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Impact of disaster-related mortality on gross domestic product in the WHO African Region

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Abstract

Background: Disaster-related mortality is a growing public health concern in the African Region. These deaths are hypothesized to have a significantly negative effect on per capita gross domestic product (GDP). The objective of this study was to estimate the loss in GDP attributable to natural and technological disaster-related mortality in the WHO African Region.

Methods: The impact of disaster-related mortality on GDP was estimated using double-log econometric model and cross-sectional data on various Member States in the WHO African Region. The analysis was based on 45 of the 46 countries in the Region. The data was obtained from various UNDP and World Bank publications.

Results: The coefficients for capital (K), educational enrolment (EN), life expectancy (LE) and exports (X) had a positive sign; while imports (M) and disaster mortality (DS) were found to impact negatively on GDP. The above-mentioned explanatory variables were found to have a statistically significant effect on GDP at 5% level in a t-distribution test. Disaster mortality of a single person was found to reduce GDP by US$0.01828.

Conclusions: We have demonstrated that disaster-related mortality has a significant negative effect on GDP. Thus, as policy-makers strive to increase GDP through capital investment, export promotion and increased educational enrolment, they should always keep in mind that investments made in the strengthening of national capacity to mitigate the effects of national disasters expeditiously and effectively will yield significant economic returns.

Background

This paper focuses on the economic impact of deaths attributable to natural and technological disasters. Natural disasters include avalanches, landslides, cold waves, cyclones, hurricanes, typhoons, droughts, earthquakes, floods, volcanic eruptions, wildfires, epidemics and famines (excluding famines resulting from conflicts) [1]. Technological disasters include accidents, chemical accidents and urban fires.

The United Nations Development Programme (UNDP) has estimated that between 1980 and 1999, globally, a total of 1,429,412 people were killed by disasters [1]. About 96.4% (1,377,318) of those deaths occurred in developing countries, of which 38% (520,165) occurred in the countries that comprise the African Region of the World Health Organization (WHO). About 96% (499,510) of the disaster-related deaths in the Region resulted from natural disasters and the remaining 4% (20,655) from technological disasters [2].

Out of the 499,510 deaths that were caused by natural disasters, 80.9% resulted from droughts, 14.5% from epidemics (e.g. cholera, acute watery diarrhoeal syndrome, Ebola haemorrhagic fever, meningococcal disease), 2.3% from famines, 0.6% from earthquakes, 0.4% from volcanoes and 0.4% from windstorms (tornado, storm, cyclone). On the other hand, of the 20,655 technological disaster-related deaths, 83% were caused by transport accidents, 13% by industrial accidents and 4% by miscellaneous accidents [2].

Although natural disasters cannot be prevented, better preparedness for and effective response to such disasters when they do occur could help reduce the number of human deaths and the extent of damage to property, including capital investments. On the other hand, it is possible to implement measures for preventing technological disasters and mitigating their adverse effects on human lives, infrastructure and property, if and when they occur.

Due to the increased vulnerability of people and property to natural disasters, the United Nations General Assembly, in December 1987, adopted a resolution designating the 1990s as the International Decade for Natural Disaster Reduction (IDNDR). The resolution, *inter alia*, stated:

"The objective of the IDNDR is to reduce through concerted international action, especially in developing countries, the loss of life, property damage and social and economic disruption caused by natural disasters such as earthquakes, windstorms, tsunamis, floods, landslides, volcanic eruptions, wildfires, grasshopper and locust infestations, drought and desertification and other calamities of natural origin" [3].

It called upon all governments to: formulate national disaster-mitigation programmes; participate in concerted international action to reduce the effects of natural disasters; establish appropriate national committees in cooperation with relevant scientific and technological institutions and organizations; mobilize necessary support from the public and private sectors; take appropriate measures to increase public awareness of the potential risk and the importance of preparedness, prevention and relief; pay special attention to activities aimed at reducing the vulnerability of hospitals and health centres, food storage facilities, human shelters and other social and economic infrastructures; and improve the availability of appropriate emergency supplies through storage of such supplies in disaster-prone areas.

Cognizant of the high frequency of disasters in the Region (with the accompanying adverse effects on health and its risk factors) and in an effort to implement the UN resolution on IDNDR, the WHO Regional Committee for Africa adopted a series of resolutions [4-7] urging its Member States to allocate adequate resources for strengthening their technical, institutional/organizational and logistical capacities in emergency preparedness and response. These resolutions culminated in the adoption by the Regional Committee of the regional strategy for emergency and humanitarian action in 1997. The strategy calls for an interdisciplinary and multi-sectoral approach to emergency management, i.e. prevention, preparedness, readiness and response [8].

To date, to the best of our knowledge, no study has attempted to estimate the loss in GDP attributable to mortality caused by natural and technological disasters in the Member countries of the WHO African Region. The objective of the present study was to bridge this knowledge gap.

This study could be used by different stakeholders in various ways: (i) to sensitize non-health sectors (especially ministries of State, Finance and Economic Development/ Planning) in order to generate political and economic support for emergency preparedness and response; (ii) it could be used by international non-governmental organizations that support emergency preparedness and response in Africa to lobby for continued support from abroad; and (iii) researchers undertaking economic-burden studies in future could adapt the methodology used in the current study.

Methods

Conceptual framework

The study used the Production Function (PF) analytical framework to estimate the loss in GDP attributable to deaths related to disasters in the Region. A PF describes the transformation of the factors of production (inputs) into outputs with its existing technology. The general mathematical form of the production function is: $Y = f(L, K, R, S, v, \tilde{a})$, where: Y = output, L = labour (skilled, semi-skilled and unskilled), K = capital (buildings, equipment and inventories), R = raw materials, S = land input (which encompasses all natural resources), v = returns to scale, and $\tilde{a}$ = efficiency parameter, measuring the entrepreneurial-organizational aspects of production [9]. Thus, a PF shows the maximum amounts of the various combinations of outputs that a country can produce with its existing resources and techniques [10].

The gross domestic product (GDP) is one of the main national output measures. GDP is the sum of the total value of consumption expenditure, total value of investment expenditure, government purchases of goods and services and net exports (i.e. exports minus imports) of goods and services. It can also be viewed as the total value of consumption expenditure, gross private savings (including business and personal savings); net tax revenues (tax revenue minus domestic transfer payments, net interest paid and net subsidies); and total private transfer payments to foreigners [11].

Intuitively, disaster-related deaths can impact on the production of GDP in a number of ways. First, they reduce the quantity of the labour force and hence the number of people involved in output production. Second, disasters maim and kill the unskilled, semi-skilled and highly skilled labour force and entrepreneurs, who are in acute short supply in the African Region. The attrition of the latter three categories of human resources may impact negatively on GDP.

Third, the typically high funeral-related costs might force affected households to liquidate/sell off some of the output-producing assets (e.g. land, farm machinery and equipment) to pay for funerals. In third world economies, characterized by the high levels of underemployment/ unemployment of the labour force and the low levels of capital investment, depletion of these assets could spontaneously lead to a reduction in output.

Fourth, given the high levels of poverty across the African Region, the bereaved children may be forced to drop out of school due to lack of school fees, or to work in order to compensate for the lost household income. This would have adverse repercussions on human capital creation (i.e. the quality and quantity of future labour force) and hence on the sustainability of GDP and its growth.

Fifth, premature death of people in active labour force may lead to a reduction in the total household consumption expenditure, government tax revenues, private business and personal savings, and hence the resources available for investment purposes.

Sixth, when disasters strike, households, governments and non-governmental organizations are forced to divert resources from productive sectors into reconstruction/ rehabilitation programmes. And often, such programmes do not make net contributions to GDP.

Formally, the effect of disaster-related mortality on GDP can be expressed as follows:

$$GDP = f(D, L, K, HK, EA, OE, DS) \quad (i)$$

where: GDP = real per capita gross domestic product, i.e. real value of annual volume of goods and services divided by population; D = land; L = labour input (persons aged 15 years and above); K = physical capital stock; HK = human capital, i.e. the skills and knowledge embodied in a person; EA = entrepreneurial ability (the ability to plan, organize and produce new commodities); OE = openness of the economy; and DS = number of people killed by disasters.

Equation (i) shows the effect of DS on GDP, holding the effects of D, L, K, HK and EA constant. If deaths caused by disasters are a burden on the economies of African countries, the coefficient for DS variable would be expected to assume a negative sign. The effects of the explanatory variables on the dependent variable (GDP) are unlikely to be linear; thus, in this study we shall estimate Cobb-Douglas production function of the following form:

$$GDP = aD^{ß1}L^{ß2}K^{ß3}LE^{ß4}EN^{ß5}X^{ß6}M^{ß7}DS^{ß8}e \quad (ii)$$

where: LE is life expectancy; EN is school enrolment; X is exports and M is imports.

Taking the logarithms of both sides of equation (ii), we obtain the following log-log (or double-log, log-linear or constant elasticity model):

$$\log GDP = \log a + ß_1 \log D + ß_2 \log L + ß_3 \log K + ß_4 \log LE + ß_5 \log EN + ß_6 \log X + ß_7 \log M + ß_8 \log DS + e \quad (iii)$$

where: log is the natural log (i.e. log to the base e, where e equals 2.718); a is the intercept term (i.e. the output if all the explanatory variables included in the model were equal to zero); ß's are the coefficients of elasticity, which can take any value between 0 (perfectly inelastic) to 8 (perfectly/infinitely elastic); and e is a random (stochastic) error term capturing all factors that affect gross domestic product but are not taken into account explicitly in the model [12]. Why, readers might ask, did the authors choose to include the above-mentioned variables in the model?

'Land' includes all natural resources like soil, mineral deposits, rivers, lakes, sea, fish, forests, oil (petroleum), natural gas, wild animals, etc. Civilizations have drawn great strength from productive land resources [13]. It is common knowledge that agriculture is the backbone of the majority of the economies in Africa. Most of the African people earn their livelihood from land, either directly (through farming) or indirectly (in agro-processing industries). More than three decades ago, Professor Gunnar Myrdal [14], a Nobel laureate in economics, made the following remarkable statement: "It is in the agricultural sector that the battle for long-term economic development will be won or lost." That statement is very pertinent to Africa even today. We would expect a positive relationship between the arable land per capita and GDP per capita, since agriculture makes substantive contribution to the latter.

'Capital' means the stock of physical reproducible factors of production, i.e. tangible investment goods, e.g. plant and equipment, machinery, buildings, etc. [15]. Development economists have argued that capital formation (i.e. investment in capital goods that leads to increase in capital stock, national output and income) is the key to economic growth and development. The process of capital formation entails: (i) an increase in the volume of real savings; (ii) the existence of credit and financial institutions to mobilize savings and channel them to productive use; and (iii) the use of these savings for investment in capital goods [10].

There are a number of ways of bringing about capital accumulation/formation: (i) forced savings through taxation (to siphon them off into the coffers of the State), deficit financing and borrowing from the public; (ii) government could use the profits earned by public corporations for capital formation; (iii) government could restrict importation of luxury consumer commodities through import duties or tariffs; (iv) removal of underemployed agricultural workers whose marginal productivity is negligible or zero from the land and employing them on various capital projects such as irrigation, roads, railways, hospitals, house buildings, etc.; (v) start of joint ventures whereby foreign investors bring technical know-how along with capital, and train local labour and entrepreneurs; and (vi) negotiate for favourable terms of trade, save part of the export earnings and invest them in the acquisition of capital stocks. Since capital is acquired primarily to boost production, one would expect a direct (positive) relationship between capital investment and GDP per capita.

'Labour force' refers to all economically active persons, including the armed forces and the unemployed but excluding housewives, students and economically inactive groups [15]. Given the high levels of unemployment and under-employment in African economies, it is difficult to predict whether an increase in the labour force, with the stock of capital held constant, would translate into an increase in the total output (GDP).

'Human capital' are the productive investments embodied in human beings. These include skills, abilities, ideals, values and health resulting from expenditures on education, on-the-job training programmes and health care (including curative, rehabilitative, preventive and promotive care). It is the human resource of a nation (i.e. the quantity and quality of its labour force) and not its physical capital or natural resources that ultimately determines the character and pace of its economic and social development [15]. Unlike capital and natural resources, which are passive factors of production, human beings are the active agents who accumulate capital, exploit natural resources, build social, cultural, economic and political institutions and carry forward national development [16]. To be consistent with the past production function studies on the economic burden of health problems [17], we have used two proxies of the human capital in this study.

(i) Combined primary, secondary and tertiary school enrolment ratio (EN) as a proxy for education-related human capital, the rationale being that there is evidence in the economics of education literature that schooling raises earnings and productivity mainly by providing knowledge, skills and a way of analysing problems [18]. Some studies have shown that education promotes health, reduces the likelihood of smoking [19], increases the likelihood of toilet ownership [20], improves the probability of the use of contraceptives [21], raises the propensity to vote (i.e. participate in the democratic process) and stimulates the appreciation of classical music, literature and even sports [22], all these being non-monetary benefits. Other studies have also found that health education knowledge about modes of transmission of HIV/AIDS, its prevalence and preventive measures empowered women to exercise their right to uncoerced choice to have safe sexual relationships [23]. Given the direct relationship between education and earnings, it is expected that the education variable (EN) will have a positive impact on GDP.

(ii) We have used life expectancy at birth (LE) to capture health-related human capital. Of course, we are aware that health consists of both health-related quality of life as well as quantity of life. Since in this study we are concerned with only the mortality aspect of disasters, it made sense to include only life expectancy. According to the World Bank [24], there is strong evidence which shows that poor health (from high morbidity and mortality) imposes immense economic costs on individuals, households and society at large. Becker [18] argued that a decline in the death rate at working ages may improve earning prospects by extending the period during which earnings are received. Ram [25] found a positive relationship between life expectancy and real GDP per capita. Keeping in view the foregoing arguments, one would expect life expectancy to have a positive partial effect on GDP per capita.

All economies in the countries in the African Region are open economies, which means that they do not exist in isolation but trade goods and services [26]. However, the degree of 'openness' among countries varies considerably. In this study we have used exports and imports as a proportion of GDP as a measure of the degree of openness. *Export* (X) is the value of all goods and non-factor services *sold* to the rest of the world; they include merchandise,

Table 1: Variable descriptions

Variable	Variable description
GDP	Per capita gross domestic product (GDP), i.e. real value of annual volume of goods and services (in purchasing power parity US$) divided by population
D	Hectares of arable land per capita, i.e. total arable land divided by population
L	The number of people who are currently employed and people who are unemployed but seeking work, as well as first-time job-seekers
K	Capital stock proxied by gross domestic investment (as a percentage of GDP). It consists of additions to fixed assets of the economy plus net changes in inventory
LE	Life expectancy in years
EN	Combined primary, secondary and tertiary gross enrolment ratio
X	Openness of economy proxied by exports of goods and services (each expressed as a percentage of GDP)
M	Openness of economy proxied by imports of goods and services (as a percentage of GDP)
DS	Number of people killed by natural and technological disasters in a year

Table 2: Means and standard deviations

Variable	*Mean*	*Standard deviation*
GDP	2149.463	2388.444
Land (D)	0.243	0.154
Labor (L)	5,933,333	8776000
Capital (K)	22.053	13.431
Life expectancy (LE)	51.117	8.414
Education (EN)	46.732	19.55
Exports (X)	32.713	21.792
Imports (M)	45.993	30.334
Disaster-related deaths (DS)	11991.044	48826.814

freight, insurance, travel and other non-factor services [15]. Since exports represent an injection of expenditure by foreigners into the domestic expenditure/income flow, it is expected to be directly related to GDP per capita.

'Import' (M) is the value of all goods and non-factor services 'purchased' from the rest of the world; they include consumer goods (e.g. pharmaceuticals, non-pharmaceutical supplies) and capital goods (e.g. machinery, equipment, medical technologies, vehicles, computers). Thus, M captures all expenditure on imports by all economic agents – households, business enterprises, the government sector, parastatal institutions, non-governmental organizations, etc. Imports (M) mean a leakage from the national income/expenditure flow to the rest of the world [27], implying that it would be expected to be inversely related to GDP per capita.

The purpose of the current study was to estimate the loss in GDP attributable to natural and technological 'disaster-related deaths' (DS). Thus, it is obvious that the variable had to be included in the analysis. If DS imposes economic burden on African economies, its coefficient would be expected to assume a negative sign.

Data sources and analysis

The data used to estimate equation (iii) was obtained from two sources – GDP per capita (GDP), capital (K), school enrolment (EN), life expectancy (LE), exports (X), imports (M) and disaster deaths (DS) from UNDP [1], and arable land per capita (D) and labour force (L) from The World Bank [28].

The raw data were entered into the computer using the EXCEL spreadsheet program and subsequently exported to STATA software [29] for statistical analysis. In order to estimate the double-logarithmic equation (iii), standard STATA commands were used to transform the dependent and independent variables into their logarithms. The dependent and independent (explanatory) variables are defined in Table 1.

Table 3: Effects of various explanatory variables on GDP per capita

variable	elasticity (t statistic)	Slope coefficient [1] (t statistic)	P > |t|
log (D)	0.043 (1.19)	380.358 (1.19)	0.243
log (L)	-0.010 (-1.22)	-0.0000036 (-1.22)	0.232
log (K)	0.545 (2.33)*	53.120 (2.33)*	0.025
log (LE)	1.396 (2.45)*	58.702 (2.45)*	0.019
log (EN)	0.647 (3.01)*	29.759 (3.01)*	0.005
log (X)	0.698 (3.68)*	45.863 (3.68)*	0.001
log (M)	-1.065 (-3.67)*	-49.772 (-3.67)*	0.001
log (DS)	-0.102 (-2.08)*	-0.018 (-2.08)*	0.044
constant	0.261 (0.12)		0.907
Number of observations = 45			
F(8, 36) = 13.18			
Prob > F = 0.0000			
Adjusted R-Squared = 0.6888			

[1]Average (across the 45 countries) GDP per capita and those for individual explanatory variables are used in estimating the slope coefficients. * means that the variable has a statistically significant impact on GDP per capita at 95% level of significance.

Results

Table 2 presents the means and standard deviations of the untransformed values of the dependent and independent variables.

Table 3 summarizes the GDP elasticities and slope coefficients. The adjusted R-squared value of 0.6888 means that about 69% of the variations in the log of GDP (the dependent variable) are explained by the (log of) capital (K), school enrolment (EN), life expectancy (LE), exports (X), imports (M) disaster deaths (DS), arable land per capita (D) and labour force (L).

The capital (K), life expectancy (LE), educational enrolment (EN) and exports (X) variables have a statistically significant (at 5% level) positive impact on GDP. On the other hand, the coefficients for imports (M) and disaster mortality (DS) have a statistically significant negative effect on GDP per capita.

The coefficient ß measures the elasticity of GDP with respect to a particular explanatory variable, that is, the percentage change in GDP for a given small percentage change in the explanatory variable in question. For example, the life expectancy (LE) elasticity of GDP is 1.396, implying that, on average, a unit percentage increase in life expectancy will cause a 1.396 percentage increase in per capita GDP. Since the LE elasticity value of 1.396 is greater than 1 in absolute terms, we can say that GDP per capita is elastic, i.e. responsive to changes in life expectancy (human capital investment).

Since elasticity is given by the expression

$$\left[\left(\partial GDP \div \partial R_i\right)\times\left(\bar{R}_i \div \overline{GDP}\right)\right],$$

we obtained the slopes coefficients in column 3 of Table 3 by applying the following formula: $\left(\overline{GDP_i} \div \bar{R}_i\right)\times\beta$.

Where: R_i is i[th] independent (explanatory) variable; $\bar{R}_i$ is the mean of i[th] independent variable; $\overline{GDP}$ is the mean of dependent variable, i.e. GDP; ß is the elasticity of log(DS). For example, the slope for DS was obtained as follows: [(2,149.463/11991.044) × (-0.102)] = -0.01828. The interpretation of the slope coefficient -0.01828 is that if disaster-related deaths increase by one person, the GDP per capita on average decreases by US$-0.01828, i.e. the economic burden of a single disaster-related death.

Table 4 provides estimates of the annual loss (in column 3) and lifetime loss (in column 4) in GDP sustained by each Member country due to disaster-related deaths in 1999. The annual GDP loss (AGL) per country was obtained using the following formula: *DSA* × *GDPL*, where: DSA is the annual number of disaster-related deaths and GDPL is the annual GDP loss per disaster-related death. For example, the loss sustained by Mozambique was estimated as follows: 113,974 × US$0.018 = US$2,052. The annual GDP loss sustained by the 45 Member countries (contents of column 3) were obtained applying the following formula:

Table 4: Total annual and lifetime loss in GDP attributable to disaster-related deaths (in US$)

Countries	*Disaster deaths*	*Annual GDP loss*	*Lifetime GDP loss*
Algeria	3434	61.8	1545
Angola	4162	74.9	1873
Benin	655	11.8	295
Botswana	211	3.8	95
Burkina Faso	9496	170.9	4273
Burundi	398	7.2	179
Côte d'Ivoire	298	5.4	134
Cameroon	4890	88.0	2201
Cape Verde	159	2.9	72
Central African Republic	94	1.7	42
Chad	4918	88.5	2213
Comoros	318	5.7	143
Congo	690	12.4	311
Democratic Republic of Congo	3663	65.9	1648
Equatorial Guinea	15	0.3	7
Eritrea	130	2.3	59
Ethiopia	311602	5608.8	140221
Gabon	142	2.6	64
Gambia	292	5.3	131
Ghana	3169	57.0	1426
Guinea	1121	20.2	504
Guinea-Bissau	1455	26.2	655
Kenya	4905	88.3	2207
Lesotho	40	0.7	18
Madagascar	1702	30.6	766
Malawi	1273	22.9	573
Mali	7128	128.3	3208
Mauritania	2521	45.4	1134
Mauritius	166	3.0	75
Mozambique	113974	2051.5	51288
Namibia	120	2.2	54
Niger	6137	110.5	2762
Nigeria	30028	540.5	13513
Rwanda	483	8.7	217
Sâo Tomé and Principe	181	3.3	81
Senegal	1189	21.4	535
Seychelles	5	0.1	2
Sierra Leone	1427	25.7	642
South Africa	3323	59.8	1495
Swaziland	663	11.9	298
Tanzania, U. Rep. of	5441	97.9	2448
Togo	948	17.1	427
Uganda	1248	22.5	562
Zambia	3162	56.9	1423
Zimbabwe	2221	40.0	999
TOTAL GDP LOSS (US$)	539597	9712.7	242819

$$\sum_{i=1}^{45}(DSA \times GDPL) = 539,597 \times \$0.018 = US\$9,712.7$$

The $\sum_{i=1}^{45}$ means {SUM} from the 1st country to the 45th country. The meanings of all the variables are as defined earlier.

The lifetime economic loss (LTEL) were estimated as follows:

$$\sum_{i=1}^{45}(AGER - AGED)\times(DSA\times GDPL)$$
$$= (55-30)\times(539597)\times(US\$0.018) = US\$242819,$$

where: AGER is the average retirement age in the Region, which was assumed to be 55 years; AGED is the average age of disaster-related death, which was assumed to be 30 years; the other variables have been defined earlier.

Discussion

Key findings

The key findings of this study are that: (i) disaster-related deaths have a statistically significant negative effect on GDP per capita; (ii) a unit increase in disaster mortality was found to decrease GDP per capita by US$0.01828, which is the economic burden of a single disaster-related death; (iii) the annual GDP lost by the Region has been estimated at US$9,713; and (iv) the undiscounted lifetime GDP lost through the death of 539,597 people was estimated at US$242,819.

Limitations of the current research

This study may have a number of limitations related to:

Model specification

We estimated a double-log (log-log, log-linear or constant elasticity) model. This specification has two attractive attributes: (i) its coefficients measure the elasticity of dependent variable (GDP per capita in our case) with respect to individual explanatory variables; and (ii) the double-log function mimics the economic concept of a production function, specifically the isoquant [12]. The model assumes that the elasticity of coefficients between dependent variable (lnGDP) and individual explanatory variables ($\ln X_i$) remains constant throughout, hence the alternative name, *constant elasticity* model. Some may legitimately argue that there is no reason why elasticities involved should be expected to be constant.

The equation estimated in this study is "instantaneous" in nature. In other words, it included independent and dependent variables from the same time period. It does not allow for the possibility that time might elapse between a change in the independent variable (for example, disaster-related death) and the resulting change in the dependent variable (GDP per capita). For example, the full economic effects of a disaster-related death may not be fully felt within a period of one year (for which GDP is calculated) but over a period of several years. Therefore, by considering the economic effects for a single year, we may have underestimated the economic impact of disaster-related deaths.

Use of a static as opposed to a dynamic model

Parents make a remarkable contribution in socializing and educating their children, thus their death (from disasters or other causes) may have adverse inter-generational effects on human capital creation, and hence future GDP production. Sadly, the GDP calculus does not capture those inter-generational contributions, although they may be of phenomenal value for the sustainability of economic growth.

On the other hand, death of children when disasters occur constitutes a loss in the quantity of future labour force, and hence future productivity. This kind of loss cannot be captured in static analyses, such as the one reported in this paper.

Data

This study used cross-country data from secondary sources, mainly the World Bank and UNDP. It is common knowledge that due to weak health management information systems (especially vital birth and death registration systems) across the African Region, the accuracy and reliability of data on disaster-related deaths might be questionable. However, since there are no better alternative sources of data, the use of data from such sources is common. Of course, such an argument does not obviate the need for developing and institutionalizing information management systems (including vital registration) that would yield more reliable data in the future.

Omission of economic burden of disaster-related morbidity

The results reported in this article refer only to the economic burden of disaster-related deaths. Thus, the economic costs of non-fatal health effects (i.e. morbidity) of natural disasters (e.g. droughts, famines, earthquakes) and technological disasters (e.g. transport and industrial accidents) were not included. This was due to the non-availability of information on non-fatal health effects of natural and technological disasters.

Under-estimation of the economic burden of disaster-related mortality

This study attempted to estimate the loss in GDP and not the total economic cost of disaster-related mortality. The social value of the contribution that victims of disasters could make to society would be much greater than that captured in GDP calculations. This is because the International Labour Organisation's definition of 'labour force' includes the employed (including the armed forces), the unemployed and the first-time job-seekers, but excludes home-makers and other unpaid care-givers and workers in the informal sector [15]. The majority of women in Africa are either full-time home-makers and/or informal-sector workers, and thus their invaluable contribution to society is excluded from the total GDP calculations.

Conclusion

In spite of its limitations, this study has demonstrated that disaster-related mortality has a statistically significant negative effect on GDP per capita. Thus, as policy-makers strive to increase GDP through capital investment, export promotion and educational enrolment, they should always keep in mind that investments in strengthening national capacity to mitigate the health effects of national disasters expeditiously and effectively will yield some economic returns.

The 'production function' approach employed in this study does not capture the full socioeconomic loss incurred by society as a result of the health impact of disasters. Therefore, there is a need for further research to estimate the economic burden of disaster-related morbidity and mortality in a sample of countries in the African Region, using micro-level costing and contingent willingness-to-pay [30] methods. The latter approach might enable policy-makers to capture all socioeconomic losses related to disaster morbidity and mortality. There is also a need for economic evaluations (especially cost-benefit analysis) of alternative ways of reducing disaster-related morbidity and mortality.

Competing interests

None declared.

Authors' contributions

JMK obtained the data from secondary sources, entered it into STATA spreadsheet, analysed the data and wrote sections of the manuscript. LGS, WA and GM participated in the design of the study, coordination of the analyses and drafting of the manuscript. All authors read and approved the final manuscript.

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