Economic burden of chronic conditions among households in Myanmar: the case of angina and asthma

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Background Non-communicable diseases (NCDs) are becoming a major source of the national disease burden in Myanmar with potentially serious economic implications.

Methods Using data on 5484 households from the World Health Survey (WHS), this study assessed the household-level economic burden of two chronic conditions, angina and asthma, in Myanmar. Propensity score matching (PSM) and coarsened exact matching (CEM) methods were used to compare household out-of-pocket (OOP) spending, catastrophic and impoverishment effects, reliance on borrowing or asset sales to finance OOP healthcare payments and employment among households reporting a member with angina (asthma) to matched households, with and without adjusting for comorbidities. Sensitivity analyses were carried out to assess the impacts of alternative assumptions on common support and potential violations of the assumption of independence of households being angina (asthma) affected and household economic outcomes, conditional on the variables used for matching (conditional independence).

Results Households with angina (asthma) reported greater OOP spending (angina: range I$1.94–I$4.31; asthma: range I$1.53–I$2.01) (I$=125.09 Myanmar Kyats; IS=International Dollar) almost half of which was spending on medicines; higher rates of catastrophic spending based on a 20% threshold ratio of OOP to total household spending (angina: range 6–7%; asthma: range 3–5%); greater reliance on borrowing and sale of assets to finance healthcare (angina: range 12–14%; asthma: range 40–49%); increased medical impoverishment and lower employment rates than matched controls. There were no statistically differences in OOP expenses for inpatient care between angina-affected (asthma-affected) households and matched controls. Our results were generally robust to multiple methods of matching. However, conclusions for medical impoverishment impacts were not robust to potential violations of the conditional independence assumption.

Conclusions Myanmar is expanding public spending on health and has recently launched an innovative programme for supporting hospital-based care for poor households. Our findings suggest the need for interventions to address OOP expenses associated with outpatient care (including drugs) for chronic conditions in Myanmar’s population.

Keywords Angina, asthma, coarsened exact matching, economic burden, households, Myanmar, propensity score matching
KEY MESSAGES

- Very little is known about the economic burden of non-communicable diseases (NCDs) on households in Myanmar, which is facing major challenges related to economic deprivation and poor population health.
- Analysis of the household economic burden of two chronic conditions, angina and asthma, among Myanmar households reveals significant levels of out-of-pocket (OOP) spending, reliance on borrowing and asset sales to finance care and work participation.
- As Myanmar scales up its public sector allocations to health, it will need to address OOP expenses associated with NCDs, including for outpatient care and drugs.

Introduction

Myanmar is amongst the poorest countries of Asia with 32% of its population living below the poverty line [Ministry of National Planning and Economic Development (MNPED) 2007]. It also lags behind other Asian countries in population health outcomes [World Bank 2012]. Although maternal and child health outcomes and chronic infectious conditions such as tuberculosis continue to be major sources of disease burden, non-communicable chronic conditions are emerging as a serious population health challenge in Myanmar. The global burden of disease (GBD) 2010 study showed that the share of asthma, stroke, cancers, ischemic heart disease (IHD) and diabetes in deaths from all causes increased from 24.9% in 1990 to 35.9% in 2010 [Institute of Health Metrics and Evaluation (IHME) 2012].

Studies conducted in other countries have shown that chronic conditions can have significant economic implications for households in developing nations due to illness-related income losses and out-of-pocket (OOP) spending (Abegunde and Stanciole 2008; Rao et al. 2011; Mahal et al. 2013). Given limited private and social insurance cover, subsidized public health facilities offer an important safety net for the majority of Myanmar’s population. The public sector accounts for 90% of all hospital beds in the country and government primary care health facilities reach all the way down to villages. However, patients pay for any drugs and non-durables not available in hospitals and health facilities in the public sector. Ministry of Health data also suggest serious shortages in the health workforce in Myanmar (Htet et al. 2015). With public sector health spending stagnant at 0.2% of gross domestic product (GDP) until recently, households containing members with non-communicable diseases (NCDs) in Myanmar are forced to rely on private sources of care. Over 70% of outpatient visits in Myanmar are accounted for by private providers and paid for OOP which is significant, given that chronic NCDs are typically managed in outpatient settings (Htet et al. 2015).

Little is known about the economic implications of chronic NCDs in Myanmar despite their accounting for more than half of all cause deaths. In this article, we highlight the economic burden of NCDs among Myanmar households by focusing on two chronic conditions, angina and asthma, for which information was available in World Health Survey (WHS) data. Angina, a chest pain or discomfort that occurs due to lack of oxygen-rich blood to the heart, is strongly associated with IHD, which accounted for 11.4% of deaths from NCDs in Myanmar in 2010. Asthma accounted for 4.9% of deaths from NCDs in 2010. Diabetes, stroke and cancers are other major chronic conditions in Myanmar in 2010 as per the GBD 2010 study, but available surveys do not contain adequate individual or household-specific information on these diseases.

Although not a severe health condition, such as a heart attack, people with angina will need treatment and preventive measures to avoid longer term adverse health outcomes. These measures include medication (e.g. beta blockers and ACE inhibitors) and surgical procedures such as angioplasty and cardiac bypass surgery, which can be expensive. Analyses of the economic consequences of angina on households are relatively scarce in developing countries, although some work exists for middle- and high-income countries. For example, research for Ukraine showed that angina imposed significant OOP health expenditures, particularly for drugs, on households (Murphy et al. 2013). In the United States, angina has been shown to impact ability to work and healthcare costs (Javitz et al. 2004). Asthma treatment can also be expensive as it requires regular medication (e.g. corticosteroids) and in acute cases, hospitalization. A recent systematic review of >30 (primarily developed) countries concluded that asthma can impose high resource costs on health systems due to hospitalization and medication expenses but did not assess household-level economic burden (Bahadori et al. 2009). Studies in Brazil and Turkey (middle-income countries) show that households spent significant amounts OOP on treatment of asthma-affected members, and individuals with asthma were at high risk for job loss (Beyhun et al. 2007; Cruz and Bousquet 2009; Franco et al. 2009). The financial burden of asthma is likely to be significantly greater in poor countries where health insurance coverage is low.

Using WHS data for Myanmar, we compared household OOP spending, financing for healthcare spending and work participation among households reporting a member with angina or a member with asthma to a set of matched control households. Matching was necessary because the association between illness and household healthcare spending and other economic outcomes is likely to depend on socioeconomic status, demographic composition, residential location and other factors. Propensity score matching (PSM) and coarsened exact matching (CEM) methods were used for these comparisons. Our analysis contributes to the literature on the household economic burden of NCDs in low-income countries and to the development of appropriate policy responses to NCDs.

Methods

Data

We used data from the WHS, implemented by the WHO in >70 countries around the world, including Myanmar, during 2002–
2003. Our sample consisted of 5484 households, with a sampling frame that covered 90% of the population of Myanmar, covering all major geographical regions and population sub-groups. The survey instrument for WHS collected information on household socioeconomic and demographic characteristics and components of consumption spending, including OOP healthcare expenditures. Survey respondents were also asked a number of questions about their own health status, including about angina and asthma from one adult member (randomly chosen using Kish tables) in each household, aged 18 years or older. Detailed household-level information on OOP health spending related to inpatient care, ambulatory care, drugs, healthcare products, laboratory tests and other categories was also collected as part of the survey. Sample households were selected based on a random, stratified sampling procedure. The sampling procedure is described in detail elsewhere (WHO 2003). The interviews were conducted in person following written consent from the respondent and institutional ethical approval for the survey at each study site.

Matching methods: PSM and CEM

We used two matching methods, PSM and CEM, to compare economic outcomes for a household affected by angina (asthma) to a set of matched control households. The indicator of a household affected by angina (asthma) was whether the key respondent reported angina (asthma). The PSM procedure involved two steps (Dehejia and Wahba 2002). In the first step, the probability (the ‘propensity score’) that a household affected by the chronic condition, angina or asthma as appropriate, was predicted based on observed household and individual characteristics, sometimes referred to as ‘pre-treatment’ covariates. This (pre-processing) step involved estimating the following (logit) model:

\[
P(i_t = 1) = \frac{e^{\beta X_i}}{1 + e^{\beta X_i}}
\]

Here \(i_t\) indicates whether household \(i\) contains a respondent with angina (asthma). The vector \(X_i\) indicates household demographic and socioeconomic characteristics, and \(\beta\) is a vector of the parameters to be estimated. In the second step, angina (asthma)-affected households were matched to control households with similar propensity scores using STATA, version 12.1 under the restriction of common support. ‘Common support’, i.e. overlap in the propensity scores between the treatment and control groups, is needed for obtaining consistent estimates of household-level economic impacts of angina (asthma) (e.g. Nannicini 2007).

A key step in PSM methods is balance checking of pre-treatment covariates \(X_i\). For each covariate used in the regression model that generated the propensity scores, we compared the means between the angina-affected and asthma-affected households and matched control households using a t-test. We also assessed whether the ‘standardized bias’—the differences in means between treated and matched control households divided by the square root of the average of the sample variances of the two groups—was <25% (Ho et al. 2007). However, even with these precautions, matching can lead to the inclusion of treatment and control households with very different socioeconomic and demographic characteristics when using a summary measure such as the propensity score. Matching simultaneously on all the pre-treatment covariates (‘exact’ matching) removes the need for balance checking but results in very few matched angina (asthma)-affected households and control households, particularly when the matching variables are continuous or numerous. CEM is a compromise in that angina (asthma)-affected and control households are exactly matched but only after a coarsening of continuous variables into categorical variables.

Households affected by angina and asthma

WHS collected information on angina in two different ways: by inquiring whether the respondent was diagnosed with angina by a medical practitioner or whether the respondent had a set of symptoms consistent with angina, based on the Rose questionnaire (Rose 1965, Rose et al. 1977). We defined a household as being angina affected if the respondent either reported as being diagnosed with angina or had symptoms consistent with angina in the last 12 months: 2.70% of the respondents reported having diagnosed angina and 2.12% were identified as having angina based on symptoms. Combining the two sets of households, 4.09% of the households were defined as being angina affected. Asthma-affected households were identified using an exercise similar to that for angina-affected households; 3.02% of respondents reported as being diagnosed with asthma and 2.22% of respondents possessed symptoms consistent with asthma in the 12 months preceding the survey (whether or not diagnosed as having asthma) using definitions in Levesque et al. (2013). A household was identified as being asthma affected if the respondent reported being either diagnosed with asthma or having symptoms consistent with asthma. Overall, 3.94% of households were identified as asthma affected.

Variables used to construct propensity scores

Individual respondent characteristics

Age (in the form of indicator variables for whether an individual was 60 years or older and whether the individual was between the ages of 20 and 59 years) and sex of the respondent were included along with an indicator for marital status of the respondent. Ever married and cohabiting respondents were assigned a value of 1, 0 otherwise. An indicator of educational attainment of the household head was included, taking the value of 1 if s/he had completed primary schooling, 0 otherwise. The height and weight of the respondent were converted into body mass index (BMI) and an indicator for ‘overweight’ (BMI > 25) was used. Finally, we included an indicator variable for whether the respondent ‘ever consumed’ alcohol (1 if yes, 0 otherwise), given the well-known links between alcohol use, asthma and cardiovascular disease.

Other household members

We used information on socioeconomic and demographic characteristics for household members other than the respondent in the propensity score equation. These included an indicator for a child under 5 years (1 if a member of the household, 0 otherwise), an indicator for an elderly person (defined as being 60 years and over) being a member of the household, the age of the household head (in the form of
indicator variables for whether an individual was 60 years or older and whether the individual was between the ages of 20 and 59 years) and sex of the household head (1 if male, 0 otherwise). Indicators of socioeconomic status and living conditions were also included specifically the type of floor of the dwelling and whether the household belonged to the majority Bamar community.

**Other household characteristics**
Household size and indicators of geographical location such as rural or urban residence and seven indicators of locational strata used for sampling purposes in the WHS were included.

**Outcome variables**

**OOP health spending**
Data on OOP health spending were collected in the WHS for the 4 weeks preceding the survey, using both an omnibus estimate and item-wise estimates for expenses incurred on overnight stays at a hospital or health facility, care received as an outpatient, dental care, care by traditional or alternative healers, drugs, healthcare products (e.g. prosthetics), diagnostic and laboratory tests and a residual category. Item-wise recording of expenditures yields higher estimates in survey data (Xu et al. 2009). In this study, we used itemized health spending. Expenditure data were measured in international dollars (IS) using an exchange rate of IS1 = 125.09 Myanmar Kyats, based on World Bank data (World Bank 2014).

**Spending on drugs**
OOP health spending on drugs by households was measured using a reference period of 4 weeks preceding the survey.

**Spending on hospitalization**
There were two variables for which information was available: OOP health spending on hospitalization in the 4 weeks preceding the survey and OOP health spending on hospitalization in the year prior the survey. We used information on inpatient spending using the 4-week reference period (Lu et al. 2009).

**Indicators of the burden of OOP spending**
We included multiple indicators of the burden of OOP spending suggested in the literature. These included two indicators of catastrophic spending. First, OOP health spending was defined as catastrophic if it exceeded 20% of total household expenditure. The corresponding indicator used took the value 1 if OOP health spending was catastrophic in this sense, 0 otherwise. Our second measure of catastrophic spending was similar to that used in Xu et al. (2003). Household subsistence spending was calculated from the estimates of the national poverty line (World Bank 2012) and subtracted from the total household expenditure to get a measure of the household’s ‘capacity to pay.’ An indicator of catastrophic levels of OOP health spending was defined as taking the value of 1 if OOP spending exceeded 40% of a household’s ‘capacity to pay’ and 0 otherwise.

A measure of household impoverishment due to ill health was also constructed, as in Doorslaer et al. (2006). Specifically, aggregate household expenditure was assessed net and gross of OOP spending on health. If the household’s aggregate expenditure gross of OOP health payments exceeded the national poverty line, it was defined to be non-poor ex ante. Then we considered the same household’s aggregate health expenditure net of OOP spending on health. If, upon netting OOP health spending, the household’s total expenditure fell below the national poverty line, a household was defined as poor ex post. Finally, if a household was ex ante non-poor, but poor ex post, it was said to be impoverished by the OOP payments associated with illness. An indicator variable (for impoverishment due to illness) was defined, which took the value of 1 for such households and 0 otherwise.

**Financing of OOP health expenditure**
The WHS also collected information on the methods households used to finance health expenditures in the year preceding the survey. Although not directly corresponding to the data on OOP spending (which used a 4-week reference period), we used a binary outcome indicator for distress financing (=1 for any reported household borrowing or asset sales to finance OOP healthcare, 0 otherwise) in our analysis.

**Employment**
A binary outcome indicator was constructed taking the value 1 if the individual was employed and 0 otherwise.

**Robustness checks and comorbidities**
We assessed the robustness of our findings by measuring the economic burden on households using multiple propensity score methods, such as nearest-neighbour matching, radius matching, kernel matching and stratification, in addition to CEM.

Impact estimates based on matching methods (particularly kernel matching) are sensitive to the common support requirement given that it can result in the exclusion of some of the treatment households from the analysis. To assess whether exclusion of treatment households influences our results, we first explored whether and how many asthma (angina)-affected households were excluded from the sample due to the common support restriction. Moreover, the ‘thinness’ of the overlap in propensity scores has also been raised as a concern in the literature. Thus, we examined the implications for impact estimates of further restricting the common support region by dropping treatment [angina (asthma)-affected] households with the lowest density (in the respective empirical distributions). Specifically, we experimented by dropping between 1 and 10% of the angina (asthma)-affected households with the lowest density for propensity scores to assess the sensitivity of our results to assumptions about common support.

Consistency of impact estimates based on matching methods also requires that conditional on observed covariates used for matching, the distribution of asthma- and asthma-affected households is statistically independent of (potential) household outcomes in the absence of asthma and angina. This is the conditional independence assumption (CIA). Because it is not possible to directly test the validity of this assumption, we followed a strategy suggested in the literature to evaluate the robustness of our impact estimates to violations of CIA. Specifically, we assumed that CIA does not hold for observed covariates used for matching and that there is an unobserved
binary variable (say \( U \)), which, if it were observed and included in the set of matching variables, would lead to CIA being satisfied (Nannicini 2007). Alternative assumptions on its distribution determine how \( U \) influences the likelihood of selection into treatment (i.e. household being angina (asthma) affected), the magnitude of household outcomes (whether above or below the sample mean) in the absence of angina (asthma) and economic impact estimates if \( U \) were observed and used to generate propensity scores for matching. We asked how large the selection and outcome effects had to be to overturn our findings on the economic effects of angina and asthma on households (Nannicini 2007; Ichino et al. 2008).

In our sensitivity analyses, we first assessed the impact of an unobserved confounder on our findings of economic impacts under six different hypothetical scenarios, with each scenario comparing (1) the odds of selection into angina (asthma)-affected household when the binary variable \( U \) takes the value of 1, vs the odds of selection when \( U \) equals zero and (2) the odds of outcomes taking a value greater than the sample mean when \( U = 1 \) vs the odds of outcomes taking value greater than the sample mean when \( U = 0 \), in the angina (asthma)-affected household. In one of these scenarios, we also examined the implications of including an unobservable with the same distribution as an already existing binary variable in our sample—namely, whether the respondent had comorbidities. In the case of angina, information was available on respondents' status with respect to asthma, diabetes and depression and we used a comorbidity indicator that took the value 1 if the respondent reported any of these three conditions, 0 otherwise. In the case of asthma, we used a comorbidity indicator that took the value 1 if the respondent reported any one of angina status, diabetes and depression, 0 otherwise.

### Results

Table 1 reports the results of the first-stage probit regressions for generating propensity scores for a household being angina (asthma) affected. Although many of the coefficients are statistically indistinguishable from zero, the age of the

<table>
<thead>
<tr>
<th>Matching variable</th>
<th>Indicator variable for angina-affected household</th>
<th>Indicator variable for asthma-affected household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural residence (1 if rural, 0 otherwise)</td>
<td>0.46 (0.56)</td>
<td>0.44 (0.56)</td>
</tr>
<tr>
<td>Household with an individual aged 60+ years (1 if yes, 0 otherwise)</td>
<td>−0.38* (0.20)</td>
<td>−0.18 (0.18)</td>
</tr>
<tr>
<td>Household with an under-5 child (1 if yes, 0 otherwise)</td>
<td>0.00 (0.16)</td>
<td>−0.07 (0.17)</td>
</tr>
<tr>
<td>Household size</td>
<td>0.02 (0.04)</td>
<td>0.02 (0.04)</td>
</tr>
<tr>
<td>Sex of affected individual (1 if female, 0 otherwise)</td>
<td>0.70*** (0.17)</td>
<td>0.45*** (0.17)</td>
</tr>
<tr>
<td>Age of respondent is 60+ years (1 if yes, 0 otherwise)</td>
<td>1.43*** (0.54)</td>
<td>2.08*** (0.61)</td>
</tr>
<tr>
<td>Age of respondent is 20–59 years (1 if yes, 0 otherwise)</td>
<td>1.01* (0.52)</td>
<td>1.16** (0.60)</td>
</tr>
<tr>
<td>Marital status of respondent (1 if ever married, 0 otherwise)</td>
<td>0.04 (0.23)</td>
<td>−0.04 (0.22)</td>
</tr>
<tr>
<td>Residence has concrete/hard floor (1 if yes, 0 otherwise)</td>
<td>−0.14 (0.52)</td>
<td>−0.35 (0.47)</td>
</tr>
<tr>
<td>Overweight respondent (BMI &gt; 25) (1 if yes, 0 otherwise)</td>
<td>−0.06 (0.24)</td>
<td>−0.00 (0.26)</td>
</tr>
<tr>
<td>Whether respondent ever consumed alcohol (1 if yes, 0 otherwise)</td>
<td>0.59*** (0.21)</td>
<td>0.79*** (0.26)</td>
</tr>
<tr>
<td>Sex of household head (1 if female, 0 otherwise)</td>
<td>0.05 (0.22)</td>
<td>−0.01 (0.23)</td>
</tr>
<tr>
<td>Age of household head is 60+ years (1 if yes, 0 otherwise)</td>
<td>−1.38** (0.68)</td>
<td>−0.93 (0.66)</td>
</tr>
<tr>
<td>Age of household head 20–59 years (1 if yes, 0 otherwise)</td>
<td>−0.93 (0.64)</td>
<td>−0.89 (0.65)</td>
</tr>
<tr>
<td>Household head completed primary schooling (1 if yes, 0 otherwise)</td>
<td>−0.13 (0.17)</td>
<td>0.04 (0.19)</td>
</tr>
<tr>
<td>Bamar ethnic status (1 if yes, 0 otherwise)</td>
<td>0.43* (0.25)</td>
<td>0.46* (0.28)</td>
</tr>
<tr>
<td>Indicator variable for strata 1</td>
<td>0.61 (0.61)</td>
<td>−0.59 (0.78)</td>
</tr>
<tr>
<td>Indicator variable for strata 2</td>
<td>0.06 (0.59)</td>
<td>−0.70 (0.66)</td>
</tr>
<tr>
<td>Indicator variable for strata 3</td>
<td>0.81 (0.54)</td>
<td>0.02 (0.36)</td>
</tr>
<tr>
<td>Indicator variable for strata 5</td>
<td>−0.17 (0.30)</td>
<td>−0.34 (0.31)</td>
</tr>
<tr>
<td>Indicator variable for strata 6</td>
<td>−1.05*** (0.34)</td>
<td>−0.73** (0.33)</td>
</tr>
<tr>
<td>Indicator variable for strata 7</td>
<td>0.18 (0.30)</td>
<td>0.40 (0.31)</td>
</tr>
<tr>
<td>Constant</td>
<td>−4.18*** (1.10)</td>
<td>−4.28*** (1.12)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>5484</td>
<td>5484</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.05</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Notes: Estimates are based on data from the WHS for Myanmar for 2003. Stratum 1 is the excluded category. Standard errors are reported in parentheses below the coefficient estimates.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.
### Table 2: Summary statistics for angina-affected and control (matched and unmatched) households

<table>
<thead>
<tr>
<th>Matching variable</th>
<th>Angina-affected households (95% CI)</th>
<th>Control households—matched (95% CI)</th>
<th>Control households—unmatched (95% CI)</th>
<th>t-statistic</th>
<th>% Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural residence (%)</td>
<td>68.28 (62.18–74.37)</td>
<td>70.93 (67.94–73.91)</td>
<td>76.43 (75.28–77.58)</td>
<td>−0.73</td>
<td>−5.74</td>
</tr>
<tr>
<td>Households with individuals aged 60 years and older (%)</td>
<td>18.06 (13.02–23.10)</td>
<td>19.38 (16.78–21.98)</td>
<td>26.40 (25.21–27.59)</td>
<td>−0.44</td>
<td>−3.38</td>
</tr>
<tr>
<td>Households with an under-5 child (%)</td>
<td>33.92 (27.71–40.12)</td>
<td>29.07 (26.09–32.06)</td>
<td>32.68 (31.41–33.95)</td>
<td>1.26</td>
<td>10.43</td>
</tr>
<tr>
<td>Household size</td>
<td>4.84 (4.56–5.12)</td>
<td>4.83 (4.70–4.96)</td>
<td>4.94 (4.88–4.99)</td>
<td>0.05</td>
<td>0.42</td>
</tr>
<tr>
<td>Age of affected individual (years) (female) (%)</td>
<td>66.96 (60.79–73.12)</td>
<td>67.84 (64.77–70.92)</td>
<td>55.70 (54.35–57.04)</td>
<td>−0.22</td>
<td>−1.88</td>
</tr>
<tr>
<td>Age of affected individual over 60 years (%)</td>
<td>15.86 (11.07–20.65)</td>
<td>14.54 (12.22–16.86)</td>
<td>13.56 (12.64–14.49)</td>
<td>0.48</td>
<td>3.68</td>
</tr>
<tr>
<td>Marital status of affected individual—ever married (%)</td>
<td>82.37 (77.39–87.37)</td>
<td>82.38 (79.87–84.89)</td>
<td>81.85 (80.81–82.89)</td>
<td>−0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Living in houses with hard/concrete floor (%)</td>
<td>98.24 (96.51–99.96)</td>
<td>98.24 (97.37–99.10)</td>
<td>97.87 (97.48–98.26)</td>
<td>−0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Overweight respondent (BMI &gt; 25) (%)</td>
<td>9.25 (5.45–13.05)</td>
<td>8.81 (6.95–10.68)</td>
<td>8.41 (7.66–9.16)</td>
<td>0.21</td>
<td>1.53</td>
</tr>
<tr>
<td>Whether ever consumed alcohol (%)</td>
<td>17.62 (15.11–20.13)</td>
<td>18.50 (13.45–23.56)</td>
<td>15.16 (14.19–16.13)</td>
<td>−0.28</td>
<td>−2.29</td>
</tr>
<tr>
<td>Sex of household head (whether female head) (%)</td>
<td>18.94 (13.80–24.08)</td>
<td>20.70 (18.04–23.37)</td>
<td>16.51 (15.51–17.51)</td>
<td>−0.57</td>
<td>−4.42</td>
</tr>
<tr>
<td>Age of household head over 60 years (%)</td>
<td>9.69 (5.81–13.37)</td>
<td>9.25 (7.34–11.16)</td>
<td>14.93 (13.97–15.90)</td>
<td>0.19</td>
<td>1.50</td>
</tr>
<tr>
<td>Age of household head 20–59 years (%)</td>
<td>88.99 (84.89–93.09)</td>
<td>89.87 (87.88–91.85)</td>
<td>84.48 (83.50–85.46)</td>
<td>−0.35</td>
<td>−2.86</td>
</tr>
<tr>
<td>Whether household head completed primary schooling (%)</td>
<td>72.69 (66.85–78.53)</td>
<td>74.01 (71.12–76.90)</td>
<td>78.79 (77.68–79.89)</td>
<td>−0.38</td>
<td>−2.99</td>
</tr>
<tr>
<td>Whether of Bamar ethnicity (%)</td>
<td>77.09 (71.58–82.60)</td>
<td>79.74 (77.09–82.38)</td>
<td>72.07 (70.86–73.29)</td>
<td>−0.79</td>
<td>−6.42</td>
</tr>
<tr>
<td>Number of observations</td>
<td>227</td>
<td>888</td>
<td>5257</td>
<td>1115</td>
<td>1115</td>
</tr>
</tbody>
</table>

**Notes:** Estimates are means from the 2003 WHS data for Myanmar. In columns (2)–(4), 95% confidence intervals (CI) are reported in parentheses below the means. For matching purposes, propensity score calculations were based on probit regression estimates as reported in Table 1. The t-test reported in column (5) compares the means between matched angina-affected and control households; the standardized bias (% Bias) reported in column (6) refers to the difference of the sample means of the angina-affected and control households as a percentage of the square root of the average of the sample variances in the angina-affected and matched control households.

respondent, being female, whether the respondent ever consumed alcohol, Bamar ethnicity and geographic location (sampling stratum 6) are associated with the likelihood of a household being angina affected and being asthma affected.

Tables 2 and 3 present summary statistics for angina-affected households and asthma-affected households, unmatched control households and matched control households. The comparison between asthma (angina)-affected and matched households used nearest-neighbour PSM for illustrative purposes. The data show that the means of indicators for angina-affected and control households track each other well, so we could expect non-trivial matches over the region of common support. Moreover, the support for unmatched controls contains the support for asthma (angina)-affected households, so the standard common

matching. In Tables 2 and 3, t-tests for differences in sample means of angina-affected and control households in the matched dataset (after nearest-neighbour matching) showed no statistically significant differences at the 5% level. In addition, estimates of ‘standardized bias’ are reported in the last columns of Tables 2 and 3 and are <12% in all cases, considerably less than the 25% threshold recommended in Ho et al. (2007). The data also confirm that over 70% of the survey households lived in rural areas. One-fifth of the households are headed by women and the majority ethnic Bamar group accounted for more than three quarters of the sample.

Figures 1 and 2 describe the empirical distribution of propensity scores for angina (asthma)-affected households and their respective unmatched controls. In general, the empirical distributions of angina (asthma)-affected households and control households track each other well, so we could expect non-trivial matches over the region of common support.
Household with an individual aged 60 years or older (%): 26.02 (20.16–28.03) vs 25.11 (22.20–28.03), p = 0.27

Household with an under-5 child (%): 72.60 (69.69–75.52) vs 72.60 (69.69–75.52), p = 0.00

Sex of affected individual is female (%): 58.90 (52.33–65.47) vs 55.25 (51.91–58.59), p = 0.87

Age of affected individual over 60 years (%): 26.02 (20.16–28.03) vs 25.11 (22.20–28.03), p = 0.27

Age of affected individual is 20–59 years (%): 72.60 (66.65–78.55) vs 72.60 (69.69–75.52), p = 0.00

Marital status of affected individual (%): 83.07 (75.06–85.66) vs 83.11 (80.59–85.62), p = 0.00

Household has concrete/hard floor (%): 97.72 (96.72–99.71) vs 98.17 (97.27–99.07), p = 0.43

Overweight respondent (BMI > 25) (%): 8.22 (6.37–10.06) vs 8.45 (7.70–9.20), p = 0.00

Whether ever consumed alcohol (%): 21.92 (16.43–27.41) vs 25.11 (22.20–28.03), p = 0.93

Whether sex of household head is female (%): 17.81 (12.70–22.92) vs 14.16 (11.81–16.50), p = 0.29

Whether age of household head is over 60 years (%): 19.18 (13.92–24.42) vs 19.63 (16.97–22.30), p = 0.15

Age of household head 20–59 years (%): 79.45 (74.06–84.84) vs 80.37 (75.06–85.66), p = 0.29

Whether household head completed primary schooling (%): 81.74 (76.59–87.83) vs 81.11 (80.59–85.62), p = 0.43

Bamar ethnic status (%): 80.37 (75.06–85.66) vs 81.14 (79.14–84.33), p = 0.42

Number of observations: 219 vs 852

Notes: Estimates are means from the 2003 WHS data for Myanmar. In columns (2)–(4), 95% confidence intervals (CI) are reported in parentheses below the means. For matching purposes, propensity score calculations were based on probit regression estimates as reported in Table 1. The t-test reported in column (5) compares the means between matched asthma-affected and control households; the standardized bias (% Bias) reported in column (6) refers to the difference of the sample means of the asthmatic-affected and matched control households as a percentage of the square root of the average of the sample variances in the treated group. There are, however, a number of cases of angina (asthma)-affected households and controls with a low density for propensity scores, the implications of which were further explored in sensitivity analyses (see below).

Household economic burden of angina

Table 4 reports estimates of angina’s economic burden on households in Myanmar under alternative matching methods, namely PSM methods (nearest-neighbour, radius, kernel and stratification matching) and CEM. Per person OOP spending of angina-affected households was significantly greater than matched controls in the 4 weeks preceding the survey, ranging from US$3.67 to US$4.31 under different PSM methods and US$1.94 under CEM. Between 38% and 60% of this expenditure was accounted for by greater drug spending, across the various matching methods; drug spending per person was also greater in angina-affected households compared with matched controls by US$0.72–US$2.41. No statistically significant differences were, however, observed for OOP spending on hospitalization. Respondent employment was lower in angina-affected households relative to matched counterparts, by about 1–8% across the matching methods, but the estimates were mostly statistically insignificant. The estimates in Table 4 also suggest that households where the respondent reported angina incurred significantly higher levels of catastrophic spending than matched controls. An extra 6–7% of angina-affected households incurred catastrophic spending if we use the 20% threshold for the ratio of OOP health spending to total household spending and an extra 5–7% of angina-affected households incurred catastrophic spending if we use the 40% catastrophic threshold for the ratio of OOP health spending and household ‘capacity to pay’. Depending on the matching method used, the proportion of angina-affected households impoverished by OOP spending on health was 5–12% higher than matched controls. Finally, the proportion of angina-affected households reporting financing healthcare by borrowing or sale of assets was 12–14% greater than controls across the matching methods.
Household economic burden of asthma

Table 5 reports our findings on the estimates of the household economic burden of asthma under alternative matching methods. Across the different methods, asthma-affected households incurred an extra I$1.53–I$2.01 per person in OOP health spending relative to matched controls in the 4 weeks preceding the survey. The difference was driven mainly by OOP drug expenditure, which was higher in asthma-affected households by I$0.81–I$1.08 per person relative to matched controls. As in the case of angina, no statistically significant differences were observed in OOP spending for hospitalization between asthma-affected and matched controls. Asthma-affected households were 3–5% more likely to incur catastrophic spending compared with their matched controls when the catastrophic threshold of OOP was defined as 20% of the total household expenditure and by 2–4% when the catastrophic threshold was 40% of a household’s ‘capacity to pay’, although these were not always statistically distinguishable from zero at the 5% level of significance. Asthma-affected households were also 4–8% more likely to report medical impoverishment due to OOP. Respondent employment among asthma-affected households was between 8 and 14% lower than matched households. The proportion of asthma-affected households reporting either borrowing or asset sales to finance healthcare was 7–9% greater than of matched controls under PSM but small and statistically insignificant under CEM.

Sensitivity analyses

Common support and trimming

Our sensitivity analyses for common support involved re-estimating the household economic impacts of angina and asthma under alternative ‘trimming’ assumptions, ranging from dropping 1 to 10% of total treatment households that had propensity scores with a low density in the empirical distribution. The results of this analysis, which are summarized in Supplementary Appendix Tables A1.1–A1.16, show that trimming of the sample of angina (asthma-) affected households with low density propensity scores does not influence our findings on the magnitude of the estimated impacts and overall conclusions.

Figure 1 Distribution of propensity scores for angina-affected households and unmatched controls

Figure 2 Distribution of propensity scores for asthma-affected households and unmatched controls

The results of our sensitivity analysis for confounding by an unobserved binary variable are reported in Supplementary Appendix Tables A2.1–A2.16. Although we cannot directly test for the failure of the CIA, these results (shown for kernel and nearest-neighbour matching) suggest that an unobserved confounder with a distribution similar to that of the comorbidity indicator variable among respondents in our survey data will not affect our main conclusions. Specifically, to overturn our economic impact estimates of angina (in Tables 4 and 5) on total OOP spending (including on drugs), and borrowing and asset sales, the distribution of the unobservable would have to be such as to increase the odds of selection into the treatment group by a factor of 8 or more and the odds of having an outcome greater than the mean by factor of >11. To overturn findings for indicators of catastrophic spending, workforce participation and impoverishment effects require a distribution of the unobservable that increases the odds of selection into the treatment group by a factor of 5 or more and the odds of having an outcome greater than the mean by factor of >8. For asthma, our analysis indicates that with one exception (the impoverishment indicator), the odds of selection into treatment and into an outcome higher than the mean would have to be higher by 8 and 13 times, respectively, to overturn our findings for most outcome indicators under kernel matching. For nearest-neighbour matching, however, the threshold for the odds ratios is lower, roughly 4.5 for selection and 7 for outcomes. The impact estimates for the impoverishment indicator, however, appear quite sensitive to even a small change (due to the unobserved confounder) in the odds of selection into treatment and outcomes greater than the mean. We conclude that with the exception of impact estimates for impoverishment, our results are fairly robust to violations of the CIA of the type assessed in this article, given the fairly rich set of variables used to construct our propensity scores.

Discussion and conclusions

Our findings contribute to the limited literature that exists on the household economic implications of NCDs in developing countries, a major contributor to the GBD (Bloom et al. 2011).
Borrowing and selling assets to pay any OOP health spending as share of total OOP health spending as share of total OOP payments in our analysis. OOP payments were largely driven by payments for medicines, asthma are not associated with hospitalization expenses. Rather outpatient care. But increased OOP payments for angina and asthma are associated with a single binary unobserved variable.

Using multiple matching methods, our results suggest that chronic conditions such as angina and asthma are associated with a significantly higher economic burden on affected households in Myanmar relative to a set of closely matched control households. Moreover, our conclusions are mostly robust to sensitivity analyses that allow for varying the range of common support for matching and violations of the CIA associated with a single binary unobserved variable.

We find, firstly that the economic burden associated with angina (asthma) takes the form of increased OOP payments for outpatient care. But increased OOP payments for angina and asthma are not associated with hospitalization expenses. Rather OOP payments were largely driven by payments for medicines, which accounted for 38–60% of OOP payments in our analysis. Although we are unaware of any previous work on OOP spending by households on non-communicable chronic conditions in Myanmar, Lonnroth et al. (2007) estimated high levels of OOP spending on tuberculosis treatment in Myanmar, with 60% of all such expenditures being on drugs, comparable to our results. Multiple reports of the Ministry of Health describing the National Health Accounts of Myanmar also estimate shares of OOP spending on drugs (in total OOP spending) of the order of 50–55% during the period 2003–2010. This conclusion is not surprising given the limited government financing for healthcare in Myanmar and an absence of other mechanisms for health insurance, which has led households in Myanmar to rely on their own funds to pay for drugs and health services (Ministry of Health 2007, 2009, 2011).

Our analysis suggests that asthma in particular may be associated with lower household incomes. Although direct data on household earnings from work or income from assets were unavailable, we did find that employment among respondents with asthma was generally lower relative to matched controls by about 8–14%, which confirms findings from other studies for middle-income countries (Franco et al. 2009). All else the same, lower employment is likely to lower household incomes. We also found that households affected by angina relied more on borrowings or asset sales to finance their OOP healthcare spending than matched controls. To the extent that some of these may have been productive assets such as land, machinery or livestock, future household incomes could be adversely affected.

There are some limitations to our analysis. The analysis is limited to only the chronic conditions (angina or asthma and associated comorbidities) reported by the respondent. We could not get information on the health status of other household members and this could potentially influence our findings. If, for instance, some household members with angina (asthma) ended up in controls (due to being non-respondents), our estimates of the household economic burden could be biased towards the null. On the other hand, it is possible that individuals reporting angina/asthma may be more aware of their health or have worse health and more likely to seek care than average. In this case, there will be an upward bias in our measures of economic burden of angina/asthma. It is also possible that additional comorbidities of individuals reporting angina/asthma may not have been captured. But sensitivity analyses to assess the impacts of the CIA suggest that these biases may be insufficient to overturn our results.

Finally, our analysis is based on WHS data from nearly 10 years ago (2002). This appears not to be a serious concern given...
the low and fairly stable share of public and private spending on health in Myanmar (as a share of GDP) until fairly recently. OOP health spending as a share of total household expenditure has also remained unchanged over the last decade at about 6%.

Survey data also show that real aggregate household expenditure per capita also remained unchanged during 2004–2010, suggesting stagnant living standards [Ministry of National Planning and Economic Development (MNPED) 2007, 2011]. National Health Accounts data also show that the share of OOP spending allocated to drugs has remained stable at 50–55% over the last decade (Ministry of Health 2007, 2009, 2011). Data on individual drug price trends is unavailable, however, and given the absence of drug price controls in Myanmar and dominance of private pharmacies in drug retail, the economic burden associated with drug expenses for chronic conditions could have risen over time.

These limitations apart, we believe our analysis makes an important contribution to the policy challenges related to NCDs, including the appropriate allocation of health sector resources, in developing countries. Even for conditions that are ordinarily managed in outpatient settings—angina and asthma—we find that economic burden on households could be significant. In Myanmar’s case, this seems to be a direct consequence of limited public spending on health services. Our findings suggest a need for expanding spending on subsidised healthcare, including in outpatient settings for chronic care needs of Myanmar’s population. Recent efforts to expand healthcare services in Myanmar have included a Global Alliance on Vaccines and Immunization (GAVI) initiative and government budgetary allocation increases to health. The GAVI initiative, however, is intended to support inpatient care. Other new government programmes have focused on child and maternal health services. Our analysis highlights the need to include subsidized access to chronic care in outpatient settings and drugs.

Supplementary data

Supplementary data are available at Health Policy and Planning online.

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References


