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Economic Effects of Non-Communicable Diseases on Household Income in Kenya: A Comparative Analysis Perspective

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Abstract ***Introduction*:** Non-Communicable Diseases (NCDs) have been on the increase in Kenya over the past decade. This rising trend has led NCDs to account for over 30% of the annual total disease-related deaths in the country. Between 2005 and 2009, major NCDs (cancer, cardiovascular diseases, respiratory ailments and diabetes) accounted for over half of the top 20 causes of disease-related deaths in Kenya. The high expenditures for managing NCDs expose households to risks of financial catastrophe and poverty. ***Methodology*:** The paper has adopted an econometric method to investigate the effects of NCDs on household income in Kenya. Further, the paper establishes the comparative analysis of NCDs with illnesses due to communicable diseases (CDs) in order to argue for the potential effect of NCDs, relative to other illnesses, on households' income. Sample design and possible heterogeneity arising from unobserved households' characteristics correlated with household income levels has been addressed. To achieve this, Kenya Household Health Expenditure and Utilization Survey of 2007 data is utilized. ***Findings, Conclusions and Policy Recommendations*:** The key finding is that, while general ailments reduce household income by 13.63%, NCDs reduce household income by 28.64%. NCDs are associated with a 23.17% reduction in household income relative to a household affected by communicable disease. Another key finding is that, although all types of ailments have negative effects on household income and welfare, NCDs have more severe impacts. The key policy recommendation is for the government to put in place a health financing strategy for NCDs, and especially one that subsidizes the cost of care and treatment of NCDs.

Keywords Non-Communicable Diseases (NCDs), Catastrophic health expenditures, Household impoverishment

1. Introduction

Non-Communicable Diseases (NCDs) are increasingly posing a major healthcare challenge in middle and low income countries just like it had been in high developed countries. Communicable diseases were the main causes of death around the world when life expectancy was often limited by uncontrollable epidemics for centuries. Medical research successes in vaccines and antibiotics, tied with improvements in living standards have ushered in a new dawn of managing communicable diseases [1, 2]. Even though communicable diseases such as malaria, pneumonia, diarrhoea and peri-natal complications continue to threaten healthcare management systems in developing countries, predictions show that at least 7 out of 10 deaths in developing countries by 2020 will be related to NCDs [3]. As observed, developing countries are currently facing a twin challenge of controlling both communicable and non-communicable diseases with limited resources [4]. For example it is notable that in 2005 NCDs accounted for 60% of all deaths and 47% of global burden of disease [5].

Although NCDs in Kenya are becoming more prevalent, the population as well as the government lacks adequate awareness and knowledge on the impact and control channels of NCDs [2]. The key NCDs can be grouped into malignant neoplasm (cancer), cardiovascular attacks, respiratory ailments and diabetes. They are together responsible for most of disease-related deaths in Kenya [4]. The Global Medicine [6] also found that most NCDs in Kenya are detected late due to lack of awareness, and this makes their treatment very costly. The implication is that, given that only about 6% of Kenyan population has a form of health insurance, a large population is at a big risk of catastrophic health expenditure (Mwai., and Muriithi, [38]). Despite this, it is evident that Kenya is yet to prioritize prevention and control of NCDs, as noted in its Vision 2030. This low prioritization, or lack of it, is partly due to lack of empirical understanding on the impact of NCDs on individuals and households [4, 7, 8, 9].

Several studies done on the costs of treatment and care have shown that NCDs emaciates disposable incomes thus,

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leaving families with less to use on other critical needs such as food and education [10-14]. It is also notable that NCDs eat into a household's current income and reduces the future productivity of the patients [15]. For developing countries, challenges in accessing drugs for NCDs are piling, with the cost of medicine accounting for at least half of the out-of-pocket (OOP) spending for the majority of the households [16]. In India, on the other hand, it was observed that at least 25% of people hospitalized over chronic diseases usually end up poorer, and in most cases end up with huge debts [17].

The aim of this paper is thus to explore the effects of NCDs on household's income in Kenya by means of an econometric approach that controls for endogeneity and heterogeneity estimation problems.

2. Methodology and Data

2.1. Analytical Framework

The framework begins with a straightforward household utility maximizing model developed by Becker [18, 19]. The unitary household model of consumer behaviour assumes that a household behaves as if it maximizes a sole price-independent social benefit function subject to a family budget restriction [20]. Household choices are determined jointly, implying that household members have identical preferences, or that within a household there is a single decision maker who makes choices for the entire household. The choices maximize utility of all the household members and satisfy the Beckerian notion of caring [20]. Equation 1 shows that household members whose characteristics are given by h are said to derive benefit from the consumption of goods C. Total household income Y is the sum of incomes earned by each household member (labour income, $l_i w_i$ and non-labour income, y_i), and the income earned by the household members jointly, y_j, [20]. Hence, a household with members $i \in \{1, 2...n\}$ is faced with the following utility maximization problem:

$$MaxU = u(c,h) \text{ subject to } Y = \sum_{i=1}^{n} l_i w_i + \sum_{i=1}^{n} y_i + y_j \quad (1)$$

Following Gravelle and Rees [21] on duality, household demand or consumption decision can be articulated in terms of expenditure or cost function that specifies the money needed by a household to maximize its utility. Assuming that the influence of household characteristics on income is the same across all households, then household income is a function of a series of household characteristics (h) such as age, household size, gender of the household head and epidemiological environment such as prevalence of NCDs (ncd) or sickness (S).

2.2. Estimation Technique

The paper estimated the impact of sickness on household income regardless of the disease type -whether NCD or CD. This was followed by an estimate of an income equation from a sub-sample of households reporting being healthy and those reporting an NCD. Thirdly, we estimated the income equation from a sub-sample of households affected by NCDs and those affected by CDs. The essence of using three sub-samples was to determine whether the effects of NCDs differ significantly between households without any illness, households afflicted by NCDs, and households affected by communicable diseases (CDs).

This study assumed that changes in household income are accounted for by its characteristics, the epidemiological environment, and institutional factors such as education. Following Gravelle and Rees [21], Kioko [22], Mwabu [23, 24], Wooldridge [25, 26], and Laxmanayan [27], and with appropriate modifications, this paper examined the effect of sickness (S) and NCDs on household income by estimating equation 2 and 5.

$$\ln Y = a_1 S + \sum_{j=2}^{n} a_j h_j + \varepsilon_1 \quad (2)$$

$$s = \sum_{i=1}^{n} b_i h_i + \varepsilon_2 \quad (3)$$

Where ln$Y$ is log of household income, s is sickness variable that captures the presence of a disease in a household regardless of type, and h_j is a vector of exogenous variables while h_i is a vector of exogenous variables consisting of instrumental variables that affect sickness, but have no significant effect on household income. It is also notable that h_i are covariates belonging to the income and sickness equations. The notations a_1, a_j and b_i are parameters to be estimated as ε_1 and ε_2 are the disturbance terms.

$$\ln Y = c_1 ncd + \sum_{j=2}^{n} c_j z_j + \varepsilon_a \quad (4)$$

$$ncd = \sum_{i=1}^{n} d_i z_i + \varepsilon_b \quad (5)$$

Where lnY in equation 4 is the log of household income as defined earlier, ncd is a variable for epidemiological environment (presence of a non- communicable disease), and z_j is a vector of exogenous variables that are instrumental for NCDs.

While estimating household income equations 2 and 4, endogeneity was a possible problem arising from bi-directional causality between household income and sickness. The endogneity problem can be assumed to occur due to bi-directional causality where though NCD can reduce household productivity and income, an increase in income increases the probability of a household developing an NCD

in spite of income increasing the household's ability to seek prompt treatment or to take on preventive measures.

The paper has assessed the validity of the instruments [28, 29] and used distance to the nearest health facility as the instrument for NCD and general sickness. The problem of heterogeneity, was addressed by use of control function approach [30]. Control function approach involves adding interaction terms of the variables of interest (sickness and NCD) and their relevant residuals in the second step regression. The interaction term controls for the interaction effects of the unobserved factors on explanatory variables [3, 32].

2.3. Data Source

The data is sourced from a cross-section survey that was conducted under the 2007 Kenya Household Expenditure and Utilization Survey (KHHEUS). The design of the survey is discussed in KHHEUS 2007. KHHEUS gathered information on a wide range of socio-economic indicators which were intended to monitor, analyse and measure the development made in improving living standards. The sample comprised of 8,844 households of which 6,072 were rural and 2,772 were urban. A response rate of 96 per cent was achieved meaning 8,453 household were successfully interviewed. From the 8,423 households, 39,798 individuals were interviewed. The survey covered all the eight provinces in Kenya with a total of 737 clusters selected and divided into 506 rural and 231 urban. Appendix Table A1 provides the sampling design.

Table 1. Estimates of the impact of sickness on household income

Dependent variable is log of household income	**Estimation methods**		
Explanatory Variables	**OLS (1)**	**IV (2)**	**Control function approach (3)**
Sickness	-0.0503* [0.0503]	-0.1363** [0.0493]	-0.0851** [0.0050]
Urban	0.0276*** [0.0051]	0.0278*** [0.0051]	0.0276*** [0.0051]
Age	0.0014* [0.0006]	0.0014*** [0.0005]	0.0011** [0.00057]
Age squared	-0.0366** [0.0075]	-0.002** [0. 0086]	-0.0034** [0.0061]
Household size	0.0028)*** [0.0009]	0.0017 [0.0010]	0.0044*** [0.0012]
Log years of experience	0.2754*** [0.0151]	0.2821*** [0.0156]	0.2761*** [0.0151]
Log years of experience squared	0.0391*** [0.0008]	0.0387*** [0.0009]	0.0390** [0.0008]
Working status household head	0.0104* [0.0062]	0.0102* [0.0063]	0.0093 [0.0062]
Years of schooling	-0.0005 [0.0005]	-0.0008 [0.0005]	-0.0001 [0.0006]
Married	0.0133* [0.0046]	0.1342** [0.0051]	0.0113* [0.0056]
Male	0.0029 [0.0041]	0.0005 [0.0045]	0.0074 [0.0048]
Sick residual			-0.1586** [3.2523]
Sick*residual			0.2460*** [0.0707]
Constant	3.2856*** [0.0689]	3.2725*** [0.0697]	3.2523*** [0.0697]
Durbin Wu – Hausman		3.1018*	
R-squared	0.0915	0.0910	0.0916
Sample size	26,624	26,624	26,624

*Source: Author's computation. Note: ***, ** and * show significance at 1%, 5% and 10% level, respectively. Standard errors are in parenthesis*

2.4. Ethical Consideration

The data used in this study did not require any field work for it is derived from a survey conducted by Kenya National Bureau of Statistics (KNBS), which is a national body bestowed with the responsibility of conducting national surveys on living standards in the country. Thus we did not require an ethical letter or any other form of permission for using this data, since it is available on request from the Ministry of Planning, or the Kenya National Bureau of Statistics.

3. Discussion of Results

3.1. Descriptive Statistics

Descriptive statistics are presented in Appendix Table 2. The respondents in the survey had a mean age of 29.42 years. Their average schooling was 7.49 years, and the average household size was 5.21 persons. About 39.39% of the respondents were married, and 21.09% of household heads were working. About 35% of the households reported illness, with about 12% of the sick suffering from NCDs.

The results further shows that the majority (71.67%) of the households were residing in rural areas. The mean log of the household income was 8.74. Household members on average travelled a distance of about 1.44 kilometres to access health services from the nearby health facility. There was a marginal difference in the number of male and female in the survey, with 44.32% of the respondent's being male and 55.68 being female.

3.2. Regression Results

In interpreting the results, we note that coefficients of variables in semi-logarithmic functions are interpreted as percentage effects by multiplying the coefficients by 100. But this is only correct for continuous variables. Results would be misleading for dummy variables. To resolve the problem, our results were interpreted following the approach suggested by Halverson and Palmquist [33], where the relative effect of a dummy variable is expressed as $\exp(\beta)-1$, and the percentage effect is $100*\{\exp(\beta)-1\}$.

The estimated individual models explaining the impact of sickness and NCDs on household income are presented in Tables 1, 2 and 3. The table presents the results with and without controls for endogeneity and heterogeneity problem. For all models, controlling for endogeneity and heterogeneity problem has some marginal impact on the betas and levels of significance of some variables.

3.2.1. Impact of Sickness on Household Income

The results indicate that sickness was a significant determinant of household income, and that its effect is negative.[1] The income of a household afflicted by sickness is 8.89% lower than for a household free from sickness. In addition, the coefficient on sickness residual is statistically significant, confirming that the sickness is endogenous. These results are consistent with other in the literature [23, 35, 36] who found that households derive disutility from sickness. Other factors found to be key determinants of household income include area of residence, marital status, household size, work experience, age and age squared.

Living in Urban relative to rural area has a significant and positive effect on household income. Households residing in urban areas have 3.04% higher income compared to those living in rural areas. Marital status is significantly and positively associated with household income. Households with husband and wife have 1.15% higher income compared to a single person's household. Married individuals often receive spousal support, and this has positive effects on household income.

Work experience as measured by the number of years a person has worked in a certain job is positive and highly significant in the three models. This suggests that work experience increases household income by 27.61%.

3.2.2. Impact of NCDs on Household Income

Based on control function approach estimations in Table 2, reduction of income due to NCDs is higher relative to those with no illness. NCDs are associated with a 33.16% reduction in household income.

This is higher than the 8.89% reported in Table 1 column 4, implying that NCDs are associated with higher welfare losses.

The results are consistent with those of Brummet *et al* [37], which conclude that sickness through NCDs reduce household income significantly. This is explained by lowered earnings occasioned by lower productivity, which is a precipitation of a prolonged care and treatment period associated with NCD.

3.2.3. Impact of Communicable and NCDs on Household Income

Table 3 provides the estimates of NCDs on household income relative to other illnesses. The results discussed are obtained from a sub-sample of households that reported illness. The results from the control function show that the coefficient of NCD is negative and significant. The incomes of households with an NCD case are 26.07% lower than households with a communicable disease. This indicates that the loss in household income due to NCDs is greater relative to losses from communicable diseases. This could be attributable to the high treatment cost of NCDs, as well as lost labour hours by household members offering care to the affected member(s) of the society. This supports the notion that some communicable diseases such as common flu require non-expensive care to treat as opposed to common NCDs such as diabetes or high blood pressure.

1 Halverson and Palmquist (1980) suggested a transformation of dummy variable where the relative effect of a dummy variable is expressed as $\exp(\beta)-1$, and hence the percentage effect is $100*\{\exp(\beta)-1\}$.

The three sub-samples point out that poor health lowers household productivity and income. Households affected by sickness of any type have lower incomes relative to disease-free households. Further, the results illustrate that although ill health lowers household income, in general households afflicted by NCDs experience greater income loss relative to households reporting general illnesses.

4. Conclusions and Policy Recommendations

Currently NCDs is the leading causes of morbidity and mortality in Kenya. Their draining effect on financial and time resources has adversely affected household income and welfare. From the estimates, although all types of sickness have depressing effects on income and welfare of the household, NCDs have more severe impacts.

It is notable from this study that health expenditure on NCDs has significant economic losses and poverty impact on households in Kenya. The study proposes that the government, development partners and other key stake holder in health sector put in place measures to halt the rising prevalence of NCDs. One such measure is putting in place a health financing plan through health insurance (*See* Mwai., and Muriithi, [38]), and resource pooling as a route towards social protection.

Education which was found to be inversely related with NCDs is another policy dimension that can be considered. Improvement in the level of education in the public could decrease the households' risk of developing an NCD. The Government of Kenya needs to set aside a budget for country-wide campaigns to increase awareness on NCDs risk factors and early detection of symptoms with a view to reducing mortalities and costs associated with NCDs.

Table 2. Estimated effect of NCDs on household income using a data sub-sample of households reporting NCDs and those without any illness

Dependent variable is log of household income	**Estimation Methods**		
Explanatory Variables	**OLS (1)**	**IV (2)**	**Control function approach (3)**
Non-communicable diseases	-0.1533** [0.0075]	-0.1247** [0.0538]	-0.2864*** [0.0504]
Urban	0.0339*** [0.0053]	0.0361*** [0.0062]	0.0331*** [0.0053]
Household size	0.0360*** [0.0009]	0.0047* [0.0019]	0.0032** [0.0009]
Log years of experience	0.2901*** [0.0160]	0.2849*** [0.0178]	0.2867*** [0.0161]
Log years of experience squared	0.0383*** [0.0008]	0.0384*** [0.0009]	0.0385*** [0.0009]
Working status of household head	0.0032 [0.0064]	0.0049 [0.0133]	0.0066 [0.0065]
Years of schooling	0.00132 [0.0008]	0.0002 [0.0005]	0.0001 [0.0005]
Married	0.0140** [0.0050]	0.0036 [0.01576]	0.0176*** [0.0054]
Male	0.0046 [0.0043]	0.0088 [0.0078]	0.0027 [0.0044]
NCD residual			0.0605** [0.0362]
NCD* residual			0.0914** [0.0734]
Constant	3.214*** [0.0731]	3.2301*** [0.0773]	3.2349*** [0.0735]
Durbin Wu – Hausman		1.5039**	
R-squared	0.0913	0.0844	0.0954
Sample size	23,442	23,442	23,442

*Source: Author's computation. Note: ***, ** and * represent significance at 1%, 5% and 10% level, respectively. Standard errors are in parenthesis*

Table 3. Estimated impact of NCDs on household income using a sample of households reporting sickness

Dependent variable is log of household income	**Estimation methods**		
Explanatory Variables	**OLS (1)**	**IV (2)**	**Control function approach (3)**
NCD	-0.1669* [0.0100]	-0.2138** [0.3341]	-0.2317*** [0.0360]
Urban	0.0143 [0.0120]	0.0102 [0.0140]	0.0141 [0.0120]
Household size	0.0028 [0.0022]	0.0032 [0.0024]	0.0031 [0.0021]
Log years of experience	0.5742*** [0.0409]	0.5954*** [0.0499]	0.5655*** [0.4108]
Log years of experience squared	0.0248** [0.0220]	0.0244*** [0.0250]	0.0254*** [0.0220]
Working status of household head	0.0035 [0.0124]	0.034 [0.0325]	0.0128 [0.0128]
Years of schooling	0.0063 [0.0010]	0.0018 [0.0016]	0.0012 [0.0010]
Married	0.0169* [0.0100]	0.0601* [0.4317]	0.0277* [0.0113]
Male	0.0055 [0.0102]	0.0003 [0.0125]	0.0038 [0.0103]
NCD residual			0.1451** [0.0485]
NCD* residual			0.1237** [0.0625]
Constant	1.6686*** [0.1880]	1.7204*** [0.2168]	1.8510*** [0.1893]
Durbin Wu – Hausman		1.3427**	
R-squared	0.0907	0.0884	0.0902
Sample size	5,375	4,956	4,944

*Source: Author's computation. Note: ***, ** and * represent significance at 1%, 5% and 10% level, respectively. Standard errors are in parenthesis while the rest are coefficients. OLS are the ordinary Least Square while IV stand for Instrumental variable approach*

Appendix

Table A1. Distribution of clusters and household by province and place of residence, 2007

Cluster				**Household**		
Province	Rural	Urban	Total	Rural	Urban	Total
Nairobi	0	90	90	-	1,080	1,080
Central	82	18	100	984	216	1,200
Coast	53	37	90	636	444	1,080
Eastern	85	15	100	1,020	180	1,200
North Eastern	34	11	45	408	132	540
Nyanza	82	18	100	984	216	1,200
Rift Valley	98	21	119	1176	252	1,428
Western	72	21	93	864	252	1,116
Total	506	231	737	6,070	2,772	8,844

Table A2. Descriptive statistics of variables included in the income equation

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Log of household income (Dependent variable)	37,981	8.7437	1.1159	0	15.3853
Region (urban=1)	37,996	0.2833	0.4506	0	1
Household size	37,981	5.2117	2.398	1	15
Age	37,509	29.416	22.9161	15	108
Age squared	37,509	1390.38	1721.613	0	1,1664
Log years of experience	37,992	2.802	1.1615	0	4.3171
Log years of experience squared	37,992	4.7508	1.2131	0	6.6374
Working status of head	37,981	0.2193	0.4138	0	1
Years of schooling	26,764	7.4886	4.7213	0	29
Married	37,509	0.3939	0.4886	0	1
Male	37,996	0.4432	0.4968	0	1
Distance to nearest health facility	19,794	1.4443	1.0403	0	6.6859
Sickness	37,996	0.3545	0.4784	0	1
Chronic illness	37,397	0.1227	0.4784	0	1

Source: Author's computation

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