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The Indirect Cost of Disability Adjusted Life Years Lost among the Elderly in Kenya

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Abstract

Background: As Kenya accelerates the momentum to attain the Sustainable Development Goals (SDG) 3 on health and 13 on combatting impacts of climate change, it is critically important not to overlook their impacts on the elderly, i.e. people aged 60 years and above (elderly). The objective of this study was to estimate the indirect cost (productivity losses) of disability-adjusted life years (DALYs) lost among the elderly in Kenya in 2015.

Methods: The indirect cost associated with j^{th} disease (or health condition) DALYs lost among the elderly is the product of the per capita non-health GDP in purchasing power parity (PPP) and the total j^{th} disease (or health condition) DALYs lost in a specific age group. Per capita non-health GDP equals Kenya's per capita GDP minus total health expenditure in 2015. The study covers all the diseases and health conditions reported in WHO Global Health Observatory (GHO). The data on DALYs and per capita total health expenditure were obtained from WHO GHO; while per capita GDP data was from IMF World Economic Outlook database.

Results: About 2,238,004 DALYs were lost among the Kenya's elderly in 2015. That health loss resulted into a total indirect cost of Int$ 7,088,274,986; which was evenly distributed among males and females. Approximately, 64.1% of the indirect cost resulted from non-communicable diseases, 29.3% from communicable and nutritional conditions, and 12.2% from injuries. If Kenya is able to fully achieve SDG targets 3.1 on maternal mortality, 3.3 on communicable diseases, 3.4 on NCDs and 3.6 on road traffic accidents by 2030, that would lead to a reduction of 625,238.21 DALYs (38.4%) lost among the elderly, which is equivalent to a saving of Int$ 1,986,641,742 (44.9%) in indirect costs (productivity losses).

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Conclusions: Kenya incurs every year substantive productivity losses due to morbidity and premature mortality among the elderly. Therefore, there is need for increased government, private sector and development partner's investments into health and wellbeing of the elderly to prolong their intrinsic and functional capacities.

Keywords
Elderly; Indirect Cost; Productivity Loss; Disability-Adjusted Life Year (DALY).

Background

Kenya is one of the five East African Community (EAC) countries. In 2015 it had an estimated population of 46,034,000 people; which was about 4% of Africa's population. About 1,921,000 (4%) of Kenya's population was 60 years and above, i.e. the elderly [1]. Sixty-five percent of the elderly were aged 60 to 69 years and the remaining 35% were aged 70 years and above. Sixty-seven and 33% of the elderly were female and male respectively. The World Health Organization (WHO) projects that the number of people aged 60 years (or over) in Africa will increase by 3.2 fold between 2015 and 2050; meaning that Kenya will have approximately 6.2 million elderly people by 2050.

During the same year there occurred a total of 317,173 deaths from all causes in Kenya; which was 3% of deaths borne by Africa [2]. Approximately 93,693 (30%) of Kenya's deaths were among the elderly; 33% among 60-60 year olds and 67% among 70 years and above. Fifty-one percent of the deaths were female.

Kenya incurred a total loss of 21,854,898 disability-adjusted life years (DALYs) from all causes in 2015, i.e. 3.1% of Africa's loss [1]. About 2,238,004 (10.2%) of the DALY loss occurred among the elderly; of which half were among those aged 60-69 years and other half among 70 years and above. Again almost 51% of the DALY loss was incurred by females.

The disability-adjusted life years (DALYs) losses are attributable to three very broad causes [1]. First, 656,637 (29.3%) of the DALY lost in 2015 were caused by communicable, maternal, perinatal and nutritional conditions. Second, 1,434,494 (64.1%) were from non-communicable diseases. Lastly, 146,873 (6.6%) were from intentional and unintentional injuries. Thus, it is clear that majority of health problems of elderly persons are inextricably linked to chronic non-communicable diseases.

According to WHO most of the chronic NCD conditions can be prevented or delayed by healthy behaviours, including physical activity, stoppage of substance abuse (including alcohol and tobacco consumption), and good nutrition. WHO adds that if declines in functional capacities are detected early, supportive environments can ensure that concerned elderly persons can enjoy dignified lives and continued personal growth [3].

The Kenya National Commission on Human Rights report entitled 'Growing old in Kenya: making it a positive experience' alluded in 2009 that: "There is no adequate recognition within government policies and practices of growing old as a process that has to be factored in both planning and resource allocation; and policies in critical sectors such as health, housing, employment and social protection are not old age focused (p.VIII)" [4].

The 2010 Kenya Constitution article 57 stipulates that "The State shall take measures to ensure the rights of older persons (a) to fully participate in the affairs of society; (b) to pursue their personal development; (c) to live in dignity and respect and be free from abuse; and (d) to receive reasonable care and assistance from their family and the State" [5]. In 2014, the current Kenya Government

published a national policy on older persons and ageing with 10 thematic areas: older persons and the Law; poverty and sustainable livelihood; health, HIV and AIDS: family; community and culture; food security and nutrition; infrastructure; housing and recreational facilities; education, training and ICT; employment and income security; social protection and services and cross cutting issues [6]. The Government is rolling out a social protection fund which was envisaged in its 2030 vision [7]. The 2014 national health policy makes a commitment to define a health service package and delivery system for elderly (60 years and over), among others [7].

In 2007 the Government of Kenya started Older Persons Cash Transfer (OPCT) programme targeting poor households with at least one member above the age of 65 years. In the Financial Year 2015/2016, the total number of beneficiaries were 325,000 and received Ksh. 2,000 per household every two months [8]. They were also registered with National Hospital Insurance Fund (NHIF). The cash transfers and the health insurance are expected to cushion the recipient from vagaries of nutrition related deficiencies, and thus, improve quality of their lives. Inspite of these recent positive steps by the Kenyan government, there still exists large unmet need for social and financial protection among the elderly in Kenya.

The ushering of the United Nations Sustainable Development (SDG) Goal 3 - To ensure healthy lives and promote wellbeing for all at all ages through universal health coverage including financial risk protection – provides a good opportunity for Kenya to mount a comprehensive multi-sectoral action to create enabling healthy ageing policies in all sectors; food, nutrition, education (life-long learning), health and economic security systems, and physically secure and healthy living environments that will enable elderly citizens to restore, sustain and/or improve their intrinsic capacities and functional abilities [9, 10].

There is urgent need for information on the productivity losses associated with DALYs lost among the elderly for use by relevant government Ministries and civil society organizations to advocate strongly with the Ministry of Finance and development partners for increased investments into health and general socioeconomic welfare of the elderly.

This paper answers the question: What is the indirect cost of DALYs lost from all diseases and health conditions among the elderly in Kenya? The objective was to estimate the indirect cost of DALYs lost among the elderly people in Kenya in 2015.

Methods

Framework for Estimating Indirect Cost Associated with 2015 DALYs Lost from all causes among the elderly

According to WHO, DALY is a summary measure which combines years of life lost (YLL) through premature death and years of life lived with disability (YLD). The methodological details on calculations of DALYs and data sources are contained in WHO technical paper [11].

The non-health GDP loss ($NHGDPLoss$) associated with DALYs lost from j^{th} disease (or health condition) in Kenya is the sum of the potential non-health GDP loss due to DALYs lost from j^{th} disease among those aged 60-69 $NHGDPLoss_{60-69}$ and those aged 70 years and above $NHGDPLoss_{\geq 70}$.

The non-health GDP loss associated with j^{th} disease (or health condition) DALYs lost among persons in the two age groups is the product of the per capita non-health GDP in purchasing power parity (PPP) and the total j^{th} disease (or health condition) DALYs lost in a specific age group. Kenya's discounted total non-health GDP loss attributable to j^{th} disease (or health condition) DALYs was estimated using the equations (1) to (3) below.

$$NHGDPLoss_{ij} = \left(NHGDPLoss_{60-69} + NHGDPLoss_{\geq 70}\right) \quad (1)$$

$$NHGDPLoss_{60-69} = \left[NHGDPPC_{Int\$}\right] \times \left[DALY_{60-69}\right] \quad (2)$$

$$NHGDPLoss_{\geq 70} = \left[NHGDPPC_{Int\$}\right] \times \left[DALY_{\geq 70}\right] \quad (3)$$

Where: $NHGDPPC_{Int\$}$ is per capita non-health GDP in purchasing power parity (PPP), which is obtained by subtracting per capita total health expenditure ($PCTHE$) from per capita GDP ($GDPPC_{Int\$}$); $DALY_{60-69}$ is the total DALYs lost to j^{th} disease (or health condition) between the age of 60–69 years in country i in 2015; and $DALY_{\geq 70}$ is the total DALYs lost to j^{th} disease (or health condition) between the age of 70 years and above in country i in 2015. The non-health GDP per capita in purchasing power parity for Kenya is the difference between per capita GDP and per capita total health expenditure.

The year 2015 was used as the base year for all the calculations because it marks the end of the MDG era and serves as the baseline for the SDGs [9]. The DALY estimates published by WHO in the Global Health Observatory are already discounted at a 3% discount rate. Therefore, any attempt to introduce discount factor in the equations (1) to (3) would be double discounting.

Data Sources

The data on the indicators contained in **Table 1** were solely obtained from WHO and IMF databases. Those indicators were used in the study to estimate the productivity losses incurred by Kenya.

The DALYs lost in 2015 for Kenya's elderly by cause were obtained from the WHO Global Health Observatory [1]. Methods and data sources for global burden of disease 2000-2015 are reported in WHO technical paper [11].

Table 1. Indicators.

Variable	Indicator	Sources
Morbidity and mortality in 2015	Disability-Adjusted Life years (DALYs) by country by age bracket (2015)	WHO [1].
Health SDG Targets	Target 3.1: By 2030, reduce maternal mortality ratio; Target 3.2: By 2030, end preventable deaths of new-borns and children; Target 3.3: By 2030, end the epidemics of AIDS, TB, Malaria & NTDs; Target 3.4: By 2030, reduce by one third NCD mortality; Target 3.6: Halve deaths & injuries from road traffic accidents	United Nations [9].
Average economic output per person in 2015	Gross Domestic Product (GDP) per capita in 2015	International Monetary Fund (IMF) [12].
Expenditure on health in 2015	Projected 2015 total expenditure on health (THE) per person per country in Africa (projected using 2013 and 2014 THE data). Assumed constant growth.	WHO [13].

The 2015 Per capita GDP in International Dollars (Int$) or Purchasing Power Parity (PPP) for each country was obtained from the IMF World Economic Outlook database [12].

The per capita total expenditure on health for 2015 was not available. Therefore, projections for 2015 were calculated using 2013 and 2014 per capita total expenditure on health for each country from the WHO Global Health Observatory [13].

The issues of sampling and sample size were not relevant for the current study. This is because we analysed DALYs from all causes that exists within the WHO Global Health Observatory [1].

Ethical Clearance

No ethical clearance was required from the Meru University of Science and Technology (MUST) Institutional Research Ethics Review Committee (MIRERC) because the study relied completely on analysis of

publicly available secondary data in the WHO and IMF databases.

Results

The total indirect cost of DALYs lost from all causes among the elderly in Kenya was Int$ 7,088,274,986. The losses were evenly distributed between the 60-69 years and 70 years and above age brackets. The females and males bore Int$ 3,609,997,094 (50.9%) and Int$ 3,478,277,848 (49.1%) of the indirect cost respectively.

Communicable diseases and nutritional conditions indirect costs

As shown in **Table 2**, approximately Int$ 2,079,721,129 (29.3%) of the total indirect costs from all causes resulted from communicable and nutritional (CON) conditions. The indirect costs attributable to CON cluster resulted from five broad causes. First, 445,894 DALYs equivalent to Int$ 1,412,249,484

Table 2. Indirect cost of DALY lost from infectious and parasitic diseases among the Kenya's elderly (Int$ or Purchasing Power Parity).

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Tuberculosis	84,919	268,959,620	19.0
2	STDs excluding HIV (a+b+c+d+e+f)	1,477	4,676,569	0.3
	a) Syphilis	1,039	3,291,464	70.4
	b) Chlamydia	21	65,666	1.4
	c) Gonorrhoea	49	154,401	3.3
	d) Trichomoniasis	67	212,854	4.6
	e) Genital herpes	208	659,568	14.1
	f) Other STDs	92	292,615	6.3
3	HIV/AIDS	26,882	85,140,127	6.0
4	Diarrhoeal diseases	237,243	751,404,227	53.2
5	Tetanus	6,641	21,032,067	1.5
6	Meningitis	15,107	47,847,805	3.4
7	Encephalitis	2,028	6,422,604	0.5
8	Hepatitis (a+b+c+d)	3,014	9,547,522	0.7
	a) Acute hepatitis A	6	18,441	0.2
	b) Acute hepatitis B	2,356	7,462,555	78.2
	c) Acute hepatitis C	126	397,664	4.2
	d) Acute hepatitis E	527	1,668,862	17.5
9	Parasitic and vector diseases (=a+b+c+d+e+f+g+h+i+j)	38,679	122,506,450	8.7
	a) Malaria	22,508	71,289,312	58.2
	b) Schistosomiasis	11,451	36,269,369	29.6
	c) Leishmaniasis	42	133,389	0.1
	d) Lymphatic filariasis	1,053	3,336,188	2.7
	e) Cysticercosis	2,322	7,353,814	6.0
	f) Echinococcosis	99	313,663	0.3
	g) Dengue	89	280,783	0.2
	h) Trachoma	898	2,844,254	2.3
	i) Yellow fever	31	98,938	0.1
	j) Rabies	185	586,739	0.5
10	Intestinal nematode infections (a+b+c)	385	1,220,034	0.1
	a) Ascariasis	30	94,842	7.8
	b) Trichuriasis	11	35,263	2.9
	c) Hookworm disease	344	1,089,928	89.3
11	Leprosy	262	828,436	0.1
12	Other infectious diseases	29,257	92,664,024	6.6

(67.9%) of the CON economic losses were caused by infectious and parasitic diseases, including tuberculosis, sexually transmitted diseases (STDs excluding HIV), HIV/AIDs, diarrhoeal diseases, childhood diseases, meningitis, encephalitis, hepatitis, parasitic and vector diseases, intestinal nematode infections, and leprosy, among others. Diarrhoeal diseases and tuberculosis accounted for 72% of the infectious and parasitic diseases indirect costs.

Second, respiratory infections accounted for Int$ 486,385,189 (23.4%) of the CON cluster indirect

Table 3. Indirect cost of DALY lost from respiratory infections, maternal and neonatal conditions, and nutritional deficiencies among the Kenya's elderly (Int$ or Purchasing Power Parity).

Disease/Conditions		DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
B	Respiratory Infections	153,568	486,385,189	23.4
	1) Lower respiratory infections	151,922	481,171,698	98.9
	2) Upper respiratory infections	727	2,302,168	0.5
	3) Otitis media	919	2,911,323	0.6
C	Maternal conditions	363	1,150,801	0.1
D	Neonatal conditions	1,647	5,216,980	0.3
	1) Preterm birth complications	286	904,788	17.3
	2) Birth asphyxia and birth trauma	1,130	3,579,580	68.6
	3) Neonatal sepsis and infections	-	-	0.0
	4) Other neonatal conditions	231	732,612	14.0
E	Nutritional deficiencies	55,164	174,718,675	8.4
	1) Protein-energy malnutrition	24,475	77,518,705	44.4
	2) Iodine deficiency	1,025	3,247,215	1.9
	3) Vitamin A deficiency	51	162,512	0.1
	4) Iron-deficiency anaemia	28,176	89,240,560	51.1
	5) Other nutritional deficiencies	1,436	4,549,683	2.6

cost. A majority of 98.9% of this cost emanated from lower respiratory infections **(Table 3)**. Third, Int$ 1,150,801 (0.1%) of the CON indirect cost resulted from maternal conditions. Fourth, Int$ 5,216,980 (0.3%) of the CON indirect costs were related to neonatal conditions.

Lastly, nutritional deficiencies led to a loss of 55,164 DALYs which resulted into an indirect cost of Int$ 174,718,675, i.e. 8.4% of the CON. Protein-energy malnutrition and iron-deficiency anaemia were responsible for 95.5% of this loss.

Indirect costs of non-communicable diseases

As portrayed in **Table 4**, about Int$ 4,543,372,566 (64.1%) of the total indirect costs from all causes were from non-communicable diseases (NCD) cluster. The economic losses attributable to NCD cluster emanated from fifteen broad causes. Firstly, the malignant neoplasms (cancers) were responsible for a loss of 368,272 DALY which translated to an indirect cost of Int$1,166,403,036 (25.7%). About Int$ 540,944,576 (46%) of this economic loss resulted from oesophagus cancer, stomach cancer, breast cancer, cervix uteri cancer and prostate cancer.

Table 4. DALY losses and indirect cost of malignant neoplasms (cancers) among elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

A	Malignant neoplasms	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Mouth and oropharynx cancers (a+b+c)	19,297	61,117,984	5.2
	a) Lip and oral cavity	9,593	30,383,928	49.7
	b) Nasopharynx	4,186	13,257,244	21.7
	c) Other pharynx	5,518	17,476,811	28.6
2	Oesophagus cancer	51,294	162,461,038	13.9
3	Stomach cancer	28,223	89,389,481	7.7
4	Colon and rectum cancers	18,352	58,123,753	5.0
5	Liver cancer (a+b+c+d)	13,499	42,753,788	3.7
	a) Liver cancer secondary to hepatitis B	2,368	7,498,886	17.5
	b) Liver cancer secondary to hepatitis C	4,625	14,649,902	34.3
	c) Liver cancer secondary to alcohol use	5,443	17,239,028	40.3
	d) Other liver cancer	1,063	3,365,972	7.9
6	Pancreas cancer	9,034	28,613,636	2.5
7	Trachea, bronchus, lung cancers	6,629	20,994,798	1.8

A	Malignant neoplasms	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
8	Melanoma and other skin cancers (a+b)	3,374	10,685,112	0.9
	a) Malignant skin melanoma	2,421	7,666,982	71.8
	b) Non-melanoma skin cancer	953	3,018,130	28.2
9	Breast cancer	22,987	72,805,913	6.2
10	Cervix uteri cancer	28,417	90,002,248	7.7
11	Corpus uteri cancer	4,581	14,507,944	1.2
12	Ovary cancer	7,114	22,532,870	1.9
13	Prostate cancer	39,873	126,285,896	10.8
14	Testicular cancer	296	937,892	0.1
15	Kidney cancer	3,223	10,208,717	0.9
16	Bladder cancer	3,492	11,058,600	0.9
17	Brain and nervous system cancers	6,740	21,346,861	1.8
18	Gallbladder and biliary tract cancer	3,978	12,599,507	1.1
19	Larynx cancer	3,933	12,456,779	1.1
20	Thyroid cancer	3,126	9,899,299	0.8
21	Mesothelioma	185	585,270	0.1
22	Lymphomas, multiple myeloma	15,421	48,842,071	4.2
	a) Hodgkin lymphoma	2,537	8,034,368	16.4
	b) Non-Hodgkin lymphoma	7,837	24,820,102	50.8
	c) Multiple myeloma	5,048	15,987,601	32.7
23	Leukaemia	8,348	26,441,433	2.3
24	Other malignant neoplasms	66,857	211,752,145	18.2

Secondly, other neoplasms accounted for Int$22,568,469 (0.5%) of NCD indirect cost **(Table 5).** Thirdly, diabetes mellitus was responsible for Int$241,215,813 (5.3%) of the loss. Fourthly, Int$41,865,425 (0.9%) of the NCD economic losses were from endocrine, blood, and immune disorders.

Fifthly, mental and substance abuse disorders among elderly in Kenya led to 49,976 DALY losses; which were equivalent to Int$ 158,285,962 (3.5%) of the NCD indirect costs **(Table 6)**. About 70% of

Table 5. DALY losses and indirect cost of other neoplasms, diabetes mellitus and endocrine, blood and immune disorders among elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

Disease/Conditions		DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
B	Other neoplasms	7,126	22,568,469	0.5
C	Diabetes mellitus	76,160	241,215,813	5.3
D	Endocrine, blood, immune disorders (1+2+3+4)	13,218	41,865,425	0.9
	1) Thalassaemias	131	415,971	1.0
	2) Sickle cell disorders and trait	2,699	8,546,963	20.4
	3) Other haemoglobinopathies and haemolytic anaemias	7,394	23,417,216	55.9
	4) Other endocrine, blood and immune disorders	2,995	9,485,274	22.7

Table 6. DALY losses and indirect cost of mental and substance abuse disorders among elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

Disease/Conditions		DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Depressive disorders (a+b)	28,821	91,283,975	57.7
	a) Major depressive disorder	23,635	74,858,847	82.0
	b) Dysthymia	5,186	16,425,128	18.0
2	Bipolar disorder	1,863	5,901,142	3.7
3	Schizophrenia	4,227	13,386,409	8.5
4	Alcohol use disorders	2,604	8,248,133	5.2
5	Drug use disorders (a+b+c+d+e+f)	343	1,085,637	0.7
	a) Opioid use disorders	267	844,784	77.8
	b) Cocaine use disorders	28	87,701	8.1

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
5	c) Amphetamine use disorders	3	10,666	1.0
	d) Cannabis use disorders	17	55,014	5.1
	e) Other drug use disorders	28	87,472	8.1
6	Anxiety disorders	5,915	18,735,065	11.8
7	Eating disorders	-	-	0.0
8	Autism and Asperger syndrome	2,225	7,047,873	4.5
9	Childhood behavioural disorders (attention deficit/hyperactivity syndrome and conduct disorder)	0	0	0.0
10	Idiopathic intellectual disability	1,039	3,290,961	2.1
11	Other mental and behavioural disorders	2,938	9,306,766	5.9

this economic loss resulted from depressive disorders and anxiety disorders.

Sixth, the neurological conditions caused a loss of 54,774 DALYs; which was equivalent to an indirect cost of Int$ 173,481,335 (3.8% of NCDs losses) **(Table 7)**. Alzheimer disease and other dementias accounted for about 77% of the indirect costs from neurological conditions. **Table 5** provides the distribution of DALYs and indirect costs by individual neurological conditions among the elderly in Kenya in 2015.

Seventh, the sensory organ diseases were responsible for a loss of 111,390 DALYs, which were equivalent to indirect cost of Int$ 352,796,856, i.e. 7.8% of NCD economic losses. A majority of 61.2% of the economic losses resulted from hearing losses and uncorrected refractive errors in vision. **Table 8** presents the distribution of DALY losses and indirect cost by individual sense organ diseases among the elderly in Kenya in 2015.

Eighth, cardiovascular diseases (CVD) led to 415,793 DALY losses, which translated to total indirect cost of Int$ 1,316,913,496, i.e. 29% of the total NCD productivity losses **(Table 9)**. Stroke and ischaemic heart disease accounted for Int$ 876,674,592 in indirect costs, i.e. 67% of CVD productivity losses.

Ninth, respiratory diseases accounted for a loss of 79,151 DALYs which translated to Int$ 250,690,809 indirect cost, i.e. 5.5% of the NCD productivity losses. About 66.5% of the respiratory diseases losses resulted from chronic obstructive pulmonary disease, 26.8% from asthma, and 6.7% from other respiratory diseases.

Table 7. DALY losses and indirect cost of neurological conditions among elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

	Diseases	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Alzheimer disease and other dementias	42,045	133,167,751	76.8
2	Parkinson disease	2,276	7,210,043	4.2
3	Epilepsy	3,224	10,212,005	5.9
4	Multiple sclerosis	162	513,022	0.3
5	Migraine	4,437	14,053,336	8.1
6	Non-migraine headache	1,354	4,289,289	2.5
7	Other neurological conditions	1,274	4,035,889	2.3

Table 8. DALY losses and indirect cost of sense organ diseases among the elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Glaucoma	2,788	8,830,516	2.5
2	Cataracts	16,242	51,443,617	14.6
3	Uncorrected refractive errors	19,427	61,528,373	17.4
4	Macular degeneration	6,455	20,444,134	5.8
5	Other vision loss	11,665	36,945,764	10.5
6	Other hearing loss	48,841	154,689,405	43.8
7	Other sense organ disorders	5,972	18,915,048	5.4

Table 9. DALY losses and indirect cost of cardiovascular diseases among the elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Rheumatic heart disease	5,124	16,230,326	1.2
2	Hypertensive heart disease	51,229	162,252,894	12.3
3	Ischaemic heart disease	107,805	341,443,739	25.9
	Stroke (a+b)	168,990	535,230,853	40.6
4	a) Ischaemic stroke	71,964	227,925,754	42.6
	b) Haemorrhagic stroke	97,026	307,305,100	57.4
5	Cardiomyopath, myocarditis, endocarditis	8,384	26,553,679	2.0
6	Other circulatory diseases	74,261	235,202,005	17.9

Tenth, the digestive diseases led to a loss of 139,229 DALYs among the elderly. This was equivalent to an indirect cost of Int$ 440,971,945, i.e. 9.7% of NCD productivity losses. Peptic ulcer disease, cirrhosis of the liver, gastritis and duodenitis, and paralytic ileus and intestinal obstruction were responsible for 80% of losses in digestive diseases related DALY losses and indirect costs. **Table 10** provides distribution of DALYs lost and indirect costs by individual digestive diseases.

Eleventh, genitourinary diseases were responsible for 35,880 DALYs lost, which was equivalent to Int$ 113,639,424, i.e. 2.5% of the NCD productivity losses. About 66% of the genitourinary diseases DALY and indirect costs emanated from kidney diseases and benign prostatic hyperplasia. **Table 11** provides distribution of DALYs lost and indirect costs by individual genitourinary diseases.

Twelfth, skin diseases led to a loss of 11,922 DALYs which was equivalent to Int$ 37,758,337 of indirect costs, i.e. 0.8% of the total NCD productivity losses.

Thirteenth, musculoskeletal diseases accounted for a loss of 60,112 DALYs which was equivalent to Int$ 190,389,627 indirect cost, i.e. 4.2% of the

Table 10. DALY losses and indirect cost of digestive diseases among the elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Peptic ulcer disease	20,100	63,660,908	14.4
2	Cirrhosis of the liver (a+b+c+d)	51,401	162,798,258	36.9
	a) Cirrhosis due to hepatitis B	7,721	24,454,693	15.0
	b) Cirrhosis due to hepatitis C	12,924	40,934,375	25.1
	c) Cirrhosis due to alcohol use	23,502	74,437,342	45.7
	d) Other liver cirrhosis	7,253	22,971,849	14.1
3	Appendicitis	1,739	5,508,947	1.2
4	Gastritis and duodenitis	13,681	43,330,184	9.8
5	Paralytic ileus and intestinal obstruction	26,272	83,208,311	18.9
6	Inflammatory bowel disease	4,078	12,914,821	2.9
7	Gallbladder and biliary diseases	7,007	4,139	5.0
8	Pancreatitis	1,362	4,314,095	1.0
9	Other digestive diseases	13,590	43,042,282	9.8

Table 11. DALY losses and indirect cost of genitourinary diseases among the elderly in Kenya in 2015 (Int$ or Purchasing Power Parity).

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
1	Kidney diseases (a+b+c)	19,461	61,637,029	54.2
	a) Acute glomerulonephritis	29	92,735	0.2
	b) Chronic kidney disease due to diabetes	5,406	17,120,961	27.8
	c) Other chronic kidney disease	14,026	44,423,333	72.1
2	Benign prostatic hyperplasia	4,382	13,878,275	12.2

	Disease/Conditions	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
3	Urolithiasis	122	386,021	0.3
4	Other urinary diseases	10,280	558,902	28.7
5	Infertility	-	-	0.0
6	Gynaecological diseases	1,635	5,179,197	4.6

NCD productivity losses. Out of that cost, 7.6% was due to rheumatoid arthritis, 28.7% to osteoarthritis, 2% to gout, 51.3% to back and neck pain, and 10.4% to other musculoskeletal disorders. Thus, over half of the DALYs and productivity losses were due to back and neck pain.

Fourteenth, congenital anomalies led to a loss of 3,140 DALYs which were equivalent to Int$ 9,946,618, i.e. 0.2% of the NCD indirect costs. About 2.2% of the congenital anomalies indirect costs were from neural tube defects; 0.1 from cleft lip and cleft palate; 6% from down syndrome; 13.4% from congenital heart anomalies; 5.6% from other chromosomal anomalies; and 72.7% from other congenital anomalies.

Fifteenth, oral conditions caused a loss of 8,350 DALYs which translated to Int$26,445,416, i.e. 0.6% of the NCD total productivity losses. Out of that loss, 3% was from dental caries, 55.5% from periodontal disease, 25.2% from edentulism, and 16.3% from other oral disorders.

Indirect cost of injuries

In 2015 the injuries cluster accounted for a loss of 146,873 DALYs which resulted in total indirect cost of Int$ 465,181,291, which was equivalent to 6.6% of the total country's loss from all causes. About 128,884 DALY losses were from unintentional injuries causing an indirect cost of Int$ 408,206,456 (87.85%). Unintentional injuries resulted from the eight causes listed in **Table 12**. About 60.4% of unintentional injuries indirect costs resulted from road injuries and falls.

Table 12. DALY losses and indirect cost of injuries among the elderly in Kenya in 2015 (Int$ or Purchasing Power Parity.

	Malignant neoplasms	DALYs lost in 2015	Indirect Cost (Int$ or Purchasing Power Parity)	Percent of Indirect Cost
A	Unintentional injuries (1+2+3+4+5+6+7+8)	128,884	408,206,456	87.8
	1) Road injury	43,440	137,585,580	33.7
	2) Poisonings	3,223	10,209,422	2.5
	3) Falls	34,372	108,863,474	26.7
	4) Fire, heat and hot substances	10,980	34,777,748	8.5
	5) Drowning	4,567	14,465,403	3.5
	6) Exposure to mechanical forces	7,929	25,113,018	6.2
	7) Natural disasters	61	191,919	0.0
	8) Other unintentional injuries	24,311	76,999,892	18.9
B	Intentional injuries (1+2+3)	17,989	56,974,835	12.2
	1) Self-harm	14,552	6,089,103	80.9
	2) Interpersonal violence	3,015	9,550,150	16.8
	3) Collective violence and legal intervention	422	1,335,582	2.3

Intentional injuries were responsible for 17,989 DALY losses which translated into an indirect cost of Int$ 56,974,835 (12.2% of injuries total loss). Approximately 80.9% of intentional injuries indirect costs resulted from self-harm or self-inflicted injuries.

Discussion

There were a number of key findings. First, the elderly in Kenya are confronted with a triple burden of disease – including communicable diseases and nutritional deficiencies, non-communicable diseases, and injuries. Second, top 20 diseases in **Table 13** were responsible for 62% of the DALY losses and indirect costs incurred by the elderly in Kenya. Three, NCDs (stroke, cardiovascular diseases, dia-

Table 13. Top 20 causes of DALY loss and indirect costs among the elderly in Kenya.

Diseases	Percent
Diarrhoeal diseases	10.60
Stroke	7.55
Lower respiratory infections	6.79
Ischaemic heart disease	4.82
Tuberculosis	3.79
Diabetes mellitus	3.40
Chronic obstructive pulmonary disease	2.35
Cirrhosis of the liver	2.30
Oesophagus cancer	2.29
Hypertensive heart disease	2.29
Other hearing loss	2.18
Road injury	1.94
Alzheimer disease and other dementias	1.88
Prostate cancer	1.78
Falls	1.54
Back and neck pain	1.38
Depressive disorders	1.29
Cervix uteri cancer	1.27
Stomach cancer	1.26
Iron-deficiency anaemia	1.26

betes, cancer and hearing loss) were the cause of majority of the losses in intrinsic and functional capacities of the elderly, and hence, indirect costs in Kenya. Four, diarrhoea diseases, lower respiratory infections, tuberculosis, and iron-deficiency were among the top 20 causes of DALY losses and indirect costs. Fifth, road injuries and falls were among the top twenty.

In September 2015, the United Nations General Assembly adopted resolution A/RES/70/1 with 17 Sustainable Development Goals (SDGs) [9]. The SDG 3 is about ensuring healthy lives and promoting well-being for all at all ages - including the elderly. SDG target 3.c requires Kenya (among others) to substantially increase health financing and health workforce within the national and county health systems, including those services that specifically address the health needs of the elderly. SDG target 3.8 calls upon all countries to ensure universal health coverage. In the context of the current study, this includes ensuring that all the elderly in need have financial risk protection, and unfettered access to safe, effective, and quality essential health-care services (including essential medicines and vaccines).

Adequately resourced national and county health systems and other systems that assure elderly's universal access to basic needs (food, shelter, clothing, water and sanitation, education) may enable Kenya to achieve the following SDG targets:

- 3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births;
- 3.3: By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases;
- 3.4: By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being; and
- 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents.

The achievement of the abovementioned SDG targets would enable Kenya to reduce the SDG diseases and health conditions-related DALYs lost from 1,629,030 to 1,003,792, i.e. 38.4% reduction. The related indirect costs (productivity losses) incurred by Kenya due to morbidity and premature mortality would be reduced from Int$ 5,165,881,655 to Int$ 3,179,239,913, i.e. 44.9% saving in GDP.

Various WHO strategies, strategic plans and action plans provide clear guidance to countries on the proven cost-effective interventions related to the various health SDG targets. In order to achieve the communicable diseases target SDG 3.3, the Seventieth World Health Assembly (WHA) adopted a resolution on global vector control response 2017-2030 aimed at reducing the burden and

threat of vector-borne diseases through effective locally adapted sustainable vector control [14]. That resolution provides extra guidance and impetus for accelerated implementation of the global technical strategy and targets for malaria [15]. WHO also developed a framework detailing strategies and interventions for malaria elimination [16]. The Sixty-Ninth WHA adopted global health sector strategies for combatting HIV [17], sexually transmitted infections [18] and hepatitis [19].

In order realize SDG target 3.4 for the elderly, Kenya needs to accelerate the implementation of the actions contained in the WHO the global strategy and action plan for the prevention and control of NCDs [20, 21]. The country also needs to fully implement the actions proposed in the WHO mental health action plan to prevent and/or delay temporal decline in elderly's intrinsic and functional capacities [22].

With a view to giving impetus for Member States push towards SDG target 3.6, the Sixty-Ninth WHA adopted two pertinent resolutions. Resolution WHA 69.5 adopted the WHO global plan of action to strengthen the role of the health system within a national multisectoral response to address interpersonal violence [23] and WHA69.7 on addressing the challenges of the UN Decade of Action for Road Safety [24]. The latter calls upon Member States (including Kenya) to implement the Brasília Declaration on Road Safety [25]; to renew commitment to the UN Decade of Action for Road Safety 2011-2020; to implement the Global Plan for the Decade of Action for Road Safety 2011-2020 [26]; and to implement the recommendations contained in the WHO Global Status Report on Road Safety [27]. The latter report recommends to countries to enforce road safety laws (e.g. those related to reducing speed, increasing motorcycle helmet use, reducing drink-driving, increasing seat-belt use, reducing drug-driving, reducing distracted driving, e.g. talking on phone while driving) and take appropriate actions to ensure safer roads and vehicles.

The Sixty-Ninth WHA resolution WHA69.3 calls upon Member States to implement the proposed actions in the Global strategy and action plan on ageing and health through a multisectoral approach [28]. It also urges international, intergovernmental and nongovernmental organizations, as well as self-help and other relevant organizations to support and contribute to the accomplishment of the Global strategy and action plan on ageing and health [29].

There exists political will at the global and continental level to tackle the triple burden of disease. In 2011, the UN General Assembly (UNGA) adopted a Political Declaration on the Prevention and Control of NCDs [30].

In September 2016, the UNGA adopted resolution A/RES/70/300 encouraging Member States to consolidate gains and accelerate efforts to control and eliminate malaria in developing countries, particularly in Africa, by 2030 [31]. In 2001 the UNGA adopted resolution A/RES/S-26/2 declaring commitment on HIV/AIDS [32]; and resolution A/RES/60/262 entitled political declaration on HIV/AIDS [33]. In June 2011 and 2000 the UN Security Council adopted resolutions S/RES/1983 (2011) and S/RES/1308 (2000) on HIV/AIDS [34].

In March 2010, the UNGA resolution 64/255 proclaimed 2011-2020 the Decade of Action for road safety, with a global goal of stabilizing and then reducing the forecasted level of global road fatalities by increasing activities conducted at national, regional and global levels [35]. In the follow-up, the UNGA adopted resolutions 66/260 of 19 April 2012, 68/268 of April 2014 and 70/260 of April 2015 on improving global road safety [36, 37].

Conclusion

This study demonstrates that morbidity and premature mortality among the elderly results in sizeable GDP losses in Kenya. The finding is even of greater significance when one recalls that our study focussed only on productivity losses, and did not take

into account the direct costs incurred by the national health system and communities. We did not include other non-monetary contributions made by the elderly to the society, including guidance and counselling of younger people in communities, caring for the orphaned children, brokering of peace in families, transmission of indigenous knowledge and cultural values.

Thus, there are three arguments for increased government and partner investments into health and wellbeing of the elderly: (a) the elderly have a human right to health; (b) the elderly have made in the past, and continue to make, a substantive contribution to Kenya's economic development; and (c) the elderly make a significant non-monetary contribution to societal wellbeing.

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Authors declare that no competing interests exist.

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