 otherwise; <b>Low quality/no care for any illness</b> = 1 if at least one ill member of the household does not seek health care even when ill, = 0 at least resort healthcare in spite of chronic illness (at least one case); =0. *, ** and *** indicate 1%, 5% and 10% level of significance respectively.				
Source: Estimated from Birbhum Population Project Survey data (2012).				

The household level variables which are found to contribute higher odds favouring distressed financing are presence of elderly (OR = 1.17), acute (OR = 1.44) and chronically ill members (OR = 2.13), hospitalization (OR = 11.05), number of OP visits (OR = 1.16) and number of OP visits to private facilities (OR = 1.76). The odds favouring distress financing are higher for casual labour (OR = 1.72), SC (OR = 1.84) and Muslim households (OR = 1.74) in comparison to their corresponding reference categories. Compared to upper middle households, poor, lower middle class and middle-middle class have higher odds in favour of distressed financing. The last column of the Table 4 shows that households with children, acute and chronically ill members and households who are poorly endowed such as households with members engaged as casual labourers, ST, SC and Muslim households and households belonging to poor economic strata have significantly higher odds of availing low quality care or no care in spite of severe illness.

It should be noted that while the threshold centric measure of health expenditure catastrophe can tell us what percentage of households incur CME for each value of threshold, the multidimensional measure suggested in this paper can tell us what percentage of households are multidimensionally vulnerable for each aggregate score. To bring out the contrast of our suggested method with the threshold centric approach, we compare the detailed results obtained through application of these methods. We estimate the percentage of households with CME (Wagstaff and van Doorslaer method) and how the average percentage is distributed across economic and socio-religious classes. Similarly, we also estimate what is the percentage of households which are multidimensionally vulnerable (our method) and how the average percentage is distributed across economic and socio-religious classes. It is obvious that the percentage of households with CME and multidimensionally (MD) vulnerable would depend on the threshold. When the threshold is low, higher percentage of household would qualify to call them as medical catastrophe or vulnerable

due to medical care related reasons and as the threshold become stricter (higher in values), percentage would come down gradually. This is true for both the methods and is shown in Fig. 1 (also see Table 5) and Fig. 2 (also see Table 6).

Table 5  
Absolute and cumulative percentages of households multidimensionally deprived to health shocks

Multidimensional deprivation scores	Frequency of households (in percentages)	Cumulative deprivation to health shock scores	Cumulative population percentage
0	64(0.51))	$\geq 0$	100
1	536(4.27)	$\geq 1$	99.49
2	1219(9.71)	$\geq 2$	95.22
3	1644(13.09)	$\geq 3$	85.51
4	1891(15.06)	$\geq 4$	72.42
5	1835(14.61)	$\geq 5$	57.36
6	1727(13.75)	$\geq 6$	42.75
7	1340(10.67)	$\geq 7$	29
8	932(7.42)	$\geq 8$	18.33
9	660(5.26)	$\geq 9$	10.91
10	371(2.95)	$\geq 10$	5.65
11	191(1.52)	$\geq 11$	2.7
12	95(0.76)	$\geq 12$	1.18
13	36(0.29)	$\geq 13$	0.42
14	13(0.1)	$\geq 14$	0.13
15	3(0.02)	$\geq 15$	0.03
16	0(0)	$\geq 16$	0.01
17	0(0)	$\geq 17$	0.01
18	0(0)	$\geq 18$	0.01
19	(0)	$\geq 19$	0.01
Total	12557(100)		

Source: Estimated from Birbhum Population Project Survey data (2012).

Table 6

Cumulative percentages of households with catastrophic health expenditure by threshold percentages

Threshold 1 (OOP health expenditure as percentage of total consumption expenditure)	Cumulative percentage of households	Threshold 2 (OOP health expenditure as percentage of total non-food expenditure)	Cumulative percentage of households
>=1	93.01	>=1	97.03
>=5	45.69	>=5	87.92
>=10	24.32	>=10	76.09
>=15	15.58	>=15	65.09
>=20	10.80	>=20	57.03
>=25	7.76	>=25	50.01
>=30	5.71	>=30	43.40
>=35	4.42	>=35	38.30
>=40	3.69	>=40	34.66
>=45	3.05	>=45	31.14
>=50	2.53	>=50	28.73
>=55	2.17	>=55	25.57
>=60	1.85	>=60	23.61
>=65	1.66	>=65	21.81
>=70	1.47	>=70	20.11
>=75	1.32	>=75	18.88
>=80	1.19	>=80	17.63
>=85	1.08	>=85	16.43
>=90	0.95	>=90	15.40
>=95	0.89	>=95	14.56
>=100	0.83	>=100	13.94
Source: Estimated from Birbhum Population Project Survey data (2012).			
Source: Estimated from Birbhum Population Project Survey data (2012).			

To continue our comparison further, we ask the following question: if we set the thresholds of Wagstaff and van Doorslaer method and the method suggested in this paper in such way that both generate similar percentage of households with catastrophe or medical care related vulnerability, will the distribution across economic or socio-

religious classes be the same? It is found that percentage of households which have incurred CME as share of TCE with 13 per cent threshold is 18.50. This percentage of households spending more than equal to 13 per cent of their TCE as medical expenses is almost similar to households which are multidimensionally vulnerable in 8 or more dimensions (18.32 per cent). Figures 3 (also refer to Table 1 in Additional File 2) shows how the aggregate percentages derived using both the methods are distributed across socio-religious classes. Wagstaff-van Doorslaer's measure suggest that CME is highest for (non-ST, non-SC, non-Muslim) other class, followed by Muslims and SC and lowest for ST, a pattern which is counter-intuitive at least if one compares the ST and Other class. On the other hand, the multidimensional measure yields a more realistic and acceptable picture – the percentage of multidimensionally vulnerable households are highest for the Muslim households, followed by the SC and ST households and it is the least for the other households. In fact, the percentage of multidimensionally deprived households is higher for the ST households as compared to the other class households. However, like the Wagstaff-van Doorslaer's measure, SC and Muslim show higher vulnerability than the Scheduled Tribe – a pattern which is also observed in Wagstaff van Doorslaer measure. Similarly, just for the sake of understanding, let us again conduct a comparative analysis of both the methods across income groups. Figure 4 (also refer to Table 2 in Additional File 2) shows how the aggregate percentages derived using both the methods are distributed across income groups. Following Wagstaff-van Doorslaer's method, we find a counter-intuitive pattern - percentage of households having incurred CME is lowest for the poorest class, gradually increases as we move up economic status ladder and highest for the richest class. However, the multidimensional method portrays an opposite picture as the economically backward households are more multidimensionally deprived than their better-off counterparts, which seems to be more practical and reasonable.

## Discussion:

The study seeks to find the correlates of healthcare utilization, catastrophic health expenditure, distressed financing and seeking low quality or no medical care at the household level. It further attempts to explore the catastrophe related to medical care by going beyond the conventional method of threshold-specific measure of health catastrophe and attempts to draw from Alkire and Foster's multidimensional vulnerability to poverty approach [22]. The study finds that having large household size, elderly, children, chronically and acute ill members as well as females in the reproductive age increases the rates of seeking hospitalization care. In addition, SC and Muslim households have significantly higher expected rates of hospitalization as compared to ST and non-SC and non-Muslim households. Also, households with elderly members have higher rates of seeking OP care outside district, while having children increases the rates of OP visits in private centres. Even having chronically ill member(s) increases the rates of all types of OP visits, while having acute ill members significantly increases the rates of seeking OP care, both in general as well as in private facilities. These findings can be justified on the basis that both children and elderly are dependent members and prone to multiple diseases leading to an increased utilization of healthcare services. Even larger households especially those with higher share of dependent members will have to take care of the health of its members, leading to an increased utilization of hospitalisation care in either private facilities or outside district as well as OP visits in private facilities. As chronic care requires prolonged care and multiple checkups, households having chronically and acute ill members have higher expected rates of OP visits in both private facilities and outside districts. It thus seems that households with more dependent members and prominent illness characteristics are more prone to seek healthcare. This can be attributed to the positive impact of public health insurance to encourage households to seek care [25, 26]. However, with reference to the richer income groups and forward caste and religious groups, poor and backward socio-religious households have lower expected rates of seeking healthcare. Also households with insured members have higher expected rates of seeking hospitalisation in private facilities. Thus, although public hospitals provide subsidized care, low quality of care might force socio-economically and religiously backward households to have lower rates of

utilization of medical care on one hand, with households having insured members seeking hospitalisation in private facilities, on the other.

The study also finds that having elderly and chronically ill members and hospitalizations and OP visits (both in private facility and outside district) in the household significantly increases the likelihood of incurring catastrophic medical care expenditure for both the thresholds 1 and 2 [26–32]. As elderly members are vulnerable to ailments and chronically ill members require multiple OP visits and hospitalization events, they are more likely to incur OOP medical payments. This may also be due to the fact that for elderly, longer life span can lead to the emergence of non-communicable diseases such as musculoskeletal, neurological and dementia diseases which are costly and increase health expenses in the process [32]. It can be further justified by the lack of healthcare resources for the elderly and poor management of chronic diseases. Also seeking good quality care have resulted in people shifting to private hospitals for both inpatient and OP care which play an instrumental role in triggering OOP health expenses [25]. There also exists evidence that outpatient care expenses have the highest proportion in healthcare costs [28] and this can be attributed to the fact that social health insurance schemes in developing countries like India do not cover outpatient care [33]. There also exists enough empirical literature that suggests a positive relation between chronic illness and OOP health expenditure in LMICs [10, 34–38]. This is primarily because chronic care for NCDs is costly and place substantial burden on household budgets by increasing OOP payments and impoverishing households [39–41]. Our study also indicates that having health insurance significantly reduces the odds of spending more than 40 per cent of non-food expenditure as medical payments as well as likelihood of incurring distressed financing [42, 43]. The muted impact of health insurance can also be attributed to the locality of our sample as health insurance coverage is low or almost non-existent in rural areas.

The findings of the study further reveal that households belonging to lower economic and social strata are less likely to face CHE but have more likelihood to resort to distress financing or seek low quality care or avoid care as compared to their counterparts. Better-off households are more likely to incur catastrophic health spending have been supported by other studies conducted in Nigeria [44, 45], Mongolia [46, 47], Egypt [11] and Cambodia [48]. A possible explanation is that they have higher capacity to pay and might replace low quality public healthcare service with private healthcare. On the other, it reflects the inability of less-endowed households to divert resources from other basic needs which hinder them to seek care, thereby relying on low quality or no care [48–50]. Also, the lesser likelihood among the poorer economic groups to not face CHE might be explained by the lack of rigour to seek healthcare if their illness is not perceived to be severe. This pattern is however not true for the richer households who are willing to utilize health services at the early signs of illness.

Further, the decision to seek medical care among the poor households also poses a substantial risk of financial loss due to loss of income and added costs of food and accommodation for the caregivers [39, 51–52]. Studies have found that the poor were more prone to not seeking care as they could not afford to seek treatment and/or were unable to take time off work for seeking outpatient care [51, 53]. Similar results are found in a study conducted in Bangladesh on patients with acute febrile illnesses which shows that the mean time of arrival at the referral hospital is longer for the multidimensionally poor households as compared to their richer counterparts [54]. This association of barriers to care with poverty might start at an early stage from first seeking medical help to household's decision to escalate care to referral hospitals, are also accompanied with higher frequency of visits to unqualified healthcare professionals such as medicine shop owners, private allopathic/non-allopathic doctors or quacks. This is further supported by the growing dissatisfaction among the poorest households regarding the quality of public healthcare [54]. Other factors which might be attributing to this scenario are absenteeism, under-staffing, poor infrastructure, behaviour of health personnel and irregular supply of essential medicines in rural sectors [55, 56]. The higher tendency among the rural sample population to seek low quality or avoid care even with the presence of chronically and acute ill members can also be on

account of culturally ingrained traditions and beliefs as well as inconsistencies in accessing affordable healthcare services. Thus, inability of socio-economically and religiously backward households to pay for good quality or prolonged health care may exaggerate their sickness and limit their ability to work, thereby reducing their net earnings. This can contribute to poor health and decreased earnings, thereby placing them in the vicious circle of poverty.

The comparative analysis of the Wagstaff and van Doorslaer approach and the multidimensional approach also shows that backward socio-religious categories such as ST, SC and Muslims had a higher representation in the latter approach vis-à-vis the former. Similarly, the representation of the poor households is highest in the multidimensional approach, which decreases gradually for the higher income groups. This implies that the poor, ST, SC and Muslim households are deprived in more dimensions/indicators apart from incurring catastrophic expenditures more than 10 per cent of TCE or 40 per cent of CTP. The fact that socially backward castes and religious groups face the brunt of medical care catastrophe more than their better off counterparts is also observed in other studies [57, 58]. Thus, while the catastrophic measurement of healthcare payments only focus on the money metric measures, the multidimensional approach looks at demographic, household and healthcare seeking dimensions and highlights those households who are actually more vulnerable. Hence it provides a more convincing and reliable picture of vulnerability imparted as a result of health shocks as compared to identifying households by Wagstaff and van Doorslaer's method.

However, the limitations of the current approach must be spelt out. First, all the indicators are given equal weightage which might not be acceptable from a theoretical viewpoint. Second, only headcount measures are considered for the analysis and as such for capturing the extent of households with medical care related catastrophe other measures are required as well. Third, the study is not free from the regular limitations of self-reported illness, costs and healthcare utilization data that have been provided to the interviewers by the respondents. Despite these limitations and caveats, the findings of the study might be useful in providing appropriate policy framework and a more refined version can provide further insightful findings.

## **Conclusion:**

The frequently applied threshold-oriented measure of Wagstaff and van Doorslaer has several limitations. By using multiple dimensions related to household, individual and health seeking behavior, this paper tries to capture medical care related catastrophe faced by households. The multivariate analysis brings out many findings which makes the justification of using multiple indicators stronger. The presence of elderly member, hospitalization and outpatient visits increases the risk of incurring catastrophic health expenditure. Similarly, healthcare utilization counts and households belonging to the casual labour class and Muslims and scheduled castes face higher odds of financing health care via selling/mortgaging of assets and borrowing and higher odds of availing informal/ no healthcare. The use of low-quality care is significantly correlated to poor households and households with members working as casual labour. The multidimensional measure, presented in this paper, seems to portray a more convincing picture of medical care related catastrophe than Wagstaff and van Doorslaer's measure of catastrophic medical expenditure. Unlike the CME measure of Wagstaff and van Doorslaer, the multidimensional measures show a higher medical care catastrophe for the poor economic classes and for backward caste and religious groups – a pattern which is more expected and convincing. Thus, this approach of measuring medical care related catastrophe by incorporating non-monetary indicators helps to understand the factors that makes households more vulnerable to face health expenditure catastrophe and even highlights those section of the population who are more likely to be affected. Encompassing multiple indicators can capture the complexity of the vulnerability induced by medical care catastrophe which might be helpful in taking informed policy decisions by targeting the vulnerable groups.

## **Abbreviations**

**CME**

Catastrophic medical expenses

**CTP**

Capacity to pay

**LMICs**

Low- and Middle-Income countries

**NCDs**

Non-communicable diseases

**NFE**

Non-food expenditure

**OOP**

Out-of-pocket

**OP**

Outpatient

**OR**

Odds ratio

**PCCE**

Per capital consumption expenditure

**TCE**

Total consumption expenditure

**SC**

Scheduled castes

**SHDS**

Society for Health and Demographic Surveillance

**ST**

Scheduled tribes

## Declarations

## Ethics approval and consent to participate

Not applicable

### Consent for publication

Not applicable

### Availability of data and materials

The data that support the findings of this study are available from Society for Health and Demographic Surveillance (SHDS) (<http://www.shds.co.in/>) but restrictions apply to the availability of these data as they have been used in a collaborative manner for this study and so are not publicly available. Data might be available from the authors upon reasonable request and only with permission of SHDS.

### Competing interests

The authors declare that they have no competing interests.

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# Authors' contributions

PD analysed, interpreted and wrote the manuscript. SM supervised and provided ideas in the process of analysis and helped to edit the manuscript. All authors read and approved the final manuscript.

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## Figures

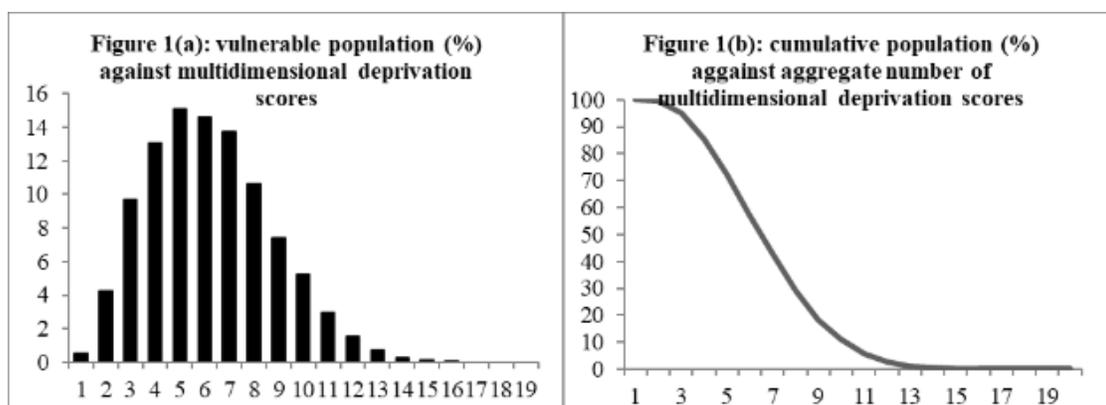
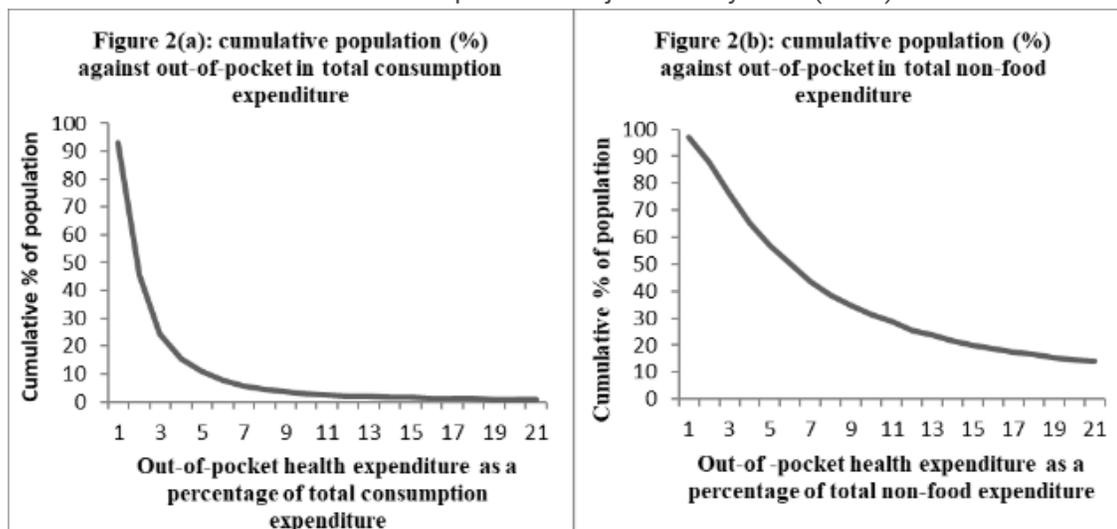


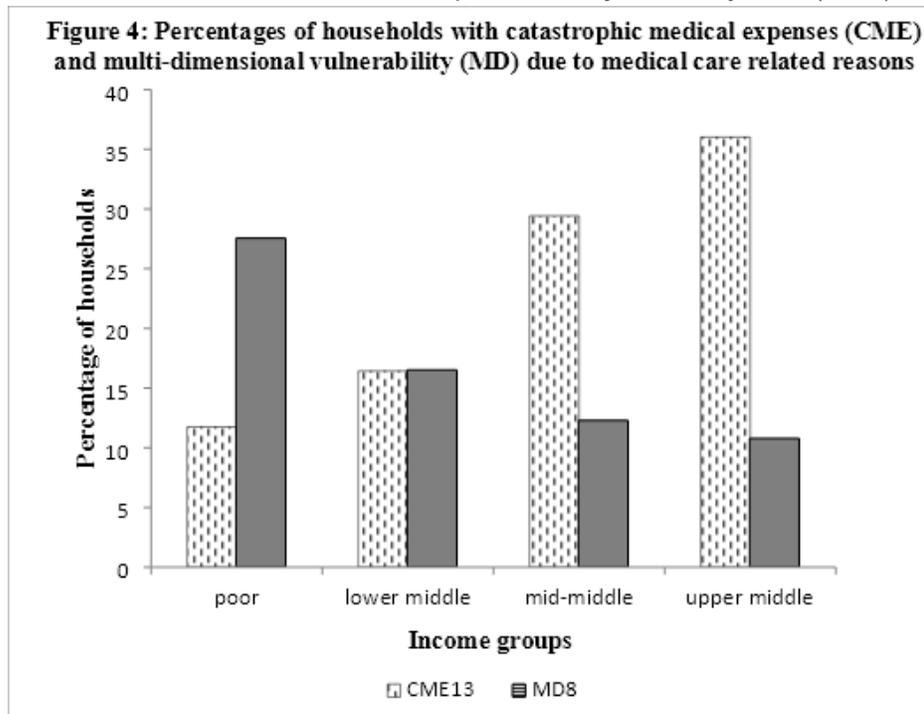
Figure 1

Source: Estimated from Birbhum Population Project Survey data (2012).



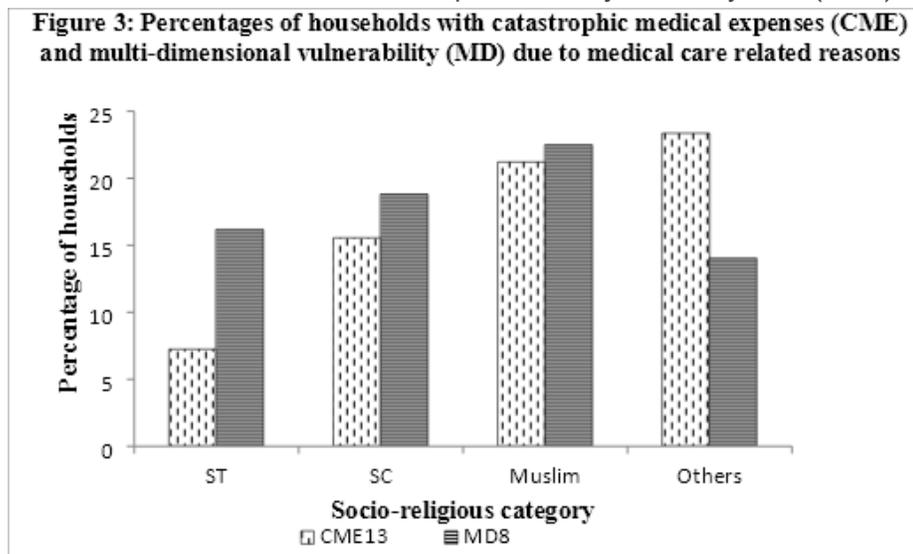
**Figure 2**

Source: Estimated from Birbhum Population Project Survey data (2012).



**Figure 3**

Source: Estimated from Birbhum Population Project Survey data (2012).



**Figure 4**

Source: Estimated from Birbhum Population Project Survey data (2012).

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