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Asset and consumption gradient of health estimates in India: Implications for survey and public health research

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ABSTRACT

The wealth index based on household assets and amenities is been increasingly used to explain economic variations of health outcomes in the developing countries. While the variables used to compute the wealth index are easy to collect and time- and cost-effective, the wealth index tends to have an urban bias, uses arbitrary weighting, does not provide per capita measures and is a poor measure of inequality. We used micro data from two of the large-scale population-based surveys, the Longitudinal Ageing Study in India, 2017–18 and the India Human Development Survey, 2011–12 that covered over 42,000 households each and collected data on household consumption, assets and amenities in India. We examined the variations and inequality in health estimates by consumption per capita and asset-based measures in India. Descriptive statistics, logistic regression model, concentration index, and concentration curve were used in the analyses.

We found a weak association between monthly per capita consumption expenditure (MPCE) and wealth index in both the surveys. Some of the health conditions such as hypertension, cataract, refractive error, and diabetes tended to be underestimated in the bottom 40% of the population when economic well-being was measured using the wealth index compared to consumption. Socio-economic inequality in health outcome, inpatient and outpatient health services were underestimated when measured using the wealth index than when measured using MPCE.

We conclude that economic gradients of health by consumption and wealth index are inconsistent and that per capita consumption predicts health estimates better than the wealth index. It is recommended that public health research using population-based surveys that provide data on consumption and wealth index use per capita consumption to explain economic variations in health and health care utilization. We also suggest that the future rounds of the health surveys of National Sample Survey and the National Family and Health Surveys include an abridged version of the consumption schedule to predict better economic variations in health and health care utilization in India.

1. Introduction

In the last two decades, large-scale population health surveys from developing countries have bridged the data gap in many health and socio-economic variables. Among others, the Demographic Health Surveys (DHSs) have contributed immensely to research, knowledge, program, policy, and public life in many countries. The DHSs and other health surveys used an asset-based index, popularly known as the wealth index, to explain economic variations and inequalities in health outcomes and health care utilization. While the variables used in the wealth index are easy to collect and time- and cost-effective, the wealth index tend to have an urban bias, uses arbitrary weighting, does not provide per capita measures, is a poor measure of inequality, and is a proxy for living standards (Joseph et al., 2018; Lindelow, 2006; Mohanty, 2009). To address some of the limitations, the methodology of computing the wealth index has been modified over time, by computing rural and

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urban specific indices (Johnston & Abreu, 2016; Rutstein, 2008). Some population-based surveys collect data on household consumption as well, along with household assets and amenities.

The association between the wealth index and consumption is not consistent across countries (Filmer & Pritchett, 2001; Poirier et al., 2020; Sahn & Stifel, 2003; Vyas & Kumaranayake, 2006). In general, an asset-based index is a weak predictor of per capita adult consumption expenditure (Filmer & Scott, 2008; Howe et al., 2008, 2009; Lindelow, 2006; Montgomery et al., 2000; Ucar, 2015). The correlation coefficient of the wealth index and consumption expenditure varies from 0.34 in Nepal (Filmer & Pritchett, 2001) to 0.77 in Papua New Guinea (Filmer & Scott, 2012) to 0.84 in Mexico (McKenzie, 2005) to 0.94 in Nicaragua (Filmer & Scott, 2012). In a study in Zambia, only 46% of households were classified in the same tertile of consumption expenditure and asset index (Boccia et al., 2013). In Turkey, the agreement of asset index, consumption expenditure, and income was found to be high for the lowest and the highest quintiles and poor for the other quintiles (Ucar, 2015). Poverty estimates were lower when estimated with asset-based measures as compared to consumption expenditure in Ethiopia and Malawi (Foreit & Schreiner, 2011, pp. 1–21).

A systematic review of 64 studies suggested that urban-rural disparities are higher when measured with wealth indices compared to income and consumption measures (Poirier et al., 2020). Health estimates differ significantly when measured using rural and urban specific wealth indices (Mohanty, 2009). In Vietnam, wealth quintiles were found to be correlated with low birth weight, education level, and occupation (Vu et al., 2011). Health estimates and health care utilization are lower when economic condition is measured using the wealth index compared to consumption expenditure (Lindelow, 2006; Srivastava & Mohanty, 2010). Studies suggest that compared to the wealth index, income predicts a higher variation in health outcomes (Fink et al., 2017; Joseph et al., 2018). Compared to household consumption and income, wealth index in some countries shows higher health inequalities (Lindelow, 2006; Opuni et al., 2011; van Leth et al., 2011). In Kenya, compared to consumption expenditure, the wealth index revealed higher inequalities in urban areas and smaller inequalities in rural areas (Chuma & Molyneux, 2009). A study of 19 countries suggested that, on average, inequalities in child malnutrition were higher when measured by consumption expenditure than by wealth index; however, the difference in the inequalities as estimated by both the measures was reasonably small (Wagstaff & Watanabe, 2003).

India has a long history of collecting consumption data through the National Sample Survey (NSS). The NSS collected detailed and abridged version of the consumption schedule in various rounds of surveys. The abridged version of consumption schedule has been integrated into some rounds of health, migration, and related schedules to explain the economic gradient. The India Human Development Survey (IHDS) and the recently conducted Longitudinal Ageing Study in India (LASI) also used an abridged version of the consumption schedule. Besides questions on household consumption, asset-based questions were also asked in both IHDS and LASI. However, the consumption schedule has not been incorporated in NFHSs on the grounds of being lengthy, time-consuming, and costly. On the other hand, in growing economies, the variables used in the construction of the wealth index are becoming a household necessity and are increasingly available in the population (Booysen et al., 2008; Chuma & Molyneux, 2009; Mohsena et al., 2010; Nwaru et al., 2012; Rohner et al., 2012). It is not clear how true are the economic differentials derived from the wealth index and consumption expenditure of the same households. For a large and heterogeneous country like India with a strong record of collecting consumption expenditure data, understanding the consumption and asset gradient of health estimates is useful for population-based surveys and evidence-based policy. We believe that the wealth index and consumption measures are fundamentally distinct and that each set produces inconsistent health estimates. Besides, the variables used in the construction of wealth index are accumulated over time while household consumption is of more of current in nature. We hypothesize that the asset-based index does not capture the true economic variation in health outcome and health care utilization in India. Accordingly, the specific objectives of this paper are to examine the variations and inequality in health estimates by consumption per capita and asset-based measures in India. The research questions that we intend to address are: "Are consumption and asset-based index gradients of health estimates similar in India?" and "To what extent does economic inequality in health outcomes vary by asset-based and consumption-based measures?"

2. Materials and methods

2.1. Data

We used the unit data from two large-scale population-based surveys, namely, the Longitudinal Ageing Study in India (LASI), wave 1, conducted during 2017–18, and the second round of the India Human Development Survey (IHDS), conducted during 2011–12. Both were large-scale, representative surveys and canvassed variables of our interest, that is, household consumption, assets and household amenities, and a set of health variables. While LASI covered extensive range of biomarkers, specific to individuals aged 45 years and older and their spouses, IHDS included all age groups and covered the maternal and child health and self-reported health. A brief description of the data structure of both the surveys is given below.

LASI is a nationally representative study on the health, economic and social wellbeing of older adults (45+) and their spouses in India. LASI has the distinction of being the largest-ever study, worldwide, with a representative sample of 72,250 individuals and 42,949 age-eligible households across all states and union territories of India except Sikkim (data orf Sikkim was not available at the time of submission of this paper). LASI used a multistage stratified area probability cluster sampling design in the selection of the sample households. The consumption schedule was an abridged version, covering about 40 questions on food, clothing, education, and health care in various reference periods. Data on food expenditure was collected for a reference period of seven days, while data on non-food expenditure was collected for reference periods of 30 days and 365 days. The survey included a set of questions on household's non-financial assets (23), financial assets, household amenities (water, sanitation, cooking fuel, electricity), housing (type of material used for floor, roof and wall, number of rooms) and land holding. The assets based questions (non-financial) included in LASI were similar to those included in NFHS-4/IHDS-2. Along with self-reported health and functional health, LASI measured blood pressure, grip strength, spirometry, and visual impairment and collected dry blood samples (DBS). The details of the sampling procedure, the instrument, and the findings of the survey are available in the national report (IIPS et al., 2020).

IHDS-2 is a population-based survey that collected comprehensive information on household consumption, assets, and income along with individual information on health and health care utilization. The details of the sampling procedure, the instrument, and the findings of the survey are available in the national report (Desai & Vanneman, 2011). IHDS-2 covered 204,568 individuals from 42,152 households across 28 Indian states and 5 union territories except Andaman & Nicobar Islands and Lakshadweep. The consumption questions were abridged versions of those used by the National Sample Survey Organization (NSSO, 2013). The questions on household consumption (food and non-food) collected in IHDS-2 were similar to those used in LASI but do vary in reference period. The questions relating to food consumption had a reference period of 30 days in IHDS-2 compared to 7 days in LASI. Questions on non-food expenditure had a reference period of 30 days and 365 days in both the surveys. We standardized the expenditure to 30 days and derived a measured referred to monthly per capita consumption expenditure (MPCE) for comparison between the two surveys. The IHDS-2 used a set of 33 variables to collect information on assets along

with household amenities such as type of house, toilet facility, source of water, cooking fuel, etc similar to LASI. Table S1 presents availability of health outcome and health care utilization along with consumption and income data derived from LASI and IHDS2. We refer IHDS-2 and IHDS interchangeably in this paper.

2.2. Variables

2.2.1. Outcome variables

A set of self-reported and measured health variables were used as outcome variables in the analyses.

Health outcome: Hypertension, vision impairment, body mass index (BMI), diabetes, heart disease, and self-rated health were used as health outcome variables.

Health care utilization: Inpatient and outpatient services, both collected in LASI and IHDS, along with a set of variables pertaining to maternal and child care (antenatal care, institutional delivery, and child immunization) that were covered in IHDS but not in LASI, were used as outcome variables. Data on inpatient health care was collected for a reference period of 365 days in both the surveys. The reference period for outpatient visit was 30 days in IHDS and the last visit in LASI.

2.2.2. Independent variables

MPCE and wealth index were the two main independent variables in the analysis. MPCE was derived by dividing the total consumption expenditure of a household by the number of household members. Food and non-food expenditures were standardized to a 30-day reference period. The wealth index was computed from household assets, housing, and household amenities by using the principal component analysis (PCA) separately for rural and urban areas and then combined as recommended by DHS (Filmer & Pritchett, 2001; Rutstein & Kiersten, 2004; Rutstein, 2015). Cronbach α was used to examine the reliability of the variables used in the construction of the wealth index. The mean, standard deviation, and the factor score of variables used in construction of the wealth index is shown in Table S2. The other independent variables used were age, sex, educational attainment, caste and religion of head of household, place of residence and household size.

2.3. Methods

2.3.1. Descriptive analysis

We used descriptive analyses to examine the variations in health estimates by MPCE and wealth quintiles. Spearman's' rank correlation coefficient was estimated to understand the association between the wealth index and MPCE. Kappa statistics was used to determine the extent of agreement or disagreement between MPCE and the wealth index. The MPCE was truncated at the 1st and the 99th percentile at the lower and upper levels respectively. We also standardized MPCE and the wealth index and plotted the cumulative probability distribution function (CDF). The standardization of MPCE and the wealth index was done using the formula given below:

$$\frac{X_i - X_{min}}{X_{max} - X_{min}} \quad (1)$$

2.3.2. Regression analyses

Ordinary least squares (OLS) regression was used to understand the association between the wealth index and MPCE. Binary logistic regression was used to examine the odds of health outcome and health care utilization by MPCE quintile and wealth quintile. The set of socio-demographic variables controlled in the regression were age, sex, education, place of residence, caste, household size, and states.

2.3.3. Concentration curve and concentration index

To measure the differential in the socioeconomic inequality in health estimates and health care utilization by the wealth index and MPCE, concentration index and concentration curve (CC) were used. The concentration curve plots the cumulative proportion of the population ranked on living condition (MPCE/wealth index) against the cumulative population by health variables and varies between −1 and +1. A concentration curve above the line of inequality shows a pro-poor while one that lies below the line of equality shows pro-rich (O'Donnell et al., 2008).

2.3.4. Sensitive analyses

As a sensitive analysis, we estimated most of the health outcome and health care utilization by using adult equivalent per capita consumption expenditure (APCE). We used the standard equivalent scale that adjust for household age composition and household size to consumption expenditure. A weight of 0.5 was assigned to children under 15 years and a weight of 1 to adult 15 years and above, as done in previous Indian studies (Pandey et al., 2018). The following equation was used for determining the adult equivalent size

$$AE_i=(A_i+0.5C_i)^{0.75} \quad (2)$$

Where A_i is the number of members aged 15+ in the ith household.

C_i is the number of children aged 0–14 years.

And AE_i is the adult equivalent scale of ith households

Adult equivalent per capita consumption expenditure = Total consumption expenditure of a household/ Adult equivalent scale of the household (3)

3. Results

3.1. Association between MPCE and wealth index

Table 1 presents the sample profile of the LASI and IHDS surveys. The average household size was 4.8 in IHDS and 4.6 in LASI. The MPCE was ₹1889 in IHDS and ₹2967 in LASI. Non-food consumption expenditure accounted three-fifths of MPCE in IHDS and for about a half in LASI. The proportion of SCs/STs and Hindus was almost similar in both the surveys. The gini index of MPCE was 0.37 in LASI and 0.41 in IHDS. The distribution of most of the variables and the factor loadings of the variables were broadly similar for LASI and IHDS (Table S2). These were also similar in NFHS-4 (table not shown), indicating that the variables in the three surveys had a comparable variance and covariance structure).

Fig. S1 presents the percentage of households owning consumer durables and household amenities in LASI and IHDS. The distribution of many of the variables was higher in the LASI compared to IHDS. Fig. 1(a) and (b) compare the cumulative distribution function (CDF) of normalised MPCE and the wealth index from LASI and IHDS-2 respectively. The CDF of the wealth index was below the CDF of MPCE in most part of the distribution, suggesting that both the measures were distinct in both the surveys. For example, the cumulated probability of the normalised score below the threshold of 0.2 was 0.1 in the case of wealth index compared to 0.6 in case of MPCE. The patterns of CDF based on MPCE and the wealth index were also similar from LASI and IHDS. The inferences drawn from plotting the CDF of MPCE and the wealth index were similar when we used the adult equivalent per capita consumption expenditure (APCE) and the wealth index from the same surveys (Fig. S2).

Table 2 presents the distribution of households according to MPCE quintiles and wealth index quintiles in the LASI and IHDS surveys. If all the households were classified in the same quintile using both of the measures, the vertical cells would have been 100%. However, we found that, about 33% households were in the poorest quintile in terms of both MPCE and the wealth index in the LASI survey, while 67% were misclassified. Similarly, of all the households in the poorer MPCE quintile, only 23% were in the poorer wealth quintile, which suggests a weak overlap of consumption and wealth index. The pattern of

Table 1
Descriptive statistics of sample households and individuals as obtained from LASI, 2017–18, and IHDS-2, 2011-12.

	LASI, 2017-18			IHDS-2, 2011-12		
	Rural	Urban	Total	Rural	Urban	Total
No. of households	27,576	15,373	42,949	27,579	14,573	42,152
No. of individuals	46,534	25,716	72,250	1,35,118	69,450	2,04,568
Average HH size	4.7	4.4	4.6	4.8	4.7	4.8
Median age	30.3	31.2	30.5	25.0	28.0	26.0
MPCE (95%CI) (Rs)	2543 [2501–2586]	3944 [3888–4000]	2967 [2932–3001]	1588 [1568–1607]	2541 [2501–2582]	1889 [1870–1908]
Median MPCE(Rs)	2040	3009	2287	1183	1936	1376
Non-food expenditure (95%CI) (Rs)	1193 [1153–1233]	2103 [2066–2140]	1468 [1438–1500]	905 [887–923]	1656 [1619–1694]	1143 [1125–1160]
Non-food expenditure as a share of MPCE	46.9	53.3	49.5	57.0	65.2	60.5
Mean number of assets	5.1	7.8	6.0	12.2	19.7	14.6
Mean years of schooling	7.0	8.9	7.9	6.8	10.4	8.0
SC/ST (%)	34.7	16.9	29.1	34.8	20.9	30.4
Hindu (%)	83.1	76.9	81.1	84.4	79.0	82.6
Gini Index of MPCE	0.363	0.359	0.374	0.389	0.397	0.409

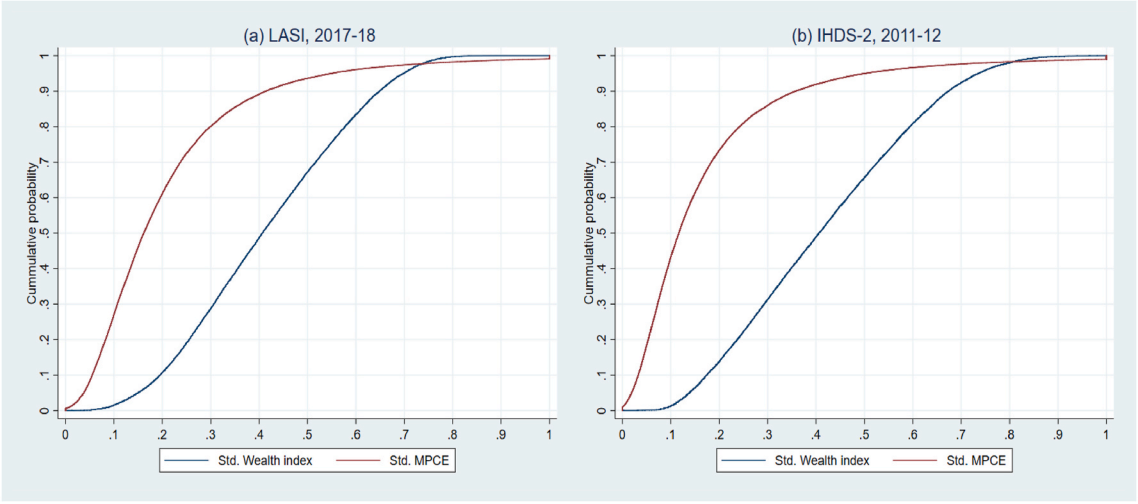


Fig. 1. Cumulative probability distribution function of MPCE and wealth index from LASI, 2017–18, and IHDS-2, 2011-12.

Table 2
Percent distribution of MPCE quintile by wealth quintile in LASI, 2017–18, and IHDS-2, 2011-12.

LASI, 2017-18					
	MPCE quintile				
Wealth quintile	Q1	Q2	Q3	Q4	Q5
Poorest	**33.3**	21.1	16.7	11.4	7.3
Poorer	24.3	**23.0**	19.3	16.8	11.6
Middle	19.1	22.0	**20.6**	19.4	16.6
Richer	14.8	18.8	21.7	**26.0**	21.5
Richest	8.6	15.2	21.8	26.4	**43.1**
Total Percent	100.0	100.0	100.0	100.0	100.0
N	10,841	10,007	8611	7383	6107
IHDS-, 2011–12					
	MPCE quintile				
Wealth quintile	Q1	Q2	Q3	Q4	Q5
Poorest	**42.4**	24.7	16.1	9.9	5.1
Poorer	25.4	**25.8**	21.1	16.5	9.3
Middle	16.3	21.8	**23.0**	21.8	17.8
Richer	11.7	18.3	22.2	**23.9**	23.3
Richest	4.2	9.4	17.5	27.9	**44.5**
Total Percent	100.0	100.0	100.0	100.0	100.0
N	11,098	9533	8092	7170	6236

misclassification was similar in the IHDS survey. The extent of misclassification was relatively lower at the lower and upper ends of the distribution. By considering the distribution across all the households we found that 33% households were placed in the same quintile in both MPCE and the wealth index in 2011–12 and 29% were so by 2017–18 ((Table S3(a)).

The correlation coefficient of MPCE and the wealth index was 0.44 (0.50 for rural areas and 0.53 for urban areas) in IHDS and 0.29 (0.34 for rural areas and 0.33 for urban areas) in LASI (Table 3). The Kappa statistics was 0.15 in IHDS; 0.17 for rural areas and 0.20 for urban areas. It

Table 3
Correlation coefficient, Kappa statistics of MPCE and wealth index and regression result of consumption expenditure and wealth index in India.

	LASI, 2017-18			IHDS-2, 2011-12		
	Rural	**Urban**	**Total**	**Rural**	**Urban**	**Total**
Spearman's rank correlation of wealth index and MPCE	0.337	0.328	0.294	0.496	0.525	0.439
Kappa statistics of wealth index and MPCE	0.098	0.106	0.091	0.172	0.204	0.146
Agreement (%)	27.82	28.47	27.13	33.75	36.35	31.7
Coefficient[a]	0.107	0.103	0.116	0.151	0.171	0.158
R^2	0.135	0.121	0.189	0.288	0.315	0.359

[a] OLS regression with consumption expenditure as dependent variable and wealth index as independent variable.

was 0.09 in LASI; 0.010 for rural areas and 0.11 for urban areas suggesting weak agreement between consumption and wealth measures. On regressing MPCE (dependent variable) on the wealth index (independent variable) from IHDS, we found that 36% variation in MPCE is being explained by wealth index. Similarly, from the LASI, 19% variation in MPCE could be explained by the wealth index. The results were similar when the analyses were carried out using APCE and the wealth index (Table S3 (b)).

3.2. Variations in health estimates by MPCE and wealth index

Fig. 2 presents the age and sex adjusted prevalence of hypertension by MPCE and the wealth index percentiles from LASI survey. Hypertension is defined as having systolic blood pressure of 140 or more or the diastolic blood pressure of 90 or more or as being on medication for hypertension or ever been diagnosed with hypertension by a medical professional. The results suggest that the prevalence of hypertension in the bottom half of the population was higher when households were ranked by MPCE than by the wealth index percentiles. On the other hand, the prevalence was relatively lower at the higher percentile when the households were ranked by MPCE than the wealth index percentile. Figs. 3 and 4 presents the adjusted prevalence of inpatient visits controlling for age, sex, education, residence, marital status, living arrangement, religion, caste, working status (currently working), smoking status (currently smoking), history of chronic diseases, and health insurance, as estimated from the LASI and IHDS surveys respectively. The adjusted prevalence of inpatient visits as derived from LASI survey increased consistently from 4.3% in the poorest quintile to 10.3% in the richest quintile while it was not consistent in terms of the wealth quintiles. A similar pattern was observed in the IHDS survey; with visit for inpatient care increases consistently from 3.7% in the poorest MPCE quintile to 9.4% in the richest MPCE quintile and no systematic pattern in the case of the wealth quintile. The prevalence of hypertension by the APCE quintile in both the surveys showed as pattern similar to that of the MPCE quintiles (Fig. S3, Fig. S4).

Table 4 presents the health estimates (measured and self-reported) by the MPCE and wealth quintiles from the LASI and Table 5 presents these estimates from IHDS. We observed that most of the health outcomes are consistent when households were ranked by MPCE than by the wealth index. In the LASI survey, the inpatient care (unadjusted) increased consistently from 4.3% in the poorest MPCE quintile to 11.8% in the richest MPCE quintile, whereas it did not show a consistent pattern by the wealth quintile. When compared with the wealth quintile, we did not find a similar pattern of health estimates The prevalence of hypertension increased with increase in both MPCE and wealth quintiles, but the gradient was relatively higher for the poorest, poorer and middle quintiles when households were classified by the MPCE quintiles compared to the wealth quintiles. The pattern was similar for hypertension without medication and hypertension with medication. The prevalence of underweight (BMI≤18.4) decreased systematically by both MPCE and wealth quintiles, but the gradient was higher in the middle, richer and richest quintiles when classified by the MPCE quintile.

The estimates of self-reported health outcomes– such as eye problems, cataracts, refractive error, high blood pressure/hypertension, diabetes, and cardiovascular diseases were higher for the poorest, poorer and middle quintiles when households were classified by MPCE than by the wealth index. For example, reporting of eye or vision problem was 38.2% in the poorest MPCE quintile compared to 32.5% in the poorest wealth quintile. Similarly, it was 43.3% in the poorer MPCE quintiles compared to 41.6% in the poorer wealth quintiles (Table 4). Table S4 present these estimates by APCE quintiles and shows a similar pattern. The health estimates also differed considerably by the MPCE and wealth quintiles in the IHDS survey (Table 5). The estimates of self-reported high blood pressure, diabetes and cardiovascular disease in the poorest and poorer quintiles were lower when households were ranked in terms of the wealth index than MPCE quintiles.

The information on institutional delivery and antenatal care was collected only in IHDS and not in LASI. Table 5 also presents the estimates of Institutional delivery by both consumption and wealth quintiles using IHDS data. The estimates were relatively higher for the poorest, poorer, and middle quintiles when households were classified by the MPCE quintile compared to the wealth quintile. The pattern was similar for the utilization of other maternal care services such as antenatal care, post-natal care, and child immunization. The estimates of maternal care were lower for the poorest, poorer and middle quintiles when measured using wealth quintiles than the MPCE quintiles. For childhood stunting and underweight, the estimates were higher for the poorest and the poorer quintiles when using the wealth index than MPCE. Child wasting did not show any specific pattern, whether in terms of MPCE or the wealth quintile. Table S5 present these estimates by the APCE quintiles and shows a similar pattern.

3.3. Inequality in health estimates by MPCE and wealth index

We have estimated the concentration indices and plotted the concentration curve for a set of health services and health outcome (Table 6) using the LASI and IHDS surveys. Fig. 5 presents the concentration curve of inpatient and outpatient care based on MPCE and the wealth index based on the LASI survey. The concentration curve for inpatient visits by

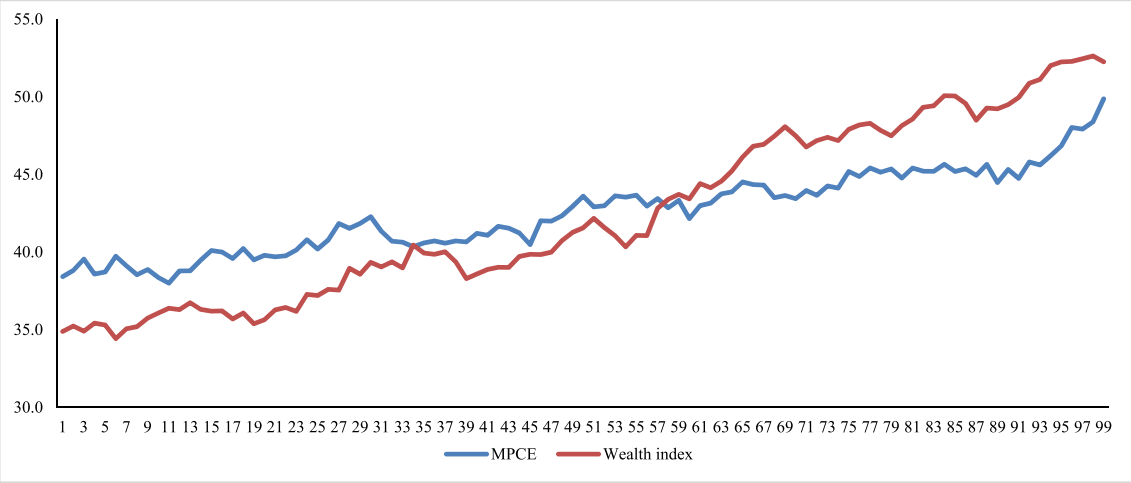
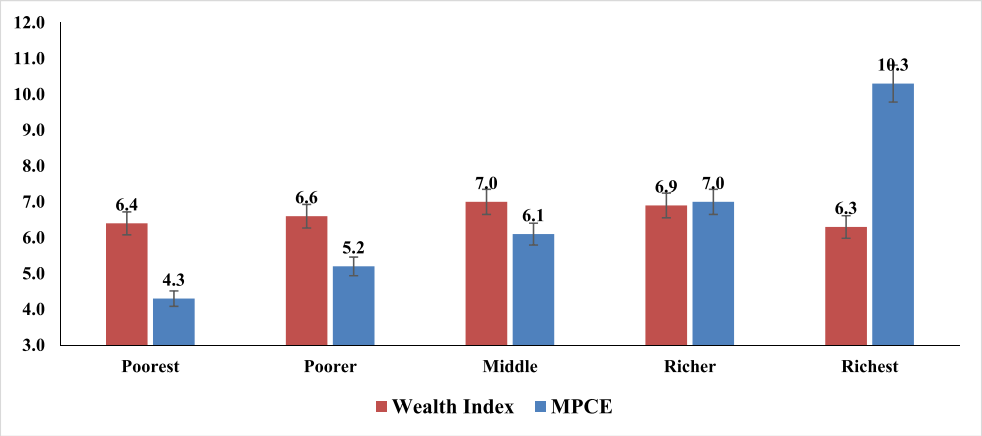
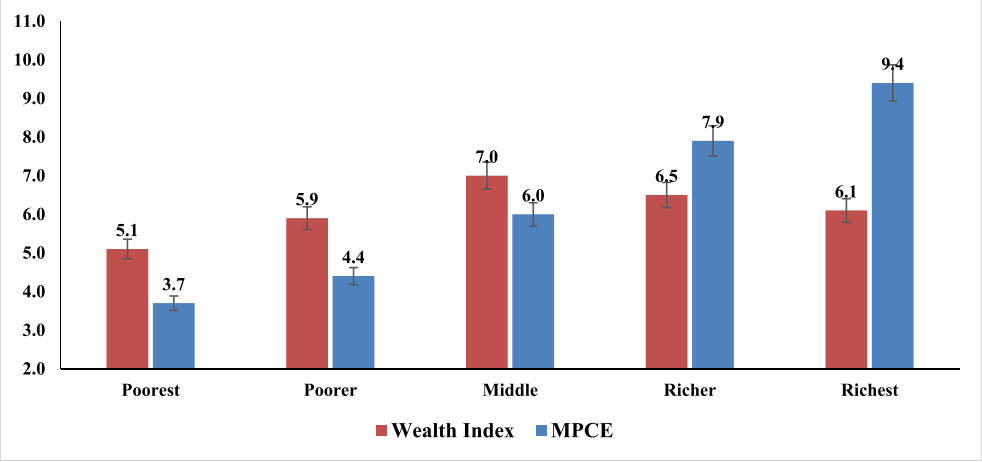


Fig. 2. Age and sex adjusted prevalence of hypertension (%) by MPCE and wealth percentile, LASI, 2017-18.



*Adjusted to age, sex, education, residence, living arrangement, religion, caste and health insurance

Fig. 3. Adjusted* prevalence of inpatient visits (%) by MPCE and wealth quintile, LASI,2017-18.
*Adjusted to age, sex, education, residence, living arrangement, religion, caste and health insurance.



*Adjusted to age, sex, education, residence, living arrangement, religion, caste and health insurance

Fig. 4. Adjusted prevalence of inpatient visits (%) by MPCE and wealth quintile, IHDS-2,2011-12.
*Adjusted to age, sex, education, residence, living arrangement, religion, caste and health insurance.

MPCE and the wealth index lay below the line of equality; however, the curve was farther away from the line of inequality when households were ranked by MPCE than the wealth index. The inferences drawn from MPCE and the wealth index were consistent, but the degree varied. The concentration index of inpatient visit was 0.192 based on MPCE, while it was 0.036 based on the wealth index. For outpatient services, the concentration curve based on MPCE and the wealth index also lay below the line of equality, but the inequality was greater when households were ranked by MPCE than the wealth index (Fig. 5). The concentration index of outpatient care was 0.029 based on MPCE, while it was 0.004 based on the wealth index (Table 6). The findings suggest that the use of both inpatient and outpatient care was pro-rich both on MPCE and wealth index; the gradient in inequality however was higher in terms of MPCE than the wealth index. The pattern was true for CVDs and diabetes as well (Fig. 5). Similar patterns of inequality in inpatient and outpatient services were observed in the IHDS survey. The concentration index of inpatient and outpatient visits based on MPCE were 0.200 and 0.125 respectively, whereas they were 0.039 and 0.082 respectively based on the wealth index (Table 6). The pattern of concentration indices was similar when derived using APCE (Table S6).

The prevalence of cardiovascular diseases (CVD) and diabetes, when measured by consumption as well as by the wealth index, was also pro-rich, and this finding was consistent for both the LASI and the IHDS surveys. However, the inequality in CVDs and diabetes was concentrated in the richer households when households were ranked by the wealth index, but was not so when ranked by MPCE.

The prevalence of institutional delivery and antenatal care by MPCE and the wealth index was pro-rich, and the findings were consistent. The concentration index suggests that the inequality in maternal care was similar whether the households were ranked by the wealth index or by MPCE. For example, the concentration index was 0.126 for institutional delivery based on MPCE, while it was 0.143 according to the wealth index (Table 6).

3.4. Consumption and asset gradient of health estimates

Table 7 and Table 8 present the results of the binary logistic regression model for selected health outcomes and health services for India using the LASI and IHDS surveys respectively. All the models were controlled for age, sex, education, residence, caste, religion, marital status, living arrangement, working status (currently working), smoking status (currently smoking), history of chronic diseases, health insurance, and states. The likelihood of receiving inpatient services increased with the increase in the MPCE quintile, while it was not so with the wealth

Table 4
Health estimates by MPCE and wealth quintile, LASI, 2017-18.

	Poorest		Poorer		Middle		Richer		Richest	
	Wealth Index	MPCE	Wealth Index	MPCE	Wealth Index	MPCE	Wealth Index	MPCE	Wealth Index	MPCE
Inpatient care	6.0	4.3	6.7	5.4	7.1	6.4	7.6	7.6	7.4	11.8
Outpatient care	50.6	56.3	58.0	57.7	59.5	57.2	60.2	58.8	59.9	57.6
Measured Prevalence										
Hypertension without medication	26.7	29.3	29.0	29.5	29.2	29.5	32.0	29.7	33.0	31.6
Hypertension with medication	32.0	35.8	36.6	38.1	38.1	39.3	45.0	41.0	50.0	46.9
Body Mass index										
Underweight (≤18.4)	37.4	27.9	26.2	24.5	19.0	20.9	11.4	17.1	6.6	11.1
Normal (18.5–24.9)	53.3	53.1	55.1	52.1	55	51.7	50.8	51.7	40.9	46.5
Overweight and Obese (≥25.0)	9.3	19.1	18.7	23.4	26	27.5	37.8	31.2	52.5	42.4
Self-Reported Measures										
Eye or vision problem	32.5	38.2	41.6	43.3	45.6	46.5	53.2	50	60	53.8
Cataract	12.2	12.9	11.9	13.3	12.6	12.8	14.0	13.4	14.7	12.6
Glaucoma	2.0	1.8	1.7	1.9	2.2	1.8	1.8	2.0	1.8	2.0
Refractive error	20.8	25.9	30.6	31.6	34.3	35.1	40.5	37.6	47.5	42.8
Diabetes	4.2	7.9	6.8	8.6	10.2	10.5	15.5	12.5	20.4	17.3
Cardiovascular diseases	18.0	21.4	24.7	25.0	26.8	28.6	33	30.3	39.0	36.0
Asthma	4.7	4.0	4.4	4.1	4.3	3.9	3.6	4.2	4.6	5.5
Arthritis	7.1	7.1	9.0	8.6	9.4	8.5	9.1	9.0	9.4	10.8
Cancer	0.3	0.4	0.6	0.4	0.5	0.5	0.7	0.7	0.7	1.0
At least one NCDs	31.4	35.6	40.4	40.7	44	43.2	48.8	46.8	54.6	52.6

*Cardiovascular diseases includes hypertension, chronic heart diseases, and stroke.
**At least one NCD was made from combining hypertension, diabetes, cancer, chronic lung disease, chronic heart diseases, stroke, and arthritis.

Table 5
Health estimates by MPCE and wealth quintile, IHDS-2, 2011-12.

	Poorest		Poorer		Middle		Richer		Richest	
	Wealth Index	MPCE	Wealth Index	MPCE	Wealth Index	MPCE	Wealth Index	MPCE	Wealth Index	MPCE
Inpatient care	5.6	3.7	5.9	4.7	7.4	5.6	6.8	7.2	6.6	10.4
Outpatient care	22.4	18.9	21.5	22.2	25.0	25.0	27.8	27.5	31.5	33.3
Cataract	5.3	4.1	4.4	4.0	4.1	4.2	4.4	4.5	3.9	5.2
Hypertension	3.5	5.3	5.2	6.8	8.8	9.0	12.5	10.3	15.5	13.5
Diabetes	1.1	2.5	2.3	4.0	5.2	5.2	7.6	6.6	11.4	8.9
Cardiovascular diseases	4.1	6.2	6.2	8.0	10.6	10.2	14.3	11.9	17.6	15.9
Cancer	0.16	0.11	0.19	0.13	0.16	0.16	0.28	0.15	0.23	0.42
Asthma	4.4	2.7	3.0	3.0	2.9	2.9	2.3	2.9	2.0	3.1
Institutional delivery	45.3	53.6	58.8	63.8	71.9	72.8	81.6	75.6	88.8	87.6
4 + ANC Visits	25.0	39.9	43.0	46.4	54.3	53.2	63.2	58.7	69.5	69.3
PNC within 2 days	76.7	71.9	70.7	71.5	67.5	70.6	68.3	68.4	70.6	70.4
Child full immunization	35.0	41.2	44.8	47.5	51.1	51.6	55.8	53.3	62.4	55.0
Stunting	63.2	60.0	57.3	53.7	53.7	50.6	47.7	46.1	39.8	41.8
Wasting	15.6	18.0	17.9	15.3	16.2	15.6	15.3	13.2	13.4	13.2
Underweight	49.2	46.1	40.8	38.4	39.0	34.0	32.4	30.2	24.8	26.6

Table 6
Concentration index (95% CI) of health estimates and health care utilization by wealth index and MPCE, LASI, 2017–18 and IHDS-2, 2011–12).

	LASI, 2017-18		IHDS-2, 2011-12	
	Wealth Index	MPCE	Wealth Index	MPCE
Inpatient	0.036(0.020,0.053)	0.192(0.176, 0.208)	0.039(0.020,0.058)	0.200(0.181,0.219)
Outpatient	0.004(0.0003, 0.008)	0.029(0.025,0.033)	0.082(0.073,0.090)	0.125(0.116,0.133)
Eye or vision problem	0.121(0.115,0.125)	0.098(0.094,0.103)	[a]	[a]
Hypertension	0.153(0.145,0.160)	0.129(0.121,0.136)	0.289(0.273,0.304)	0.242(0.226,0.257)
Diabetes	0.296(0.284,0.308)	0.224(0.211,0.236)	0.389(0.369,0.410)	0.318(0.297,0.338)
CVD	0.146(0.139,0.153)	0.123(0.116,0.131)	0.281(0.267,0.295)	0.243(0.229,0.257)
Asthma	0.001(-0.022,0.021)	0.057(0.036,0.077)	−0.160(-0.189, −0.132)	−0.013(-0.041,0.016)
Arthritis	0.057(0.043,0.071)	0.084(0.070,0.099)	–	–
Cancer	0.142(0.083,0.201)	0.227(0.168,0.285)	0.091, (−0.020,0.201)	0.327(0.217,0.438)
Institutional delivery	[a]	[a]	0.143, (0.141,0.146)	0.126(0.123,0.129)
Four or more ANC visits	[a]	[a]	0.184(0.180,0.189)	0.148(0.144,0.153)

[a] Not available.

index (Table 7). In LASI, the adjusted odds ratio (AOR) for inpatient services in the richest quintile was 2.97 [95% CI: 2.65–3.32] in the richest MPCE quintile compared to 1.08 [95% CI: 0.94–1.23] in the richest wealth quintile. With respect to high blood pressure (HBP), cardiovascular diseases (CVD), and diabetes, the AORs were higher and significant for both MPCE and wealth quintiles. However, the AORs

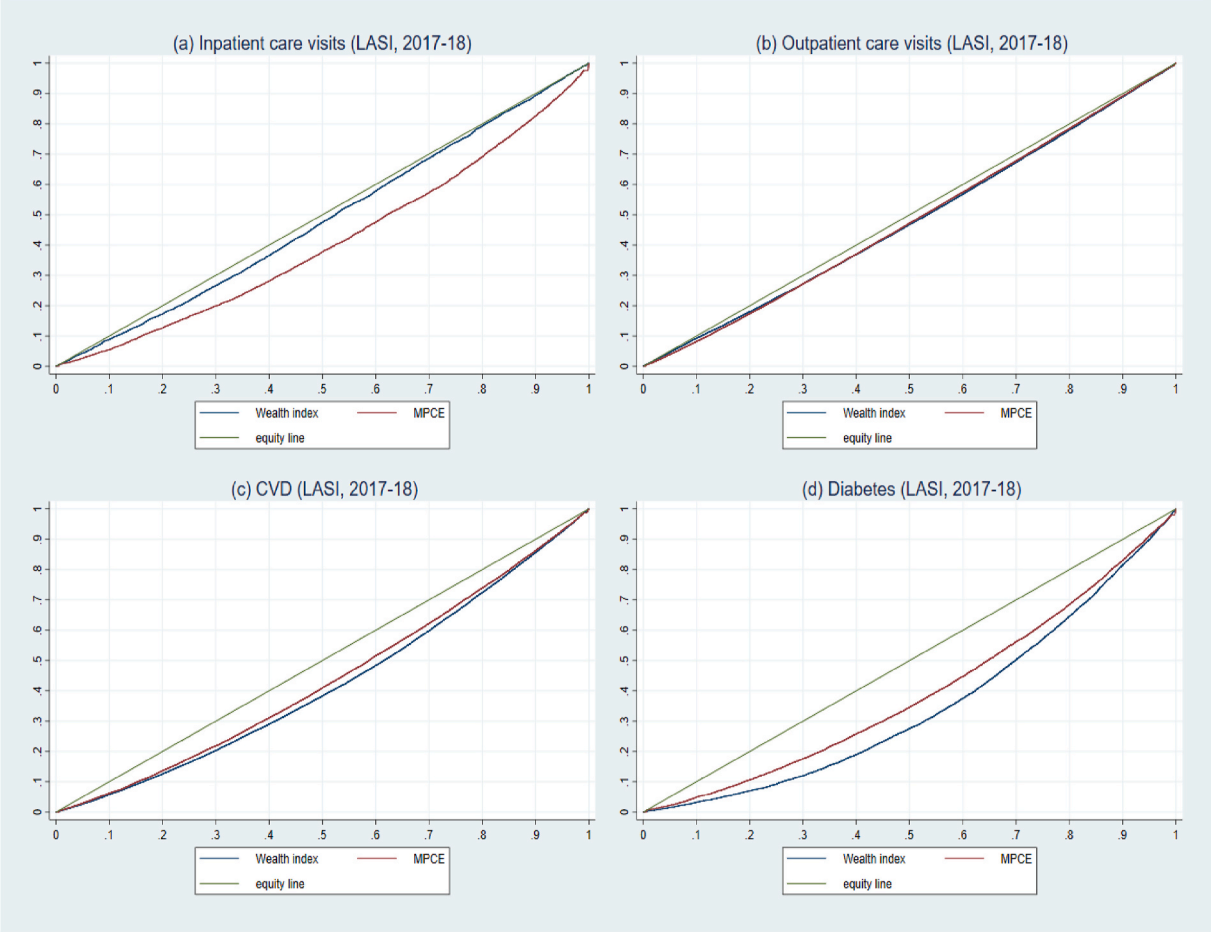


Fig. 5. Concentration curves of inpatient care, outpatient care, CVD and diabetes by wealth index and MPCE in India, LASI, 2017–18.

Table 7
Logistic regression odds ratios of health estimates by wealth quintile and MPCE quintile, LASI, 2017-18.

	Inpatient [AOR (95% CI)]	Outpatient [AOR (95% CI)]	Hypertension [AOR (95% CI)]	CVD [AOR (95% CI)]	Diabetes [AOR (95% CI)]
Wealth Quintile					
Poorest					
Poorer	1.028(0.92,1.15)	1.172***(1.11,1.24)	1.333***(1.25,1.43)	1.335***(1.25,1.43)	1.472***(1.31,1.65)
Middle	1.092(0.98,1.22)	1.276***(1.21,1.35)	1.507***(1.41,1.61)	1.513***(1.42,1.62)	1.951***(1.74,2.18)
Richer	1.127**(1,1.27)	1.415***(1.33,1.5)	1.866***(1.74,2)	1.872***(1.75,2.01)	2.463***(2.2,2.76)
Richest	1.075(0.94,1.23)	1.597***(1.49,1.71)	1.979***(1.83,2.14)	1.994***(1.85,2.15)	2.929***(2.6,3.3)
MPCE Quintile					
Poorest					
Poorer	1.250***(1.11,1.41)	1.274***(1.21,1.34)	1.179***(1.11,1.25)	1.171***(1.1,1.24)	1.184***(1.08,1.3)
Middle	1.519***(1.35,1.7)	1.316***(1.25,1.39)	1.373***(1.29,1.46)	1.363***(1.28,1.45)	1.395***(1.28,1.52)
Richer	1.812***(1.62,2.03)	1.500***(1.42,1.58)	1.571***(1.48,1.67)	1.559***(1.47,1.66)	1.623***(1.49,1.77)
Richest	2.968***(2.65,3.32)	1.650***(1.56,1.75)	1.770***(1.66,1.89)	1.797***(1.69,1.91)	1.999***(1.83,2.19)

Note: Adjusted for age, sex, education, residence, caste, religion, marital status, living arrangement, currently working, currently smoking, history of chronic diseases, health insurance, and states.

were similar for the wealth quintile and MPCE quintiles in both the surveys. For instance, the AOR for hypertension was 1.98 [95% CI: 1.83–2.14] in the richest wealth quintile compared to 1.77 [95% CI: 1.66–1.89] in the same MPCE quintile (Table 7). Similarly, in the case of outpatient services, the AOR increased significantly from the poorer quintile to the richest quintile in the case of both MPCE and the wealth quintiles, the gradient being higher in the case of MPCE quintile compared to the wealth quintile in both the LASI and the IHDS surveys (Table 8).

4. Discussion and conclusions

Research and evidence-based policy on the economic gradient of health in India is increasingly derived from the wealth index. The wealth index, based on a set of consumer durables and household amenities, is a proxy for household economic well-being and not a direct economic variable like consumption expenditure. The wealth index is based on variables that are stock and accumulated over time while consumption is a period construct and more recent in nature. It is not known as to what extent the economic gradient is similar based on the wealth index and household consumption. Some of the large-scale population-based

Table 8
Logistic regression odds ratios of health estimates by wealth quintile and MPCE quintile, IHDS-2, 2011-12.

	Inpatient [AOR (95% CI)]	Outpatient [AOR (95% CI)]	Hypertension [AOR (95% CI)]	CVD [AOR (95% CI)]	Diabetes [AOR (CI 95%)]
Wealth Quintile					
Poorest					
Poorer	1.061(0.85,1.33)	1.197***(1.05,1.36)	1.703***(1.28,2.26)	1.724***(1.33,2.23)	2.529***(1.53,4.18)
Middle	1.223(0.96,1.56)	1.256***(1.09,1.45)	2.353***(1.76,3.14)	2.332***(1.79,3.04)	3.483***(2.11,5.75)
Richer	1.101(0.83,1.45)	1.374***(1.17,1.62)	3.389***(2.5,4.6)	3.349***(2.53,4.43)	4.675***(2.78,7.86)
Richest	1.053(0.76,1.46)	1.601***(1.33,1.93)	3.443***(2.47,4.81)	3.533***(2.6,4.81)	7.688***(4.49,13.17)
MPCE Quintile					
Poorest					
Poorer	1.101(0.86,1.41)	1.186**(1.04,1.35)	1.189(0.94,1.5)	1.208*(0.97,1.5)	1.271(0.92,1.75)
Middle	1.495***(1.18,1.9)	1.492***(1.31,1.7)	1.717***(1.38,2.14)	1.686***(1.37,2.07)	1.458**(1.06,2)
Richer	2.048***(1.62,2.59)	1.605***(1.4,1.84)	1.537***(1.22,1.93)	1.638***(1.32,2.02)	1.957***(1.44,2.66)
Richest	2.483***(1.95,3.17)	2.122***(1.85,2.44)	2.249***(1.79,2.82)	2.306***(1.86,2.85)	2.392***(1.76,3.26)

Note: Adjusted for age, sex, education, residence, caste, religion, marital status, currently working, currently smoking, health insurance, and states.

health surveys such as the IHDS and the LASI do collect data on the health variables along with household consumption and wealth index. In this context, this paper examines the asset and consumption gradient of health estimates in India using micro data from IHDS and LASI. The followings are the salient findings of the paper.

First, with a few exceptions, the factor loading, that is, the weights of the variables used in the construction of the wealth index were broadly similar in LASI and IHDS suggesting a similar variance and covariance structure for the variables in these surveys The mean value of asset distribution and MPCE was higher in LASI than IHDS as the former was conducted five years later than IHDS and covered households with at least one member aged 45 year or older. The CDF plots of normalised wealth index as derived from the LASI and IHDS surveys were similar. The CDF plot was also similar for MPCE from both these surveys. Second, we found a weak association between MPCE and the wealth index in both the surveys (LASI and IHDS). This was also true for both rural and urban areas across India. Over three-fifths of households were misclassified across the MPCE and wealth quintiles in both the surveys. The Kappa statistics of the wealth index and MPCE confirmed weak agreement in both the surveys. The CDF plot of wealth index and MPCE derived from both the survey were quite different suggesting the ranking of households based on asset and household consumption does not yield similar results. These findings suggest that the wealth index and MPCE are two distinct measures of households. Third, health care utilization, such as inpatient care increases linearly when households were ranked based on per capita consumption whereas it did not show any pattern by wealth index in either of the survey. The use of inpatient services was higher among the richer households; this finding is consistent with literature. However, the pattern was not consistent by the wealth index in either of the surveys. The prevalence of hypertension based on the wealth index was underestimated for the bottom half of the population compared to when measured using MPCE in both of the surveys. Fourth, the extent of inequality in inpatient and outpatient care was higher when households were ranked by MPCE than by the wealth index. The concentration curves also confirmed that the use of inpatient and outpatient services was pro-rich and had a higher gradient based on MPCE than the wealth index in both the surveys. The inequality in CVD, diabetes, vision problem, arthritis, and cancer were higher when households were ranked by the wealth index than by consumption in both the surveys. These findings suggest that socio-economic inequality in health care utilization is underestimated when measured using the wealth index compared to MPCE.

Our result on the weak association between MPCE and wealth index is consistent with the available literature (Filmer & Scott, 2008; Howe et al., 2008, 2009; Lindelow, 2006; Ucar, 2015). The wealth index merely records the presence or absence of assets/amenities in households and does not take into account monetary valuation. Besides, it assigns weights to each variable based on PCA, which has little theoretical significance and possibly leads to inconsistent health gradient. The misclassifications of consumption and wealth quintile may be because of the fact that in this globalised economy, with an increase in development and urbanisation, the variables used in the wealth index have become household necessities and are increasingly available and accessible to the population. MPCE, by contrast, is a stable and reliable measure of household economic wellbeing. It has been extensively used to measure poverty, inequality, and living standard worldwide including India. Our findings of consistent increase in the use of inpatient care with the increase in MPCE quintile compared to the wealth index underscore the better predictability with the use of MPCE than the wealth index. Previous studies suggest higher inpatient visits among the economically better-off households,; we found a similar pattern using MPCE but not the wealth index (Joseph et al., 2018; Lindelow, 2006). Hypertension showed a stronger gradient with MPCE than the wealth index, reaffirming the inability of the wealth index to predict the health outcomes better than MPCE. Our findings regarding inconsistent health estimates using the wealth index and consumption are in line with those found in other countries (Filmer & Scott, 2012; McKenzie, 2005). Considering consumption as the gold standard, the wealth index tends to underestimate the disease burden among the poor. It also underestimates inequality in many of the health variables compare to consumption per capita.

Protecting the poor and the vulnerable has been the cornerstone of health policy, which invariably uses the wealth index. Unfortunately, the wealth index does not have the ability to define the poverty line and does not segregate the poor. Our results confirm wealth index as a poor predictor of health care utilization and health outcomes compared to consumption. Both LASI and IHDS have demonstrated that collecting consumption data is very much possible in health/socio-economic surveys and that it provides reliable estimates.

What are the implications of these findings? We put forward following implications based on our results. First, it is recommended that public health research and evidence-based policy that use population-based surveys that provide data on both household consumption and the wealth index use the former instead of the latter to explain economic variations in health outcomes and health care utilization. This is so because the wealth index found to be a poor predictor of health and socio-economic inequality in the population. Second, we recommend the integration of an abridged version of the consumption schedule in the forthcoming health surveys conducted by the National Sample Survey and NFHS. It may be mentioned that data on consumption expenditure has been collected regularly by the National Sample Survey (NSS), the official statistical system in India, for the last six decades and forms the basis for estimating the extent of poverty and inequality in the country. Both abridged and detailed versions of consumption data have been collected in various rounds of NSS. Surprisingly, the NSS-based health surveys have not integrated an abridged version of the consumption schedule. The NSS health surveys use a single question on consumption expenditure, which tends to produce

unreliable estimates. The average time taken to collect information on consumption data using an abridged version of the consumption schedule in LASI was about 11 min, and the estimates were robust. Besides, data from the NFHSs has been extensively used for research and evidence-based policy at the national, state and local level. The richness of the data, the technical proficiency, the ease of accessibility, and the contemporary relevance of these surveys have resulted in their global, national, regional, and local acceptance. The NFHS instruments have been regularly revised to comprehensively capture the health and wellbeing of the population and have incorporated several innovations on biomarkers to provide robust health estimates. However, they do not include the consumption schedule on the pretext of time constraint and length of the survey instrument. We suggest integrating an abridged consumption schedule in the NFHS survey as that will help us understand the true economic differential in health outcome in India. Integrating a consumption schedule in the surveys would make it possible to derive poverty-based estimates and the catastrophic health expenditure on institutional delivery. We believe that estimating the true wealth of a household is more challenging than estimating household income or household consumption. Finally, the variables used for estimating the wealth index need to be relooked. Some of the variables used in the wealth index are obsolete now (for example transistor) whereas some asset tends to accumulated over the life time. Future research may focus on the use, utility and methods of computing wealth indices to better capture the economic gradient in health and health care utilization.

To conclude, the economic gradient of health, as estimated by per capita consumption and the wealth index, are inconsistent in India. Health care utilization – such as inpatient and outpatient care, institutional delivery, four or more ANC visits, and full immunization – is better predicted by the MPCE than the wealth index. Inequality patterns derived from the wealth index are underestimated compared to those derived from MPCE. It is about time that consumption data began to be collected, for it is myth that a consumption survey is time consuming and the data is more difficult to obtain.

Ethics

This study is based on secondary data, and is available in public domain for research purpose. Therefore, no ethical approval was required from any institutional review board.

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Conflict of interest

The authors declare that they have no conflict of interest.

Author statement

Conceptualisation: SKM, Data Analyses: SKM, SS, KB; First Draft: SKM, SKS, Comments and edit: RA, SKS, KB.

Data availability

Data used in this paper is publicly available.

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Appendix A. Supplementary data

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