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Measuring households' multidimensional vulnerability due to health shocks: Evidence from National Sample Survey 71st round data

Subrata Mukherjee

Priyanka Dasgupta

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INSTITUTE OF DEVELOPMENT STUDIES KOLKATA

DD 27/D, Sector I, Salt Lake, Kolkata 700 064

Phone : +91 33 2321-3120/21 Fax : +91 33 2321-3119

E-mail : idsk@idskmail.com, Website: www.idsk.edu.in

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Measuring households' multidimensional vulnerability due to health shocks: Evidence from National Sample Survey 71st round data

Subrata Mukherjee[1]

Priyanka Dasgupta[2]

Abstract

A large body of empirical literature, examining the degree and extent of households' vulnerability due to health shock, has applied a concept of *catastrophic healthcare expenditure* suggested by Wagstaff and van Doorslaer (2003). In this approach, a household is considered to have incurred *catastrophic health expenditure* if its out-of-pocket health expenditure exceeds a certain percentage of its capacity to pay, where capacity to pay is household's consumption expenditure or non-food expenditure. The major limitations of this approach are the following: (i) it solely relies on consumption expenditure data generally collected through cross sectional survey; (ii) it ignores other forms of vulnerability such as avoidance, delay and use of low quality inexpensive health care and (iii) it does not distinguish households with different likelihood of facing health shocks and different capacities to absorb the shocks. Borrowing the conceptualisation of multidimensional poverty developed by Alkire and Foster (2008), this paper goes beyond a money-centric measure of vulnerability based on consumption expenditure data and offers a multidimensional measure which is free from some of the limitations of the approach suggested by Wagstaff and van Doorslaer. The multidimensional measure of *vulnerability due to health shock* suggested in this paper considers four dimensions

1. Associate Professor, Institute of Development Studies Kolkata. Email: msubrata100@gmail.com

2. PhD Student, Institute of Development Studies Kolkata Email: pdg0812@gmail.com

of a household viz. Illness, Utilisation, Capacity and Observed Vulnerability and uses 17 available indicators to capture all four dimensions. Validity and mutual connections of these indicators are examined using regression and correlation techniques. In the first stage, we fix indicator-specific cut-offs based on distributional features of variables (measured by estimated parameters) and evidence from literature. In the second stage the cut-off for aggregate vulnerability score is fixed considering its comparability with the Wagstaff-van Doorslaer's approach. Our results suggest that multidimensional measure of *vulnerability due to health shock* is more convincing compared to catastrophic health expenditure measure suggested by Wagstaff and van Doorslaer. However, equal weightage to all indicators and limiting the suggested measure to headcount ratio are two limitations of the new approach in its present form.

Keywords: health catastrophe, vulnerability, multidimensional, NSSO, India

Introduction

Health care financing in many low and middle income countries is still dominated by out-of-pocket (OOP) expenses made by the households. A high OOP health expenditure, most of the time, turns out to be catastrophic for many households, especially for the poor ones and for those who are not covered by adequate health expenditure protection schemes (such as insurance). In such situations households are forced to spend on health care by compromising on other necessities such as nutrition and education, which may lead to long-term welfare loss. A large OOP health expenditure, when it is financed by depleting savings or selling productive assets such as land, cattle etc., also has negative implications for a household's long-term income and welfare (Berki 1980; Peters *et al.,* 2002; Wagstaff and van Doorslaer 2003; Xu *et al.,* 2003; Damme *et al.,* 2004; Krishna 2004; Rusell 2004; Garg and Karan 2005; Su *et al.,* 2006; McIntyre 2006; van Doorslaer *et al* 2006; Schneider and Hanson 2006).

According to Wagstaff and van Doorslaer (2003), a household incurs catastrophic health expenditure if its OOP medical expenses exceed a certain fraction or proportion of its income or available resources or capacity to pay, generally measured by the household's total consumption or non-food expenditure. Following this approach, a large body of empirical literature has tried to quantify the incidence and the intensity of catastrophic health expenditure experienced by households in different contexts. In many of these empirical studies a household spending more than 10 per cent of its total consumption expenditure or more than 40 per cent of its non-food expenditure on health is considered as one with *catastrophic health expenditure*.

Majority of the literature, primarily coming from the developing countries context where large part of the population is not covered by effective insurance coverage, have found type of care utilised (inpatient care), type of provider utilised (private facilities), place of residence (rural areas), presence of chronically ill, presence of elderly, presence of children in the household, household size (big households), capacity to pay (poor), employment status (labour/ household with unemployed members), insurance coverage (no or public insurance) as key determinants of catastrophic health

expenditure (Su *et al* 2006; Vainshnavi and Das 2009; Berman *et al* 2010; Mondal *et al* 2010; Shi *et al* 2011; Fang *et al* 2012; Ye Li 2012; Abolhallaje *et al* 2013; Brinda *et al* 2014; Oyinpreye and Moses 2014; Rashad and Sharaf 2015; Kumara and Samaratunge 2016; Kien *et al* 2016; Rashidul *et al* 2017). Though not many empirical studies have mentioned them, there are other factors such as presence of disabled member, incidence of accident and injury in the household, sex of the head, education of the head, living conditions of the household etc. that are found to have influence on catastrophic health expenditure (Malik and Syed 2012; Buigut *et al* 2015; Kumar *et al* 2015; Molla *et al* 2017; Rashidul *et al* 2017). There are also some studies which have identified macro-level factors (such as state, public expenditure on health, quality of government facilities) having influence on catastrophic health expenditure (Bonu *et al* 2007; Samadi and Homaie 2013).

In spite of its ease of interpretation, popularity and widespread application, certain drawbacks of Wagstaff and van Doorslaer's approach cannot be ignored. First, in this approach the whole exercise of identifying a household with *catastrophic health expenditure* and measuring the intensity of catastrophe is based only on money-metric consumption data collected through cross sectional surveys. The accuracy of the catastrophic measure, therefore, depends on the quality and completeness of consumption expenditure data. Second, ignoring various household characteristics which show strong relation with a household's need for health care, its access to health care and the capacity to incur OOP health expenditure prevents us from distinguishing between households with similar level of out-of-pocket health expenditure in a given year but with different levels of health care need and capacity to satisfy the need. Third, there may be occasions when households avoid or delay health care utilisation fearing high OOP health expenditure or go for less expensive low-quality health care. The measure of catastrophic health expenditure suggested by Wagstaff and van Doorslaer is limited in its scope to address these limitations. We argue that a measure which addresses these limitations as much as possible may portray a more accurate picture of the households' vulnerability due to health shock. Therefore, against this background, this paper takes up the following two objectives: (i) to develop a

multidimensional measure for capturing households' vulnerability due to health shock; and (ii) to provide some empirical illustrations of the new measure and assess its comparative advantages over the existing measure proposed by Wagstaff and van Doorslaer.

Data and Methods

The paper uses data from National Sample Survey's 71s round entitled "Social Consumption: Health", which was conducted during January to June 2014. The survey collected detailed information on reported illness, utilisation of health care and expenditure on health care including coping strategies to meet the OOP health expenditure from 65,932 households living all across the country.

The paper attempts to go beyond the concept of *catastrophic health expenditure* incurred by households as suggested by Wagstaff and van Doorslaer (2003) and applied in a large number of empirical studies. Though the idea of vulnerability was never explicitly mentioned in the conceptualisation of catastrophe suggested by Wagstaff and van Doorslaer, the implication of health expenditure catastrophe on vulnerability was obvious. It is quite evident that a household spending large share of its accessible monetary resources on health care will be constrained to spend for other necessities. This is true for both poor households and non-poor households with little savings. Incurring high OOP health expenditure may force households to deplete their savings, sell productive assets (such as land, cattle), or to borrow money at high rates of interest. Fear of high OOP health expenditure may discourage households to seek health care on time (i.e. avoiding or delaying treatment) or make them seek healthcare from less expensive low quality providers. It is not difficult to foresee that many of these coping strategies may result in adverse consequences (such as increased severity or complication of ailments) finally increasing the level of vulnerability even further.

We define vulnerability, in our context, as a difference between household's exposure to risk due to health shock or illness and its capacity to absorb the health shock. Risk is an essential component of vulnerability due to uncertainty associated with illness and resultant out-of-pocket expenditure. Some households, due to their demographic compositions, presence of ill

members and other factors, are more prone to health shock than others. Similarly, some households due to their better access to health care, higher purchasing power, secured occupational nature, better insurance coverage, are more protected to absorb the health shock than others. Going beyond the money-metric measure suggested by Wagstaff and van Doorslaer, our approach attempts to capture these multiple characteristics of a household which have direct and indirect bearing on its vulnerability due to health shock. Since our measure relies on multiple characteristics of a household, it faces the standard challenges that any multi-dimensional measure encounters while summarising the attributes of the population.

To assess its level of vulnerability, we propose to look at each household in terms of four different dimensions:

- Dimension capturing the risk of illness: Under this dimension we look at characteristics of the household which positively contribute to the likelihood of illness. (Dimension I)
- Dimension capturing the utilisation of health care by the household during a particular time period. This dimension captures to what extent risk of illness gets translated into utilisation through realisation of illness. (Dimension U)
- Dimension capturing the household's lack of capacity or inability to utilise healthcare in the face of an illness and also its lack of capacity to absorb the risk of high OOP health expenditure. Illness results in utilisation only when it is backed by capacity to access health care. (Dimension C)
- Dimension capturing household's observed vulnerability to health shock during a particular time period. This is observed when there is a mismatch between realised illness and/or utilisation and capacity to pay. (Dimension O).

It must be noted that Dimensions I and C are more deterministic in nature and are less influenced by probabilistic elements. In other words, a household having all preconditions to induce health shock not experiencing illness or reporting utilisation of health care in a particular time period is purely due to random chance and should not be excluded in vulnerability count. Utilisation of health care (captured under dimension U) contributes to OOP health expenditure. However, utilisation which can also be termed

as effective demand for health care is expected to depend on two factors namely need for health care (as felt by the household) as well as its capacity to translate that need into effective demand. While the former is captured by dimension I to a great extent, dimension C is a reasonable aspect to capture the latter. For a given capacity of household (captured by Dimension C), one would expect a positive relation between need for health care (captured by Dimension I) and utilisation of health care (Dimension U). Similarly for a given level of need for health care (captured by Dimension I), lower capacity of the household (Captured by Dimension C) would result in lower utilisation (Dimension U). Vulnerability is observed or predicted when there is a mismatch between need (Dimension I) and/or utilisation (Dimension U) on the one hand and capacity of the household (Dimension C) on the other. Dimension D is crucial to observe such mismatch. We propose to include all these four dimensions in a multi-dimensional measure to capture household's vulnerability to health shock.

The information collected by NSSO allows us to construct an exhaustive list of indicators which fairly capture these multiple dimensions. These indicators are chosen observing their importance in the empirical literature. The list of dimensions and indicators are presented in Table 1. The table also presents the threshold value for each indicator which is discussed later. Under dimension I, five indicators are considered: (i) size of the households; (ii) number of elderly persons in the household; (iii) number of chronically ill persons in the household, (iv) number of women belonging to reproductive age group and (v) number of children (0-5 years). Higher values of these indicators are expected to increase a household's need for health care and when supported by favourable access to health care conditions, it would result in higher utilisation of health care by the household. A set of five indicators has been considered to capture Dimension U and they are (i) number of hospitalisation episodes; (ii) number of hospitalisation episodes in private facilities; (iii) number of hospitalisation episodes outside the state; (iv) number of private OP visit and (v) number of OP visits outside the state. Four indicators are used to capture Dimension C, which are (i) economic status of the household (proxied by per capita consumption expenditure), (ii) place of residence of the household; (iii) occupational nature of the household; and (iv) proportion of

household members who are covered by health insurance or similar health expenditure protection mechanisms. Finally, three indicators are considered to capture the observed vulnerability due to health care: (i) out-of-pocket health expenditure as a percentage of household consumption expenditure; (ii) source of finance for meeting the out-of-pocket expenses and (iii) number of severe illness episodes which did not receive any health care in the household.

To identify the households which are vulnerable in our multidimensional measure, we follow the approach suggested by Alkire and Foster (2008) for their conceptualisation of multidimensional poverty. We use cut-offs at two stages: in the first stage for each individual indicator we set our threshold or cut-off to identify if a household shows vulnerability with regard to that particular indicator. Following this process for all seventeen indicators enables us to know on how many indicators/counts a particular household is vulnerable. In the second stage, we set another cut-off for the total count to identify a household vulnerable due to health shock.

Like multidimensional poverty measurement, in our approach household is the unit of analysis for vulnerability measurement. Once a household is identified as *vulnerable due to health shock* a simple measure of headcount ratio is estimated to measure the extent of vulnerability for the entire population. To avoid any arbitrariness in setting up cut-offs for the indicators in the first stage we take a mixed approach. For majority of the indicators the cut-off is set by looking at the estimated distributional parameters of those indicators. For most of the indicators with count or measurement data, the integer value of the indicator higher than *mean plus one standard deviation* is considered as threshold. This rule is followed for the following indicators: household size, number of elderly person, number of children, number of chronically ill persons, number of women in the reproductive age group, number of hospitalisation, number of private hospitalisation, number of private OP visits, number of OP visits outside the state, nature of finance for meeting OOP health expenses and no health care (Table A1) . The available existing evidence guides us to choose threshold for the rest of the indicators. We have taken the poverty line (Rs 1000) for urban India (Tendulkar Method on Mixed Reference Period) for the year 2011-12 to define poor and non-

poor. The rural population's poor access to health care in comparison to their urban counterparts and financial constraints faced by casual labour households in accessing health care is well documented in the literature. To define high OOP health care expenditure, we have relied upon the existing definition of catastrophic health expenditure proposed and popularised by Wagstaff and van Doorslaer. For majority of the studies households spending more than 10 per cent of their consumption expenditure on health care is considered as catastrophic and we have taken that as threshold value. Only for insurance coverage, we have arbitrarily chosen 50 per cent or half of the family members having insurance coverage as threshold. In the second stage the cut-off has been fixed to make the new multidimensional measure comparable with the results obtained from Wagstaff-van Doorslaer's approach. In other words, in the second stage we choose the cut-off in such a way which gives similar percentage of households with catastrophic health care payments.

Results

The household level averages of all indicators under four dimensions (outlined in Table 1) along with their 95 per cent confidence intervals are presented in Table 2. The average household size of our all India sample is approximately 4.5 and data shows that almost three-fourth of country's households have five or less members. According to the latest Census (2011) data, the elderly account for 8.0 per cent of India's population. In our sample, the average number of elderly persons in each household is 0.35, indicating that there is roughly one elderly per 3 households. On average there is one chronically ill person per five households (mean 0.218). Similarly, on average each household has more than one woman (of reproductive age group) and child (0-5 years). The percentage of household members covered under some kind of health expenditure protection has not exceeded 20 per cent even by now (16.89 per cent). The distribution of households by their occupational type shows that little less than half of our households are self-employed (46.95 per cent) , followed by casual labour (little more than a quarter, precisely 26.14 per cent) and regular wage or salary earning households is roughly one-fifth of the total number of households (19.9 per cent). During one year preceding the survey, 220 episodes of

hospitalisation were observed per 1000 households, out of which 125 episodes of hospitalisation were in private hospitals and 13 episodes of hospitalisation took place outside the native state of utilisers. During last 15 days preceding the survey, 286 private OP visits were observed per 1000 households, out of which 17 were outside the state. Households, on an average, spend more than 12 per cent of their consumption expenditure on health care and 8.1 per cent households reported to have borrowed money and sold assets to finance their OOP health expenditure. Though rare, one seriously ill person per 1000 households was observed who did not receive any health care. By seriously ill we mean the ill person was either on restricted activity or was confined to bed.

Since number of episodes of hospitalisation and OP visits are all count data, Poisson or Negative Binomial regression models are suggested to model them instead of Linear Regression Model because of using OLS regression models for count data might result in biased and inefficient estimates for count data analysis (Cameron and Trivedi 2005). The negative binomial regression has an advantage over Poisson regression in this regard as it is a better fit for over-dispersed count outcome variables and gives more precise results. Table 3 presents results of negative binomial regressions for five utilisation variables, namely, number of hospitalisation, number of hospitalisation at private facilities, number of hospitalisation outside states, number of private OP visits and number of OP visits outside state. Except private OP visit, household size is positively associated with all four utilisation variables. As found in the literature, both number of elderly members and number of chronically ill members in a household are positively associated with all or four utilisation variables. There is no statistical evidence of association between number of women in a household and utilisation variables, especially for outpatient care utilisation. As expected, household's capacity to pay (proxied by per capita consumption expenditure and transformed to logarithmic values in order to remove skewness of the distribution) is positively associated with utilisation of all types. It is surprising to see that having more members covered under insurance in a household reduces the average values of the utilisation variables. This is an indication that utilisation is more influenced by the objective healthcare need of the household and there is no evidence of moral hazard (i.e. overuse of health care due to

insurance coverage). The association of a household's occupational type with utilisation does not follow uniform pattern, though some categories are significant.

Dimension O in our approach aims to capture a household's observed *vulnerability due to health shock* observed during a particular reference period (say, a year). Due to data constraints, we are able to observe only three indicators under this dimension, namely, catastrophic health expenditure; distress financing (to meet out-of-pocket health expenditure) and untreated illness. Following the definition of Wagstaff and van Doorslaer, a household spending more than 10 per cent of its consumption expenditure on health is considered to have incurred catastrophic health expenditure. A household resorting to borrowing, sale of assets or similar means for financing the OOP health expenditure is a clear indication of distress financing. The third indicator of observed vulnerability is the presence of at least one seriously ill person who did not seek health care. Each of these variables, capturing the observed vulnerability, is converted into binary variables and the used as dependent variables to explore their association with various household level characteristics using logistic regression technique. The results of the logistic regressions are presented in Table 4.

The first odds ratio column in Table 4 shows the association between a household incurring catastrophic health expenditure and indicators used for capturing dimensions U and C. Though most of the variables are significant, having odd ratios higher than one, three points must be noted. First, utilisation of private facilities both for inpatient or outpatient care is showing stronger association with catastrophic health expenditure (OR=7.12 for number of private hospitalisation; OR = 12.06 for private OP visits). Second, households staying in the rural areas are more likely to incur catastrophic health expenditure than households staying in the urban areas. Third, households' occupational type may not make a difference in its likelihood of incurring catastrophic health expenditure and the effect is probably captured by a household's economic status or ability to pay. In the second odd ratio column, except one variable, all the odd ratios for the dependent variable 'households reported distress financing' to meet out-of-pocket expenditure are significant. There are two points to observe: first, having higher proportion of members covered under some kind of

health expenditure protection reduces the likelihood of distress financing. Second, compared to regular wage/salaried and self-employed, casual labour households have higher likelihood of distress financing. Pair-wise correlations between all indicators in their vulnerable and non-vulnerable dichotomisation are presented in Table 5. The binary dichotomisation of all indicators between vulnerable and non-vulnerable is presented in Table A2. Table 5 indicates that not all dimensions and their constituent parts are significantly and positively correlated. By including dimensions which are contradictory to each other, we are perhaps able to include the variability of the factors which are conceptually linked to vulnerability. For example, the negative correlation between chronically ill and being in the rural areas is puzzling. There could be several reasons for several reasons. Due to lack of awareness about chronic illness and people's poor access to chronic care, chronic illness is grossly under-reported in the rural areas. But the influence of urban life style (which promotes more chronic illness) and larger share of elderly population in the urban areas who are more prone to chronic illness could also be equally important reasons.

The first set of cut-offs allows us to identify the indicators where a household shows its vulnerability. Since our data allows us to rely on 17 indicators to capture four dimensions, a household's vulnerability scores could sum up to 17 at the maximum if a household shows vulnerability in all indicators. Similarly, if a household does not show vulnerability in any of these 17 indicators, its vulnerability score should become zero. Therefore, theoretically the vulnerability score is expected to vary between 0 and 17 (inclusive of both the scores). Figure 1 presents both the histogram of the vulnerability score (panel A) as well as cumulative relative frequency curve of the vulnerability score (Panel B). Households' vulnerability scores seem to follow a mild positively skewed distribution with a long right tail. However, if one ignores its long right tail, the histogram is fairly symmetric with fewer proportions of households having very low and very high count of vulnerability scores and majority of the households have vulnerability scores ranging from 3 to 6. (The estimated data used for drawing Figure 1 are presented in Appendix Table A3).

The second stage cut-off is set by comparing it with the

percentage of households incurring *catastrophic health expenditure* for a different cut-off as per the method suggested by Wagstaff and van Doorslaer. This is done for making our results comparable with results accruing from Wagstaff and van Doorslaer's approach. This equivalence is required to compare the merits and demerits of our results with results obtained by using the methods of Wagstaff and van Doorslaer.

Following Wagstaff and van Doorslaer's method, the percentage of households having incurred *catastrophic health expenditure* falls as we increase the catastrophe cut-off (share of out-of-pocket expenditure in total consumption expenditure). This is presented in Figure 2 and the estimated data for drawing Figure 2 are provided in Appendix Table A4. A comparison of Figure 1 (or Table A3) and Figure 2 (or Table A4) shows that a 5% cut-off according to Wagstaff and van Doorslaer's method is comparable to a cut-off of 5 or more dimensions according to multidimensional method. In other words, percentage of households who are incurring OOP health expenditure more than 5 per cent of their total consumption expenditure is almost equivalent to percentage of households who are vulnerable in 5 or more dimensions. Both the figures are close to 31 per cent. In a similar way, percentage of households who are incurring OOP health expenditure more than 17 per cent of their total consumption expenditure is almost equivalent to percentage of households who are vulnerable in 6 or more dimensions. Both are closer to 17-18 percentages. We need this equivalence (i) to make both the methods comparable and (ii) for exploring the distributive results that these two separate methods generate. We have chosen cut-off at 17 percent for Wagstaff and van Doorslaer's method and a cut-off of 6 or more dimensions for multidimensional method for illustration purposes.

How the percentage of multidimensionally vulnerable households for the whole population is distributed across PCCE quintiles are presented in Figure 3. The same figure also shows how the percentage of households with catastrophic health expenditure (Wagstaff-van Doorslaer's method) is distributed across the same PCCE quintiles. Whereas there is no significant variation in the percentage of households with catastrophic health expenditure across PCCE quintiles, the variation is substantial and on expected lines for multidimensionally vulnerable households based

on our method. The multidimensional vulnerability shows a clear positive gradient as we move from bottom PCCE quintile to the top PCCE quintile. Figure 4 presents similar observations by household castes. The percentage of households with catastrophic health expenditure shows a clear positive gradient as we move from ST group to Other (General) group – a pattern goes against our intuition. It is intuitively difficult to accept a social group (ST) as least *vulnerable due to health shock* where there is an overwhelming evidence of their vulnerability in terms of many other indicators of wellbeing (Kabeer 2002; Mukherjee et al 2011). However, this intuitively unacceptable perverse ordering is not observed in the multidimensional measure. Other (General) caste shows the lowest incidence of vulnerability in comparison to all caste groups and ST households show vulnerability well above the Other (General) castes. The multidimensional vulnerability seems to be highest for the SC households but less for OBC and Other (General) caste groups. The percentages of households with catastrophic health care expenditure and multidimensionally vulnerable due to health shock are given in Table 6. The table also shows the ranking of the states based on two measures. It is important to notice that though many of the states are able to retain their relative positions in both the measures, for some states these two measures give completely different rankings.

Conclusion

The evidence generated by our analysis seems to suggest that multidimensional measure presents a more accurate picture of *vulnerability due to health shock* in comparison to Wagstaff and van Doorslaer's method of identifying households with *catastrophic health expenditure*. Many of the dimensions that we have considered show significant and positive correlation with Wagstaff and van Doorslaer measure indicating that multi-dimensional measure is in line with the well-received notion of vulnerability due to health expenditure catastrophe. However, the multidimensional measure has also considered indicators which either show insignificant or negative relation with Wagstaff and van Doorsler's measure but are important in their own rights to capture a somewhat complete picture of *vulnerability due to health shocks*. Our comparison of results based on Wagstaff–van Doorslaer's approach and multidimensional approach clearly shows that the

same average rate of vulnerability for the whole population can emerge from two completely different distributions. The distribution of vulnerability due to catastrophe across class and caste groups that Wagstaff-van Doorslaer's approach suggests is not intuitively convincing – a limitation that multidimensional measure of vulnerability does not suffer from. Moreover two constituent dimensions of this approach, namely, Dimensions I and C have little probabilistic elements. This may help targeting of households in order to protect them from health shock induced vulnerability in an efficient way.

However, the multidimensional approach, in its present form, suffers from two limitations: First, all indicators have been given equal weightage (indicating dimensions are given unequal weightage) which may not be acceptable from a theoretical point of view. Second, we have only considered the headcount measure of vulnerability. The concept of catastrophic health expenditure by Wagstaff and van Doorslaer has gone beyond simple headcount measure and suggests measures capturing intensity of catastrophe (viz. overshot and mean positive overshot). In multidimensional poverty approach, the measure is extended beyond the headcount ratio and offers measures of higher degrees. An extension and more refined version of the current approach is capable of addressing these limitations.

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Table 1: Dimensions, indicators and threshold values

Dimensions	Indicators	Threshold for vulnerability
Dimension I: Illness inducing factors	Household size	≥ 7
	Number of elderly persons	≥ 1
	Number of children (0-5 years)	≥ 3
	Number of chronically ill persons	≥ 1
	Number of women belonging to reproductive age group	≥ 3
Dimension U: Utilisation of health care	Number of hospitalisation	≥ 1
	Number of private hospitalisation	≥ 1
	Number of hospitalisation outside the state	≥ 1
	Number of outpatient visit	≥ 1
	Number of outpatient visit outside state	≥ 1
Dimension C: Inability or negative capacity of the household	Per capita consumption expenditure (PCCE)	Poor households (households with less than Rs. 1000 PCCE)
	Location of residence	Household living in rural areas
	Number of members having insurance coverage	More than half of the members not having insurance coverage
	Occupational type of household	Casual labour households
Dimension O: Observed vulnerability	Out-of-pocket health expenditure as a proportion total consumption expenditure	≥ 10 per cent
	Nature of finance for meeting out-of-pocket expenditure	At least one incidence of borrowing/selling any asset for meeting hospitalisation expenses
	No health care	At least one incidence of no healthcare in case of severe illness

Table 2: Household level summary statistics of the indicators

Variables/Indicators (sample size)	Mean (95% Confidence Intervals)
Household size (n=333,104)	4.51 (4.49,4.53)
Number of elderly members (n=27,245)	0.35 (0.35,0.36)
Number of children (n=47,949)	1.126 (1.116,1.136)
Number of chronically ill members (n=18,212)	0.218 (0.214, 0.222)
Number of females in the reproductive age (n=88,440)	1.194 (1.188,1.200)
Per capita consumption expenditure (Rs) (number of households with PCCE <Rs.1000 = 16,740)	1848 (1835,1860)
Number of households residing in rural areas (n=36,480)	0.674 (0.670,0.677)
Number of households residing in urban areas (n=29,452)	0.325 (0.322,0.329)
Percentage of households members with insurance coverage (n=50,234)	16.89 (16.25, 17.53)
Number of self-employed households (n=31,615)	0.469 (0.465,0.473)
Number of regular wage/salaried households (n=15,723)	0.198 (0.195,0.202)
Number of casual labour households (n=14,255)	0.261 (0.258,0.264)
Number of households engaged in other occupations (n=4339)	0.070 (0.068,0.0721)
Number of hospitalization events (n=55,026)	0.220 (0.216, 0.224)
Number of private hospitalization events (n=30,017)	0.125 (0.1225,0.128)
Number of hospitalization events outside state (n=3821)	0.013 (0.012,0.014)
Number of outpatient visits in private facilities (n=19,747)	0.286 (0.281,0.291)
Number of outpatient visits outside state (n=1437)	0.017 (0.0160,0.018)
Out-of-pocket health expenditure as a percentage of total consumption (n=29,645)	12.479 (12.106,12.851)
Number of households reporting borrowing/selling of assets to as major source to finance health care (n=12,391)	0.081 (0.079,0.083)
No. of households with no care despite serial illness (72)	0.001 (0.0007,0.0012)

Source: Estimated from 71st round unit-record data

Table 3: Results of the Negative Binomial regressions

Variables	Hospitalization	Hospitalization in private facilities	Hospitalization outside state	Outpatient visits in private facilities	Outpatient visits outside state
	IRR	IRR	IRR	IRR	IRR
Household size	1.129*	1.177*	1.296*	1.023	1.195*
Number of elderly members	1.174*	1.206*	1.154**	1.062**	1.069
Number of children	1.128*	1.070*	1.070***	1.121*	0.973
Number of chronically ill members	1.528*	1.618*	1.321*	3.211*	3.060*
Number of women in the reproductive age	1.142*	1.129*	1.102	1.035	1.006
Log of per capita consumption expenditure	1.375*	2.040*	1.753*	1.277*	0.886
Number of members having insurance coverage	0.978*	0.983**	0.818*	1.008	0.771*
Place of residence (Ref: Urban)					
Rural	1.118*	1.103*	1.049	0.919**	0.729
Household's occupational type (Ref: Regular wage/salaried)					
Self employed	0.986	0.991	1.279**	0.944	2.111*
Casual Labour	1.088**	0.898**	0.934	0.912	1.721**
Others	0.992	1.011	1.015	1.061	2.046*
Constant	0.007*	0.0002*	0.0001*	0.021*	0.018*

Note: *, ** and *** indicate 1%, 5% and 10% level of significance respectively.
Source: Estimated from NSS 71st Round unit-record data

Table 4: Results of the logistic regressions

Variables	Catastrophe	Distress financing	No healthcare
	Odds Ratio	Odds Ratio	Odds Ratio
Total number of hospitalization events	3.281*	3.354*	1.328**
Total number of hospitalization events in private institutions	7.367*	1.632*	0.600***
Total number of hospitalization events outside state	1.760*	1.598*	0.266
Total number of outpatient visits in private institutions	11.873*	1.419*	0.918
Total no. of outpatient visits outside state	5.476*	1.374**	0.995
Percent of members having insurance coverage	1.002*	0.993*	0.996
Log of per capita consumption expenditure	0.507*	0.695*	0.437**
Place of residence (Ref: Urban)			
Rural	1.246*	1.215*	0.575
Household occupational type (Ref: Regular wage/salaried)			
Self employed	0.966	0.953	0.796
Casual labour	0.998	1.472*	0.782
Others	1.897*	1.581*	0.737
Constant	6.046*	0.748	0.925

Notes: Definitions of dependent variables - **Catastrophe**: = 1 if a household's out-of-pocket health expenditure is more than 10 % of its consumption expenditure, = 0 otherwise; **distress financing** = 1 if household resorts to selling of assets, borrowing and contribution from others to finance health care, = 0 otherwise; **no health care** = 1 if at least one ill member of the household does not seek health care even when seriously ill, =0, otherwise; *, ** and *** indicate 1%, 5% and 10% level of significance respectively.

Source: Estimated from NSS 71st Round unit-record data

Table 5: Correlation matrix of the dimensions

Dimensions/ Indicators	Big household	Elderly	Children	Chronically Ill	Women	Poor	Rural	No insurance	Labour	Hospitalisation	Private hospitalisation	Out of state hospitalisation outside state	Private OP visit	Outside state OP visit	Catastrophic health expenditure	Distance financing
Big household																
Elderly	0.172*															
Children	0.396*	-0.023														
Chronically Ill	0.031*	0.237	-0.057*													
Women	0.0323*	0.004	0.034*	.0108*												
Poor	0.177*	-0.007	0.239*	-0.102*	0.052*											
Rural	0.075*	0.021*	0.104*	-0.076*	0.004	0.276*										
No Insurance	0.078*	-0.031*	0.086*	-0.130*	0.028*	0.087*	0.045*									
Labour	-0.036*	-0.086*	0.043*	-0.047*	-0.035*	0.193*	0.175*	0.017*								
Hospitalisation	0.139*	0.079*	0.073*	0.123*	0.068*	-0.019*	0.006	-0.014*	-0.011*							
Private hospitalisation	0.092*	0.090*	0.021*	0.136*	0.055*	-0.082*	-0.043*	-0.025*	-0.055*	0.691*						
Outside state hospitalisation	0.016*	0.020*	-0.002	0.034*	0.008*	-0.030*	-0.009*	-0.053*	-0.020*	0.225*	0.224*					
Private OP visits	0.051*	0.133*	-0.003	0.386*	0.017*	-0.076*	-0.072*	-0.068*	-0.048*	0.049*	0.079*	0.008*				
Outside OP visit	0.004	0.041*	-0.019*	0.136*	-0.011*	-0.037*	-0.011*	-0.098*	-0.010*	0.029*	0.036*	0.220*	0.052*			
Catastrophic health expenditure	0.056*	0.152*	0.004	0.416*	0.028*	0.002	0.004	-0.023*	-0.024*	0.368*	0.414*	0.128*	0.331*	0.153*		
Distress financing	0.026*	0.062*	0.003	0.223*	0.009*	0.006	0.029*	-0.075*	0.034*	0.352*	0.329*	0.134*	0.079*	0.065*	0.271*	
No healthcare	0.012*	0.009*	0.009*	0.032*	0.0032	0.001	-0.002	-0.003	0.002	0.002	-0.005	-0.003	-0.001	-0.0001	0.037*	0.005

Note: * indicates significant phi values (5 per cent)
Source: Estimated from NSS 71st round unit-record data

Table 6: Percentage of households with catastrophic health care payments and multidimensionally vulnerable due to health shock across select Indian states and all India

Select State & all India	Households with catastrophic health expenditure (Wagstaff-van Doorslaer Method :17% cut-off)		Households vulnerable due to health shock (new multidimensional Method: 6 dimension cut-off)	
	percentage	rank	Percentage	Rank
Andhra Pradesh	21.98	6	13.84	16
Assam	8.84	20	8.66	20
Bihar	13.29	15	23.29	3
Chhattisgarh	9.21	19	13.01	18
Delhi	4.09	21	1.99	21
Gujarat	10.54	18	15.12	15
Hariyana	16.09	11	16.4	11
Jharkhand	11.07	17	20.83	4
Jammu &Kashmir	17.68	9	15.97	13
Karnataka	18.29	7	18.14	7
Kerala	28.98	1	27.45	1
Maharashtra	15.95	12	16.19	12
Madhya Pradesh	15.37	13	17.64	10
Odisha	23.94	2	17.68	8
Punjab	23.77	3	19.41	5
Rajasthan	12.48	16	15.81	14
Telengana	22.8	5	18.64	6
Tamil Nadu	17.15	10	13.13	17
Uttar Pradesh	18.1	8	24.23	2
Uttarakhand	13.64	14	9.81	19
West Bengal	23.55	4	17.66	9
All India	17.24		17.79	

Source: Estimated from NSS 71st unit record data

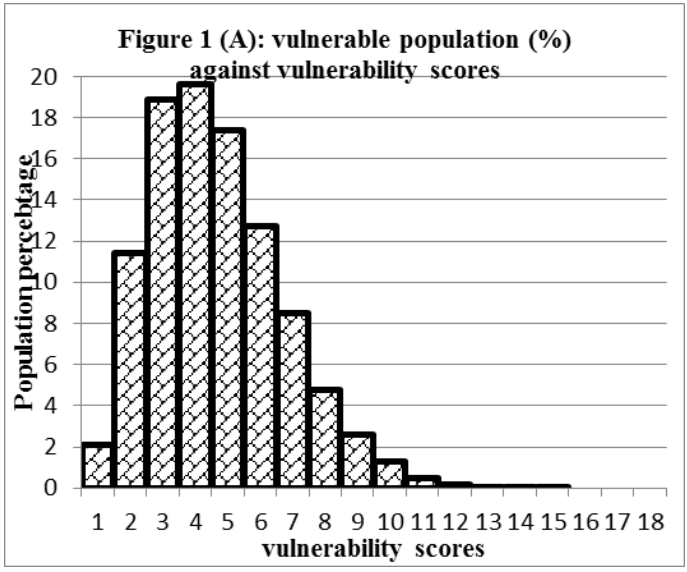
Figure 1 (A): vulnerable population (%) against vulnerability scores
Population percebtage
0
2
4
6
8
10
12
14
16
18
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
vulnerability scores

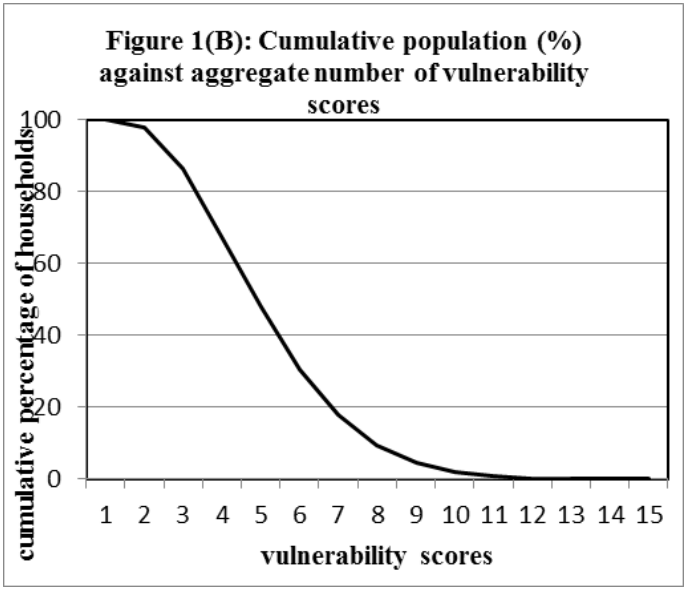
Figure 1(B): Cumulative population (%) against aggregate number of vulnerability scores
cumulative percentage of households
0
20
40
60
80
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
vulnerability scores

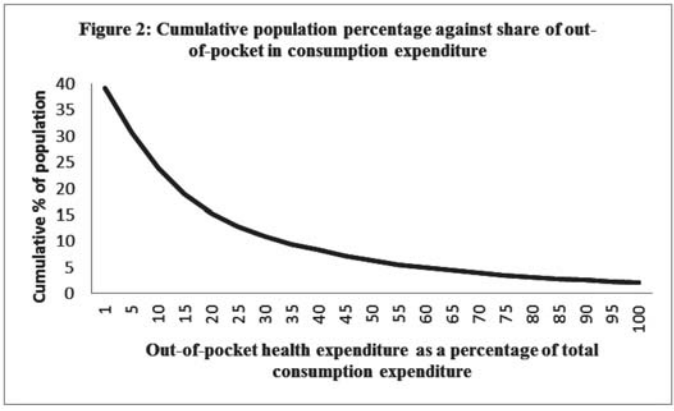
Figure 2: Cumulative population percentage against share of out-of-pocket in consumption expenditure
Cumulative % of population
0
5
10
15
20
25
30
35
40
1
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Out-of-pocket health expenditure as a percentage of total consumption expenditure

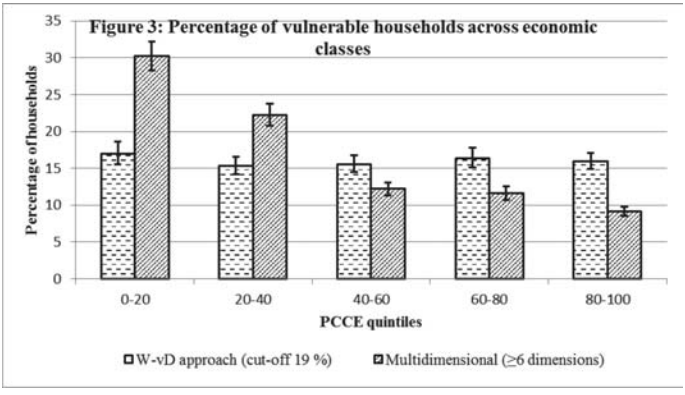
Figure 3: Percentage of vulnerable households across economic classes
Percentage of households
0
5
10
15
20
25
30
35
0-20
20-40
40-60
60-80
80-100
PCCE quintiles
W-vD approach (cut-off 19 %)
Multidimensional (≥6 dimensions)

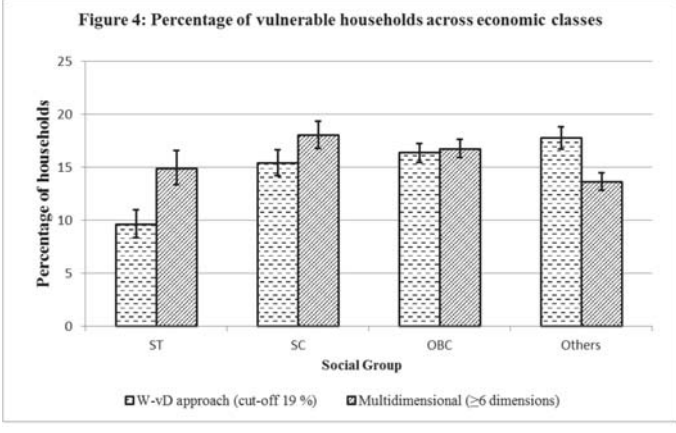
Figure 4: Percentage of vulnerable households across economic classes
Percentage of households
0
5
10
15
20
25
ST
SC
OBC
Others
Social Group
W-vD approach (cut-off 19 %)
Multidimensional (≥6 dimensions)

Table A1: Summary statistics and calculated threshold for select indicators

Variables	Mean	Standard Deviation	Mean + SD	Threshold
Household size	4.51	2.155	6.665	7
Number of elderly members	0.35	0.633	0.983	1
Number of children	1.126	1.284	2.41	3
Number of chronically ill members	0.218	0.527	0.745	1
Number of females in the reproductive age	1.194	0.825	2.019	3
Number of hospitalization events	0.22	0.538	0.758	1
Number of private hospitalization events	0.125	0.421	0.546	1
Number of hospitalization events outside state	0.013	0.136	0.149	1
Number of outpatient visits in private facilities	0.286	0.664	0.95	1
Number of outpatient visits outside state	0.017	0.151	0.168	1
Number of households reporting borrowing/selling of assets to as major source to finance health care	0.081	0.273	0.354	1
Number. of households with no care despite severe illness	0.001	0.031	0.032	1

Source: Estimated from NSS 71st unit record data

Table A2: Binary vulnerability indicators and their definitions

Variables	Definitions
Big house	7 or more persons (1); 1-6 persons (0)
Elderly	At least one elderly (1); no elderly (0)
Children	3 or more children (1); 2 or less children (0)
Chronic	At least one chronically ill person (1): no chronically ill person (0)
Female	3 or more females of reproductive age group (1); 2 or less female of reproductive age group (0)
Poor	Household with PCCE <Rs1000 (1); household with PCCE >= Rs. 1000 (0)
Rural	Residing in rural area (1); residing in urban area (0)
Insurance	More than half of the family members are having no insurance coverage (1); more than half of the family members are having insurance coverage (0)
Labour	Casual labour households (1); self-employed, regular wage/ salaried or other households (0)
Hospitalisation	Any episode of hospitalisation (1); no episode of hospitalisation (0)
Private hospitalisation	At last one episode of hospitalisation in private hospital (1); no case of private hospitalisation (0)
Outside state hospitalisation	At least one episode of hospitalisation outside state (1); no episode of hospitalisation outside state (0)
Private OP visits	1 or more OP visit to private facility (1): no visit to private facility (0)
Outside state OP visit	At least one OP visit outside state (1): no OP visit outside state (0)
Catastrophic health expenditure	Out-of-pocket health expenditure as a percentage of household consumption expenditure > 10% (1); <=10 % (0)
Distress finance	For at least one episode of hospitalisation, the major source of financing out-of-pocket expenditure is by borrowing or selling assets (1): by other sources (0)
No healthcare	At least one untreated episode of illness when the ill person was on restricted activity or confined to bed (1): otherwise (0)

Table A3: Absolute and cumulative percentage of vulnerable households by vulnerability to health shock scores

Vulnerability to health shock scores	Percentage of vulnerable households	Cumulative vulnerability to health shock scores	Cumulative population percentage
0	2.16	≥ 0	100
1	11.89	≥ 1	97.84
2	20.08	≥ 2	85.95
3	20.73	≥ 3	65.86
4	17.41	≥ 4	45.13
5	11.81	≥ 5	27.73
6	7.69	≥ 6	15.92
7	4.18	≥ 7	8.23
8	2.35	≥ 8	4.05
9	1.08	≥ 9	1.70
10	0.43	≥ 10	0.63
11	0.14	≥ 11	0.19
12	0.05	≥ 12	0.05
13	0.01	≥ 13	0.01
14	0.00	≥ 14	0.00
15	0.00	≥ 15	0.00
16	0.00	≥ 16	0.00
17	0.00	≥ 17	0.00

Source: Estimated from the NSS 71st round unit record data

Table A4: Cumulative percentage of households with catastrophic health care expenditure by threshold percentages

Threshold (Out-of-pocket health expenditure as percentage of total consumption expenditure)	Cumulative percentage of households
≥ 1	39.23
≥ 2	36.72
≥ 3	34.41
≥ 4	32.60
≥ 5	30.74
≥ 6	29.01
≥ 7	27.55
≥ 8	26.25
≥ 9	24.77
≥ 10	23.81
≥ 1	22.53
≥ 12	21.59
≥ 13	20.66
≥ 14	19.84
≥ 15	19.01
≥ 16	18.12
≥ 17	17.26
≥ 18	16.57
≥ 19	16.01
≥ 20	15.44
≥ 25	12.85
≥ 30	10.99
≥ 35	9.48
≥ 40	8.37
≥ 45	7.28
≥ 50	6.33
≥ 55	5.57
≥ 60	4.94
≥ 65	4.42
≥ 70	3.94
≥ 75	3.49
≥ 80	3.16
≥ 85	2.85
≥ 90	2.60
≥ 95	2.32
≥ 100	2.18

Source: Estimated from the NSS 71st round unit record data

Table A5: Percentage of households with catastrophic health expenditure and multidimensionally vulnerable households by PCCE quintiles

PCCE Quintiles	Catastrophic household (W-vD method with cut-off at 19%)	Multidimensionally vulnerable households with (cut-off at ≥ 6 dimensions)
Bottom (0-20)	16.99 (15.52,18.58)	30.22 (28.29,32.22)
2nd (20-40)	15.32 (14.15,16.57)	22.23 (20.81,23.71)
Middle (40-60)	15.55 (14.45,16.73)	12.2 (11.35,13.1)
4th (60-80)	16.39 (15.12,17.74)	11.59 (10.69,12.56)
Top (80-100)	15.94 (14.93,17.02)	9.11 (8.497,9.757)
Total	15.97 (15.43,16.52)	15.92 (15.41,16.44)

Note: Figures in the brackets show 95% confidence intervals.

Source: Estimated from the NSS 71st round unit record data

Table A6: Percentage of households with catastrophic health expenditure and multidimensionally vulnerable households by Caste groups

Caste (Social group)	Catastrophic household (W-vD method with cut-off at 19%)	Multidimensionally vulnerable households with (cut-off at ≥ 6 dimensions)
ST	9.59 (8.338,11.01)	14.9 (13.34,16.6)
SC	15.38 (14.19,16.64)	18.01 (16.77,19.33)
OBC	16.37 (15.53,17.25)	16.75 (15.93,17.61)
Others	17.76 (16.74,18.82)	13.64 (12.84,14.49)
Total	15.97 (15.43,16.52)	15.92 (15.41,16.44)

Note: Figures in the brackets show 95% confidence intervals.

Source: Estimated from the NSS 71st round unit record data

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