

Haemorrhage of Gross Domestic Product from Disability-Adjusted-Life-Years Among 15-59 Year Olds in Kenya

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Abstract

Background: This article estimates non-health gross domestic product (GDP) losses associated with Disability-Adjusted Life Years (DALY) lost among 15-59 year olds (most productive age bracket) in Kenya in 2015.

Methods: This study employs the lost output or human capital approach (HCA) to convert the DALYs lost from all causes into their monetary equivalents. The magnitude economic haemorrhage from each disease was obtained by multiplying the per capita non-health GDP in International Dollars by the total number of DALYs lost in a specific age group (15-29 years, 30-49 years, 50-59 years). Per capita non-health GDP equals per capita GDP minus total health expenditure in 2015. Data on DALYs and per capita total health expenditure were obtained from the World Health Organization and per capita GDP data was from IMF databases.

Results: Kenya lost 9,405,184 DALYs among 15-59 years olds in 2015. That DALY loss caused a haemorrhage in GDP of Int\$ 29,788,392,419. Approximately 48.6% of the GDP haemorrhage resulted from communicable diseases and nutritional conditions, 37.4% from non-communicable diseases, and 14.0% from injuries.

Conclusion: There is need to augment domestic and external investments into national health systems and other systems that meet basic needs (education, food, water, sanitation, shelter) to reduce disease burden.

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Keywords

Non-health GDP;
Economic Haemorrhage;
Disability-Adjusted Life Year (DALY).

Background

Kenya's population was estimated at 46,034,000 people in 2015 [1]. In the same year the country lost a total of 21,854,898 Disability-Adjusted-Life-Years (DALYs) from all causes. Out of that total DALY loss, 59% were from communicable, maternal, perinatal and nutritional conditions; 30% from non-communicable diseases (NCDs); and 11% from intentional and unintentional injuries. About 54% and 46% the total DALYs lost occurred in male and female gender respectively.

The total DALYs losses were distributed unevenly across various age groups: 33.2% among 0-4 year-old; 13.6% among 5-14 year-old; 18.5% among 15-29 year-old; 18.8% among 30-49 year-old; 5.7% among 50-59 year-old; 5.1% among 60-69 year-old; and 5.1% among those aged 70 years and above [1]. Thus, 43% of the depletion in health or human capital was sustained by the most economically and socially productive age bracket of 15-59 years. The current study focuses on this age bracket.

The large loss in DALYs has been attributed to weaknesses in national and local health systems responsible for providing quality health services [2, 3]; systems that assure access to other basic needs (food, water, sanitation, education, clothing, shelter) or social determinants of health [4, 5]; and national health research system that produces knowledge and facilitates its use in development of discoveries and innovations aimed at addressing health and socioeconomic needs [6, 7].

Various studies have attempted to estimate the productivity losses attributable to premature mortality from one or a group of disasters, diseases and health conditions in the WHO African Region (AFR). A study conducted in 2004 used regression modelling to estimate the impact of disaster-related mortality on gross domestic product (GDP) in AFR [8]. Kirigia *et al* [9] estimated the effects of maternal mortality on GDP in AFR using econometric production function modelling. Kirigia *et al* [10] used cost-

of-illness (COI) method to estimate the economic burden of diabetes mellitus in AFR. Kirigia *et al* [11] used COI approach to estimate the economic burden of cholera in AFR. Okorosobo *et al* [12] used a combination of methods to estimate the economic burden of malaria in five AFR countries. Orem *et al* [13] used production function approach to estimate the impact of malaria morbidity on GDP in Uganda. Kirigia *et al* [14] used COI approach to estimate the indirect cost of maternal deaths in AFR. Kirigia *et al* [15] used COI approach to estimate the cost of child mortality in the AFR.

Kirigia *et al* [16] estimated the indirect cost associated with deaths from the Ebola Virus disease in West Africa. Kirigia and Muthuri [17] estimated productivity losses associated with tuberculosis deaths in AFR. Kirigia *et al* [18] estimated the indirect cost of maternal deaths in the AFR. Kirigia *et al* [19] estimated indirect cost of non-communicable diseases deaths in the AFR. Those studies have two main limitations. First, they all estimated the productivity losses attributable to premature deaths but omitted the economic impact of non-fatal disability resulting from various diseases or health conditions. Second, none of those studies estimated the productivity losses of premature mortality from all causes. Third, except for Kirigia *et al* [20] study on the indirect cost of DALYs lost among the elderly in Kenya, no other study in Kenya has attempted estimate the GDP losses emanating from DALYs lost.

The objective of this study was to estimate non-health gross domestic product (GDP) losses associated with DALYs lost among 15-59 year-old in Kenya in 2015.

Methods

Study area and population

The study reported in this paper focusses on all DALYs lost among 15-59 year olds in Kenya, i.e.

the most economically productive age bracket. The study encompasses all communicable diseases, maternal conditions, neonatal conditions and nutritional deficiencies; a wide range of NCDs, including 24 malignant neoplasms, 11 mental and substance-use disorders, 7 neurological conditions, 7 sense-organ diseases, 6 cardiovascular diseases, respiratory diseases, 9 digestive diseases, 6 genitourinary diseases, 5 musculoskeletal diseases, 6 congenital anomalies, oral conditions and sudden infant death; and intentional and unintentional injuries reported in the 2015 World Health Organization (WHO) global health (DALY) estimates [1].

Study design

The lost output or human capital approach

This study employs the lost output or human capital approach (HCA) to convert the DALYs lost in Kenya in 2015 from all causes into their monetary equivalents. The approach was first used in 1699 [21], and its theoretical underpinnings honed in subsequent studies [22, 23, 24, 24]. The availability of data on DALYs, total health expenditure per capita and GDP per capita for Kenya influenced our choice of HCA. The per capita GDP of Kenya is equal to total expenditure (i.e. consumption expenditure, investment, government expenditure and net exports) divided by total population. Our hypothesis is that DALY losses from any disease haemorrhages incomes of households and firms (and hence consumption expenditure), savings (and hence resources available for investment), taxes and service fees (and hence revenues available for government spending), and numbers of export producers (and hence quantity of exports).

The Murray [25], Struijk *et al* [26] and WHO [27] global health estimates technical papers details DALY methods and data sources.

Kenya's non-health GDP haemorrhage ($NHGDPHA$) associated with DALYs lost from k^{th} disease (or health condition) is the sum of the $NHGDPHA$ due to DALYs lost from k^{th} disease among people aged 15-29 years ($NHGDPA_{15-29}$), 30-49 years ($NHGDPA_{30-49}$), and 50-59 years ($NHGDPA_{50-59}$)

The $NHGDPHA$ linked with k^{th} disease among persons of a specific age group equals non-health GDP per capita times total DALYs lost from k^{th} disease. Kenya's discounted $NHGDPHA$ attributable to k^{th} disease was calculated using the equations (1) to (4):

$$NHGDPHA_k = NHGDPA_{15-29} + NHGDPA_{30-49} + NHGDPA_{50-59} \quad 1$$

$$NHGDPA_{15-29} = [NHGDPPC_{Int\$}] \times [DALY_{15-29}] \quad 2$$

$$NHGDPA_{30-49} = [NHGDPPC_{Int\$}] \times [DALY_{30-49}] \quad 3$$

$$NHGDPA_{50-59} = [NHGDPPC_{Int\$}] \times [DALY_{50-59}] \quad 4$$

Where: $NHGDPPC_{Int\$}$: is per capita non-health GDP in purchasing power parity (PPP), obtained by subtracting per capita total health expenditure ($PCTHE$) from per capita GDP ($GDPPC_{Int\$}$) [14-20]; $DALY_{15-29}$ is the number of DALYs lost from k^{th} disease among those aged 15-29 years in Kenya in 2015; $DALY_{30-49}$ is the number of DALYs lost from k^{th} disease among those aged 30-49 years in Kenya in 2015; and $DALY_{50-59}$ is the number of DALYs lost from k^{th} disease among those aged 50-59 years in Kenya in 2015. Discount factor was not introduced in equation (2) to (4) because DALY estimates contained in the WHO Global Health Observatory are already discounted at a rate of 3% [27].

Data Sources

The aforementioned four equations were estimated using secondary data from per capita GDP data from the International Monetary Fund (IMF) World Economic Outlook database [28], per capita total health expenditure from the WHO Global Health Expenditure Database [29], and DALYs data from the WHO Global Health Observatory [1].

Data Analysis

The Excel Software developed by Microsoft (New York) was used to estimate equations (1) to (4).

Results

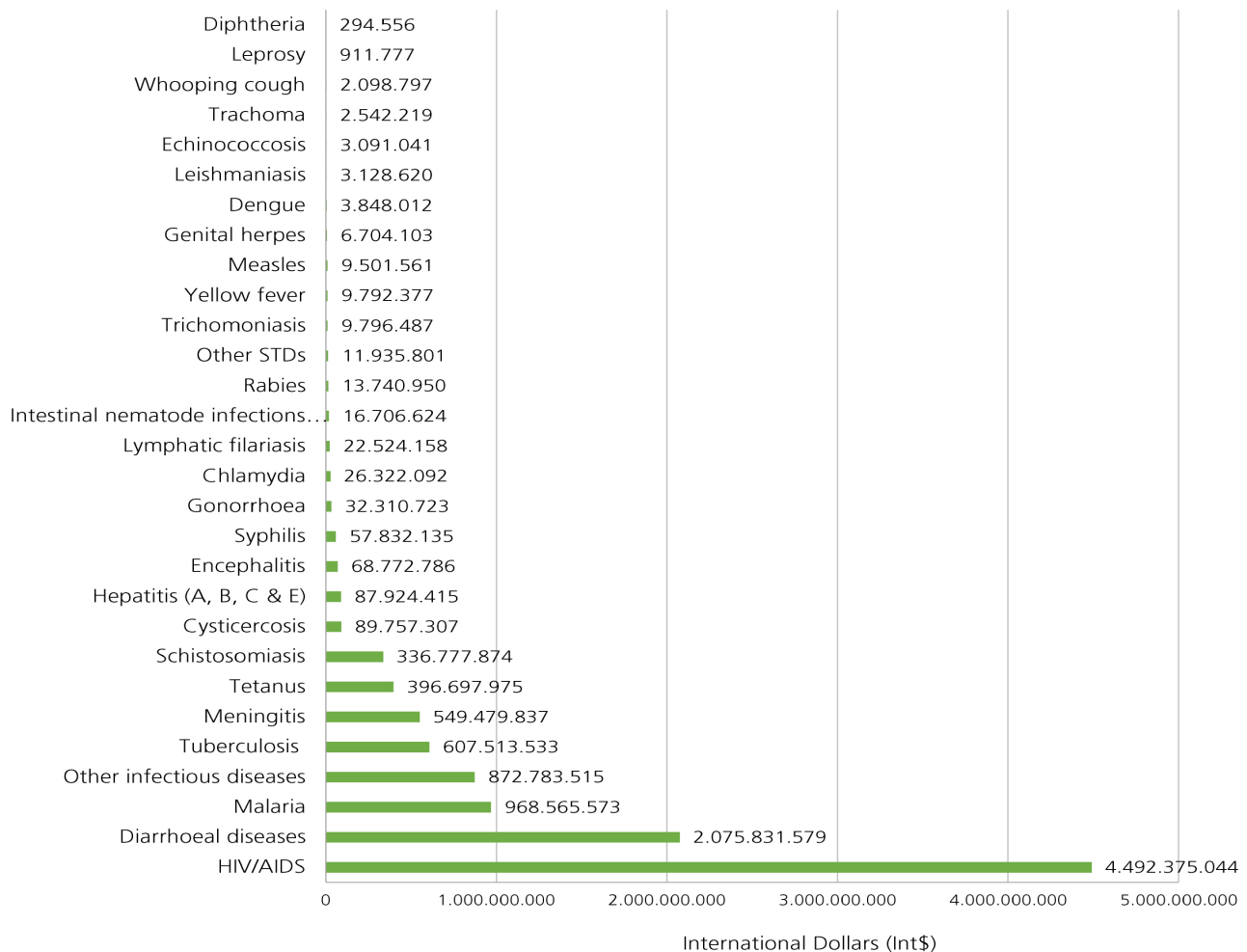
Kenya sustained a loss of 9,405,184 DALYs among 15-59 years olds in 2015. That DALY loss caused

a haemorrhage in GDP of Int\$ 29,788,392,419. About 43% of the economic loss was sustained by the 15-29 year-old; 43.7% by the 30-49 year-old; and 13.3% by the 50-59 year-old.

GDP haemorrhage from communicable diseases and nutritional conditions indirect costs

About Int\$ 14,482,888,888 (48.6%) of total GDP haemorrhage was caused by communicable diseases and nutritional conditions (CDs). This loss was due to four categories of causes. First, 3,403,288 DALYs were lost from infectious and parasitic diseases, which was equivalent to Int\$10,779,561,469 (74%) (Figure 1). Eighty-five percent of this loss was from HIV/AIDS, diarrhoea diseases, parasitic and vector diseases, tuberculosis, and meningitis.

Figure 1: GDP haemorrhage from infectious and parasitic diseases 15-59 year olds in Kenya in 2015 (Int\$).



Second, 297,097 DALYs were lost from respiratory infections, which was equivalent to Int\$ 940,973,619 (Figure 2).

Ninety-three percent of the loss emanated from lower respiratory infections. Third, maternal and neonatal conditions led to a loss of 560,389 DALYs, equivalent to Int\$ 1,774,881,139. Fourth, nutritional deficiencies resulted in 311,778 DALYs lost, which was equal to Int\$ 987,472,662. Eighty-four percent

of the latter loss was from iron-deficiency anaemia and 11% from protein-energy malnutrition.

GDP haemorrhage from non-communicable diseases (NCDs)

Approximately Int\$ 11,132,722,393 (37.4%) of total GDP haemorrhage was caused by non-communicable diseases (NCDs) (Figure 3). That productivity loss was attributed to 16 broad causes.

Figure 2: GDP haemorrhage from respiratory infections, maternal and neonatal conditions, and nutritional deficiencies among 15-59 year olds in Kenya in 2015 (Int\$).

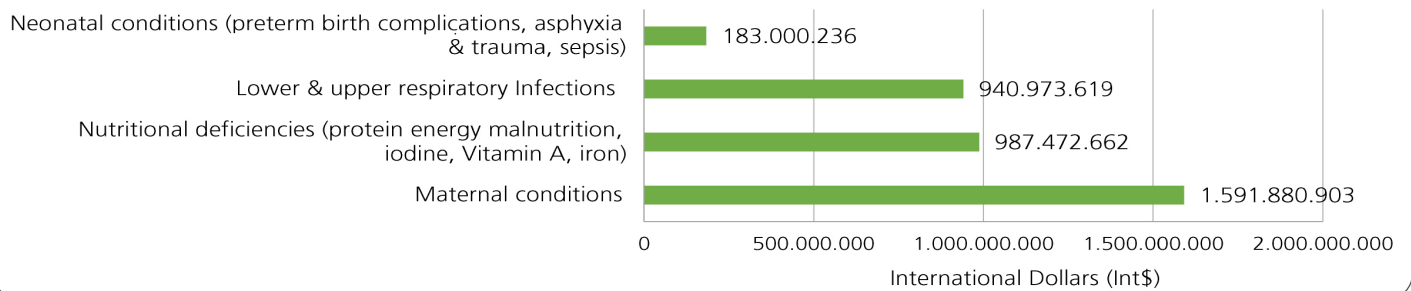


Figure 3: GDP haemorrhage from non-communicable diseases among 15-59 year olds in Kenya in 2015 (Int\$).

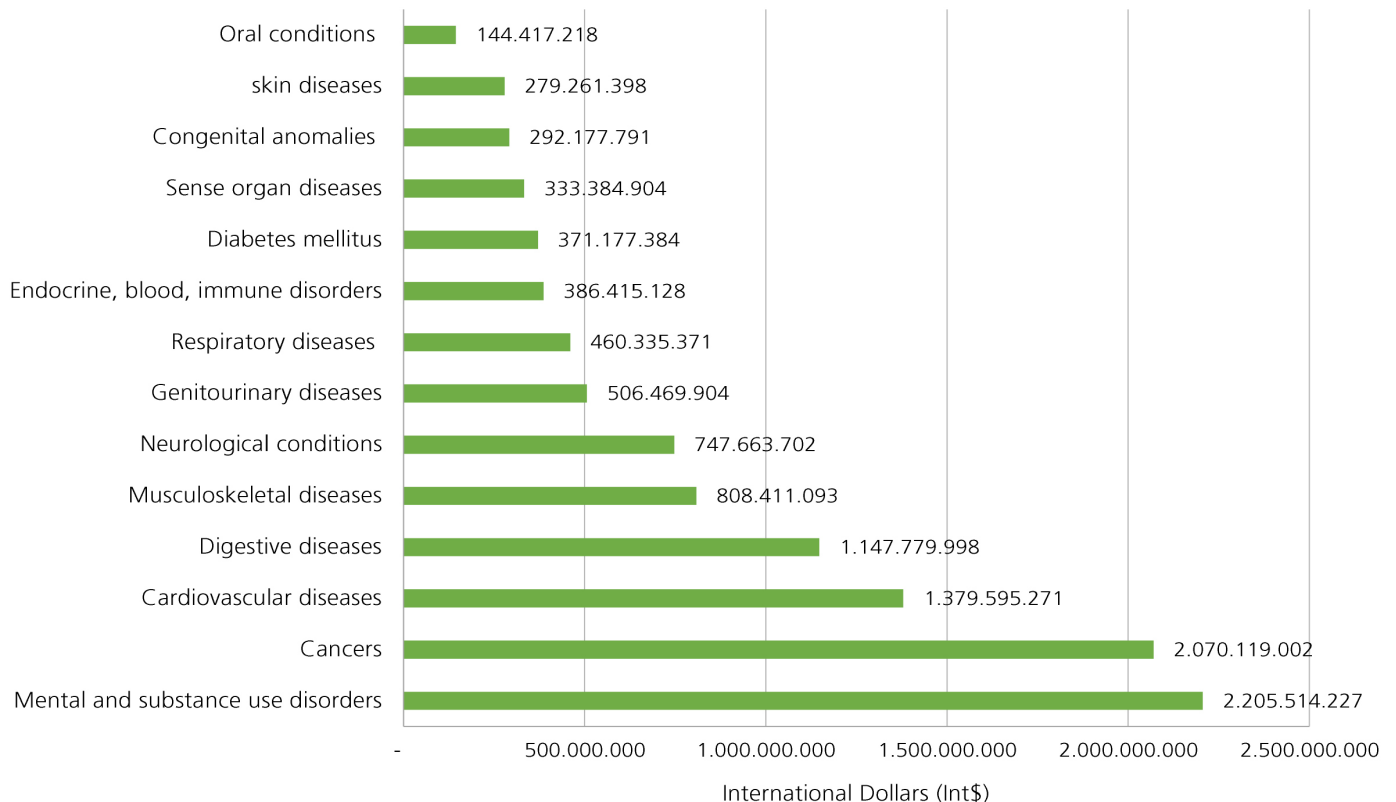
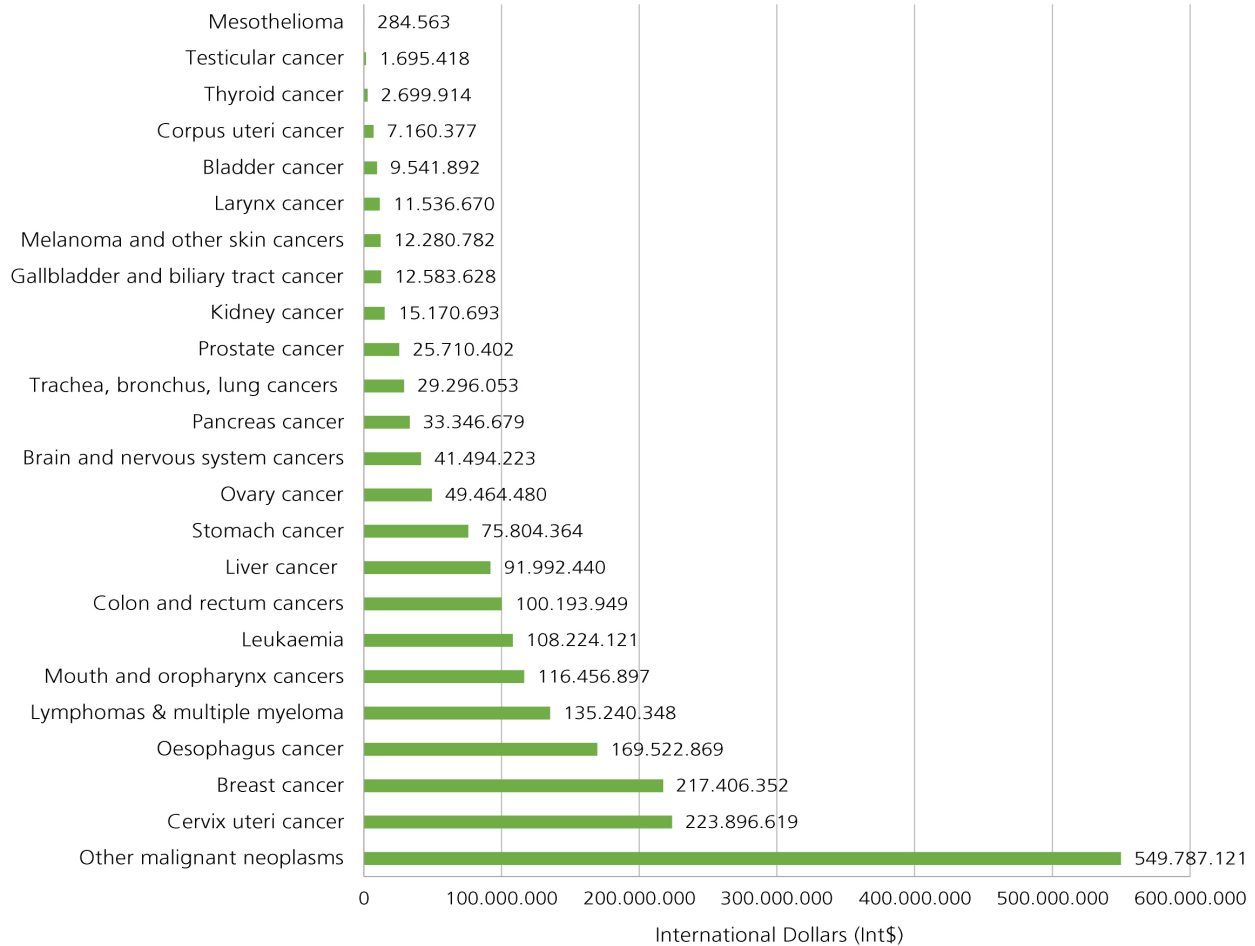


Figure 4: GDP haemorrhage from malignant neoplasms (Cancers) among 15-59 year-old in Kenya in 2015 (Int\$).



First, malignant neoplasms (Cancers) haemorrhaged 648,090 DALYs, which was equal to Int\$ 2,040,790,854. Five cancers accounted for 42.3% of the productivity losses, including cervix uteri cancer, breast cancer, oesophagus cancer, lymphomas and multiple myeloma, and mouth and oropharynx cancers (**Figure 4**).

Second, other neoplasms, diabetes mellitus and endocrine/blood/immune disorders led to a loss of 248,457 DALYs causing a haemorrhage of Int\$ 786,920,661, i.e. 7.1% of the total GDP loss in Kenya (**Table 1**).

Third, mental and substance use disorders resulted in 696,354 DALY loss, which caused a haemorrhage in GDP of Int\$ 2,205,514,227 (19.8%). About 79.4% of the GDP loss resulted from depressive disorders, bipolar disorder, schizophrenia, alcohol use disorders, and anxiety disorders (**Table 2**).

Table 1. GDP haemorrhage from other neoplasms (Cancers), diabetes mellitus, and endocrine/blood/immune disorders among 15-59 year olds in Kenya in 2015 (Int\$).

Diseases/conditions	DALY	GDP Losses (Int\$)	Percent
Other neoplasms	9,260	29,328,148	0.3
Diabetes mellitus	117,193	371,177,384	3.3
Endocrine, blood, immune disorders (a+b+c+d)	122,004	386,415,128	3.5
a. Thalassaemia	1,425	4,513,713	1.2
b. Sickle cell disorders and trait	90,249	285,840,938	74.0
c. Other haemoglobinopathies and haemolytic anaemias	21,054	66,683,416	17.3
d. Other endocrine, blood and immune disorders	9,275	29,377,062	7.6

Table 2. GDP haemorrhage from DALYs lost from mental and substance use disorders among 15-59 year-olds in Kenya in 2015 (Int\$).

Mental and substance use disorders		DALY	GDP Loss (Int\$)	Percent
1	Depressive disorders (a+b)	311,308	985,983,108	44.7
	a. Major depressive disorder	270,427	856,506,048	86.9
	b. Dysthymia	40,880	129,477,060	13.1
2.	Bipolar disorder	45,923	145,447,571	6.6
3.	Schizophrenia	49,157	155,692,769	7.1
4.	Alcohol use disorders	50,878	161,141,684	7.3
5.	Drug use disorders (a+b+c+d+e)	13,582	43,018,488	2.0
	a. Opioid use disorders	10,486	33,210,103	77.2
	b. Cocaine use disorders	316	1,001,333	2.3
	c. Amphetamine use disorders	423	1,340,938	3.1
	d. Cannabis use disorders	1,921	6,084,236	14.1
	e. Other drug use disorders	436	1,381,878	3.2
6.	Anxiety disorders	95,528	302,558,471	13.7
7.	Eating disorders	3,464	10,971,219	0.5
8.	Autism and Asperger syndrome	37,989	120,319,915	5.5
9.	Childhood behavioural disorders (a+b)	17,037	53,958,942	2.4
	a. Attention deficit/hyperactivity syndrome	2,061	6,526,788	12.1
	b. Conduct disorder	14,976	47,432,154	87.9
10.	Idiopathic intellectual disability	29,502	93,440,122	4.2
11.	Other mental and behavioural disorders	41,987	132,981,938	6.0
Total		696,354	2,205,514,227	100

Table 3. GDP haemorrhage from neurological conditions among 15-59 year-old in Kenya in 2015 (Int\$)

Neurological conditions	DALY	GDP Loss (Int\$)	Percent
1. Alzheimer disease and other dementias	2,092	6,625,654	0.9
2. Parkinson disease	591	1,870,735	0.3
3. Epilepsy	104,273	330,256,875	44.2
4. Multiple sclerosis	1,296	4,104,649	0.5
5. Migraine	102,935	326,019,488	43.6
6. Non-migraine headache	16,939	53,649,829	7.2
7. Other neurological conditions	7,936	25,136,471	3.4
Total	236,062	747,663,702	100

Table 4. GDP haemorrhage from DALYs lost from sense organ diseases among 15-59 year-olds in Kenya in 2015 (Int\$).

Sense organ diseases	DALY	GDP Loss (Int\$)	Percent
1. Glaucoma	865	2,738,480	0.8
2. Cataracts	6,207	19,659,908	5.9
3. Uncorrected refractive errors	15,500	49,090,982	14.7
4. Macular degeneration	710	2,248,227	0.7
5. Other vision loss	14,270	45,197,672	13.6
6. Other hearing loss	52,217	165,383,404	49.6
7. Other sense organ disorders	15,492	49,066,231	14.7
Total	105,261	333,384,904	100

Fourth, 236,062 DALYs were lost from neurological conditions translating to Int\$ 747,663,702 GDP loss, i.e. 6.7% of losses related to NCDs (**Table 3**). Epilepsy and migraine accounted for 87.8% of neurological conditions.

Table 5. GDP haemorrhage from cardiovascular diseases among 15-59 year-old in Kenya in 2015 (Int\$).

Cardiovascular diseases	DALY	GDP Loss (Int\$)	Percent
1. Rheumatic heart disease	18,600	58,910,580	4.3
2. Hypertensive heart disease	44,390	140,594,328	10.2
3. Ischaemic heart disease	111,944	354,551,267	25.7
4. Stroke (a+b)	161,604	511,838,612	37.1
a. Ischaemic stroke	23,478	74,360,714	14.5
b. Haemorrhagic stroke	138,126	437,477,898	85.5
5. Cardiomyopathy, myocarditis, endocarditis	23,794	75,360,220	5.5
6. Other circulatory diseases	75,252	238,340,264	17.3
Total	435,584	1,379,595,271	100

Fifth, 105,261 DALYs were lost from neurological conditions translating to Int\$ 333,384,904 GDP loss, i.e. 3% of losses related to NCDs (**Table 4**). Other hearing loss, uncorrected refractive errors, and other vision loss accounted for 77.9% of GDP losses attributed to sense organ diseases.

Sixth, 435,584 DALYs were lost from cardiovascular diseases haemorrhaging Int\$1,379,595,271, i.e. 12.4% of the total losses related to NCDs (**Table 5**). Hypertensive heart disease, ischaemic heart disease and stroke were responsible for 73% of cardiovascular diseases related GDP losses.

Seventh, 145,343 DALYs were lost from respiratory diseases haemorrhaging GDP by Int\$ 460,335,371, i.e. 4.1% of total NCD productivity losses. About 32%, 59% and 9% of those losses resulted from chronic obstructive pulmonary disease, asthma and other respiratory diseases respectively.

Eighth, 362,392 DALY losses stemmed from digestive diseases, which in turn accounted for Int\$ 1,147,779,998, i.e. 10.3% of NCD-related economic losses (**Table 6**). About 70.8% of the digestive disease GDP loss was caused by peptic ulcer disease, cirrhosis of the liver, and paralytic ileus and intestinal obstruction.

Table 6. GDP haemorrhage from digestive diseases among 15-59 year-old in Kenya in 2015 (Int\$).

Digestive diseases	DALY	GDP Loss (Int\$)	Percent
1. Peptic ulcer disease	33,847	107,201,715	9.3
2. Cirrhosis of the liver (a+b+c+d)	137,232	434,644,576	37.9
a. Cirrhosis due to hepatitis B	37,547	118,919,196	27.4
b. Cirrhosis due to hepatitis C	12,761	40,417,916	9.3
c. Cirrhosis due to alcohol use	64,321	203,719,038	46.9
d. Other liver cirrhosis	22,603	71,588,426	16.5
3. Appendicitis	11,519	36,484,855	3.2
4. Gastritis and duodenitis	28,267	89,528,397	7.8
5. Paralytic ileus and intestinal obstruction	85,434	270,590,268	23.6
6. Inflammatory bowel disease	19,029	60,270,279	5.3
7. Gallbladder and biliary diseases	11,660	36,929,535	3.2
8. Pancreatitis	9,578	30,334,718	2.6
9. Other digestive diseases	25,826	81,795,656	7.1
Total	362,392	1,147,779,998	

Ninth, 159,909 DALYs were caused by genitourinary diseases, which haemorrhaged Int\$ 506,469,904 (4.5% of NCD-related GDP losses) (**Table 7**). Gynaecological diseases and kidney diseases accounted for 75.2% of the GDP losses related to genitourinary diseases.

Tenth, 88,172 DALYs were lost from skin diseases, which contributed to Int\$ 279,261,398 haemorrha-

ge in GDP, i.e. 2.5% in NCD-related productivity losses.

Eleventh, 255,242 DALYs were lost from musculoskeletal diseases, congenital anomalies, and oral conditions, haemorrhaging Int\$ 808,411,093 in GDP, i.e. 7.3% in NCD-related productivity losses. Approximately, 54.2% of musculoskeletal diseases losses emanated from back and neck pain; 38.1%

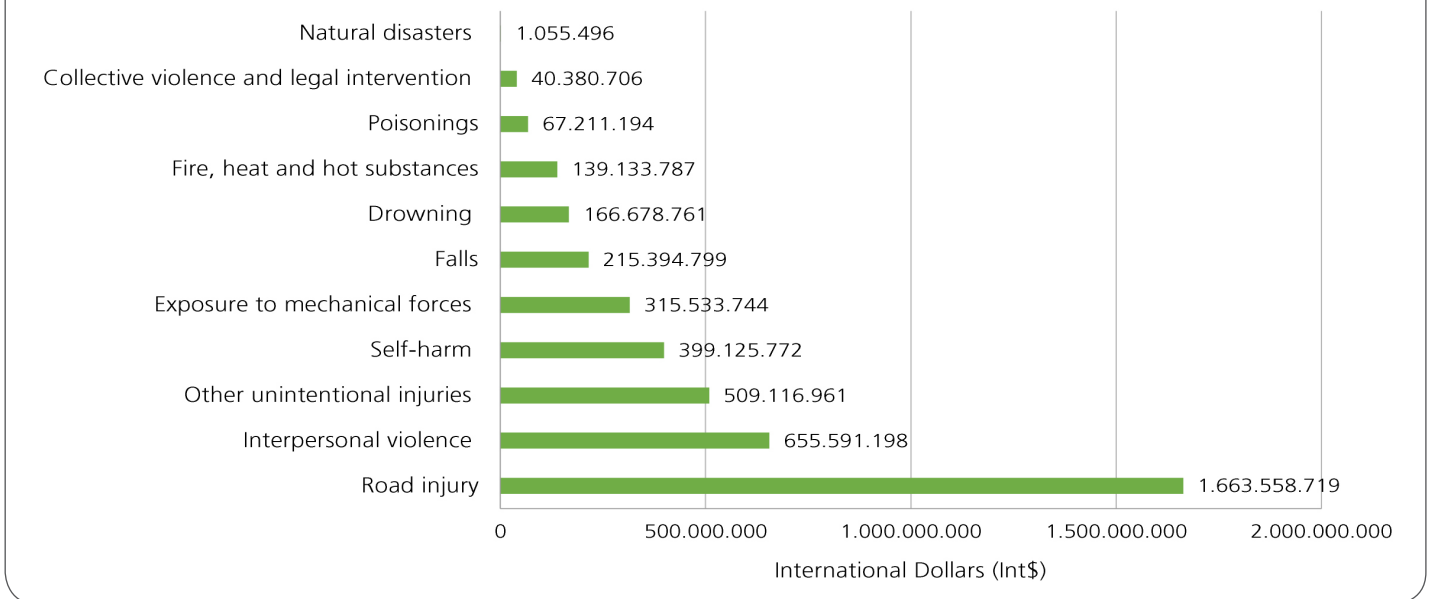
Table 7. GDP haemorrhage from genitourinary diseases among 15-59 year-old in Kenya in 2015 (Int\$).

Genitourinary diseases	DALY	GDP Losses (Int\$)	Percent
1. Kidney diseases (a+b+c)	62,611	198,303,186	39.2
a. Acute glomerulonephritis	329	1,042,783	0.5
b. Chronic kidney disease due to diabetes	18,593	58,887,298	29.7
c. Other chronic kidney disease	43,689	138,373,104	69.8
2. Benign prostatic hyperplasia	1,739	5,506,804	1.1
3. Urolithiasis (urinary tract stones)	693	2,194,317	0.4
4. Other urinary diseases	18,921	59,927,015	11.8
5. Infertility	18,332	58,060,186	11.5
6. Gynaecological diseases	57,614	182,478,397	36.0
Total	159,909	506,469,904	100.0

Table 8. GDP haemorrhage from musculoskeletal diseases, congenital anomalies, and oral conditions among 15-59 year-olds in Kenya in 2015 (Int\$)

Diseases	DALY	GDP Loss (Int\$)	Percent
1. Musculoskeletal diseases	311,308	985,983,108	44.7
a. Rheumatoid arthritis	270,427	856,506,048	86.9
b. Osteoarthritis	40,880	129,477,060	13.1
c. Gout	45,923	145,447,571	6.6
d. Back and neck pain	49,157	155,692,769	7.1
e. Other musculoskeletal disorders	50,878	161,141,684	7.3
2. Congenital anomalies (a+b+c+d+e+f)	92,250	292,177,791	2.6
a. Neural tube defects	6,072	19,230,532	6.6
b. Cleft lip and cleft palate	196	620,116	0.2
c. Down syndrome	6,778	21,466,108	7.3
d. Congenital heart anomalies	35,107	111,192,151.3	38.1
e. Other chromosomal anomalies	4,226	13,384,109	4.6
f. Other congenital anomalies	39,872	126,284,775	43.2
3. Oral conditions (a+b+c+d)	45,597	144,417,218	1.3
a. Dental caries	3,928	12,439,523	8.6
b. Periodontal disease	20,833	65,982,699	45.7
c. Edentulism	5,450	17,262,220	12.0
d. Other oral disorders	15,387	48,732,777	33.7

Figure 5: GDP haemorrhage from injuries among 15-59 year-old in Kenya in 2015 (Int\$).



congenital anomalies GDP losses were from congenital heart anomalies; and 45.7% of oral condition losses were from periodontal diseases (**Table 8**).

GDP haemorrhage from injuries

Twelfth, 1,317,485 DALYs lost were from injuries, which haemorrhaged Int\$ 4,172,781,137 of GDP, i.e. 14% of the grand total productivity losses from all causes (**Figure 5**). About 73.8% of the losses were from unintentional injuries; and the remaining 26.2% from intentional injuries. Sixty-four percent of the unintentional injuries GDP losses were from road injury and exposure to mechanical forces. Ninety-six percent of the intentional injuries GDP losses resulted from self-harm and interpersonal violence.

Discussion

The 9,405,184 DALYs lost among 15-59 years olds are estimated to have haemorrhaged equivalent to 21% of Kenya's GDP in 2015. In other words, if Kenya could avert all the DALYs lost in 2015, it could increase its GDP by 21%. Kenya could potentially avert majority of the GDP losses from commu-

ble and non-communicable diseases and injuries by implementing pertinent policies and strategies agreed upon at the United Nations General Assembly, World Health Assembly, African Union and WHO Regional Committee for Africa.

Global and regional policies and strategies for combatting communicable diseases

HIV/AIDS

In May 2016, the Sixty-ninth World Health Assembly (WHA) endorsed the Global Health Sector Strategy for HIV (2016-2021) [30] that envisions zero new HIV infections, zero HIV-related deaths and zero HIV-related discrimination in a world where people living with HIV are able to live long and healthy lives [30, 31]. Its goal is to end the AIDS epidemic as a public health threat by 2030, within the context of ensuring healthy lives and promoting well-being for all at all ages [31]. The strategy has five strategic directions: strategic information for focussed action and accountability, essential interventions for impact, delivering for quality and equity, financing for sustainability and financial risk protection, and innovation to bridge knowledge and technological gaps for acceleration [31]. The 62nd WHO Regio-

nal Committee for Africa resolution AFR/RC62/R2 adapted the global HIV strategy to the African region context to facilitate implementation of the global strategy [32].

Diarrhoeal diseases

The Thirty-first WHA resolution WHA31.44 of 1978 urged Member States to implement effective interventions for prevention and case management of diarrhoeal diseases in the primary health care context [33]. The 1987 Fortieth WHA resolution WHA40.34 underscores that prevention of diarrhoeal diseases entails improving nutrition, promoting breast-feeding, access to and use of safe water, personal hygiene (including hand washing with soap), sanitation, and immunization against measles [34]. It also adds that an effective diarrhoeal diseases control programme must include careful planning, adequate health manpower training and information, effective communication as well as education on health, sanitation, nutrition promotion, adequate production, distribution and social marketing of oral rehydration preparations, and appropriate supervision, monitoring and evaluation [34]. The 2011 Sixty-fourth WHA resolution WHA64.15 called upon Member States to mobilize sufficient technical and financial resources for coordinated and multi-sectoral measures for preparation, prevention and control of cholera [35]. The 2017 cholera outbreaks in Kenya's Nairobi capital city clearly indicates that there is need for implementing sectoral and inter-sectoral interventions (health education, personal hygiene, potable water, improved sanitation, environmental conditions and cultural practices) to prevent recurrence of diarrhoeal diseases [36].

Parasitic and vector diseases

The Seventieth World Health Assembly in 2017 through its resolution WHA70.16, adopted the Global Vector Control Response 2017-2030, which envisions a world free of human suffering from

vector-borne diseases [37]. According to the WHA resolution and strategy, Kenya's national vector control strategy and operational plan(s) should, among others, feature needs assessment and resource mobilization plan; training of relevant staff from national and County ministries of health in public health entomology; establishment of functional national institutional network(s) to support education and training in public health entomology; and development of a national agenda for basic and applied research on entomology and vector control. In order significantly reduce the burden and threat of vector-borne diseases, Kenya's strategic vector control plan will need to be supported by four pillars: inter- and intra-sectoral action and collaboration; engaging and mobilizing communities; enhancing vector surveillance and monitoring and evaluation of interventions; and scaling up and integrating tools and approaches [38].

Tuberculosis

The Sixty-Seventh WHA, in 2014, through resolution WHA67.1 adopted the global strategy and targets for tuberculosis (TB) prevention, care and control after 2015 [39]. The strategy envisions a world without TB. It targets ending the global TB epidemic by 2035 through a reduction in TB deaths by 95% and in TB incidence by 90%, and elimination of associated catastrophic costs for TB-affected households. The strategy has three pillars: integrated, patient-centred care and prevention (early diagnosis of TB, treatment of all people with TB, management of HIV/TB co-morbidities, preventive treatment of persons at high risk, and vaccination against TB); bold policies and supportive systems (adequate resources for TB care and prevention, engagement of stakeholders, social protection, and universal health coverage policy and regulatory frameworks); and intensified research and innovation (development and uptake of new tools, optimization of implementation) [40].

Meningococcal meningitis

The WHO strategy for the control of epidemic meningitis is based on three key pillars: surveillance (to detect the first cases, identify the pathogen as well as the serogroup of the meningococcus); treatment and care (providing prompt, appropriate, accessible and affordable treatment with antibiotics and care); and vaccination (large-scale vaccination of population groups that are at risk) [41].

Global and regional policies and strategies for battling non-communicable diseases

Following the adoption of the UN General Assembly (UNGA) decisions [42, 43, 44], WHA resolutions [45, 46, 47, 48], and WHO Regional Committee for Africa resolutions [49,50,51] related to NCDs, WHO specified 10 indicators which the Director-General will use to report [52], by the end of 2017, to the UNGA on the progress achieved in the implementation of the time-bound commitments included in the 2014 Outcome Document [53]. By end of 2015, Kenya had fully achieved the following: formulated national NCDs targets and indicators; developed national integrated NCD policy/strategy/action plan; developed public awareness on diet and/or physical activity; articulated guidelines for the management of major NCDs; and legislated tobacco advertising ban. The country had partially achieved the indicators on: risk factor surveys, health warnings tobacco demand-reduction measure, and harmful use of alcohol reduction measures, such as availability of regulations, advertising and promotion bans, and pricing policies. The following indicators had not been achieved: NCD mortality data surveillance; taxation and smoke-free policies tobacco demand-reduction measures; unhealthy diet reduction measures (salt/sodium policies, saturated fatty acids and trans-fats policies, marketing to children restrictions, and marketing of breast-milk substitutes restrictions); and drug therapy/counselling for high risk persons [52].

The 2030 Agenda for Sustainable Development aims to reduce premature deaths from NCDs by

one-third by 2030 (SDG target 3.4), strengthen implementation of the WHO Framework Convention on Tobacco Control (FCTC) (3.a), strengthen the prevention and treatment to reduce the harmful use of alcohol (3.5), support the research and development on medicines for NCDs that primarily affect developing countries (3.b), and achieve universal health coverage (3.8) [54]. This historic decision to include NCDs within the scope of SDGs is grounded in the commitments made at two high-level meetings of the UNGA in 2011 and 2014 to track the exponential increase in prevalence of NCDs and its impact on development, make prevention the cornerstone of the global response, and strengthen national health systems capacities tackle NCD epidemic [44, 53].

Kenya national policies and strategies for combatting communicable and non-communicable diseases

Kenya's national health policy goal is to attain the highest possible health standard in a manner responsive to the population needs through provision of equitable, affordable and quality health and related services to all Kenyans [55]. Its policy objectives are to eliminate communicable diseases; halt and reverse rising burden of NCD's; reduce the burden of violence and injuries; provide essential health services; minimize exposure to health risk factors; and strengthen collaboration with private and health-related sectors. Kenya national health sector strategic plan (NHSSP) expounds on the strategies for realizing those policy objectives [56]. It explains how investments would be increased and efficiently utilized to strengthen health system building blocks (organization of services, health workforce, health infrastructure, health products and technologies, health information and research, health finance, and leadership and governance) at community, primary, county and national levels to provide unfettered access to an Essential Package of Health Services to all Kenyans in need. However,

Kenya's current total health expenditure per capita of US\$68 [29] is far much lower than the USD US\$ 271 total cost per person needed to achieve health SDG 3 [57].

Global and regional policies and strategies for preventing injuries

Road traffic injuries and Interpersonal violence alone account for 55.6% of violence-related productivity losses. Due to great concern about health losses attributable to road traffic accidents the UNGA adopted eight resolutions on improving global road safety between 2003 and 2014 [58-65]. The 2010 resolution proclaims the period 2011–2020 as the Decade of Action for Road Safety, with a goal of stabilizing and then reducing road traffic fatalities [60]. It called upon member states to implement road safety activities, particularly in the areas of road safety management, road infrastructure, vehicle safety, and road user behaviour, among others.

The UNGA has also adopted conventions and resolutions for curbing other forms of injuries. The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) asserts the rights of women and elimination of all forms of discrimination [66]. The UNGA A/RES/48/104 asserted women's right to life and called upon governments to budget adequate resources for implementing action plans to eliminate all forms of violence against women [67]. By resolution A/RES/54/134, the UNGA designated 25 November as the International Day for the Elimination of Violence against Women [68].

This political momentum culminated in UNGA adoption of its resolution A/RES/70/1 of 25 September 2015 entitled "Transforming our world: the 2030 Agenda for Sustainable Development" [54]. The Goal 3 on ensuring healthy lives and promoting well-being for all at all ages has a target 3.6, which aspires to halve the number of global deaths and injuries from road traffic accidents by 2020 [54].

Thus, there is political commitment at the UNGA Heads of State level to curb injuries. What about at the WHA?

The UNGA in 2004 designated WHO the coordinator on road safety issues [63]. WHO accepted the responsibility through resolution WHA57.10 [69]. Subsequently, in 2007, the WHA adopted resolution WHA60.22 calling upon Member States to strengthen emergency care systems to improve provision of trauma and emergency care [70]. The WHA resolution WHA69.7 of 2016 urged Member States to implement the Brasília Declaration on Road Safety [71]; commit to implement the Decade of Action for Road Safety 2011–2020 and the Global Plan for the Decade of Action for Road Safety 2011–2020 [72]; develop and implement a national strategy and action plan; adopt and enforce laws on the key risk factors (speeding, drinking alcohol and driving; non-use of motorcycle helmets, seat-belts and child restraints; distracted or impaired driving), improve the quality of road safety data; and improve prevention and emergency medicine training programmes [73].

The Sixty-seventh WHA, in 2014, adopted resolution WHA67.15 that urges Member States to develop comprehensive and effective multi-sectoral response to interpersonal violence against women, girls and children [74]. The Sixty-Ninth WHA, in 2016, adopted resolution WHA69.5 urging Member States to implement the WHO global plan of action to strengthen the role of the health system within a national multi-sectoral response to address interpersonal violence against women, girls and children [75]. Thus, there is expressed commitment among global ministers of health to tackle injuries in countries. Is there commitment at Africa continent level prevent injuries?

At the Continental level, the African Union has a Road Safety Charter [76] and an African Road Safety Action Plan [77]. In order for African countries to fully implement the action plan, the First Ordinary Session of the African Union Specialized

Technical Committee, recommended that Member States create and/or strengthen their Lead Road Safety Agencies, involve private sector and civil society organizations, build a critical mass of skilled road safety experts, modernize management of national database on road safety, strengthen human and financial resources of emergency services of hospitals, develop national monitoring frameworks, enhance sensitization on Road Safety, sustainably finance national road safety programme, celebrate the African Road Safety Day on 18th November, and appoint high-level political Road Safety Champions [78].

In order to curb domestic violence, the African Union adopted the Protocol to enshrining the Rights of Women in Africa. The protocol calls upon State Parties to enact and enforce laws to prohibit all forms of violence against women including unwanted or forced sex whether the violence takes place in private or public [79]. Thus, political commitment also exists within the African Union to curb all forms of injuries.

Does commitment exist among ministers of health in Africa? The WHO Regional Committee for Africa has over the years adopted a number of resolutions aimed at injury prevention and control. Resolution AFR/RC53/R3 urges Member States to adopt and implement national policies and programmes on injury and violence prevention and control [80]. Resolution AFR/RC53/R4 called upon Member States to accelerate the implementation of interventions aimed at eliminating all forms of violence and harmful traditional practices [81]. Resolution AFR/RC58/R1 called upon Member States to consider in women's health policies, the prevention of early and forced marriages, gender-based violence and all forms of discrimination against women, and adopt and enforce relevant legislation [82]. Resolution AFR/RC63/R4 called upon member states to intensify action aimed at eliminating violence against women, gender discrimination, sexual coercion, early marriage and harmful tradi-

tional practices such as female genital mutilation [83]. There seems to be expressed commitment among ministers of health in the AFR.

Kenya national policies and strategies for preventing injuries

Since this paper is on indirect cost of DALYs lost in Kenya, is there commitment to tackle injuries? At the national level, Article 26 of Kenya's Constitution asserts every person's right to life; and Article 29 assures the right to security of the person, including the right not to be subjected to any form of violence from public or private sources [84]. The country has a National Transport Safety Authority (NTSA) whose functions are to implement policies relating to road transport and safety; plan, manage and regulate the road transport system; and ensure the provision of safe, reliable and efficient road transport services [85, 86]. Kenya has a comprehensive road safety action plan [87]. The country also has a Prohibition of Female Genital Mutilation (FGM) Act No. 32 of 2011 prohibiting the practice of FGM and safeguarding against violation of a person's mental or physical integrity through the practice of FGM [88]. In addition, Kenya has an Act of Parliament aimed at providing protection and relief of victims of domestic violence [89]. The existing legal framework and plans of action for preventing intentional and unintentional injuries have not been fully implemented due to inadequacy of inter-sectoral resources allocated for the purpose [90].

Limitation of this study

This study has a number of limitations. First, the focus of the current study was on productivity losses attributable to DALYs lost in Kenya in 2015. Thus, the study omitted direct health systems costs, e.g., health workforce time, medicines, diagnosis, health facility buildings and equipment.

Second, the DALY index has been criticized for age weighting (giving more weight to DALYs lost

among people in economically productive age bracket), discounting, and using the highest average life expectancy in the world instead of each country's average [91,92]. Furthermore, given Kenya's weak vital registration system for births and deaths, estimations of years of life lost are based on a combination of second-best approaches.

Third, the study uses GDP per capita to monetarily value DALYs lost. The GDP has been criticized for omitting contributions of full-time home-makers (e.g. housewives), for not reflecting inequalities in income distribution, and for valuing leisure activities at zero [93-96].

Fourth, if the HCA strictly is applied, the DALYs lost by the unemployed and full-time homemakers would be valued at zero [23, 97, 98]. In order to alleviate the impact of this limitation, the current study valued all the DALYs lost using the same per capita GDP, without adjusting for employment rates.

Conclusion

Annually Kenya suffers considerable GDP haemorrhage due to non-fatal disability and premature mortality among the 15-59 year olds, i.e. the most productive age bracket in Kenya's population. Majority of the health and economic haemorrhage from all causes can be averted using available proven promotive, preventive, curative and rehabilitative interventions. On paper, there exists political commitment at global, continental, regional and national levels to stem the tide of DALY haemorrhage. However, the political commitment does not seem to have translated into allocation of adequate budget for implementing existing policy and legal frameworks and action plan(s) to tackle the root causes DALY losses [3]. Thus, the need for evidence-based advocacy among national and county governments, private sector (industry) and external development partners to increase and use all available health development resources more

efficiently to strengthen performance of health systems [2, 99, 100, 101, 102], national health research and innovation system [6, 7], and other systems that tackle social determinants of health (e.g. education, food, water, sanitation and shelter) [4] cannot be overemphasized.

List of abbreviations

- AFR: WHO African Region
- AU: African Union
- CEDAW: Convention on the elimination of all forms of discrimination against women
- DALY: Disability-adjusted-life-year
- DALY₁₅₋₂₉: number of disability-adjusted-life years lost among those aged 15-29 years
- DALY₃₀₋₄₉: number of disability-adjusted-life years lost among those aged 30-59 years
- DALY₅₀₋₅₉: number of disability-adjusted-life years lost among those aged 50-59 years
- FCTC: Framework Convention on Tobacco Control
- FGM: Female genital mutilation
- GDP: Gross domestic product
- GHO: Global Health Observatory
- HCA: Human capital approach
- IMF: International Monetary Fund
- INT\$: International Dollars or Purchasing Power Parity (PPP)
- NCD: Non-Communicable Disease
- NHGDPA: Non-health GDP haemorrhage
- NHGDPA₁₅₋₂₉: Non-health GDP haemorrhage among people aged 15-29 years
- NHGDPA₃₀₋₄₉: Non-health GDP haemorrhage among people aged 30-49 years
- NHGDPA₅₀₋₅₉: Non-health GDP haemorrhage among people aged 50-59 years
- NHGDPPC_{Int\$}: per capita non-health GDP in purchasing power parity (PPP)
- NHSSP: National health sector strategic plan
- NTSA: National Transport Safety Authority
- PCTHE: per capita total health expenditure
- SDG: Sustainable Development Goal

STD: Sexually transmitted diseases
UNGA: United Nations General Assembly
WHA: World Health Assembly
WHO: World Health Organization
WHO/AFRO: World Health Organization Regional
Office for Africa

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Declarations

Ethics approval and consent to participate

The study reported in this paper did not entail participation of either animal or human subjects. It was based on analysis of secondary data published on the IMF and WHO websites. Therefore, according to the standard operating procedures of the Meru University of Science and Technology Institutional Research Ethics Review Committee (MIRERC), the study did not require ethical approval.

Consent for publication

Not applicable.

Availability of data and materials

The datasets analysed in this study are contained in the IMF World Economic Outlook database and the WHO Global Health Observatory.

Competing interests

The authors declare that they have no competing interests.

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Authors contributions

JMK and GMM designed the study, reviewed pertinent literature, sourced and analysed the data and wrote the manuscript. All authors approved the final version of the paper for publication.

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