Measuring Poverty in Eastern India through Multi-Dimensional Poverty Index (MPI): Tool to Focus Where to Invest in Public Health

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ABSTRACT

Background: The measurement of deprivations in the population provides valuable information for the analysis of inequality and poverty, based on which economic and public health policies and interventions are planned or implemented. This study intends to assess demographic, socioeconomic, water-sanitation & hygienic behavior of families in eastern India and measure poverty through Multi-Dimensional Poverty Index (MPI) with the relative contribution of the indicators.

Methods: A population-based door to door health survey on a population residing in 3600 households was conducted in all villages in three gram panchayats in three blocks (1200 households in each GP).

Results: Less than three –fourth of the households has been identified as MPI poor. Nearly one-fifth has been identified as vulnerable to poverty. The income poverty rate was 36%, and 76% are MPI poor The article also lens out deprivation within study areas.

Interpretations: Consumption or income-based indicators alone cannot be a good proxy to capture the multidimensional aspect of poverty and deprivations. Demographic, socio-economic, health and dietary indicators play a significant role in determining the real standard of living. This study acts as evidence in defining Multi-Dimensional Poverty Index as a tool to focus where to invest in public health.

Keywords: Poverty, Index, MPI, Consumption, Income

INTRODUCTION

Public health is defined as the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society.[1]Three main domains roofed are health protection, disease prevention, and health promotion. These are strengthened by robust public health intelligence and supported by enablers, including sustainable funding and organization, governance, workforce development, advocacy, and research. The economic crisis has led to increased demand and reduced resources for health sectors. The trend for increasing healthcare costs to individuals, the health sector, and wider society is significant. Public health can be part of the solution to this challenge.[2]In this context, it is very imperative to come to a decision where to invest in public health. The measurement of poverty or material

disadvantage and its comparison at national and sub-national level is challenging but essential. The measurement of deprivations in the population provides valuableinformation for the analysis of inequality and poverty, based on which economic and public health policies and interventions are planned or implemented. The Below Poverty Line (BPL) scale was designed by the Government of India to identify economically disadvantaged households/individuals needing government aid and subsidies.[3,4] The 10th plan BPL survey for urban families was based on the extent of deprivation on seven parameters: roof, floor, water, sanitation, education level, type of employment and status of children in a house.[5] The Multi-Dimensional Poverty Index (MDPI) is an international scale developed by the Oxford Poverty and Human Development Initiative and the United Nations Development Programme in 2010 to measure acute poverty and designed to identify the most vulnerable people, the poorestof the poor. The new Global Multidimensional Poverty Index (MPI) was developed in 2010 by OPHI and the United Nations Development Program for UNDP's Human Development Reports.[6] This index (by Alkire and Foster) is an extension of the capability approach preached by Amartya Sen, Noble Laureate in Economics. Not only are the most vulnerable people identified using the MPI, but it also shows aspects in which they are deprived. Hence MPI as aptly called looks at poverty through a 'high-resolution' lens. MPI is supposed to complement or supplement the existing income/consumption based poverty indices and reflect upon deprivations in very basic services and core human functioning that they are experiencing simultaneously.

The **objective** of this study is to assess demographic, socioeconomic, water-sanitation & hygienic behavior of families in the study area and measure poverty through Multi-Dimensional Poverty Index (MDPI) with the relative contribution of the indicators.

MATERIAL AND METHODS

A population-based survey through the door to door health survey, on a population residing in 3600 households was conducted in all villages in three gram panchayats (GP) in three blocks (1200 households in each GP).The first gram panchayat was located in Kulpi Block, second located in Diamond Harbor I Block and third gram panchayat being located in Jaynagar II Block of South 24 Parganas district in the Indian state of West Bengal.

A stratified multi-stage design has been adopted for this survey. The first stage units (FSU) were the 2011 census villages of one study Gram Panchayat (GP) in each of three blocks belonging in the study area of the District of South 24 Parganas, in West Bengal. The GP in each block was selected on the basis ofpredominantlydisadvantaged population group of schedule caste (SC) and tribes (ST), the lowest percentage of SC/ST population and minority community respectively in each of the selected blocks. The ultimate stage units (USU) were the households.

Each village in a GP was the first stage unit. The total number of such villages was 27 out of the total of 307 villages in the three study blocks. A total of 27villages (8.8%) constituted the sample size for this stage Stratification: The study GPs were considered to be the natural geographical strata for the survey. The number of villages allocated to each stratum was 11, 10 and six villages in the GP1 (Kulpi, the predominant percentage of SC/ST), GP2 (Diamond Harbour I, the lowest proportion of SC/ST) and GP3 (Jaynagar II, minority) respectively (stratum). Finally, the household in a sample village was selected by systematic sampling with a random start procedure after preparing a village map and listing of households.

A proforma, incorporating a pretested questionnaire, was developed for collection of information from the head of the family/senior family member who was interviewed for data collection during house to house visit to each household in the study village. The questionnaire incorporated information regarding demographic and socioeconomic characteristics of the family members, availability and usage pattern of safe drinking water for drinking purpose, hygienic habits and sanitation practice and morbidity pattern due to waterborne disease. Two enumerators selected from each GP and trained to conduct the survey. Field visits took place three days a week, covering 12 households each day. In the case of locked doors, field workers re-visited the houses till information was obtained.

Data entry, compilation, data cleaning and data analysis by data entry operator and rechecked by supervisor. Data were analyzed using STATA 11.0 for Windows (Stata Corp, College Station, TX, USA) software.

MPI Calculation[6]: MPI, as proposed by OPHI, has three dimensions: health, education, and standard of living which are measured by ten indicators (nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, water, electricity, floor, assets). Equal weight was assigned to the three dimensions and indicators within each dimension are also equally weighted. After summing up the weighted deprivations, the cross-dimensional cut-off is applied. A cross-dimensional cut-off of 1/3 or 33% was used. Hence

a household was considered multi-dimensionally poor is their weighted deprivation was greater than or equal to 33%. The product of incidence of multidimensional poverty (H) and the average intensity of poverty among the poor (A) was used to arrive the final MPI figure. Hence, MPI captures both the share of people in poverty and also their degree of deprivation. In the Alkire Foster Method of MPI First, we identify all households who are deprived in any dimension. Let $z_j>0$ be the poverty line (or deprivation cut-off) in dimension j, and z be the vector of poverty lines for each of the dimensions of multidimensional poverty. Defining a matrix of deprivations $g^o=[g^o_{ij}]$, whose typical element g^o_{ij} is defined by $g^o_{ij}=w_j$ when $y_{ij}<z_j$. That is, the ij^{th} entry of the matrix is equivalent to the dimensional weight w_j when household i is deprived in dimension j, and is zero when the household is not deprived. From the matrix g^0 we construct a column vector c of *deprivation counts*, whose i^{th} entry c_i represents the sum of weighted deprivations suffered by the household i

We select a second cutoff $k>0$ and apply it across this column vector c. p_k, the *identification function* takes the value of 1 when c_i is greater than or equal to k and $p_k =0$ when $c_i<k$. That means that a household is identified as poor if her weighted deprivation count is greater than or equal to k. This is called a dual cutoff method, as it uses the within dimension cutoffs z_j to determine whether a household is deprived or not in each dimension, and the cross-dimensional cutoff k to decide who is to be considered poor.

'H' is the proportion of households that are poor. That is, $H =q/n$ where q is the number of poor households; it represents the incidence of multidimensional poverty. To understand 'A,' we first notice that $c_i(k)/d$ indicates the fraction of weighted indicators in which the poor household i is deprived. The average of that fraction among those who are poor (q), is precise 'A.' 'A' represents the intensity of multidimensional poverty.

The product of 'H' and 'A,' M_0 is named as *Adjusted Headcount Ratio*. (M_0 also satisfies other properties like replication invariance, symmetry, poverty focus, deprivation focus, weak monotonicity, non-triviality, normalization, and weak re-arrangement.)

Choice of dimensions: As rightly argued by Amartya Sen, the selection of dimensions, deprivations, capabilities for any poverty measure should be a value judgment and not a mere technical exercise. Dimensions should have particular importance to the society and also social influence such that appropriate focus should be on public policy. Some possible dimensions would be health, education, the standard of living, empowerment, work, environment, safety from violence, etc.[7] We stick with the global MPI regarding the dimension.

Choice of Indicators: The MPI we used has eight indicators: two for education, two for health and five for the standard of living.

Education indicator is based on proximate literacy by Basu and Foster (1998) which discussed the role of one literate individual in the household.[8] A literate household member disseminates positive externalities to the entire household. Hence whether the household head is literate or not has repercussion effect on his employment, earnings and gets extended to health education and standard of living of other members of the family. Besides, child labor has been taken as a proxy indicator of children in the age group of 5 to 12 years as not attending formal school.

Health indicators are based on child mortality and nutrition of the household. Child mortality data was available from our survey. Household dietary diversity score is calculated to measure nutrition of the household

Standard of living indicators is similar to the global MPI indicators.

Table 1: Dimension and indicators of MPI

Dimensions & Indicators	Definition of deprivation cut-offs	Weights	% of households deprived per indicator(95% CI)
Education		1/3	
Years of Schooling	Household head education <5 years of schooling	1/6	73.42 % (71.97, 74.86))
Child Labour	Child in the age group of 5 to 12 years who are working.	1/6	0.25% (0.08,0.41)
Health		1/3	
Child Mortality	Incidence of child death in last 1 year="yes"	1/6	1.39 %(1.05,1.77)
Nutrition	Household dietary diversity score<4	1/6	92.97 %(92.13,93.80)
Standard of Living		1/3	
Water	Water source is river="true" or pond="true" or time to water=">30min"	1/15	0.58 %(.33,.83)
Sanitation	Own sanitary system="no"	1/15	26.25 %(24.81,27.68)
Flooring	Roof type= "grass/cane/leaves/straw"	1/15	5.94 %(5.17,6.71)
Cooking Fuel	Use of gas oven=No	1/15	55.58 %(53.95,57.20)
Assets	Sum of radio= "yes" + television= "yes" +bicycle="yes"=<1	1/15	51.33 %(49.69,52.96)

Unit of analysis: We have used households as our unit of analysis. Reason for that would be people in these villages lived in households and shared common resources. Household being deprived in an indicator would imply individuals residing in the households also being deprived in these indicators. The same logic holds for MPI as well.

Cutoffs for each indicator: The cutoffs for each indicatorare detailed in column 3 in Table 1.

Indicators weight: Following the global MPI, equal weight (1/3) is assigned to the three dimensions. Weights for the indicators are mentioned in column 4 of Table 1.

RESULTS

Demographic description of study population

Out of 3600 families studied, 2433 (67.58%) families were Hindu while 1167 (32.42%) were Muslim. 16942 people were residing in 3600 households surveyed. Out of these 8580 (50.6%), people were Hindu and 8362(49.4%) Muslims. The SC population constituted 5606 people, ST, 215 individuals and OBC, 908 people. Caste wise distribution of the families is given in Table-2. Out of the population studied 2435 Children were under 5years of age, 52 % being Hindu and 48% Muslims. Thus, there were more Muslim children out of less number of their families. Out of the total children population aged below five years, 65.9% belonged to General category, 27.6% SC, 1.4% ST and 5% OBC categories and these followed their family percentage composition.

Table 2 Caste wise Household distribution

Caste	Number (%)
General	2154 (59.83)
SC	1212 (33.67)
ST	47 (1.31)
OBC	187 (5.19)
Total	3600 (100)

Socioeconomic condition of the families studied

A significant number (19.19%) of the head of the Hindu families had an education above secondary compared to Muslims (6.86%) while considerably number (30.25%) of the head of the Muslim families was illiterate compared to Hindus (17.80%), (*p*<0.001). However, there was no significant difference regarding education among the head of families belonging to different cast. There is not much difference in education status of head of households belonging to General category and SC, ST and OBC category. Significantly more numbers of head of Muslim families compared to Hindus were daily laborer (52.53% vs. 46.81%) and mar-

ginal businessmen (33.50% vs.22.03%) while significantly more Hindus compared to Muslim families were service holders (9.08% vs.2.40%) (*p*<0.01). Significantly less number of head of households belonging to ST were engaged in the business profession (*p*<0.01).

Water, Sanitation and Hygienic Behavior of families studied

Tube well water was the primary source of drinking water as it was used by 3447 (95.75%) families, while tap water was used by 153 (4.25%) families only. Accessibility to the source of drinking water was smooth as it was accessible within 15 minutes' walk from households in 3285 (91.25 %) families. There were 238 tube wells in the in the 27 villages in the three GPs from where 3447 (95.75%) families were collecting drinking water for their use. According to scoring by 'sanitary survey format' Chance of contamination was found to be Very high to Medium in 135(56.7%) of tube wells, while low in 103(43.3%) tube wells. Water samples were collected from 24 sample tube wells for testing for bacteriological contamination. Coliform organism (count varying from 2 to 70 colonies/100ml) was found to present in water samples from 23 tube wells, and E coliwas found in one sample. Chemical analysis didn't show the presence of arsenic in any of these samples, but iron was present (>0.30 mg/L) in 7 (29%) samples and Manganese present (>0.30mg/L) in one (4%) sample.

The toilet was present in 2381 (66.14%) households, while the rest did not have it. The toilet was present in significantly more Hindu families (71.93%) than in Muslim families (54.07 %) [*p*<0.001]. However, there was no difference in the presence of toilet among the different casts. Maximum number (1122, 47.12%) of families had dug well latrine with a cement base, Only 6% (212) of the household dispose of solid waste in manure pit or a demarcated site, but 94% of householddispose of solid waste by open dumping (indiscriminate throwing around the houses).

Liquid waste was disposed in a drain in by few (1.45%) families, but mostly these are thrown around the house. Majority of household (3141, 87.25 %) members gave a history of regular nail cutting. However, hand washing with soap was practiced by only 1964 (54.56%) household members after defecation. In general food hygiene practice is good, 84% (3025) household members keep their cooked food covered during storage. Heating before serving stored food was practiced by 64% (2304) household members.

Poverty cutoffs

According to the Human Development Report (2011) households are identified as being vulnera-

ble to poverty if the weighted deprivation is between 20 to 33 percentages. The above 20 percentage has deprivations in one or two indicators which the households hopefully can improve. It can hence be considered not harmful to overall development context. Householdsare considered multidimensionally poor if the weighted deprivation is greater than 33%. Even among the MPI poor, those with weighted deprivation of 50 percentages or more are identified as severely poor.

Table 3: Poverty distribution among households

Poverty cut-off (Minimum deprivation)	Frequency (%)(n=3600)	Poverty distribution	MPI categories
0%	10 (0.28)	Not poor (7.25%)	MPI non-Poor (28.20%)
6.70%	63 (1.75)		
13.30%	17 (0.47)		
16.70%	171 (4.75)		
20%	2 (0.06)	Vulnerable to poverty (20.95%)	
23.30%	429 (11.92)		
30%	323 (8.97)		
33.30%	523 (14.53)	Poverty (60.69%)	MPI poor (71.80%)
36.70%	84 (2.33)		
40%	742 (20.61)		
43.30%	10 (0.28)		
46.70%	826 (22.94)		
50%	4 (0.11)	Severe poverty (11.11%)	
53.30%	327 (9.08)		
56.70%	11 (0.31)		
60%	22 (0.61)		
63.30%	26 (0.72)		
66.70%	1 (0.03)		
70%	8 (0.22)		
76.67%	1 (0.03)		

Table 4: Religion & caste wise distribution of MPI

Variables	MPI non-Poor (n=860)	MPI Poor (n=2740)	Total[a] (n=3600)
Religion			
Hindu	27%	73%	68%
Muslim	18%	82%	32%
Caste			
General	24%	76%	60%
SC	24%	76%	34%
ST	4%	96%	1%
OBC	26%	74%	5%

SC= Scheduled Caste; ST= Scheduled Tribe, OBC= Other backward caste; [a]All columns represent row percentages; only the last column represent column (overall) percentages

Table 5: Cross-table between income poor with MPI poor

	MPI non-poor(n=860)	MPI Poor (n=2740)	Total (n=3600)
APL (Not Income poor)	16.86 %	47.39%	64.00%
BPL (Income poor)	7.03%	28.72%	36.00%
Total	23.89%	76.11%	100.00%

MPI =H*A also called adjusted headcount

Here, H is the incidence of poverty (headcount or proportion of people who are poor); A is Average Intensity of deprivation (proportion of dimension in which the households are deprived at 33% cutoff, according to our data H=0.718, A=0.4298. Hence, MPI is 0.3086

A little less than three –fourth of the households has been identified as MPI poor (Table 3). Nearly one-fifth has been identified as vulnerable to poverty. Religion and caste-wise distribution of MPI poor have been shown in Table 4. According to our study, the income poverty rate was 36%, and 76% are MPI poor (Table 5).

Decomposition of Indicators contribution for the three selective gram panchayats

One of the many advantages to the MPI is its ability to compare the composition of poverty in different districts, ethnic groups, religions, etc. It can very well be the case that one ethnic group or state in the country is particularly deprived in some indicators which often gets overshadowed in the national level analysis. Two states can have similar MPI, but the contributions of the indicators have been every different for the two states, which will help us in identifying the deprived areas.
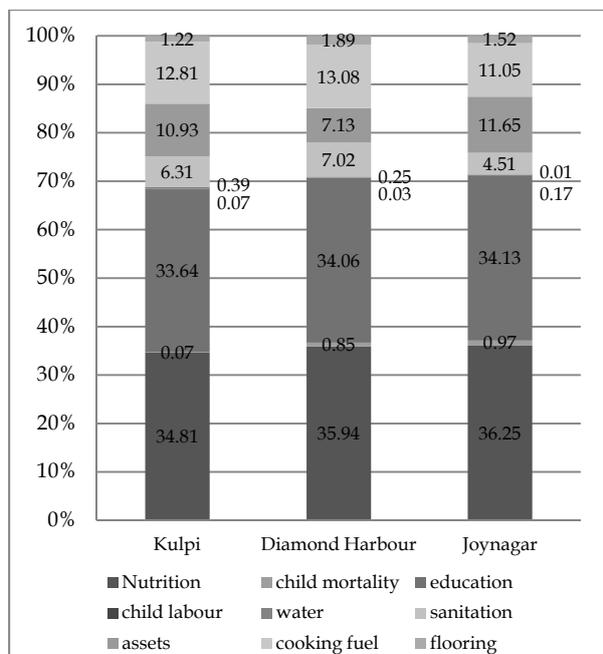
Generally, contribution of Indicator i to

$$\text{MPI} = \frac{w_i CH_i}{MPI country} * 100$$

where w_i= weight; CH_i= censored head count. In our case, the MPI of the country would refer to the MPI of the respective gram panchayats. The MPI of Kulpi is 0.168, of Joynagar, is 0.4342, and that of Diamond Harbour is 0.486.

Though Joynagar and Diamond Harbour may seem similar going by their MPI score, their composition differs. Diamond Harbour is more deprived of access to clean water than Kulpi or Joynagar. But Kulpi and Joynagar have greater asset deprivation than Diamond Harbour. Households in these GPs are deprived of sanitation. Diamond Harbour is particularly deprived of both safe water and sanitation. Graphical depiction of the same is shown in figure 1which lenses out the areas of deprivation.

DISCUSSION

This article measures Poverty through Multi-Dimensional Poverty Index (MPI) in Eastern India. In the recent literature search, to our best of knowledge, no such studies have been conducted to understand poverty and public health priorities holistically through MPI in this region of India. If we have looked only through income, the income poverty rate was only 36% but in actual 76% are MPI poor.

Figure 1: Contribution of indicators to the MPI across 3 GPs

So the obvious question comes: Do Income poverty and Multidimensional Poverty Index identify the same poor? To understand Human progress by any indicator would require encompassing the multiple aspects of life, like education, employment, nutrition, etc. Consumption or income-based indicators alone cannot be a good proxy to capture the multidimensional aspect of poverty and deprivations. Demographic, socio-economic, health and dietary indicators play a significant role in determining the real standard of living. It may be the case that income poor people would often be malnourished and uneducated, but they fail to guide policy regarding other deprivations like safe drinking water, sanitation, etc. Poverty, the standard of living and human development depend on multiple factors, and the similar view has been expressed in the literature review.[9,10,11]

Table 5 raises the important empirical question whether using only consumption /income-based indicators can potentially under or over call the poor depending on the situation. It would be interesting to see is whether there is a palpable disjunction in reporting between Income and Multidimensional Poverty Index (MPI) because if some household is poor by one measure and non-poor by another, then there will be Inclusion and Exclusion, i.e., Type I and Type II error. Ruggeri-Laderchi, Sith, and Stewart (2003) in their study in India had made a relevant point. They reported that education when used as the indicator, 43 % of the children and about 60% adults were capability poor but not monetary poor.[12] Hence income poverty may not be entirely inclusive of deprivation in oth-

er aspects. A rational approach would be using a holistic and broad measure which can identify the correct "target" groups which are an essential prerequisite for the success of any policy.

Besides this, the article lenses out deprivation within study areas. Households in these GPs are deprived of sanitation. Though there are accesses to tap/ tube-well water while going in-depth, it was observed that chances of bacteriological contamination are very high. Even one-third of households are without toilets. Similar findings were observed in literature search in rural areas.[13, 14,15]To add to these problems, hand washing with soap was practiced by only half of household members after defecation.

This creates evidence that only provision or building tap/ tube-well is not sufficient. Maintenance and making them safe from contamination is essential for a better healthy outcome. Similarly along with the creation of toilet, making them usable with behavior modification for hand washing and using it is vital. This type of multidimensional measure provides a snapshot of information for the selected dimensions across different project areas. The fact that these summary measures can be even decomposed further leads to better evaluation data of program results. When experiences of the poor are reflected in the chosen measures, it empowers whose working in the field to work on target areas more effectively and efficiently. This is helpful to determine and select areas where intervention is desired.

The measurement of socioeconomic status, water-sanitation & hygienic behavior of families and the classification of poverty are but crucial to provide an in-depth understanding of living conditions of people. This would likely provide appropriate directions in the analysis of predisposing factors, allowing designing of targeted interventions and then enabling evaluation of the effect of such interventions aimed at alleviating poverty and improving living conditions. Three crucial game changers to be taken into account are, whether resources are available to meet the needs as defined by pre-specified cutoffs, variably calculated based on income or consumption, lack of equity in the distribution of an attribute in a population. This study acts as evidence in defining MDPI as a tool to focus where to invest in public health.

CONCLUSION

The study hence highlights that measurement of deprivations in the population provides valuable information for the analysis of inequality and poverty, based on which economic and public health policies and interventions can be planned or im-

plemented. This study helps to assess demographic, socioeconomic, water-sanitation & hygienic behavior of families in eastern India and measure poverty through Multi-Dimensional Poverty Index (MPI) with the relative contribution of the indicators. Consumption or income-based indicators alone cannot be a good proxy to capture the multidimensional aspect of poverty and deprivations. Demographic, socio-economic, health and dietary indicators play a significant role in determining the real standard of living. This study acts as evidence in defining Multi-Dimensional Poverty Index as a tool to focus where to invest in public health.

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