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Original Research

Murder and ill-health: a health crime phenomenon

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Abstract

Introduction: The annual numbers of murders in Jamaica are more than the number of deaths by HIV and relatively close to those mortalities by diabetes mellitus. On average between 1988 and 2011, there were 1, 042 cases of murders, with 2009 being the murderous year in the nation's history (1,680 cases). Although the murder statistics read like many non-communicable diseases, there is limited literature on health crimes. Objectives: This paper 1) examines the bivariate correlation between ill-health and murder, 2) models ill-health over the last 21 years, 3) establishes a function of murder, 4) determines a best fit model for ill-health and murders in Jamaica from 1989-to-2010, 5) commences literature on health crimes, 6) aids policy specialists to formulate the research driven policies based on the findings, and 7) the influence of GDP, unemployment and murders on illness rates. Methods: Using data collated from Government of Jamaica Publications on murders and illness rates from 1989-to-2010, this work used SPSS to examine objectives 1 through 5. Results: The relationship between illness rate and murder is a non-linear one, which is fitted by a 3 degree polynomial. Conclusions: The causes, consequences and challenges of murders extend to ill-health. The opportunity costs of murder constitute the lost production, creativity, social contribution and scientific discovery that the society must forego because of the termination of the human life as well as the current burden of health conditions among the living that arise in the aftermath of a murder.

INTRODUCTION

Murder is among the violent crimes that are well researched in the Caribbean, especially in Jamaica [1-9]. The current status of Jamaica being amid the leading murderous nations in the world has its genesis in 1970s (Table 1), although its materialization became evident during 1980 and beyond. For the decade of 1970s (1970-1979), the average number of murders were 266 which by the end of 1980s (1980-1989) had risen by 85.3%. The geometric increased in the decade of the 1980s was the greatest in 4 decades ending 2009 (Table 1). The highest annual percentage change in the number of murders occurred in 1980, when murders increased by 153% compared to 1979 which corresponds to a 217% decline in Gross Domestic Product in the same period (Table 1).

The crime problem surfaced in the Caribbean so much so that a Conference on Crime and Criminal Justice was held in the Barbados in 1998. Statistics revealed that in 1989, there were 439 cases of murders and by 2010; it has geometrically risen by 225.3%, averaging annually 10.2% [10]. No other cause of mortality in Jamaica has been growing by this percentage [11], yet the matter is not considered as a cause of death that requires urgent examination by epidemiologists, demographers and other health specialists.

The rationale for this research is embedded in the importance of murder to public health, and not having more information in the field of health crimes as these could be used to policy formulation and the cognitive understanding of the role of murders on ill-health. The objectives of this paper 1) examines the bivariate correlation between ill-health and murder, 2) models ill-health over the last 21 years, 3) establishes a function of murder, 4) determines a best fit model for ill-health and murders in Jamaica from 1989-to-2010, 5) commences literature on health crimes, 6) aids policy specialists to formulate the research driven policies based on the findings, and 7) the influence of GDP, unemployment and murders on illness rates.

Table 1. Number of Murders and GDP Growth (Annual), 1970-2010

Year	Murders	GDP Growth	Year	Murders	GDP Growth
1970	152	7.7	1990	542	5.5
1971	145	4.4	1991	561	0.5
1972	170	7.9	1992	629	1.9
1973	227	2.8	1993	653	1.3
1974	195	-5.4	1994	690	1.1
1975	266	-1.2	1995	780	0.5
1976	367	-6.3	1996	925	-1.8
1977	409	-2.4	1997	1037	-2.4
1978	381	0.7	1998	953	-0.7
1979	351	-1.8	1999	849	-0.5
1980	889	-5.7	2000	887	0.2
1981	490	2.6	2001	1191	1.1
1982	405	1.2	2002	1045	0.4
1983	424	2.3	2003	975	1.9
1984	484	-0.9	2004	1471	1.9
1985	-	-4.6	2005	1674	1.8
1986	449	1.7	2006	1340	2.3
1987	442	6.2	2007	1574	1.2
1988	414	1.5	2008	1601	-0.6
1989	439	4.6	2009	1680	-2.8
			2010	1428	-1.1

Sources: Planning Institute of Jamaica, Statistical Institute of Jamaica, International Financial Statistics, International Monetary Fund, various years

Literature review

The World Health Assembly in 1996 called for the inclusion of violence as a public health [12] and health matter [13]. Murders in Jamaica had got the attention of the World Bank that it sponsored a study in 1996 [14]. Despite the evidence that murder had become an epidemic in Caribbean, particularly Jamaica, the area of ***health crime*** is understudied. In 2005, Jackson and Ashley [15] studied physical and psychological violence in Jamaica's health sector. This was a beginning and one year later Coleman called for violence to be examined as a public health phenomenon in Jamaica. It is surprising that murder in Jamaica for 2000 was greater than that for New York by seven times [5], and area of health crime in the region, especially Jamaica is not well established. The Director General of the Statistical Institute of Jamaica joined the call for the study of influence of violence in health even after Coleman [7], a book was published in 2005 entitled "Health Issues in the Caribbean" and there were no papers health crimes, but there were two on HIV [16-17]. In the same book, there was a section dedicated to chronic non-communicable diseases, with there being 2 papers on diabetes mellitus [18]. Comparatively, diabetes for 2005-2008 killed 6,950 Jamaicans compared to 6,189 murders and the issue of diabetes mellitus is extensively researched in the Caribbean, particularly Jamaica and not health crimes.

In 2007-8, a stratified random sample of 2,848 Jamaicans aged 15 to 74 years were surveyed on matters related to health and lifestyle, yet nowhere in the study did the researchers examined health crime [19]. The matter of violence affecting health is still lagging behind in health research in Jamaica. On reviewing the disaggregation of the causes of mortality statistics for Jamaica from 2005-to-2009, there were 1,656 cases of HIV compared to 6,189 murders. The ratio of HIV to murders was 1 to 3.7 and in this milieu HIV/AIDS is widely studied and health crimes pale in significance to HIV.

There is no denial that murder is a cause of premature mortality as the majority of those killed in Jamaica are less than 41 years (averaging 76%) [8], with a life expectancy that was 73 years for both sexes in 2008 – 71 years for men and 74 years for women [9]. For centuries, never before now, murder was viewed as a disease requiring the same degree of research focus as HIV, diabetes mellitus, hypertension and other non-communicable conditions. This paper is put forward an area in health research to be entitled 'health crime' that evaluate the gamut of the role of crimes on health. Marie Jackson and Deanna Ashley [13] have begun contributing to this new area in research, health crimes, which will be expanded upon in the present paper.

Unlike Jackson and Ashley [13] who examined

violence within the health sector, this study evaluates the role of murder on ill-health in Jamaica. The illness foci of established hospitals are well documented in the literature and this extends beyond Jamaica. Barker and Hall writing on 'Practical Epidemiology' admitted that "Too many hospitals have been built, equipped and staff without knowledge of the particular disease problem affecting the communities they are intended to serve" [20] raising not only the question of the dominance of antithesis of health in structuring the health care industry but the root of this phenomenon in health care thinking. Although the definition of the antithesis of health has been long passed [21], the dominance of the biomedical model is still widely used in many contemporary societies to structure health care delivery and the medical science curricular. In every society one of the responsibilities of health care professionals is to diagnose and treat the sick. It means that the health needs of the community must be critical to the thinking of practitioners. With murder being a leading problem in Caribbean, especially Jamaica, health crime must provide medical practitioners with empirical evidence in the area that will aid them in understanding the phenomenon.

A study conducted in Chicago found that statistical association between violence and asthma in children, and this relationship remained even after controlling for race/ethnicity [22]. The researchers also found that sociodemographic characteristics as well as violence accounted for 15% of the variability in childhood asthma in the Chicago neighbourhood. Although violence is documented in the literature as being a public health problem, MacDonald was curious as to why public health and health promotion have stayed away for an examination of its burden [23]. He believed that the absence of public health as well as health promotion away for this matter may be owing to the inevitability and non-preventability of violence in a society.

Irrespective of the side that public health and health promotion specialists may take on the matter of violence, murder is clearly a health problem that will not dissipate because we wish for this to happen. It accounts for a percentage of premature mortality that cannot be ignored. Not examining murder's influence on ill-health (physical illness) is retarding an understanding that could be a pivotal in assisting policy formulation and behavioural modification programmes if the phenomenon was studied and understood. The influence (if any) that murder has on general illness is not known and ignorance will not aid in scientific understanding of this either. There is empirical evidence that violence affects a particular illness, but the question of its impact on general self-reported illness is still not understood.

Econometric Model

Grossman's seminal work has developed a theoretical and empirical framework has been used to many independent factors simultaneously influencing a single dependent variable, health demand [24]. Grossman was in the 1970s and in 1997, a group of academic researcher expanded on Grossman's earlier work [25]. Grossman's model outlined that health demand is a function of different determinants, which are given in Equation [1]:

$H_t = f\ (H_{t-1}, G_o, B_t, MC_t, ED)$……..… [1]

In which the H_t – current health in time period t, stock of health (H_{t-1}) in previous period, B_t – smoking and excessive drinking, and good personal health behaviours (including exercise – G_o), MC_t,- use of medical care, education of each family member (ED), and all sources of household income (including current income). Smith and Kington [25] who expanded on Grossman's early model included other socioeconomic variables that were not identified by Grossman (Equation [2]).

$H_t = H^*\ (H_{t-1}, P_{mc}, P_o, ED, E_t, R_t, A_t, G_o)$……[2]

Like Grossman, many other scholars have employed the econometric modelling to the study of health [26-28]. Although it may appear outdated to operationalize health by way of illness, one scholar found that this is still a relatively good proximity for objective health (life expectancy) in 2009 [29]. With the techniques in econometric analyses allowing for the examination of single to multiple variables influencing on a single dependent variable, this is ideal for this paper.

The current work models an illness function with murder being the only independent variable, Equation [3.1]:

$I_t = \beta_0 + \beta_1 X_t + \beta_2 X_t^2 + \beta_3 X_t^3 + e_t$ ..... [3.1]

Where β_0 is a constant and $\beta_{2\text{-}3}$ are parameters of variable X, X is murder and t denotes time and e_t is the random error.

Equation [4] established that illness rate is a function of GDP, unemployment and murders:

$I_t = f(GDP_t, U_t, M_t) + e_t$ .....[4]

Where GDP_t is Gross domestic product growth, U_t denotes unemployment, M_t is number of murders, and e_t is the random error.

Data and Methods

The current work is a secondary data analysis. Data on ill-health (illness rate) and murder were collected from Jamaica Government Publications namely Jamaica Survey of Living Conditions (JSLC), and Economic and Social Survey of Jamaica (ESSJ) [8], which are

published by the Planning Institute of Jamaica and the Statistical Institute of Jamaica, and the Planning Institute of Jamaica respectively.

Data from Jamaica Survey of Living Conditions (JSLC) were on illness rate Economic and Social Survey of Jamaica murder statistics as given by the Statistical Department of the Jamaica Constabulary Force on murders. The period for this work is from 1989 to 2009. In order to ensure accuracy of data points, the latest year Publication was used to verify and modify previous year's figures.

Statistical analyses

Data were entered and stored into SPSS for Window version 17.0 (SPSS Inc; Chicago, IL, USA) which were both used to analyze the data. A p-value of 5% was chosen to indicate statistical significance. Various model fits were tested in order to establish the best model fit for the data. The best model fit for the data was based on higher R^2. Calculus was used to determine the turning points of murder in the illness rate function (differentiation).

To determine the turning point (ie maxima and/or minima) for the illness function, in which murder is the only independent variable), we will differentiate the function. Then, equate the first derivative to zero, to ascertain the values for murder. Given the first derivative of cubic function is a quadratic equation. Therefore, the quadratic formula was used to solve this function.

Illness rate$_t$ = $\frac{-b\pm\sqrt{b^2-4ac}}{2a}$, where ***a*** is the parameter for the X^2, ***b*** is the parameter for the X and ***c*** denotes the constant. The second derivative was used to determine the maxima or minima from the solution of the quadratic function.

Variables

Murder denotes the number of people unlawfully killed (a crime causing death without a lawful excuse) within a particular geopolitical zone (excluding police killings or homicides). For this work, murders represent the total number of murders for each year.

Self-reported illness (or self-reported dysfunction): The question was asked: "Is this a diagnosed recurring illness?" The answering options are: Yes, Cold; Yes, Diarrhoea; Yes, Asthma; Yes, Diabetes; Yes, Hypertension; Yes, Arthritis; Yes, Other; and No.

Illness rate is the total percent of those who reported having an illness.

Findings

Table 2 shows information on two equations that are used to fit the data for the illness rate of Jamaicans from 1989-to-2009. Based on the squared r coefficient, illness rate is best fitted by a 3 degree polynomial function (R^2 = 0.585) compared to a linear function (R^2 = 0.099).

Table 2. Model Summary and Parameter Estimates of illness rate over time (1989-2009)

Equation	Model Summary					Parameter Estimates			
	R Square	F statistic	df1	df2	Prob.	Constant	X	X^2	X^3
Linear	0.099	2.082	1	19	0.165	13.638	-0.127		
Cubic	0.585	7.987	3	17	0.002	21.096	-3.210	0.300	-0.008

Dependent variable: Illness
df denotes degree of freedom
Prob. indicates probability

Illness rate$_t$ = $21.1 - 3.21X_t + 0.3X_t^2 - 0.008X_t^3$ .....[3.2]

Where X represents each year (1989-to-2009), t = 1,2, 3,.,21

$\frac{dy}{dx}$ = $-3.21 + 0.6X - 0.024X^2$ .....[3.2.1]

For turning point, $\frac{dy}{dx} = 0$

$0 = -3.21 + 0.6X_t - 0.024X_t^2$ Or $0.024X_t^2 - 0.6X_t + 3.21 = 0$

Using the quadratic formula, solve for X

Either $X_t \approx 8$ (7.8) or ≈ 17 (17.2), t = 8 (ie 1996) or t = 17 (ie 2005)

Substitute 8 in Eqn [3] for illness rate (= 9.6%) and replace 17 for x in Eqn. [3] to find illness rate (= 12.1%)

$\frac{d}{dx}\left(\frac{dy}{dx}\right) = 0.6 - 0.048X$ .....[3.3.2]

Replace 8 for X in Eqn [3.2.2], then $d^2y/dx^2 > 0$, so (8, 9.6%) is a minimum turning point.

Substitute 17 for X in Eqn [3.2.2], then $d^2y/dx^2 < 0$, so (17, 12.1%) is a maximum turning point.

Figure 1 illustrates that illness rate in Jamaica since

1989 is a cyclical function, and is better fitted by a cubic polynomial than a straight line. From 1989 (time 1 on graph) to 1995 (time 7 on graph) the rates of illness in Jamaica have been decline and in from 1996 to 2005 the rates were increasing, which followed by falls from 2006 except in 2007 where the rate increased.

Table 3 depicts a linear and an exponential function that were used to fit the data of murders in Jamaica. Although a linear function is a good fit for the data (R^2 = 0.886), it is better fitted by an exponential function (R^2 = 0.916). The function which explains the annual number of murders from 1989-to-2010 is expressed as follows:

$$\text{Number of murders}_t = 485.3e^{0.06x} \quad \ldots\ldots\ldots\ldots\ldots\ldots [5]$$

Where X represents each year (1989-to-2010), t = 1,2, 3,…,22

Table 2 presents a number of equations that were used to fit illness rate and annual number of murders in Jamaica from 1989-to-2009. The squared r indicates that best fit equation is a 3 degree polynomial (R^2 = 0.412). Table 4 shows that there exists a correlation between illness rate and annual number of murders, but that this is non-linear function (either inverse or cubic, $P < 0.05$). However, it is better fitted by the 3 degree polynomial (R^2 = 0.412) than the inverse function (R^2 = 0.219). For this study, only the better fitted equation will be used as it captures the final model, Equation [6]:

$$\text{Illness rate}_t = 45.29 - 0.1X_t + 8.9(10^{-5})X_t^2 - 2.59(10^{-8})X \ldots\ldots [6]$$

$$\frac{dy}{dx} = -0.1 + 1.8(10^{-4})X_t - 7.8(10^{-8})X_t^2$$

For turning points, $\frac{dy}{dx} = 0$

$-0.1 + 0.00018X_t - 0.000000078X_t^2 = 0$ Or $0.00000078X_t^2 - 0.00018X_t + 0.1 = 0$

Solve for X (ie murder), using the quadratic formula.

Either $X_t = 932$ or $X_t = 1376$

Using the second derivative, it reveals that 932 is a minimum and 1376 is a maximum turning point. Although calculus was used to derive the exact value of the turning points, a rough pictorial is displayed in Figure 2.

Table 4 also illustrates four equations that are used to model the data of illness rate and annual GDP growth. The best fitted equation is a 3 degree polynomial (R^2= 0.611).

$$\text{Illness rate}_t = 11.31 + 0.64X_t + 0.06X_t^2 + 0.01X_t^3 \ldots\ldots [6]$$

Where X represents annual GDP growth, t = = 1,2, 3,…,22

A number of equations were used to fit the data of illness and unemployment rates (Table 4). From the Table 4, degree polynomial can be used to fit the data as parameter for the cubic variable is zero.

$$\text{Illness rate}_t = 12.5 - 0.59X_t + 0.05X_t^2 \ldots\ldots\ldots\ldots [7]$$

Where X represents annual unemployment rate, t = = 1,2, 3,…,22

Table 5 shows the illness function of different macroeconomic and murders variables. Model 1 comprises only GDP, Model 2 is GDP and unemployment and the final model (Model 3) constitutes GDP, unemployment and murder. GDP contributes the most to the illness rate and the least was accounted for by murder.

Table 3. Model Summary and Parameter Estimates of annual number of murders, 1989-2010

Equation	Model Summary					Parameter Estimates	
	R Square	F statistic	df1	df2	Prob.	Constant	X
Linear	0.886	148.398	1	19	< 0.0001	373.213	57.613
Exponential	0.916	208.026	1	19	< 0.0001	485.300	0.059

Dependent Variable: Murder
df denotes degree of freedom
Prob. indicates probability

DISCUSSION

Although the forty-ninth World Health Assembly in 1996 had forwarded that the prevention of violence was a public health priority, the Caribbean, particularly Jamaica, has lagged behind in the inquiry of health crime issues. In 2004, which was three years prior to the record murderous year in Jamaica's history, Harriott opined that "Traditional law enforcement methods have similarly proved to be ineffective" [30], suggesting that many options have been tried to address the crime problem. Murder is the permanent termination of a human life and while there is no denial that this is important to solve, what about murder and ill-health?

Table 4. Model Summary and Parameter Estimates of illness rate by murder, GDP growth and unemployment

Equation	Model Summary					Parameter Estimates			
	Independent variable: Murder					Constant	X	X^2	X^3
	R^2	F	df1	df2	Prob				
Linear	0.097	1.925	1	18	.182	14.328	-0.002		
Logarithmic	0.151	3.192	1	18	.091	28.601	-2.369		
Inverse	0.219	5.053	1	18	.037	9.546	2464.144		
Quadratic	0.243	2.728	2	17	.094	21.832	-0.018	7.21E-006	
Cubic	0.412	3.743	3	16	.033	45.293	-0.097	8.92E-005	-2.59E-008
Power	0.133	2.750	1	18	.115	40.295	-0.175		
Growth	0.086	1.695	1	18	.209	2.642	0.000		
Exponential	0.086	1.695	1	18	.209	14.043	0.000		
	Independent variable: Annual GDP growth					Parameter Estimates			
	R Square	F	df1	df2	Prob.	Constant	X	X^2	X^3
Linear	0.557	23.935	1	19	0.000	11.465	0.934		
Quadratic	0.610	14.064	2	18	0.000	11.211	0.705	0.098	
Cubic	0.611	8.913	3	17	0.001	11.312	0.637	0.063	0.009
Exponential	0.530	21.465	1	19	0.000	11.311	0.072		
	Independent variable: Unemployment.					Parameter Estimates			
	R Square	F	df1	df2	Prob.	Constant	X	X^2	X^3
Linear	0.400	12.669	1	19	0.002	4.281	0.711		
Quadratic	0.409	6.223	2	18	0.009	12.499	-0.591	0.049	
Cubic	0.409	6.223	2	18	0.009	12.499	-0.591	0.049	0.000
Compound	0.350	10.230	1	19	0.005	6.665	1.054		
Exponential	0.350	10.230	1	19	0.005	6.665	0.053		

Dependent Variable: Illness rate

Table 5. Illness functions with selected macroeconomic variables and murder

Characteristic	Model		
	Model 1	Model 2	Model 3
GDP_t	√	√	√
$Unemployment_t$	-	√	√
$Murder_t$	-	-	√
RMSE	1.713	1.578	1.621
MAPE	12.339	9.639	9.769
R^2	0.557	0.644	0.691

Dependent variable: Illness ratet
√ denotes inclusion in the model
- symbolizes exclusion from the model

In 2009 when murders reached a record 1,680 people, the fear of crime and victimization drove a new set of policy initiatives to address this ongoing epidemic. The number of deaths in Jamaica caused by murder was marginally lower than the number caused from diabetes mellitus or hypertension [9]. Crimes and violence are not only on the lips of majority of Jamaica, but Harriott [1] found 2 out of every 5 Jamaicans indicated that they are highly at risk of criminality. He opined that the fear had to do with physical violence than property crimes. The crime problem is undoubtedly calling for inquiries in the area of health. This paper puts forward a new area in research called 'health crime' which encompasses crime and health studies.

In this paper, there is a non-linear correlation between ill-health and murders in Jamaica. Such a finding reveals that the murder epidemic in Jamaica is explaining physical illnesses. The statistical association between asthma among children in Chicago and violence was found by Gupta and colleagues [22]. The illness rate in this work covers asthma, influenza,

diabetes, hypertension, arthritis and other specified conditions, which is an expansion of the number of conditions used by Gupta et al. Gupta and colleagues had found that asthma among the sample increased in periods of more violence, which is not entirely the case in this work. There is an inverse correlation between number of murders and illness rate up to 932 murders. Between 933 and 1, 377 murders, there is direct correlation between illness and murders indicating periods of economic recession. Then, the number murders reaches a zenith after which it begins to decline with a corresponding fall in the illness rate representing periods of positive macroeconomic performance.

More information can be given about the period in which there was a positive association between the illness rate and murders in Jamaica. Between 1995 and 2006, when the number of murders were rising as well as the illness rate, Jamaica had experienced economic recession, banking crises and high rates of unemployment (mostly double-digit) [31]. World Bank succinctly summarized the status of the nation's economy, when it postulated that '…Jamaica's recent GDP growth has been negligible, as it was over most of the last 20 years and was actually negative in 1996-1999... During the 1990s, Jamaica's per capita GDP growth was in the lowest quartile of countries' [32]. Much emphasis has been placed on the economics of the recession and financial crisis as well as their implications [31, 33-35], but what about health, especially the rate of illness.

On examination of the illness cycles in Jamaica, during periods of decline in morbidity, there were positive economic growths and lowering of unemployment, and these were associated with reduced murders. Although the contribution of GDP dominates physical illnesses in Jamaica, murders are influencing self-reported health conditions. The health crime areas highlights that while murder is a stationary and permanent end of life, it is affecting the physical health conditions of those who are currently alive. Such a finding demands the area of health crime be studied with urgency as the epidemic murder is destroying the human capital, problematic to health status and will increase the health expenditure of the nation. The health problems that murder is contributing to means reduced production, productivity, absenteeism and other socioeconomic issues that expands beyond the solved crime. As this study revealed that 69% of the variability in illness rate in Jamaica is accounted for by GDP, unemployment and murders, suggesting that murder plays two roles, 1) termination of live, and 2) terrorize the health status of those who are alive after the termination apart from the psychological conditions of the bereaved persons.

Saadah and colleagues' work revealed that morbidity slightly increased in periods of economic downturn [36], which is certainly not the case in Jamaica as found in Kim and Serra-Garcia's work [37] and the present one. This paper goes further than Kim and Serra-Garcia's research to show that illness rates cyclical flows and that murder influences ill-health among Jamaicans. The cyclical nature of the illness rates in Jamaica follow periods of growth and contraction. Simply put the decline and rise in health conditions are represented by completely different slopes, and occur during certain economic climate. In fact, although in general murders have been rising geometrically over the 4 decades (1989-2009), it is contributing to the general flows of physical health among Jamaicans. There appears to be somewhat of a paradox in the current illness rate cycle as during periods of economic growth following downturn, illness rates continue to rise. Kim and Serra-Garcia [37] had pointed out early that there is a paradox in the illness data in Jamaica. This is not a paradox as it can be interpreted within the context of lag effect.

During periods of economic recession, illness rate increase and if this is persistent as was the case in Jamaica for 4 years (1996-to-1999), an immediate change in the growth cycle to positive GDP will not see an instantaneous favour response from the illness rate. In fact, the illness rate responds slowly to positive GDP growth. After a period of negative GDP growth, illness will lag behind for some time even when there is positive growth the years afterward. This is also the case when economy changes from positive to negative growth. In such cases, the illness rate does not respond immediately to the 'bad' economic climate as the time lag takes some before it translates into an effect.

When illness shifted from a decreasing to an increasing slope in 1996, this did not suddenly happen as from 1990-to-1995, the Jamaican economy was declining from a 5.5% annual GDP growth in 1990 to 0.5% growth in 1995. The geometric decline in GDP during the early 1990s, within the context of a lag time effect, finally materializes itself in the upward movement in the illness rate, when the economy went into recession in the mid-1990s. The decreasing slope of the illness rate function since 2006 is associated with improvements in the economic base of Jamaica from 2000-to-2008. The economic recession from 2008-to-2010 will take some time before it changes the illness rate slope to an increasing rate.

It is documented that murder is an economic phenomenon and that its inducements are embedded in the economic costs, the probability of being caught (or not) and likeliness of being incarcerated (or not) [38]. Murder is not only phenomenon that is an economic issue as illness is primarily determined by economics and that murder as well as economics influence the

cyclical nature of illness rate. The present work finds that in periods of economic downturn illness rate increases as well as unemployment and murders, and that in good economic times, murder, and unemployment rates as well as illness rate declines.

Conclusion

Murder is more that a cause of mortality, termination of life, and growth retardation, it is equally a physical health phenomenon. The cyclical nature of illness rate in Jamaica is set by changes in the economic structure of the economy, which forms the outlay of health conditions among Jamaicans.

Ill-health is not only an economic phenomenon, it is influenced by murders. And that the causes, consequences and challenges of murders extend to ill-health. The causes, consequences and challenges of murders extend to ill-health. The opportunity costs of murder constitute the lost production, creativity, social contribution and scientific discovery that the society must forego because of the termination of the human life as well as the current burden of health conditions among the living that arise in the aftermath of the murder.

In summary, public health is concerned about the problems affecting health, and this must extend to murders and economics of people as economic recession contributes to murders, increased unemployment and ill-health. Violence continues to be a problematic issue in the Caribbean, especially Jamaica, which now must add health crime in order to understand the crime phenomenon.

Limitation to study

The present work is an ecological one, which employed different databases to interpret and present findings. Such an approach in and of itself is a limitation.

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