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Assessing the Economic Impact of HIV/AIDS on Nigerian Households:

A Propensity Score Matching Approach

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Abstract

We assess the impact of HIV/AIDS on individuals' health care utilization and spending in the Oyo and Plateau states of Nigeria and income foregone from work time lost. Data was from a 2004 survey of nearly 1,500 households, including 482 individuals living with HIV/AIDS. Estimating the effect of HIV is complicated by the fact that our sample of HIV positive individuals is non-random; there are selection effects, both in acquiring HIV, and in being in our sample our HIV positive people, which was based on contacts through non-governmental organizations.

To overcome this selection effect, we compare HIV positive people with a control group with similar observed characteristics, using propensity score matching. The matched control group has very different health and economic outcomes than a random sample of the population indicating that our HIV sample would not have had "average" outcomes even if they had not acquired HIV.

HIV is associated with significantly increased morbidity, health care utilization, public health facility use, lost work time and increased time devoted to care-giving relative to outcomes in the control group. Direct health care costs and indirect income loss per HIV positive individual were 16,569 Naira, about 32% of annual income per capita in affected households. About 40% of these costs are income losses associated with sickness and care-giving. 15% of the cost of HIV is accounted for by public subsidies on health. The

largest single economic cost, representing 45% of the total economic burden of HIV, are out of pocket expenses, mainly for health care.

Key Words: HIV, Nigeria, Economic Impacts, Households, Direct Costs, Propensity Score

Introduction

The economic and social impacts of the HIV/AIDS epidemic have attracted much attention in recent years (Over 1992; Yamano and Jayne 2004). The available empirical literature on Africa highlights several forms in which HIV/AIDS affects households adversely. One implication of HIV/AIDS is reduced non-health consumption expenditures among household members (Bechu 1998; Booysen et al. 2002); another is reduced nutrition and educational attainment for children in affected households (Booysen et al. 2002; Donovan et al. 2003, Nampanya-Serpell 2000). A third effect is the reallocation of household efforts away from income earning activity to care-giving roles. These effects arise because of the necessity of incurring large expenditures on treating members and care-giving responsibilities with HIV, funeral expenses, and because premature mortality and morbidity among younger adult members potentially constitutes the loss of an earning member of a household, further coupled with a lack of adequate mechanisms to cope with these financial shocks (Barnett and Blaikie 1992; Yamano and Jayne 2004). These effects are likely exacerbated if drugs for treatment of HIV/AIDS are expensive, if public subsidies for care provision remain limited, or if health insurance is unavailable to affected households (Bloom and Glied 1993; Guinness and Alban 2000). In addition, there may be psychic costs associated with the death and illness of family members, breakup of families, or stigma associated with HIV (Bolton and Ndogoni 2001; Germann 2004).

With more than 5 percent of its adult population infected with HIV, the impact of HIV/AIDS on Nigerian households is of obvious policy relevance, although little is

empirically known about such effects thus far in that country. This paper contributes firstly, by filling this gap. Secondly, it makes a methodological contribution: to estimate the direct and indirect economic costs HIV/AIDS we need to compare observed health and economic outcomes with the outcomes we would expect in the absence of HIV. Canning et al. (2006) compare economic outcomes in households with an HIV positive member with a random sample of households. However being HIV positive is not random and may be correlated with confounding characteristics, which would themselves affect health expenditures and economic outcomes. This selection effect will be present in any survey; our survey has the further selection in that our sample of HIV-positive people is non-random, being based on contacts through non-governmental organizations.

We address this selection effect by creating a control group of individuals from our random sample. For each HIV positive person we find a control that has similar observed pre-determined characteristics. Assuming that, given two people with the same observed characteristics, being in our HIV-positive sample is random, we can find the economic impact of being HIV positive by comparing the outcome for each person with their matched control. Rather than match on every characteristic, we use the propensity score matching method (Rosenbaum and Rubin 1983) to match individuals, based on the fact that we need only match on characteristics that affect selection. Some researchers have attempted to circumvent this selection problem by focusing on the economic impact of adult mortality, without reference to HIV status (Yamano and Jayne 2004; Menon et al. 1998; Over et al. 2000) but this assumes the economic effect of HIV/AIDS is the same as for other causes of death. Others have relied on *ad hoc* matching of households

affected by HIV with those that are not, using some rule of thumb criterion (Booysen et al. 2002; Pradhan et al. 2006). The method used in this paper offers one systematic way to carry out such a matching exercise.

We find that our matched control group is quite different from our random sample of people, both in terms of their observed characteristics such as education level, age, and religion, and in terms of their health and economic outcomes. Matching to the control group therefore makes a significant difference to our estimates of the economic impact of HIV.

2. Sampling Procedure, Data and Methodology

We focused on the economic impact of HIV/AIDS on households in two Nigerian states – Oyo and the Plateau. Although accounting for only about 6.3 percent of the total land area of Nigeria, and a roughly similar share of its estimated total population of about 135 million in 2003, findings for these two states could offer insights for Nigeria, firstly because of geographical variation, with one located in the South-west of Nigeria, the other in Central Nigeria and considerable variation in terms of the ethnic composition of their population. Secondly, estimated adult HIV prevalence rates in the two states are not too far from the national average of about 5.6 percent: 3.9 percent for Oyo state, and 6.3 percent for Plateau State.

For the study, we sought to sample two types of households – "general" households; and households that were explicitly identified to have HIV-positive members. For better rural-urban representation of general households, our sample was

stratified into two urban and two rural local government areas (LGA) in each state. In choosing sample households within an urban LGA, we proceeded as follows. Residential areas were stratified by economic status – low, medium and high. Within each stratum, streets were randomly chosen, followed by a systematic selection of houses on the basis of the number of buildings in each street. Only one household within each identified building was sampled. Where more than one household lived in a building, selection was by ballot. For sampling rural households, a similar procedure was used, except that stratification of residential areas by living standards was not felt necessary, given the more economically homogeneous nature of the population. This sampling approach was adopted after attempts to use enumeration area maps of the National Population Commission (NPC) based on the previous (1991) census to guide the sampling process did not prove successful, being out of date. The survey was administered to respondents by first introducing the study to the heads of household and obtaining their verbal consent. Following consent, a trained enumerator proceeded to a structured questionnaire, filled out by household responses.

For households explicitly identified to have HIV-positive members, a different sampling strategy was pursued. Households of persons living with HIV/AIDS were sampled purposively, reflecting the limitations of a probability sampling approach in identifying a sufficiently large sample, given the unwillingness of infected persons to "self-identify." The research study was introduced to hospitals and NGOs working with people with HIV and the consent of eligible respondents was initially received verbally through the representatives of these organizations. Only after this were trained field

workers introduced to persons living with HIV and AIDS, at a location convenient to the prospective respondent. At the time of this introduction, the prospective respondents were again introduced to the objectives of the study and their consent obtained in writing. Due to limited NGO activities in rural areas, the majority of this population was identified from urban locations. Hospitals were the main entry point for rural locations.

A total of 1,481 households were sampled, 999 “general” households and 482 households that had an adult member explicitly identified with HIV. 353 households that had members with HIV were identified by the purposive sampling method; another 129 reported having HIV in questions relating to morbidity and hospitalization that were part of the questionnaire for general households. Based on these self-reported cases, about 4.1 percent of the sampled individuals in Oyo state, and 6.7 percent of the sampled individuals in Plateau state were HIV-positive, similar to official estimates.

The survey collected data on a variety of household- and individual level characteristics. This included demographic information on each household member, such as age, sex, marital status and relationship to head of household; and deaths that occurred in the household in the year preceding the survey. Information collected on socioeconomic characteristics of individual members and households included education status, literacy status, earnings, ethnic and work status, income from sources other than labour earnings, household expenditure, asset holdings and other indicators of living conditions. Apart from this socioeconomic and demographic information, we collected data on illness in the four weeks preceding the survey, hospitalizations and illness of duration exceeding 3 months in the year preceding the survey, the type of health facility

where treatment was sought, out of pocket health expenditures, transportation expenses linked to care, funeral expenses (in case of death), the length of time for which an individual was unable to perform normal activities, time spent in care-giving by non-ill members of the household and the way health spending was financed.

Methodology

We compared morbidity rates, hospitalization rates, inpatient stays, amounts spent out pocket for health care, work-time forgone by sick person, time spent by other household members in care-giving for sick individuals for individuals who were HIV-positive with those who were not. In this comparative assessment, some limitations are obvious from the self-reported nature of HIV data. It is possible that at least some individuals, who were actually HIV-positive, may not have known their status and were counted as HIV-negative in our survey. If HIV-positive individuals have higher rates of morbidity, or incur more expense on treatment than HIV-negative individuals, or require greater care, our analysis would tend to underestimate the adverse impacts of HIV.

The major worry, however, is that being HIV positive and in our sample is non-random and is correlated with other confounding characteristics of the individual. To address this concern, we used the propensity score matching method to generate a set of controls (self-reported HIV-negative individuals) corresponding to treatment cases (self-reported HIV-positive individuals). Specifically, individuals who are HIV-positive are matched to HIV-negative individuals with similar predicted probabilities (propensity score) of being HIV-positive, conditional on a set of observable characteristics.

The key assumption in this approach is that conditional on the propensity score, assignment to the treatment (HIV–positive) and control (HIV-negative) groups can be taken to be random (Rosenbaum and Rubin 1983). If this is the case, then the difference in outcomes between treatment and control groups can be directly compared to give the effect of "treatment". On test of this assumption is that conditional on the propensity score, the observable predetermined characteristics of the two groups have similar distributions (the balancing property). Even if the balancing property is satisfied we still have to assume that selection to the treatment group is not being carried out on the basis of unobservable characteristics that also affect our outcome variables.

We used four different procedures, all of which use propensity scores to assess "nearness" between control and treated cases: the stratification method, nearest neighbour method, radius method and the kernel method (Becker and Ichino 2002). These methods all yielded very similar estimates of the impact of HIV/AIDS on health care utilization, lost work-time and care-giving time and associated spending, we report the results for only the "nearest neighbour" method in this paper. The method essentially amounts to picking, for each treatment case, a control that has a propensity score closest to the treated case. Treatment cases and control cases were further restricted to common support; this eliminates cases in which the nearest neighbour may be quite far away. The "propensity score" on which these individuals were matched was constructed by a logit regression of treatment status (1 if HIV-positive, 0 if not) on observables that included age, sex, age-squared, rural origin, indicators of primary, secondary and higher levels of

education, the education of head of household, state of residence, indicators of religion and ethnicity.

Differences in morbidity rates, hospitalization rates, average lengths of inpatient stay, amounts spent out pocket for health care, time spent by other household members in care-giving for sick individuals and associated direct and indirect income losses provide only a partial view of the impacts of HIV on households. Some households can better access low interest borrowing and public (or private) subsidies that enable them to broadly maintain their consumption. Others may be forced to sell productive assets that may harm their long-term economic prospects. Thus, in our analysis, we compared the incidence of asset sales among households to which matched and treatment individuals belonged.

3. Findings and Discussion

Table 1 presents summary statistics (sample means) for three groups of individuals: individuals with HIV (treatment group), individuals without HIV who are matched to the treatment group under the nearest neighbour rule (the control group) and all individuals who are HIV-negative, irrespective of whether they satisfy the matching criterion. Notice that for our pre-determined variables; age, sex, religion, and ethnicity, there are considerable differences in the sample means of the treatment group (the column 1 in Table 1) with the unmatched group (column 3 in Table 1). However, once the nearest neighbour criterion is used to generate a matched set of controls, the sample means of the pre-determined variables of the matched control group, shown in column 2

of table 1 are considerably closer to those of the treatment (HIV-positive) group. It is in this sense that the propensity score matching approach mimics an experimental design.

When we consider outcomes of interest - morbidity rates, hospitalization rates, health expenditures and work time lost - the difference in sample means between the treatment and the matched control groups, with few exceptions, are large. This difference is due to the presence of HIV. Note that the outcome variables can be very different between the matched control group and the sample of all HIV negative individuals. This indicates that individuals with the same pre-determined characteristics as HIV-positive individuals are different from average.

Table 2 presents the logit-regression used to generate propensity scores used for matching controls to treated cases. The propensity score is the predicted probability of reporting HIV-positive, conditional on the full a set of pre-determined variables reported in Table 2, for each individual. The explanatory (pre-determined) variables used for this exercise did not include household incomes, household size, health expenditures, or asset holdings, since these are all variables that are likely to be influenced by HIV-status, leading to endogeneity and consequent bias in the coefficient estimates reported.

In general, results from the propensity score regression suggest that HIV prevalence rises with age at first and then declines. The peak age at which women are most likely to report themselves HIV-positive is about 6 years lower than for men. People in Oyo are less likely to be HIV positive, reflecting lower prevalence levels in that state. For women, primary and secondary school education appear to increase the risk of HIV while for men primary schooling increases the risk but post- secondary education appears

to lower it. Muslim men appear to be more likely to be HIV-positive while being in the dominant ethnic group lowers risk.

Table 3 presents our findings on the effect that HIV has on health outcomes, spending, work-time lost and time spent on care-giving, based on our sample of matched treated and control groups. Results are based on questions referring to the 4-weeks preceding the survey, or questions based on outcomes in the previous year. In general, the shorter time frame is to be preferred since there can be considerable lack of recall of events, and expenditure, over longer time periods. However some rare, but costly, events can occur, that will be infrequent in the last four weeks, and so subject to considerable random error, but more common using a one-year window.

Irrespective of the time frame considered, individuals with HIV report a greater incidence of morbidity, utilization of health services, out of pocket health expenses and care-giving hours than matched HIV-negative counterparts. For instance, HIV-positive individuals are likely to spend nearly 7,600 Naira extra from out of pocket than matched HIV-negative individuals and to spend an extra three days as an inpatient in a hospital over the last year. HIV-positive individuals also use greater amounts of both public and private health care services, but their utilization of public services is disproportionately larger. This is not surprising in light of the expense of treating health conditions associated with HIV/AIDS, particularly if ARV treatment is involved.

The findings of the previous paragraph translate into significant losses to households (and the government) in terms of direct medical care costs as well as incomes foregone by sick members and their caregivers. Table 4 presents estimates of what we

consider lower bounds to medical care expenses and income losses associated with illness in the treatment group, the matched control group, and the unmatched set of HIV-negative individuals. Specifically, our estimates focus on incomes lost in a given year and do not include any impact on future incomes lost due to premature morbidity and mortality among sick individuals. Despite this omission, the direct and indirect costs of morbidity associated with HIV/AIDS turned out to be remarkably large. Out of pocket expenses on health care by HIV-positive individuals were nearly double that of matched HIV-negative individuals and amounted to nearly 32 percent of the per capita income of the affected households.

Our analysis also confirms the relatively large burden imposed by HIV-positive individuals on household caregivers, as well as their considerable reliance on public subsidies. Because our calculations do not fully account for differences in the intensity of care received by HIV-negative and HIV-positive individuals at public facilities, if anything, our calculations in Table 4 underestimate the reliance of HIV-positive individuals on public subsidies.

Some of these lost incomes and health expenditures may, at least in theory, be recouped by allowances for sick leave, health insurance and reimbursements for health expenses by employers, or financial support from members of the extended family, or even the community at large. In practice, such support is very limited in Nigeria, particularly for people with HIV. Health insurance coverage is extremely rare and there is some evidence that employers discriminate against employees with HIV when it comes to benefits associated with illness (Canning et al. 2006). One can also imagine that

community and extended family support may be limited as well, for individuals with HIV, who tend to be stigmatized. For these reasons, the financial burden arising from direct and indirect costs is most likely to fall upon individuals with HIV and their families. Some support for this conclusion is provided an analysis of asset sales in response to illness that we carried out based on information collected in our household survey data. Specifically, we found that 9.9 percent of individuals in the treatment group had household members selling assets to finance ill health in the preceding year, compared to only 1.5 percent for individuals in the matched HIV-negative control group.

Except perhaps for the result on Muslim men in our propensity score regression, a finding that deserves further investigation in future work, the direction of our results is similar to those observed elsewhere in the literature. Pradhan et al. (2006), using an unmatched sample of HIV-negative individuals for India, found that health expenditures of households' with an HIV-infected member amounted to about 19 percent of their non-food spending, nearly three times the share of households without any HIV-positive members. Another study for South Africa used longitudinal data to compare households with HIV-positive members with their HIV-negative neighbours (Bachman and Booysen 2003), and found that HIV-affected households reported greater morbidity and utilization of public sector health providers. Similarly, Booysen et al. (2002) found that direct and indirect income losses from HIV/AIDS amounted to more than three times the average monthly income per capita of a household, also in South Africa. Studies by Menon et al. (1998), Mujinja and Over (1993) and Yamano and Jayne (2004) that focus on adult mortality among households in areas at high risk for HIV infection in Uganda, Tanzania

and Kenya, respectively, found a strong association between adult mortality, asset sales and income losses to households.

4. Conclusions

Much as in other countries of the sub-Saharan African region, HIV-affected households in Nigeria are likely to face serious economic challenges, when compared to their HIV-negative counterparts. These include the likelihood of substantial income losses, an increased burden of care-giving as well as out-of-pocket health care spending. Moreover, community and other sources of formal or informal insurance have limited scope, so that Nigerian households, like elsewhere in the developing world, will be forced to be self-reliant towards meeting their health care expenses, and/or income losses. These challenges will only become more serious as the HIV epidemic advances in Nigeria.

These findings must of necessity be tempered by the relatively small sized and geographically limited sample of households that we worked with. Our focus on only 2 out of the 36 Nigerian states (excluding Abuja) means that our findings may not readily carry over to other states. Moreover, the survey was undertaken over a period of one month during the month of May 2004, and one might raise questions about whether it appropriate captures seasonal biases, if such biases interact with HIV status. The lack of longitudinal analysis is another issue of concern. Future research must inevitably focus on addressing these methodological and coverage gaps relating to analyses for Nigeria, by extending these analyses to other states, correcting for seasonal biases, and undertaking longitudinal studies.

These limitations notwithstanding, our strong and consistent findings we report in this paper seem to us to provide a basis for some obvious directions for policy action, even if confined to Oyo and Plateau states. Increasing public sector access is obviously important, given other sources of formal insurance, including by employers and third-party insurers, appear to have limited coverage among people with HIV. Some combination of closer physical proximity to services, particularly subsidized access to ARV drugs and a better system for care and support for patients with HIV may well be crucial. Public subsidies may have to target these very services for improvement. Where a lack of information on the demand side precludes access to public/mission facilities by patients with HIV, increased coordination with traditional health care providers, witch doctors, and others in rural areas that often treat people with HIV may lead to more referrals to public facilities. Elements of the private sector could also be co-opted. Tax deductions could be provided to firms' expenditures on ARV and treatment for opportunistic infections for their HIV-positive patients and their family members.

Because income losses owing to the death or the loss of a job for the breadwinner are a crucial element in hardships faced by households, a second area for policy intervention is increased access of HIV-positive individuals to income generation schemes. Much can be learnt from the experience of successful microfinance institutions worldwide, particularly the Grameen Bank in Bangladesh, the Banco Sol in Bolivia and institutions in other African countries such as Benin and Ghana that have helped address the financial needs of poor entrepreneurs, including women (Basu et al. 2004, Gonzalez-Vega et al. 1997). Protection of existing assets of people with HIV is also obviously

important. Thus, better protection of the property rights of survivors, especially those with HIV+ parents also ought to be the subject of policy action.

Finally, Nigeria must actively foster HIV prevention programs. There is little doubt that prevention programs are much more cost-effective than implementing treatment strategies for HIV, as noted in a recent survey article by Canning (2006). Apart from being financially expensive and potentially unsustainable (in the absence of copious amounts of foreign aid), a large-scale expansion of treatment imposes significant burdens on the health systems of developing countries such as Nigeria, in terms of demands for scarce medical personnel, infrastructure requirements and management resources.

References

Max Bachmann, Frederick Booysen. 2003. "Health and economic impact of HIV/AIDS on South African households: A Cohort study" *BMC Public Health* 3:14.

Tony Barnett, Piers Blaikie. 1992. *AIDS in Africa: Its present and future impact*. New York: The Guilford Press.

Anupam Basu, Rodolphe Blavy, Murat Yulek. 2004. "Microfinance in Africa: Experience and lessons from selected African countries." Working paper number WP/04/174 Washington, D.C.: The World Bank.

Sasha Becker, Andrea Ichino. 2002. "Estimation of average treatment effects based on propensity scores." *Stata Journal* 2(4): 358-77.

Nathalie Bechu. 1998. "The impact of AIDS on the economy of families in Cote d'Ivoire: Changes in consumption among AIDS affected households." In Martha Ainsworth, Lieve Fransen and Mead Over (eds.) *Confronting AIDS: Evidence from the developing world*, Washington, D.C.: The World Bank.

David Bloom, Sherry Glied. 1993. “Who is bearing the burden of the AIDS epidemic in Asia?” In David Bloom and Joyce Lyons (eds.) *Economic Implications of AIDS in Asia* New Delhi: Oxford University Press.

Paul Bolton, Lincoln Ndogoni. 2001. “Cross-cultural assessment of trauma-related mental illness.” Draft Report. Baltimore, MD: Johns Hopkins University. http://www.certi.org/publications/policy/ugandafinahreport.htm

Frikkie Booysen, Dingie van Rensburg, Max Bachmann, Michelle Engelbrecht, Francois Steyn. 2002. “The socioeconomic impact of HIV/AIDS on households in South Africa” *AIDS Bulletin* 11(1).

Canning, David, 2006, "The Economics of HIV/AIDS in Low-Income Countries: The Case for Prevention", Journal of Economic Perspectives, Vol. 20(3), pp 121-142.

Canning, David, Ajay Mahal, Odumosu K, Okonkwo P. "The Impacts of HIV/AIDS on Nigerian Households," in AIDS in Nigeria: A Nation on the Threshold, edited by Adeyi O, Idoko J, Kanki PJ, Odutolu O., 2006, Harvard University Press, Chapter 9, pp 193-212.

David Canning, Ajay Mahal, K. Odumosu and P. Okonkwe. 2006. “The economic impact of HIV/AIDS on Nigerian firms.” In Olusoji Oadeyi, Phyllis Kanki, Oluwole Odutolu

and John Idoko (eds.) *AIDS in Nigeria: A Nation on the Threshold*. Cambridge MA: Harvard Center for Population and Development Studies.

Sanghmitra Das, Abhiroop Mukhopadhyaya, T. Ray. 2006. "Long run economic costs of HIV/AIDS in India." New Delhi, India: Indian Statistical Institute, Planning Unit.

Cynthia Donovan, Linda Bailey, Edson Mpyisi, Michael Weber. 2003. "Prime age adult morbidity and mortality in rural Rwanda: Effects on household income, agricultural production and food security strategies." Kigali, Rwanda: Ministry of Agriculture, Livestock and Forestry.

Stefan Germann. 2004. "Psychosocial impact of HIV/AIDS on children." *AIDS Bulletin* 13(2). http://www.mrc.ac.za/aids/june2004/impact.htm

Claudio Gonzalez-Vega, Mark Schreiner, Richard Meyer, Jorge Rodriguez-Meza, Sergio Navajas. 1997. "BancoSol: The challenge of growth for microfinance institutions." In Hartmut Schneider (ed.) *Microfinance for the Poor* Paris: Organization for Economic Cooperation and Development.

L. Guinness and Anita Alban. 2000. "The economic impact of AIDS in Africa: A review of the literature." UNAIDS background paper for the Africa Development Forum (ADF). Geneva: UNAIDS.

Rekha Menon, Maria Wawer, Joseph Konde-Lule, Nelson Sewankambo and Chuan Junli. 1998. "The economic impact of adult mortality on households in Rakai district, Uganda." In Martha Ainsworth, Lieve Fransen and Mead Over (eds.) *Confronting AIDS: Evidence from the developing world*, Washington, D.C.: The World Bank.

Phare Mujinja, Mead Over. 1993. "The impact of AIDS on health care utilization and expenditure by the fatally ill in northwest Tanzania." *International Conference on AIDS 1993 June 6-11*, 9(1): 126 (Abstract No. WS-D123-1).

Namposya Nampanya-Serpell (2000). "Social and economic risk factors for HIV/AIDS affected families in Zambia." Paper presented at the AIDS and Economics Symposium, Durban South Africa, July 7-8.

Mead Over. 1992. "The macroeconomic impact of AIDS in sub-Saharan Africa." Technical Working Paper #3. Washington, D.C.: The World Bank, Africa Technical Department.

Mead Over, Matthias Lundberg, Phare Mujinja. 2000. "Source of finance assistance for households suffering an adult death." Working paper no. 2508. Washington, D.C.: The World Bank (http://econ.worldbank.org/files/1320_wps2508.pdf)

Basanta Pradhan, Ramamani Sundar and Shalabh Singh. 2006. “Socioeconomic impacts of HIV/AIDS in India.” New Delhi, India: National Council of Applied Economic Research.

Paul Rosenbaum, Donald Rubin. 1983. “The central role of the propensity score in observational studies for causal effects.” *Biometrika* 70(1): 41-55.

Takashi Yamano, T.S. Jayne. 2004. “Measuring the impacts of working-age adult mortality on small-scale farm households in Kenya.” *World Development* 32(1): 91-119.

Table 1: Summary Statistics for Households reporting HIV-positive members (Treatment) and Households without HIV-positive members (Control)

Variable	Treatment Individuals (HIV+)	Matched Control Individuals (HIV-)	All HIV-Individuals
Explanatory Variables in Propensity Score regression			
Average age (in years)	39.65	39.41	28.19
Share of Males (%)	56.97	59.87	50.62
Rural Residence (%)	43.27	43.26	39.29
From Oyo State (%)	25.00	26.01	48.08
Completed Primary Only (%)	18.27	16.57	10.20
Completed Secondary Only (%)	26.20	32.00	22.94
Completed High School or Higher (%)	25.72	26.92	21.59
Proportion belonging to dominant ethnic groups	63.94	69.44	80.17
Share of Muslims (%)	22.12	19.02	23.99
Heads of Households that can Read and Write (%)	82.93	87.23	79.56
Outcome Variables			
Illness in Last 4 Weeks (%)	40.38	15.78	10.46
Hospitalization in Last 1 Year (%)	24.28	7.18	4.44
Major Illness in Last 1	42.55	12.65	7.31

year (%)			
Hospital Expenses in Last One Year (in Naira)	10,370	2,788	1,329
Health Care Expenses in Last 4 Weeks (Naira)	1,972	992	536
Work/Usual Activity Sacrificed in Last Year (in days)	15.01	3.68	1.30
Work/Usual Activity Sacrificed in Last 4 Weeks (in days)	2.25	0.95	0.38
Household Asset Index	-0.26	-0.25	-0.08
Household Size	5.73	7.08	7.23
Number of individuals	**416**	**656**	**6,460**

Source: Authors' calculations, using household survey data for Nigeria.
Note: Asset index was derived on the basis of principal component methodology. Dominant ethnic groups referred to 4 groups that comprised 78 percent of the sample households – Yoruba, Birom, Ngas and Igbo. The matched control group was generated by identifying the individual with the closest propensity score to the corresponding treatment case under the common support option [18].

Table 2: Propensity Score Regressions

Variables	Males	Females
Constant	-11.079** (0.852)	-10.461** (0.965)
Age (in years)	0.449** (0.042)	0.448** (0.053)
Age-Squared	-0.0047** (0.0005)	-0.0054** (0.0007)
Rural Dummy (Rural = 1, 0 otherwise)	-0.124 (0.157)	-0.167 (0.171)
State Dummy (Oyo = 1, 0 otherwise)	-1.292** (0.201)	-1.046** (0.216)
Dummy for Primary Schooling	0.473** (0.233)	0.458* (0.254)
Dummy for Secondary Schooling	-0.103 (0.223)	0.680** (0.218)
Dummy for Higher Education	-0.640** (0.213)	-0.040 (0.238)
Dummy for Religion (Muslim = 1, 0 otherwise)	0.709** (0.189)	-0.255 (0.245)
Dummy for Dominant Ethnic Groups (Yes = 1, 0 Otherwise)	-0.638** (0.175)	-0.425** (0.187)
Can Head of Household Read and Write? (Yes = 1, 0 Otherwise)	0.238 (0.213)	0.052 (0.220)
LR- Chi square (21)	**675.34**	
Number of Observations	**6,522**	

Source: Authors' estimates. *Note*: **statistically significant at the 5% level; *statistically significant at the 10% level.

Table 3: Effect of HIV-positive status on Morbidity, Hospitalization, Health Spending, Loss of Usual Activity and Care-Giving among matched *Individuals*

Indicator	Number of Treated	Number of Controls	Average Treatment Effect	t-statistic
Last 4 Weeks				
Morbidity rate (percent)	416	656	24.60	7.99
Inpatient stays (percent)	416	656	4.20	2.58
Inpatient days (in days)	416	656	0.48	2.75
OOP health expenses (Naira)	416	656	980	1.69
Lost work time/usual activity for sick person (in days)	416	656	1.36	4.28
Whether public health facilities used? (percent)	416	656	12.80	5.52
Whether private health facilities used? (percent)	416	656	12.70	5.30
Major Illness in Last One Year				
Inpatient stays (percent)	416	656	17.10	6.89
Inpatient days (in days)	416	656	2.70	4.11
Incidence of major illness (percent)	416	656	29.90	10.21
OOP health expenses (Naira)	416	656	7,582	3.40
Lost work time/usual				

activity for sick person (in days)	416	656	11.33	4.64
Daily hours of care-giving for sick person when ill (hrs)	416	656	1.06	8.51
Public facilities used (percent)	416	656	17.40	7.49
Private facilities used (percent)	416	656	7.10	3.60

Source: Authors' estimates using nearest neighbor (random matching) method.

Table 4: Annual Direct and Indirect Income Losses from Ill Health (in 2004 Naira)

Individual Type	Out of Pocket Expenses	Public Subsidies	Lost income from work (ill person)	Lost income (caregiver)	***Total Loss (Direct + Indirect)***	***Household Annual Income per capita***
HIV-positive	16,806	2,578	10,230	2,762	***32,375***	***51,415***
Matched HIV-negative	8,824	321	6,041	620	***15,806***	***89,715***
All HIV-negative	3,853	281	2,578	91	***6,802***	***93,375***

Note: These estimates are for matched treated and control cases, as well for the entire HIV-negative population. *Out of pocket expenses* are primarily payments made for receiving care. These are estimated by adding annual hospitalization expenses to 12 times the out of pocket spending on outpatient care in the last 4 weeks. A small portion (in per capita terms) of these expenditures is due to funeral expenses. *Public subsidies* are calculated by multiplying utilization (of inpatient days and outpatient visits) public sector of matched HIV-positive and HIV-negative individuals by the cost of a single inpatient day and outpatient visit in the public sector (because user fees are negligible). To obtain unit costs, we divided annual total public sector expenditures for curative care (as reported for Oyo state) by a weighted sum of estimated inpatient days and outpatient visits (assuming each outpatient visit costs about one-seventh of an inpatient day), using per capita utilization estimates from out household survey and population estimates from the National Population Commission of Nigeria. Our estimated unit subsidies are Naira 139 per outpatient visit and Naira 976 per inpatient day; *Lost income/usual from work for ill person* was estimated by multiplying days lost from the survey by a daily wage

imputed (those for whom wage data were unavailable) by regressing the log of daily wage on a collection of explanatory variables such as educational status (primary, secondary, or higher education), experience and experience-squared, sex, ethnicity, state of residence and religion; Lost income from care-giving was estimated similarly.