The household-level economic burden of heart disease in India

Anup Karan1,2, Michael Engelgau3 and Ajay Mahal4

1 Public Health Foundation of India, New Delhi, India
2 Nuffield Department of Population Health, University of Oxford, Oxford, UK
3 Centers for Disease Control and Prevention, Beijing, China
4 School of Public Health and Preventive Medicine, Monash University, Melbourne, Vic., Australia

Abstract

OBJECTIVES To estimate healthcare use and financial burden associated with heart disease among Indian households.

METHODS Data from the 2004 round household survey of the National Sample Survey in India were used to assess the implications of heart disease for out-of-pocket health spending, spending on items other than health care, employment and healthcare financing patterns, by matching households with a member self-reporting heart disease (cardiovascular disease (CVD)-affected households) to (control) households with similar socio-economic and demographic characteristics. Propensity score matching methods were used.

RESULTS Compared with control households, CVD-affected households had more outpatient visits and inpatient stays, spent an extra INT$ (International Dollars) 232 ($P < 0.01) per member on inpatient care annually, had lower non-medical spending (by INT$5 ($P < 0.01) per member for a 15-day reference period), had a share of out-of-pocket health spending in total household expenditure that was 16.5% higher ($P < 0.01) and relied more on borrowing and asset sales to finance inpatient care (32.7% vs. 12.8%, $P < 0.01). Members of CVD-affected households had lower employment rates than members of control households (43.6% vs. 46.4%, $P < 0.01), and elderly members experienced larger declines in employment than younger adults. CVD-affected households with lower socio-economic status were at heightened financial risk.

CONCLUSION Non-communicable conditions such as CVD can impose a serious economic burden on Indian households.

KEYWORDS cardiovascular disease, heart disease, economic burden, matching, India

Introduction

In India, the burden of cardiovascular disease (CVD) is rising. Ischaemic heart disease was the 4th largest cause of years of life lost due to premature mortality in 2010, up from its 8th ranking in 1990 and related conditions such as stroke are becoming more common as a cause of death (Institute of Health Metrics and Evaluation 2012). This rising health burden of CVD reflects multiple risk factors, including low dietary intake of fruits and vegetables, high levels of tobacco and alcohol consumption, low levels of physical activity, high rates of abdominal obesity, untreated hypertension and ageing (Popkin et al. 2001; Reddy & Katan 2004; Prabhakaran et al. 2005; Goyal & Yusuf 2006). Moreover, morbidity and mortality associated with CVD are occurring at younger ages in India relative to other developed countries (World Health Organization 2010).

The growing health burden of CVD potentially translates into increased economic burden at both the national and household levels in India. Estimates from recent studies indicate that CVD-related aggregate medical care costs ranged from approximately US$3 billion in 2004 (Mahal et al. 2010) to US$7.5 billion in 2010 (Bloom et al. 2011). Leeder et al. (2004) also project major income declines due to CVD-related losses in productive labour and Gupta et al. (2006) estimated that CVD costs could amount to as much as 20% of the domestic product in the Indian state of Kerala.

Few studies have examined the household-level impacts of CVD in low- and middle-income countries. In India, there are two previous studies. Rao et al. (2011) assessed out-of-pocket spending by households, the frequency of hospitalization and ambulatory care visits among patients...
reporting heart disease, hypertension or diabetes. Huffman et al. (2011) examined 1637 hospitalized patients in four countries including Argentina, China, India and Tanzania (500 patients were from India) and estimated the impact of CVD (defined in their study as myocardial infarction, unstable angina, stroke, acute heart failure or peripheral vascular intervention) on catastrophic spending, 'distress' financing (borrowing or sale of assets) and workforce participation of household members. Although both studies used multivariate analyses to identify potential correlates of catastrophic spending and distress financing, both likely overestimated the potential economic burden of CVD on households at the population level. In the first study, an appropriate comparison group, which is the amount that similar households without CVD-affected members spent on health services, was not considered. In the second study, the focus on hospitalized cases possibly resulted in higher than average estimates of household economic burden and again, an appropriate comparison group was missing.

Our study uses data from a large cross-sectional household survey and considers comparison households from the same survey. Our outcome measures include healthcare utilization and out-of-pocket expenses for inpatient and outpatient care, financing patterns to cover these expenses and employment among household members. We also assessed outcomes by socio-economic status. Collectively, our results provide a comprehensive assessment of outcomes among households with a member reporting heart disease relative to households that did not contain a member reporting heart disease.

Methods

We used propensity score matching (PSM) to match case households containing a member reporting heart disease (CVD-affected households) to control households that did not contain a member reporting heart disease (Rosenbaum & Rubin 1983). This definition did not include stroke or acute heart failure, information for which was not available in our survey data. We estimated propensity scores to predict the probability of a household containing at least one member reporting heart disease (CVD-affected households) based on household socioeconomic and demographic characteristics. Each CVD-affected household was matched to one control household (not CVD-affected) with the closest propensity score. As a quality check, we conducted three additional assessments: first, for each covariate used in the regression model that generated the propensity scores, we compared the means between the CVD-affected households and matched control households using a t-test; second, we re-estimated our results after excluding households that experienced a death in the previous year, and after excluding the 1% of households with the highest out-of-pocket spending on illness; and third, we re-estimated our results using the stratification matching method, which essentially matches subgroups of cases and controls instead of on a one-to-one basis (Dehejia & Wahba 1999).

We used data from a nationally representative cross-sectional household survey of morbidity and healthcare utilization undertaken by the National Sample Survey Organization (NSSO) in India in 2004. The survey sample included approximately 74 000 households and 383 000 individuals of all ages (NSSO 2006). Information on socio-economic and demographic characteristics, insurance status, healthcare utilization, out-of-pocket medical spending for self-reported health conditions, non-medical spending, sources of healthcare financing and employment status for all household members were collected from a single key adult respondent in each household.

Definition of CVD-affected household

A household was defined as CVD affected if any of its members was reported as: (i) currently living with heart disease; and (ii) hospitalized due to heart disease in the year preceding the survey, whether or not the affected member was currently alive. The survey did not collect self-reported information on strokes and heart failure.

Variables used to construct propensity scores

CVD-affected households and control households were matched on several socio-economic, demographic and locational indicators: (i) educational status of household head (primary, secondary, college degree and above), (ii) type of house (solid (pucca), mud or similar (kuchha) or other), (iii) source of drinking water (piped or other), (iv) type of sanitation (covered drains, latrine, septic tank), (v) major source of livelihood (e.g. head of household was self-employed or paid wages), (vi) family demographics (share of children (0–15 years), share of young adults (15–59 years), share of elderly (age > 60 years)), the proportion of household members consisting of females of any age and household size, (vii) caste status (whether 'scheduled caste or tribe', 'other backward caste' or 'other'), religion (Hindu, Muslim or other), (viii) health insurance status (public or private insurance coverage for a member of the household) and (ix) rural/urban residence status. Indicator variables for 71 subareas of residence were also included to account for locational characteristics that might influence healthcare use, spending and employment.
Outcome variables

We constructed outcome variables at the household level (and not at the level of the individual patient), because healthcare use, spending and financing as well as employment reflect both individual and joint decision-making at the household level (Gruber & Madrian 2002).

Healthcare utilization outcomes were as follows: (a) hospital stays: total for all household members in the preceding year divided by household size, (b) public hospital stays: total for all household members in the preceding year divided by household size, (c) hospital days: total for all household members in the preceding year divided by household size and (d) outpatient visits: total for all household members in the preceding 15 days divided by household size.

Indicators of healthcare spending were as follows: (a) out-of-pocket (OOP) spending on outpatient care per member in the preceding 15 days, (b) OOP spending per member for hospital care in the preceding year, (c) OOP drug spending per member in the preceding 15 days, (d) OOP transportation spending per member for healthcare in the preceding 15 days and (e) the share of OOP health spending in total household spending in the preceding 15 days.

Outcome indicators for financial stress were as follows: (a) expenses on items other than healthcare, per household member (Gertler & Gruber 2002) in the preceding 15 days; (b) household borrowing and sale of assets to finance out-of-pocket spending on outpatient and inpatient health care; (c) adult employment rates (the number of members aged 15 years and over who are currently working, divided by all household members aged 15 years and older) and elderly (60 years and over) employment rates; (d) healthcare use by members not reporting heart disease in CVD-affected households. CVD might also cause less serious conditions to be neglected in the household. Hence, we compared health service use for ‘non-major conditions’ (specifically excluding cancer, heart disease, diabetes and injuries) of CVD-affected households and controls.

We examined outcomes by subgroups of socio-economic status, specifically (a) scheduled castes and tribes (SC/ST), two groups that are considered especially deprived in India, versus non-SC/ST households, and (b) households where the education of the head – an indicator of economic status – was below the median for the full sample of households in the survey vs. households where the education of the head of household was above the median. The economic burden of CVD across socio-economic groups was assessed using methods described in Appendix A1. In brief, to measure group-specific burden, propensity scores were re-estimated but after excluding the indicator for the socio-economic groups of interest (e.g. SC/ST status) from the list of variables used to generate propensity scores. The subset of matched and control households (using a matching algorithm such as nearest neighbour) was retained, and all other observations dropped. Finally, ordinary least squares methods were used to estimate linear relationships between economic outcomes, an indicator for whether a household has a member with CVD (treatment), an indicator for socio-economic status (e.g. whether SC/ST or not) and the product of the indicators for CVD status and socio-economic status.

Results

Our matched cases and control households were similar without any statistically significant differences in the variables used for generating propensity scores (Table 1). CVD-affected households experienced an extra 10.3 hospital stays per 100 members annually ($P < 0.01$), and an extra 11.2 outpatient visits per 100 members in the 15 days preceding the survey ($P < 0.01$) compared with matched control households (Table 2). CVD-affected households also reported 1.45 extra days per member spent in hospitals ($2.33 \text{ vs. } 0.88, P < 0.01$) relative to matched controls. Per person outpatient visits of members without heart disease (in CVD-affected households) were lower by almost two visits for every 100 members compared with control households in the 15 days preceding the survey ($P = 0.01$). Per person outpatient visits for ‘non-major’ health conditions in the 15 days preceding the survey were also lower in CVD-affected households, by 3.6 visits per 100 members ($P < 0.01$) compared with matched controls.

Out-of-pocket expenses were significantly higher in CVD-affected households than controls by INR$231.75 ($P < 0.01$) per household member for inpatient care in the preceding year and by INR$5.16 ($P < 0.01$) per member for outpatient care in the preceding 15 days (Table 3). The results for outpatient spending were driven mainly by differences in OOP drug expenses between CVD-affected households and controls (INR$3.58, P < 0.01$). OOP transportation expenses for healthcare accounted for 6.7% of the difference in OOP outpatient spending between CVD-affected households and controls (INR$0.34, P < 0.01$). As a share of household spending, OOP spending on healthcare by CVD-affected households significantly exceeded that of controls (27.2% vs. 10.7%, $P < 0.01$) in the preceding 15 days.
Table 1 Summary matching variables of cardiovascular disease (CVD)-affected households and control households, 2004

| Variable                                | CVD-affected households | Control households – matched | t-Values for differences in matched CVD-affected and control households |
|-----------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------------|
| Household size                          | 5.73 [5.61, 5.85]       | 5.68 [5.53, 5.83]           | 0.539 [0.590]                                                          |
| Members aged 0–14 years (%)             | 20.99 [20.17, 21.79]    | 20.46 [19.59, 21.32]        | 0.843 [0.399]                                                          |
| Members aged 15–29 years (%)            | 25.92 [25.05, 26.79]    | 25.88 [24.95, 26.81]        | 0.062 [0.951]                                                          |
| Members aged 60+ (%)                    | 17.69 [16.70, 18.67]    | 17.91 [16.80, 19.01]        | −0.288 [0.773]                                                         |
| Rural households (%)                    | 45.81 [43.77, 47.86]    | 44.50 [42.42, 46.57]        | 0.873 [0.383]                                                          |
| Illiterate head of households (%)       | 25.23 [24.15, 26.31]    | 24.43 [23.29, 25.57]        | 0.983 [0.326]                                                          |
| Head of households with primary schooling (%) | 27.05 [26.05, 28.05]    | 27.49 [26.43, 28.55]        | −0.578 [0.563]                                                         |
| Head of households with secondary schooling (%) | 12.14 [11.41, 12.87]    | 12.66 [11.88, 13.44]        | −0.946 [0.344]                                                         |
| Head of households with a graduate degree (%) | 10.18 [9.37, 11.00]    | 10.69 [9.83, 11.55]         | −0.824 [0.410]                                                         |
| Females (%)                             | 49.56 [48.87, 50.25]    | 49.48 [48.69, 50.27]        | 0.149 [0.882]                                                          |
| Households using cooking gas (%)        | 49.32 [47.27, 51.32]    | 49.54 [47.45, 51.63]        | −0.145 [0.885]                                                         |
| Households with piped water access (%)  | 53.62 [51.57, 55.66]    | 53.35 [51.27, 55.44]        | 0.174 [0.862]                                                          |
| Households with latrine with septic tank (%) | 53.22 [51.57, 55.27]    | 54.14 [52.06, 56.23]        | −0.610 [0.542]                                                         |
| Households with covered drainage (%)    | 31.74 [29.83, 33.65]    | 32.49 [30.53, 34.44]        | −0.527 [0.598]                                                         |
| Scheduled caste/tribe households (%)    | 15.61 [14.12, 17.10]    | 16.62 [15.06, 18.17]        | −0.900 [0.368]                                                         |
| ‘Other’ backward caste households (%)   | 34.63 [32.68, 36.59]    | 35.03 [33.04, 37.02]        | −0.273 [0.785]                                                         |
| Hindu households (%)                    | 76.72 [74.99, 78.46]    | 76.83 [74.86, 78.40]        | 0.069 [0.945]                                                          |
| Muslim households (%)                   | 14.51 [13.07, 15.96]    | 14.29 [12.83, 15.75]        | 0.207 [0.836]                                                          |
| Self-employed (%)                       | 30.38 [28.49, 32.27]    | 30.91 [28.98, 32.84]        | −0.378 [0.706]                                                         |
| Whether insured (%)                     | 14.12 [11.11, 17.12]    | 12.14 [9.30, 14.99]         | 0.931 [0.352]                                                          |
| Whether in northern region (%)          | 12.67 [11.30, 14.04]    | 13.72 [12.28, 15.16]        | −1.019 [0.308]                                                         |
| Whether in western region (%)           | 18.68 [17.08, 20.28]    | 17.14 [15.57, 18.72]        | 1.325 [0.185]                                                          |
| Whether in southern region (%)          | 29.50 [27.63, 31.38]    | 29.81 [27.90, 31.72]        | −0.223 [0.824]                                                         |
| Whether in eastern region (%)           | 16.70 [15.17, 18.23]    | 17.01 [15.44, 18.58]        | −0.0271 [0.786]                                                        |
| Whether in central region (%)           | 16.22 [14.71, 17.73]    | 15.78 [14.26, 17.31]        | 0.393 [0.694]                                                          |
| Sample size (N)                         | 2281                    | 2201                        |                                                                        |

Estimates are based on calculations by authors using household-level data from National Sample Survey data for 2004. The data presented refer to all households, whether or not a death was experienced in the household. The 71 residential indicators that we used in our analysis have been consolidated into large regional blocks in the table to conserve space for presentation – the actual propensity score calculations for estimating the economic burden used 71 individual dummies for each region. The comparison of means used for the t-test for balance checking reported in column 4 was based on post-matching (using nearest neighbourhood method) data; P-values are reported in parentheses besides the t-statistic in column 5 for a two-tailed test. Columns 2–3 report 95% confidence intervals in parentheses next to the means.

Per person spending on non-medical items was lower in CVD-affected households than matched controls in the preceding 15 days (INT$23.90 vs. INT$28.51, P < 0.01). CVD-affected households relied to a significantly greater extent on borrowing and/or asset sales for financing OOP inpatient spending in the preceding year (32.7% vs. 12.8%, P < 0.01) and OOP outpatient spending in the 15-day preceding (5.1% vs. 2.0%, P < 0.01), relative to controls.

Current employment rates among household members aged 15 years and above were lower among CVD-affected households relative to controls (43.6% vs. 46.4%, P < 0.01). Employment rates were lower for CVD-affected households than controls for both adult males and females (15 years and over) (males: 70.9% vs. 73.5%, P < 0.01; females: 17.7% vs. 20.4%, P < 0.01). Employment rates among males aged 15–59 years were not different between CVD-affected and control households (81.2% vs. 80.7%, P = 0.62). However, CVD-affected households had lower employment rates than controls among females 15–59 years, males 60+ years and females 60+ years by 2.5% (P < 0.01), 8.5% (P < 0.01) and 3.3% (P < 0.01), respectively.

Our subgroup analysis results are described in Tables 4 and 5. The columns labelled (1) and (2) describe the effect of CVD on healthcare use and economic outcomes.
among SC/ST and non-SC/ST households separately, and the column labelled (1)–(2) provides a test of the difference in the effect of CVD on these two groups. Similarly, the columns labelled (3) and (4) report our estimates of the effect of CVD on healthcare use and economic outcomes among households by education of the head of household. Analogous to column (1)–(2), the data in column (3)–(4) can be used to assess the difference in CVD effects between the two education subgroups.

The data in Table 4 suggest that the impact of CVD on hospital admissions and hospital days is not statistically different between low SES and high SES households. However, low SES households rely more on public hospitals than high SES households, with a statistically significant difference in public hospital admissions for SC/ST relative to non-SC/ST households (8% vs. 4%, P < 0.01).

High SES households (non-SC/ST or education of head of household above the median) generally incurred higher OOP spending on inpatient and outpatient care due to CVD relative to low SES households, but statistically significant differences were observed only for comparisons by education of head of household and in only two cases: OOP inpatient expenditures and OOP transportation expenditures. But low SES households relied more on borrowing and/or selling assets to finance their care than high SES households. CVD also increased the share of OOP spending in total household spending across all subgroups, but subgroup differences were statistically significant only for the groups classified by education of head of household (education below median 22.0% vs. education above median 15.8%, P = 0.02). All subgroups saw a reduction in non-medical spending on account of CVD, with the exception of the SC/ST group that experienced a statistically insignificant decline. CVD was also associated with larger declines in employment rates among members of low SES households than high SES households, particularly in the 15–59 year age group.

### Table 2 Implications of heart disease for households’ use of health services in India

| Outcome indicator | CVD-affected households | Matched control households | Difference between CVD-affected and matched controls |
|-------------------|-------------------------|-----------------------------|---------------------------------------------------|
| Hospital admissions per household member (1-year reference) | 0.196 [0.188, 0.203] | 0.092 [0.086, 0.099] | 0.103 [<0.01] |
| Length of hospital stay (days) per household member (1-year reference) | 2.33 [2.152, 2.51] | 0.88 [0.78, 0.98] | 1.45 [<0.01] |
| Outpatient visits per household member (15-day reference) | 0.261 [0.250, 0.271] | 0.148 [0.138, 0.158] | 0.112 [<0.01] |
| Hospital admissions per household member in public facilities (1-year reference) | 0.083 [0.078, 0.089] | 0.036 [0.031, 0.040] | 0.047 [<0.01] |
| Outpatient visits to public health facilities (15-day reference) per household member | 0.071 [0.064, 0.077] | 0.033 [0.028, 0.038] | 0.038 [<0.01] |
| Outpatient visits per person (15-day reference) excluding member with cardiovascular disease | 0.130 [0.121, 0.140] | 0.148 [0.138, 0.158] | −0.018 [0.01] |
| Outpatient visits per household member (15-day reference) on non-major health conditions | 0.078 [0.072, 0.084] | 0.114 [0.105, 0.123] | −0.036 [<0.01] |
| Number of CVD-affected (and Matched Control) Households | 2281 | 2201 | 2281/2201 |

Means of the outcome variables are reported in columns 2 and 3 for cardiovascular disease (CVD)-affected and matched controls, respectively, with 95% confidence intervals in parentheses. Column 4 reports the difference in means and the associated P-values (the probability that the outcomes for matched cardiovascular disease-affected and control households differ in a two-tailed t-test) in parentheses below coefficient estimates. ‘Non-major’ health conditions refer to conditions excluding heart disease, injuries, cancer and diabetes. One-year reference refers to the 1 year immediately preceding the survey; 15-day reference refers to the 15 days immediately preceding the survey.
Table 3 Economic burden of heart disease on households in India, 2004

| Outcome indicator | CVD-affected households | Matched control households (nearest neighbour) | Difference between CVD-affected and matched controls |
|-------------------|-------------------------|-----------------------------------------------|---------------------------------------------------|
| Out-of-pocket (OOP) spending on hospital admissions per household member (1-year reference) (INT$) | 294.08 [255.45, 332.71] | 62.33 [52.07, 72.59] | 231.75 (<0.01) |
| OOP spending on outpatient visits per household member (15-day reference) (INT$) | 9.09 [8.20, 9.99] | 3.93 [3.18, 5.68] | 5.16 (<0.01) |
| OOP spending on drugs per household member (15-day reference) (INT$) | 5.65 [5.01, 6.29] | 2.07 [1.72, 2.41] | 3.58 (<0.01) |
| OOP spending on transport per household member (15-day reference) (INT$) | 0.62 [0.48, 0.76] | 0.28 [0.24, 0.31] | 0.34 (<0.01) |
| OOP spending as proportion of total household spending (% (15-day reference period)) | 27.22 [25.11, 29.33] | 10.72 [9.47, 11.97] | 16.50 (<0.01) |
| Household non-medical spending, per household member (15-day reference) (INT$) | 23.90 [22.66, 25.14] | 28.51 [27.41, 29.61] | −6.61 (<0.01) |
| Households borrowed or sold assets to pay for inpatient expenses (1-year reference period) (%) | 32.66 [30.74, 34.59] | 12.80 [11.41, 14.20] | 19.86 (<0.01) |
| Household borrowed or sold assets to pay for outpatient expenses (15-day reference period) (%) | 5.09 [4.18, 5.99] | 2.02 [1.43, 2.60] | 3.07 (<0.01) |
| Household members (15 years and over) working (%) | 43.61 [42.60, 44.61] | 46.38 [45.26, 47.50] | −2.77 (<0.01) |
| Male household members (15 years and over) working (%) | 70.88 [69.49, 72.28] | 73.49 [72.08, 74.90] | −2.61 (<0.01) |
| Female household members (15 years and over) working (%) | 17.72 [16.41, 19.03] | 20.42 [18.95, 21.89] | −2.70 (<0.01) |
| Household members (15–59) working (%) | 49.09 [47.99, 50.19] | 50.99 [49.78, 52.19] | −1.90 [0.02] |
| Male household members (15–59) working (%) | 81.16 [79.88, 82.45] | 80.71 [79.37, 82.05] | 0.46 [0.623] |
| Female household members (15–59) working (%) | 20.57 [19.05, 22.09] | 23.07 [21.38, 24.75] | −2.49 [0.03] |
| Household members (60 years and over) working (%) | 21.30 [19.25, 23.36] | 27.37 [24.98, 29.76] | −6.07 (<0.01) |
| Male household members (60 years and over) working (%) | 34.70 [31.60, 37.80] | 43.16 [39.66, 46.65] | −8.46 (<0.01) |
| Female household members (60 years and over) working (%) | 5.37 [3.84, 6.91] | 8.62 [6.61, 10.64] | −3.25 (<0.01) |
| Number of CVD-affected (and Matched Control) Households | 2281 | 2201 | 2281/2201 |

INT$ = International Dollars. We used a conversion factor of 1INT$ = 14.52 Indian Rupees for the year 2004, as published by the World Bank. Columns 2 and 3 present mean outcomes for cardiovascular disease (CVD)-affected and matched control households, respectively, with 95% confidence intervals in parentheses; P-values are reported in parentheses below the estimates in column (4) for a 2-tailed test. ‘Non-major’ health conditions refer to conditions other than heart disease, injuries, cancer and diabetes. One-year reference refers to the 1 year immediately preceding the survey; 15-day reference refers to the 15-days immediately preceding the survey.

and they also reported more inpatient stays and outpatient visits. Household non-medical consumption can be expected to be lower when a member has heart disease, unless the household is able to effectively insure against associated financial risks, including any treatment expenses and earnings losses (Gertler & Gruber 2002; Islam & Maitra 2012). Based on the lower levels of non-medical consumption among CVD-affected households relative to controls reported in Table 3, the estimated adverse impacts of heart disease on non-medical spending per person amounted to INT$110.64 annually, so Indian households do bear financial risks related to CVD. However, this decline was considerably less than the additional annual inpatient and outpatient OOP expenditures due to CVD of INT$355.59 (INT$231.75 for inpatient care and INT$123.84 for outpatient care – the annual equivalent of INT$5.16 over a 15-day period). *Prima facie,* this suggests households were able to rely on some form of insurance or coping mechanism to partially protect their non-medical spending against treatment costs. One coping device is the increased burden on unaffected members via their lower use of health services as well as curtailing non-major health service use, similar to findings from other studies (Lilly et al. 2010). Another coping mechanism appears to be the lower employment among household members, especially among, females and older individuals. While some of this decline may be due to the ill person not working, it may also reflect...
Table 4 Differences in healthcare use between cardiovascular disease (CVD)-affected and matched control households by socio-economic status in India, 2004

| Outcome indicator                                                                 | SC/ST (1)       | Non-SC/ST (2)     | Difference (1)−(2) (P-value) | Low education (3) | High education (4) | Difference (3)−(4) (P-value) |
|-----------------------------------------------------------------------------------|-----------------|-------------------|-------------------------------|-------------------|-------------------|-------------------------------|
| Hospital admissions per household member (1-year reference)                      | 0.11 [0.09,0.14] | 0.10 [0.09,0.11]  | 0.01 (0.40)                   | 0.10 [0.08,0.13]  | 0.10 [0.08,0.11]  | 0.01 (0.42)                   |
| Length of hospital stay per household member (1-year reference)                  | 1.46 [0.77,2.15] | 1.39 [1.13,1.66]  | 0.06 (0.85)                   | 1.46 [0.94,1.97]  | 1.28 [0.99,1.58]  | 0.18 (0.42)                   |
| Outpatient visits per household member (15-day reference)                        | 0.09 [0.05,0.13] | 0.13 [0.11,0.14]  | −0.04 (0.05)                  | 0.17 [0.14,0.21]  | 0.11 [0.09,0.13]  | 0.65 (0.65)                   |
| Hospital admissions per household member in public facilities (1-year reference) | 0.08 [0.06,0.10] | 0.04 [0.03,0.05]  | 0.03 (<0.01)                  | 0.05 [0.03,0.06]  | 0.04 [0.03,0.05]  | 0.01 (0.24)                   |
| Outpatient visits to public health facilities (15-day reference) per household member | 0.06 [0.04,0.08] | 0.04 [0.03,0.05]  | 0.016 (0.13)                  | 0.05 [0.03,0.07]  | 0.04 [0.03,0.05]  | 0.01 (0.23)                   |
| Outpatient visits per household member (15-day reference) excluding member with CVD | −0.02 [−0.06,0.02] | −0.01 [−0.02,0.01] | −0.015 (0.41)                 | −0.01 [−0.05,0.02] | −0.02 [−0.04,0.00] | 0.01 (0.43)                   |
| Outpatient visits per household member (15-day reference) on non-major health conditions | −0.04 [−0.07,−0.01] | −0.02 [−0.03,−0.01] | −0.01 (0.33)                  | −0.03 [−0.06,−0.01] | −0.03 [−0.05,−0.02] | −0.00 (0.81)                   |
| Number of CVD-affected and Matched Control Households                             | 4557            | 4557              | 4557                          | 4557              | 4557              | 4557                          |

Columns labelled (1) and (2) are estimates of the impact of CVD on healthcare use by SC/ST and non-SC/ST households, respectively. Column (1)−(2) provides the difference between these two estimates and the associated P-value can be used to assess whether the two impact estimates are statistically different. Analogously, the columns labelled (3) and (4) are estimates of the impact of CVD on healthcare use by households where the education of the head of the household is below the median and households where the education of the head of the household is above the median, respectively. Column (3)−(4) provides the difference between these two estimates and the associated P-value can be used to assess whether the two impact estimates are statistically different. The precise methodology for obtaining these estimates is described in Appendix A1. Confidence intervals are reported in square brackets. Data have been rounded to the nearest two decimal places. ‘Non-major’ health conditions refer to conditions excluding heart disease, injuries, cancer and diabetes. One-year reference refers to the 1 year immediately preceding the survey; 15-day reference refers to the 15-days immediately preceding the survey.
| Outcome indicator | SC/ST (1) | Non-SC/ST (2) | Difference (1) − (2) (P-value) | Low education (3) | High education (4) | Difference (3) − (4) (P-value) |
|-------------------|-----------|---------------|-------------------------------|-----------------|-----------------|-------------------------------|
| Out-of-pocket (OOP) spending on hospital admissions per household member (1-year reference) (INT$) | 182.2 [60.2, 304.1] | 230.0 [183.6, 276.4] | −47.8 (0.41) | 118.4 [23.0, 213.7] | 340.6 [286.1, 395.1] | −222.3 (<0.01) |
| OOP spending on outpatient visits per household member (15-day reference) (INT$) | 4.0 [0.7, 7.3] | 5.4 [4.2, 6.7] | −1.4 (0.37) | 4.9 [2.3, 5.7] | 6.0 [4.5, 7.5] | −1.1 (0.31) |
| OOP spending on drugs per household member (15-day reference) (INT$) | 2.5 [0.2, 4.7] | 3.7 [2.9, 4.6] | −1.3 (0.24) | 3.1 [1.3, 4.9] | 3.9 [2.9, 4.9] | −0.8 (0.27) |
| OOP spending on transport per household member (15-day reference) (INT$) | 0.5 [0.2, 0.9] | 0.3 [0.2, 0.5] | 0.2 (0.28) | 0.3 [0.0, 0.6] | 0.5 [0.4, 0.7] | −0.2 (0.05) |
| OOP spending as % of total household spending (15-day reference period) | 16.5 [8.2, 24.7] | 18.2 [15.0, 21.3] | −1.7 (0.66) | 22.0 [15.6, 28.4] | 15.8 [12.2, 19.5] | 6.1 (0.02) |
| Household non-medical spending, per household member (15-day reference) (INT$) | −2.3 [−7.1, 2.6] | −4.2 [−6.0, −2.3] | 1.9 (0.41) | −4.1 [−7.9, −0.3] | −7.4 [−9.6, −5.2] | 3.30 (0.04) |
| Households borrowed or sold assets to pay for inpatient expenses (1-year reference period) | 24.2 [17.3, 31.1] | 18.3 [15.7, 20.9] | 5.9 (0.07) | 26.9 [21.3, 32.6] | 14.0 [10.8, 17.3] | 12.9 (<0.01) |
| Household borrowed or sold assets to pay for outpatient expenses (15-day reference period) (%) | 6.5 [3.5, 9.6] | 2.8 [1.7, 4.0] | 3.7 (<0.01) | 5.5 [2.8, 8.1] | 0.5 [−1.0, 2.0] | 4.9 (<0.01) |
| Proportion of household members (15 years and over) working (%) | −5.7 [−9.9, −1.5] | −3.0 [−4.6, −1.4] | −2.7 (0.18) | −5.4 [−8.9, −1.9] | −1.2 [−3.2, 0.8] | −4.2 (<0.01) |
| Proportion of household members (15–59 years) working (%) | −7.7 [−12.3, −3.1] | −1.4 [−3.1, 0.4] | −6.3 (<0.01) | −5.4 [−9.2, −1.5] | 0.1 [−2.1, 2.2] | −5.4 (<0.01) |
| Proportion of household members (60 years and over) working (%) | −8.0 [−17.7, 1.7] | −6.6 [−10.0, −3.2] | −1.4 (0.76) | −7.6 [−15.2, −0.1] | −3.6 [−7.9, 0.8] | −4.1 (0.20) |
| Number of CVD-affected (and Matched Control) Households | 4557 | 4557 | 4558 | 4558 | 4558 | 4558 |

INT$ = International Dollars. We used a conversion factor of 1 INT$ = 14.52 Indian Rupees for the year 2004, as published by the World Bank. Columns labelled (1) and (2) are estimates of the economic burden of CVD on SC/ST and non-SC/ST households, respectively. Column (1) − (2) provides the difference between these two estimates and the associated P-value can be used to assess whether the two impact estimates are statistically different. Analogously, the columns labelled (3) and (4) are estimates of the economic burden of CVD on households where the education of the head of the household is below the median and households where the education of the head of the household is above the median, respectively. Column (3) − (4) provides the difference between these two estimates and the associated P-value can be used to assess whether the two impact estimates are statistically different. The precise methodology for obtaining these estimates is described in Appendix A1. Confidence intervals are reported in square brackets. Data have been rounded to one decimal place. ‘Non-major’ health conditions refer to conditions other than heart disease, injuries, cancer and diabetes. One-year reference refers to the 1 year immediately preceding the survey; 15-day reference refers to the 15-days immediately preceding the survey.
greater household care-giving responsibilities borne by other members. Employment declines potentially translate into large household earnings losses given that more than 90% of India’s workforce is engaged in the informal sector with no health or employment insurance (Harris 2008; Ciani 2011; Passey et al. 2012). The households in our sample also coped with increased requirements for health spending associated with heart disease by borrowing or selling assets. Doing so can have long-term implications for household economic well-being if borrowing costs are high, or if income earning assets are sold.

Our study also sheds light on the potential economic burden on CVD-affected households in groups of different socio-economic status and suggests that low SES households are less able to protect themselves against the associated financial risk. This is reflected in their greater reliance on borrowing and sales of assets to finance health spending, and their considerably larger decline in adult workforce participation (and potential loss of earnings). These findings of a greater burden of OOP spending on low SES households are consistent with recent Indian literature on the impoverishing impact of illness on households (Garg & Karan 2009; Shahrawat & Rao 2012).

Our results underline the importance, also highlighted in other studies, of protecting Indian households against the financial burden from non-communicable conditions such as CVD. The heavy reliance on OOP spending in financing healthcare in India is not surprising given limited government financing (only about 1.2% of GDP) and other insurance mechanisms that continue to be inadequate. At most, only 1% of India’s population is covered by private health insurance. While a number of publicly funded health insurance schemes have emerged, in many cases, their coverage is not comprehensive and non-poor households are ineligible to participate. Thus, the Rashtriya Swasthya Bima Yojana (RSBY), a publicly financed third-party payment scheme, which currently covers more than one hundred million people in India and is expected to further expand its coverage to 280 million people, is restricted to the poor, and its maximum coverage is INT $2066 for a family of five. More generous publicly financed schemes that cover a broader segment of the population do exist, but their geographic coverage is limited to a few southern Indian states (Fan et al. 2012). These coverage gaps highlight the importance of establishing risk pooling mechanisms that extend beyond the poor, when considering conditions that are expensive to treat. From a longer term sustainability perspective, mechanisms to lower risk factors such as tobacco smoking, hypertension, lack of physical activity and obesity may be warranted.

A key strength of our study is our use of a nationally representative household survey with information on healthcare use, OOP spending on healthcare, healthcare financing and information on individual-level employment. Matching CVD-affected households to control households on socio-economic, demographic and locational characteristics also addresses some of the confounding arising from non-random assignment of heart disease. Our study findings also rely on multiple checks for robustness, and our main conclusions hold up across different matching methods, as well as matching after excluding households with a death from any cause, and matching after excluding the top 1% households with the most out-of-pocket spending on treatment.

There are obvious limitations to our study. Our identification of CVD-affected households relies on self-reports of heart disease, which may lead to inaccurate estimation, although we would expect that acute cases, at least, are well reported. Household survey data tend to understate deaths, and estimates based on the survey we used suggest that in 2004, 211 000 deaths occurred from heart disease in India, compared with an estimated 2.3 million deaths due to CVD from the 2008 Global Burden of Disease study. Undercounting deaths could lead to the estimated household economic burden of heart disease becoming biased downwards if healthcare use and expenditures are concentrated in the time immediately preceding death, and a disproportionate number of CVD deaths are excluded or end up in the controls. On the other hand, our estimates of the economic burden could be biased upwards given that all households that had a member hospitalized due to heart disease in the year preceding the survey were automatically defined as a CVD-affected household. Another source of upward bias in our estimates is that individuals using health services and incurring OOP spending may be those most aware of their health status, either because their condition is more serious than average or because they are naturally pre-disposed to health-seeking behaviour. We partially addressed these issues by undertaking additional analyses limited to households that did not experience deaths, irrespective of cause, and further by including hospitalization as an additional indicator of matching in the propensity score equation, but some of the biases are likely to persist.

Another limitation is that matching methods cannot account for unobservable factors that drive household risks of heart disease. Our 2004 data do not include information on tobacco and alcohol consumption, dietary history or obesity in the household. Nor do we have information on the occupational history of household
members that could affect heart disease risks (Goyal & Yusuf 2006).

Conclusion

Our study is one of only a few that estimate CVD-related economic hardship imposed at the household level in LMICs. Our finding provides a much better understanding of the economic burden of CVD at the household level than previous studies because we took into account some of the major potentially confounding effects. However, CVD is only one among a number of non-communicable conditions, such as cancer and diabetes that can be expected to impose a major financial burden on affected households. The key policy implication from our findings is the need to protect Indian households from the financial risks associated with major non-communicable conditions.

Acknowledgements

The authors acknowledge helpful research assistance from Suhith Illesinghe. Anup Karan is supported by the Wellcome Trust Capacity Strengthening Strategic Award to the Public Health Foundation of India and a consortium of UK universities. Ajay Mahal is supported by a Establishment Grant funded by the Alan and Elizabeth Finkel Foundation at the School of Public Health and Preventive Medicine at Monash University.

References

Austin P (2009) The relative ability of different propensity score methods to balance measured covariates between treated and untreated subjects in observational studies. Medical Decision Making 29, 661–677.

Bloom D, Cafiero E, Jane-Llopis E et al. (2011) The Global Economic Burden of Non-Communicable Diseases. Harvard School of Public Health and World Economic Forum, Boston, MA.

Ciani E (2011) Informal adult care and caregivers’ employment in Europe. Labour Economics 19, 155–164.

Dehejia R & Wahba S (1999) Causal effects in non-experimental studies: re-evaluating the evaluation of training programs. Journal of the American Statistical Association 94, 1053–1062.

Fan VY, Karan A & Mahal A (2012) State health insurance and out-of-pocket health expenditures in Andhra Pradesh, India. International Journal of Health Care Finance & Economics 12, 1–27.

Garg C & Karan A (2009) Reducing out-of-pocket expenditures to reduce poverty: a disaggregated analysis at rural-urban and state-level in India. Health Policy and Planning 24, 116–128.

Gertler P & Gruber J (2002) Insuring consumption against illness. American Economic Review 92, 51–70.

Goyal A & Yusuf S (2006) The burden of cardiovascular disease in the Indian subcontinent. Indian Journal of Medical Research 124, 235–244.

Gruber J & Madrian BC 2002. Health insurance, labour supply and job mobility. Working paper no. 8817. National Bureau of Economic Research, Cambridge MA.

Gupta I, Kandamurthan S & Upadhyaya D (2006) Economic impact of cardiovascular diseases in India. Institute of Economic Growth, University of Delhi, New Delhi, India.

Harris A (2008) Chronic disease and labour force participation in Australia: an endogenous multivariate probit analysis of clinical prevalence data. Research paper no. 25/08. Centre of Health Economics, Monash University, Clayton, Australia.

Huffman MD, Rao KD, Pichon-Riviere A et al. (2011) A cross-sectional study of the microeconomic impact of cardiovascular disease hospitalization in four low- and middle-income countries. PLoS ONE 6, e20821.

Institute of Health Metrics and Evaluation (IHME) (2012) GBD Profile: India. Available at http://healthmetricsandevaluation.org (Accessed March 31, 2013).

Islam A & Maitra P (2012) Health shocks and consumption smoothing in rural households: does microcredit have a role to play? Journal of Development Economics 97, 232–243.

Leeder S, Raymond S, Greenberg H, Liu H & Esson K (2004) A Race against Time: The Challenge of Cardiovascular Disease in Developing Countries. Columbia University Press, New York, NY.

Lilly M, Laporte A & Coyte P (2010) Do they care too much to work? The influence of caregiving intensity on the labour force participation of unpaid caregivers in Canada. Journal of Health Economics 29, 895–903.

Mahal A, Karan A & Engelgau M (2010) Economic Implications of Non-communicable Disease for India. The World Bank, Washington, DC.

National Sample Survey Organization (NSSO) (2006) Morbidity, Health Care and the Conditions of the Aged, NSSO 60th Round (January–June 2004). National Sample Survey Organisation, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

Passey ME, Shrestha RN, Bertram MY et al. (2012) The impact of diabetes prevention on labour force participation and income of older Australians: an economic study. BMC Public Health 12, 16.

Popkin B, Horton S, Kim S, Mahal A & Shuigao J (2001) Trends in diet, nutritional status, and diet-related non-communicable diseases in China and India: the economic costs of the nutrition transition. Nutrition Reviews 59, 379–390.

Prabhakaran D, Shah P, Chaturvedi V, Ramakrishnan L, Manhapa A & Reddy KS (2005) Cardiovascular risk factor prevalence among men in a large industry of northern India. The National Medical Journal of India 18, 59–65.

Rao K, Bhatnagar A & Murphy A (2011) Socioeconomic inequalities in the financing of cardiovascular and diabetes
Appendix A1

Methodology for subgroup analysis

We describe the approach for carrying out a subgroup analysis for the impact of cardiovascular disease (CVD) on scheduled castes and tribes (SC/ST) and non-SC/ST populations (the treatment of education subgroups is analogous). This is a three-step exercise:

First, new propensity scores (for reported heart disease) have to be generated after excluding the indicator variable for the subgroups in question (that is, after excluding the indicator variable for SC/ST status).

Second, a dataset consisting ONLY of matched households (using nearest neighbour methods on propensity scores) was constructed (all unmatched observations were dropped from the analysis).

The third step involved the use of ordinary least squares (OLS) regression to estimate relationships between each of the outcome variables (as the Y variables) and three regressors on the matched dataset: an indicator variable for CVD-affected households, an indicator variable for the socio-economic classification (SC/ST) and an interaction term consisting of the product of the two.

That is, in the context of the matched dataset, the following equation was estimated:

\[ Y = \alpha + \beta \cdot \text{CVD} + \delta \cdot \text{SC} + \theta \cdot \text{CVD} \cdot \text{SC} + \epsilon \]

Here, Y is an outcome variable (economic or health service use); CVD is an indicator variable with 1 indicating a CVD-affected household, 0 otherwise; SC is an indicator variable for SC/ST status, with 1 indicating that the household is SC/ST, 0 otherwise; CVD*SC is an interaction of the two previous indicators; \( \epsilon \) is an error term; \( \alpha, \beta, \delta \) and \( \theta \) are parameters to be estimated.

Now note that:

(a) The coefficient \( \beta \) can be interpreted as the difference in economic outcomes for CVD-affected and matched control households for the non-SC/ST households (or more simply, the impact of CVD on non-SC/ST households)

(b) The sum \( \beta + \theta \) can be thought of as the difference in economic outcomes for CVD-affected and matched control households for the SC/ST households (impact of CVD on SC/ST households)

The test for equality in subgroup effects is then based on the null hypothesis \( H(0): \theta = 0 \).

Columns (1) and (2) in Tables 4 and 5 in the study report the estimated coefficients \( \beta \) and \( \beta + \theta \), respectively. Column (1)–(2) reports the difference between the two \( \theta \) and the associated p-value. This provides a test for subgroup differences in the impact of CVD.

Corresponding Author

Anup Karan, Public Health Foundation of India, ISID Campus, 4 Institutional Area, Vasant Kunj, New Delhi, India 110070, India. Tel.: +91 9212465587; Fax: +91 1141648513; E-mail: anup.karan@dph.ox.ac.uk

© 2014 The Authors. Tropical Medicine & International Health Published by John Wiley & Sons Ltd.