Nutritional Intake Deficiency, Suicidology and Homicide Rates: An Empirical Assessment Using Data from 1990 to 2012

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ABSTRACT: *Introduction: In the English-speaking Caribbean, homicide, suicide, under-nutrition and macro-economic variables have never been linked in a single study. The gap in the literature may hold explanation for the homicide pandemic and this bridge must be mended to reflect a better understanding that extends beyond criminology.* ***Objectives:*** *This paper seeks to examine factors that determine nutritional intake including variables such as homicide, macroeconomic variables, divorce, and suicide as well as factors that impact on homicide by examining conditions such as nutritional intake, macroeconomic variables and divorce. Materials and methods: For this paper, secondary data published by various governmental agencies were collected to examine certain issues. The data for the period is from 1990-to-2012. Ordinary least square (OLS) regression was to determine factors of a single dependent variables, with the level of significance being 5% at the 2-tailed level.* ***Results:*** *Four factors explain 89.7% of the variability in logged nutritional intake deficiency rate. These factors are homicide, logged inflation rate, divorce rate and logged unemployment, with homicides contributing the majority of the variance (R2 = 60.0%). Poverty is highly inter-correlated with nutritional intake deficiency rate (rxy = 0.972, P<0.0001). Of the three factors explaining homicide rate in Jamaica, nutritional intake accounts for most of the variability (R2 = 0.600) followed by divorce rate (R2=0.172) and unemployment rate (R2 = 0.053). Six factors determine suicide rates in Jamaica - unemployment having the most influence on suicide rates in Jamaica (46.5%), followed by divorce (21.5%); homicide rate (15.3%); nutritional intake (12.4%); inflation rate (4%), and poverty rate (5%) percent.* ***Conclusion:*** *Divorce has a direct impact on the nutritional intake, suicide and homicide rates in Jamaica. Divorce or separation is a complex phenomenon as it destroys the psychological state of the individual involved, which affect the nutritional intake of foods that may lead to an increase tendency to commit or attempt a suicidal act, a likeliness to become engage in violent acts, and reduced economic resources.*

Key words: *Homicide, inflation, nutritional deficiency, poverty, suicide, undernutrition, Jamaica*

INTRODUCTION

Nutritional intake deficiency has never been linked to suicide, homicide and macroeconomic variables moreso as a public health matter in the Caribbean, especially Jamaica, because no link has been made between food intake and homicide, food intake and mental health matters as well as the economics of food intake including the role that divorce plays in nutritional intake deficiency. The issue of undernutrition is a public health matter because it impacts on 1) growth during infancy and early childhood, 2) blood pressure, 3) obesity, and 4) other chronic non-communicables diseases (Walker, 2005; Barker, 1998); but in our extensive search of the literature no research emerged nutritional intake deficiency with homicide, suicide and macroeconomic variables, particular in the Caribbean with a high prevalence of violence and knowing that violence is a public health matter. According to Walker (2005) nations that are experiencing nutrition transition are likely to have rapid increase in overweight, obesity and related diseases in adults (Walker, 2005). Outside of Walker's perspective, does divorce impact of on undernutrition, psychological issues on undernutrition, homicide on undernutrition and what are the the economics of undernutrition.

The literature is splintered on divorce, homicide, suicide, and under-nutrition (Walker, 2005; Barker, 1998; Weitzman, 1985; Ayoub, Deutsch & Maraganorr, 1999; Amato & Keith, 1991; Zill,

Morrison & Coiro, 1993; Abel et al., 2009; Abel et al., 2012; Abel & Martin, 2008; Chowdhury, 2012; Black et al, 2013), with no research bringing all the areas together. Currently, undernutrition and suicides are not major issues in Jamaica (Walker, 2005; Barker, 1998; Abel et al., 2012; Abel et al, 2009; Abel & Martin, 2008); but homicide, on the other hand, as well as divorce are in a pandemic phase in Jamaica, yet no information exist that explore whether those issues and others are influencing nutritional intake deficiency. The Caribbean has a violence and crime pandemic for some time and studies existed that empirically establish a relationship between nutrition and violence (Werbech, 1995) in addition to homicide and nutritional intake (Hibberln et al, 2004). In fact Hibberln et al, (2004) found a strong statistical association between nutritional intake (consumption of linoleic acid) and homicide ($r = 0.94$, $F = 567$, $P<0.00001$); Park et al. (2011) established an inverse statistical association between dietary fiber intake an risk of mortality from cardiovascular, infectious and respiratory conditions, and Zureik et al. (1996); Dunnigan (1993) and Ellison & Morrison (2001) empirically established statistical association between nutritional intake and suicide, with Ellison & Morrison (2001) indicating that when one's cholesterol is below 4.42 mmol/L (170 mg/dL) it increases many mental health conditions such as mood disorders, depression, and violence. Such information offer some understanding of the issues of suicide, homicide, nutritional intake and violence; but all of this knowledge is had by bivariate examination and therefore the issues have not been coalesced into one, particularly the Caribbean that has issues with homicide and violence.

This study seeks to fill the gap in the literature by evaluating factors that determine nutritional intake including variables such as homicide, macroeconomic variables, divorce, and suicide as well as factors that have an impact on homicide, by examining conditions such as nutritional intake, macroeconomic variables and divorce. None of the studies done on suicide on the Jamaicans population or sub-populations, have included homicide, nutritional intake, and macroeconomic variables inspite of the literature on the various bivariate associations (Holder-Nevins, et al., 2012; Abel, et al., 2009, 2012; Abel & Martin, 2008; Burke, 1985; Irons-Morgan, 1999) or the wider Caribbean populace (Mahy, 1993). Historically, the Caribbean literature on violent crimes including homicide, has placed the emphasis from a criminology perspective (Simmonds, 2004; Robotham, 2003; Harriott, 2003,2004, 2008; Harriott & Brathwaite, & Wortley, 2004; Headley, 1994; Sives, 1996). The literature with a focus from health perspective (Bourne, 2012, Bourne & Solan, 2012; Bourne, et al., 2012; March & Bourne, 2011) have stopped short of linking nutritional intake and suicide. Hence, this research will coalesce nutritional intake, suicide, macroeconomic variables, divorce and homicide rate all into single inquiry, which did not emerge in the examination of the literature, and so this research offers new insight into the various phenomena.

ECONOMETRIC MODEL

Hibbeln et al, (2004) used ordinary least square (OLS) regression to estimate the contribution of linoleic acid on homicide rate. Using data for the United Kingdom from 1961-2000, Hibbeln and colleagues established that nutritional intake in the form of linoleic acid is strongly correlated with homicide rates ($r = 0.89$, $r2 = 0.80$, $F = 150.6$, $P<0.0001$), which could be algebraically written as homicide rate (V_t) is a function of nutritional intake, Q_t (Equation [1]):

$$V_t = k + \beta_1 Q_t \tag{1}$$

Where k indicates a constant, Q_t denotes nutritional intake in time period t, V_t means homicide rate in time period t, $t=1961, 2000$, and $\beta_1 > 0$.

For this study, we employed multivariate analysis (i.e., OLS) to examine the likely impact of many variables on a single dependent variable. The use of OLS allows for this analysis and as such we evaluated factors of homicide, factors of nutritional intake and determinants of suicide in a single research.

MATERIALS AND METHODS

The data for this study are taken from various Jamaica Government Publications including the Demographic Statistics. Demographic Statistics provided data on mortality, population, and deaths. Jamaica Constabulary Force and Economic and Social Survey of Jamaica (ESSJ) provided the data for murders; gross domestic product per capita (i.e., GDP per capita) and suicide. The period for this work is from 1990 through 2012. Data were recorded, stored and retrieved using the Statistical Packages for the Social Sciences (SPSS) for Windows, Version 21.0. The level of significance that is used to determine statistical significance is less than 5% (0.05) at the 2-tailed level of significance. Ordinary least square (OLS) regression analyses and curve estimations were used to determine models and best fitted models. Prior to the use of the OLS, the researchers tested for normality of the variables (i.e., linearity and skewness including Durbin-Watson test). The validity of the data is relatively high as these have been tested and modified owing to previous studies (McCaw-Binns et al, 1996, 2002; Mathers et al, 2005). We also tested for the likelihood of Type I and Type II Errors, by using one-tailed and two-tailed test of significance. Based on data on poverty which commenced in 1989, we use data for inflation, poverty, exchange rate, and unemployment from 1989 to 2012 in

order to have a standard measurement for those variables.

Operational Definitions

Divorce will be used proxy separation.

Death: The absence of life.

Marriage: According to the Statistical Institute of Jamaica (STATIN), in the 2009 Demographic Statistics, marriage is "The act, ceremony or process by which the legal relationship of husband and wife is constituted" (Statistical Institute of Jamaica, 1990-2012).

Study Period: The studied period is 1990 to 2012, which means that there are 2 decades thereby. The decades are 1990-1999, and 2000-2009.

Homicide (or Murder): the unlawful killing (a crime causing death without a lawful justification) by another person(s) within a particular geopolitical zone (excluding police killings or homicides). For this work, murders represent the total number of murders for each year.

Mortality: the total number of deaths that occurred within the population for a particular period, which is usually per year. The quality of mortality statistics in Jamaica is relatively good as research conducted by McCaw-Binns and her colleagues (1996, 2002) established that in 1997, the completeness of registration of mortality was 84.8%; in 1998 it was 89.6%. The quality of completeness of mortality registration has been established by the World Health Organization (WHO), ICD classification (Mather et al, 2005). A completeness of 70-90% is considered to be medium quality while more than 90% is considered high quality data. Within the context of the WHO's classification, death statistics in Jamaica is medium quality and is relatively close to being high quality. In keeping with the completeness of mortality data the Statistical Institute of Jamaica (STATIN) has adjusted the information to reflect the 100 completeness of mortality figures (Bourne et al, 2014).

GDP per capita is income per capita.

Nutritional Intake Deficiency is the equivalent to number of people who are under nourished based on what should be normally intaken nutritional by people (i.e., recommended dietary allowance).

Suicide is used to indicate mental health issues.

RESULTS

Table 1 presents descriptive statistics on nutritional intake deficiency rate, poverty rate, inflation rate, homicide rate and daily number of people in the population experiencing nutritional deficiency. On average, in the 1990s, 9.7% of Jamaicans were noted as living below the nutritional intake requirements that fell to 4.7% in the 2000s reflected a 51.5% decline. The poverty rate fell in the 2000s compared to the 1990s by 38.8% compared to a 59.6% decline in inflation rate over a similar period. It should be noted here that in the 1990s, on average 655 Jamaicans, on a daily basis, were living without having the adequate nutritional intake, which declined by 47.8% in the decade of 2000 (Table 1).

Hypothesis

H0: Annual Nutritional Intake Deficiency rate is best expressed as a linear function

Figure 1 illustrates the nutritional intake deficiency rates for Jamaica over a 24-year period (1990-2012). Annual Nutritional intake deficiency rate in Jamaica is presents by a polynomial curve. It can be noted from the curve that nutritional intake deficiency is best expressed by eq. (2), with 66.1% of the data point explained by the polynomial function. Generally, nutritional intake deficiency rate

Table 1.
Descriptive statistics for Nutritional Intake Deficiency rate, Poverty rate, Inflation rate and Homicide rate

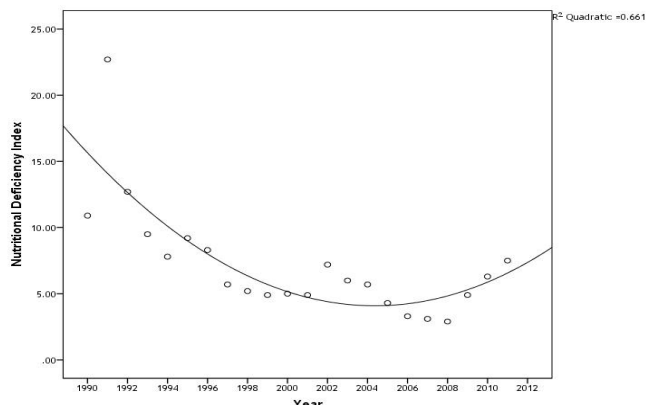| Details	1990s	2000s
Nutritional Intake Deficiency rate	9.7% ± 5.21, 95%CI: 6.5-13.0	4.7% ± 1.38, 95%CI: 3.9% – 5.6%
Poverty rate	26.0% ± 8.5, 95%CI: 20.8 – 31.3	15.9% ± 3.1, 95%CI: 14.0% – 17.9%
Inflation rate	20.7% ± 21.74, 95%CI:14.29% – 41.2%	11.2 ± 4.2, 95%CI: 8.6% – 13.8%
Homicide rate	30.0 ± 5.9, 95%CI:26.4 – 33.6	50.7 ± 10.9, 95%CI: 43.9 – 57.5
Population experiencing nutritional deficiency, daily	655 ± 340, 95%CI: 444 - 866	342 ± 96, 95%CI: 282 - 402

Figure 1. Nutritional Deficiency Rate Curve

has been rising since 2008 compared to declines in former periods (i.e., 1990-2007).

$$Qt = ax3 + bx2 + cx + k \dots\dots\dots\dots\dots\dots\dots\dots \text{ Eq. [2]}$$

where x=1990, 1991,…,2012, a, b and c are coeffients of x and k is a constant;

a, b, c and k > 0.

Hypothesis

H0: Nutritional Intake Deficiency rate for Jamaicans is not influenced by poverty and inflation

Logged Nutritional Intake Deficiency rate in Jamaica is determined by logged poverty rate and logged inflation rate. Both factors account for 95.8% of the variance in logged nutritional intake deficiency rate (Table 2). Furthermore, logged poverty rate accounts for more of the variability in logged nutritional intake deficiency rate ($R^2 = 0.945$ or 94.5%) compared to logged inflation rate ($R^2 = 0.013$ or 1.3%). However, the bivariate correlation between logged inflation and logged nutritional intake deficiency rate was 0.752 ($r_{xy} = 0.752$, P<0.0001) compared to 0.728 for logged poverty and logged nutritional intake deficiency rate (i.e., $r_{xy} = 0.728$, P<0.0001). In addition, the bivariate correlation between logged poverty and logged inflation rate was 0.688 ($r_{xy} = 0.688$, P =0.001).

The factors determining logged nutritional intake deficiency rate in Jamaica are logged poverty and logged inflation rate, which can be expressed in eq. (3):

$$\ln Qt = k + \beta_1 \ln P + \beta_2 \ln I \tag{3}$$

where Q_t indicates logged nutritional intake deficiency rate, P is the poverty rate and I denotes the inflation rate and β1 and β_2 are the coefficient of lnpoverty and lninflation rate respectively. $\beta_1 > 0$, and $\beta_2 > 0$

Table 3 presents four models for OLS estimates of logged nutritional intake deficiency rate, 1990-2012. Model 1 illustrates the factor that contributes the most to logged nutritional intake deficiency rate to model 4 which constitute all the factors of logged nutritional intake deficiency rate. Four factors explain 89.7% of the variability in logged nutritional intake deficiency rate. These factors are homicide, logged inflation rate, divorce rate and logged unemployment, with homicides contributing the majority of the

variance ($R2 = 60.0\%$). In addition, logged inflation rate contributes 19.3%; divorce rate explains 6.6% and logged unemployment only 3.8%. The factor can be expressed in an equation eq. (4) :

$$\ln Q_t = k + \beta_1 V_t + \beta_2 \ln I_t + \beta_3 Dt + \beta_4 \ln U \tag{4}$$

where Q_t indicates logged nutritional intake deficiency rate, V_t is the homicide rate, It denotes the inflation rate, Dt indicate divorce rate, U_t means unemployment rate and β1 to β4 are the coefficients of factor, with $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 > 0$ and $\beta_4 > 0$.

With very strong inter-correlation between homicide rate and exchange rate (rxy = 0.903, P<0.0001, tolerance of 0.13), we replaced the homicide rate with the exchange rate and Table 4 presents the results of such an inquiry. In the case when inflation, exchange and divorce rates are placed in single model to explain nutritional intake deficiency rate, logged inflation rate emerged as the most influential factor ($R2=0.566$) followed by the exchange rate ($R2 = 0.165$) and divorce rate ($R2 = 0.104$). The factors of logged nutritional intake deficiency rate are captured in eq. (5)

$$\ln Q_t = k + \beta_1 \ln I_t + \beta_2 D_t + \beta_3 Z \tag{5}$$

where Qt indicates logged nutritional intake deficiency rate, It denotes the inflation rate, Dt indicate divorce rate, Zt means exchange rate of 1 USD for Jamaican dollars and β1 to β3 are the coefficients of factors, with $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_3 > 0$.

Homicide rate in Jamaica can be explained by four factors (i.e., logged nutritional intake deficiency rate, divorce rate, suicide rate and logged unemployment rate). Those factors account for 98.4% of the variability in homicide rates. Of the four factors explaining homicide rate in Jamaica, unemployment rate for most of the variability ($R2 = 0.416$) followed by nutritional intake accounts the suicide rate ($R2 = 0.310$), suicide rate ($R2 = 0.132$) and divorce rate ($R2 = 0.126$) (Table 5). The factors of homicide rates are expressed in eq. (6)

$$V_t = k + \beta_1 \ln Q_t + \beta_2 D_t + \beta3 \ln U_t + \beta_4 S \tag{6}$$

where Qt indicates logged nutritional intake deficiency rate, Dt indicate divorce rate, U denotes unemployment rate, S indicates Suicide rate and β_1 to β_4 are the coefficients of factors, with $\beta_1 < 0$, $\beta_2 < 0$, $\beta_3 > 0$ and $\beta_4 > 0$.

Table 6 presents information on the OLS estimates of logged nutritional intake deficiency rate. Four variables emerged as factors of logged nutritional intake deficiency rate. The four factors (i.e., ln unemployment rate, divorce rate, homicide rate and suicide rate) account for 98.0% of the variability in logged nutritional intake deficiency rate. The factor that has the most impact on logged nutritional intake deficiency rate is logged unemployment rate ($R^2 =42.7\%$, F = 19.32, P<0.0001) followed by homicide rate ($R^2 = 31.0\%$, F = 58.8, P<0.0001), and suicide rate ($R^2 = 13.5\%$, F = 491.0, P<0.0001), lastly divorce ($R^2 = 10.8\%$, F = 93.1, P<0.0001). Suicide and logged unemployment rate positively influence logged nutritional intake deficiency rate, with divorce and homicide has the opposite effect on nutritional intake deficiency rate. It can be deduced from the direct statistical association between suicide rate and nutritional intake deficiency rate that Jamaicans who are undernourished could have mental health issues. From including inflation and suicide rates in a general model, the factors that emerge

Table 2.

OLS Estimates of logged Nutritional Intake Deficiency Rate, 1990-2012

Model	Details	Unstandardized Coefficients		Beta	t-statistic	P value	95% Confidence Interval
		B	Std. Error				Lower - Upper
1	Constant	-2.299	0.230		-10.008	<0.0001	-2.780 - -1.818
	lnPoverty Rate	1.388	0.077	0.972	18.136	<0.0001	1.228 - 1.548
2	Constant	-2.141	0.216		-9.888	<0.0001	-2.596 - -1.686
	lnPoverty Rate	1.233	0.095	0.864	13.036	<0.0001	1.034 - 1.432
	lnInflation Rate	0.113	0.048	0.157	2.372	0.029	0.013 - 0.213

Dependent variable: lnNutritional Intake Deficiency Rate
Model 1: F [1, 19] = 328.91, P<0.0001, R^2 = 0.945, Adjusted R^2= 0.943
Model 1: F [1, 19] = 207.3, P<0.0001, R^2 = 0.958, Adjusted R^2= 0.944

Table 3.

OLS Estimates of logged Nutritional Intake Deficiency Rate, 1990-2012

Model	Detail	Unstandardized Coefficients		Beta	t	P	95% Confidence Interval	
		B	Std. Error				Lower	Upper
1	Constant	3.014	0.231		13.066	<0.0001	2.531	3.497
	Homicide rate per 100, 000	-0.028	0.005	-0.774	-5.336	<0.0001	-0.040	-0.017
2	Constant	1.700	0.364		4.671	<0.0001	0.936	2.465
	Homicide rate per 100, 000	-0.020	0.004	-0.540	-4.433	<0.0001	-0.029	-0.010
	lnInflation Rate	0.357	0.087	0.498	4.085	0.001	0.173	0.541
3	Constant	1.309	0.339		3.865	0.001	0.595	2.024
	Homicide rate per 100,000	-0.026	0.004	-0.707	-5.934	<0.0001	-0.035	-0.017
	lnInflation Rate	0.325	0.075	0.453	4.331	<0.0001	0.167	0.483
	Divorce Rate per 100,000	0.013	0.004	0.299	2.823	0.012	0.003	0.022
4	Constant	-0.292	0.721		-.405	0.691	-1.820	1.236
	Homicide rate per 100,000	-0.020	0.004	-0.725	-6.903	<0.0001	-0.035	-0.018
	lnInflation Rate	0.258	0.072	0.360	3.606	0.002	0.106	0.410
	Divorce Rate per 100,000	0.012	0.004	0.288	3.088	0.007	0.004	0.020
	lnUnemployment Rate	0.770	0.316	0.214	2.440	0.020	0.101	1.439

Dependent variable: lnNutritional Intake Deficiency Rate
Model 1: F [1, 19] = 28.5, P<0.0001, R^2 = 0.600, Adjusted R^2= 0.579
Model 2: F [2, 18] = 34.3, P<0.0001, R^2 = 0.792, Adjusted R^2= 0.769
Model 3: F [3, 17] = 34.4, P<0.0001, R^2 = 0.859, Adjusted R^2= 0.834
Model 4: F [4, 16] = 34.8, P<0.0001, R^2 = 0.897, Adjusted R^2= 0.871

Table 4.

OLS Estimates of logged Nutritional Intake Deficiency Rate of Jamaicans, 1990-2012.

Model	Detail	Unstandardized Coefficients		Beta	t	P	95% Confidence Interval	
		B	Std. Error				Lower	Upper
1	Constant	0.392	0.300		1.307	0.207	-0.236	1.021
	lnInflation Rate	0.540	0.108	0.752	4.974	0.000	0.312	0.767
	Divorce Rate per 100,000							
2	Constant	1.349	0.376		3.583	0.002	0.558	2.139
	lnInflation Rate	0.367	0.102	0.511	3.596	0.002	0.152	0.581
	Exchange rate	-0.010	0.003	-0.473	-3.325	0.004	-0.017	-0.004
3	Constant	0.855	0.339		2.522	0.022	0.140	1.570
	lnInflation Rate	0.287	0.086	0.400	3.348	0.004	0.106	0.468
	Exchange rate	-0.017	0.003	-0.785	-5.258	0.000	-0.024	-0.010
	Divorce Rate per 100000	0.018	0.005	0.422	3.267	0.005	0.006	0.029

Dependent variable: lnNutritional Intake Deficiency Rate
Model 1: F [1, 19] = 24.7, P<0.0001, R^2 = 0.566, Adjusted R^2= 0.543
Model 2: F [2, 18] = 24.4, P<0.0001, R^2 = 0.731, Adjusted R^2= 0.701
Model 3: F [3, 17] = 28.6, P<0.0001, R^2 = 0.835, Adjusted R^2= 0.805

to explain logged nutritional intake deficiency rate are expressed in eq. (7):

$$\ln Q_t = k + \beta_1 V_{t+} \beta_2 D_{t+} \beta_3 \ln U_t + \beta_4 S_t \qquad (7)$$

where Qt indicates logged nutritional intake deficiency rate, Dt indicate divorce rate, U denotes unemployment rate, S indicates suicide rate and β1 to β4 are the coefficients of factors, with $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 > 0$ and $\beta_4 > 0$.

Table 7 presents the OLS estimates using stepwise regression, with the final model being model 6. Six factors determine suicide rates in Jamaica. These six factors are logged unemployment rate, logged nutritional deficiency rate, homicide rate, divorce rate, inflation rate and poverty rate, with unemployment having the most

influence on suicide rates in Jamaica (46.5%), divorce (21.5%), homicide rate (15.3%), nutritional intake (12.4%), inflation rate (4%) as well as poverty rate (5%). It should be noted that unemployment and inflation inversely influence suicide rate.

Table 8 presents Pearson's Product Moment correlations of selected macroeconomic variables, nutritional intake deficiency rate, divorce, homicide, and suicide rates for Jamaica for a two-decade period. A very strong bivariate correlation existed between lnpoverty rate and lnnutritional intake ($r_{xy} = 0.917$, P<0.0001) as well as lnunemployment ratre and divorce rate ($r_{xy} = 0.831$, P<0.0001) and divorce rate and lnpoverty rate ($r_{xy} = 0.754$, P<0.0001) compared to a moderate correlation between lnnutritional intake deficiency rate and divorce rate ($r_{xy} = 0.546$, P = 0.002). The relationship

Table 5.
OLS Estimates of Homicide rate in Jamaica, 1990-2012.

Model		Unstandardized Coefficients		Beta	t	P	95.0% Confidence Interval	
		B	Std. Error				Lower	Upper
1	Constant	77.124	7.249		10.640	<0.0001	62.195	92.053
	lnNutritional Deficiency Rate	-15.531	4.635	-0.557	-3.351	.003	-25.076	-5.986
2	Constant	-84.778	20.254		-3.111	.005	-141.020	-28.528
	lnNutritional Deficiency Rate	-23.570	3.267	-0.845	-7.214	<0.0001	-30.314	-16.820
	lnUnemployment Rate	73.013	12.109	0.706	6.029	<0.0001	48.021	98.006
3	Constant	-181.394	29.917		-6.063	<0.0001	-243.283	-119.505
	lnNutritional Deficiency Rate	-18.738	2.685	-0.672	-6.980	<0.0001	-24.292	-13.184
	lnUnemployment Rate	125.851	15.005	1.217	8.387	<0.0001	94.812	156.890
	Divorce Rate per 100,000	0.563	0.120	0.700	4.426	<0.0001	0.300	0.820
4	Constant	-328.506	14.689		-22.364	<0.0001	-358.969	-298.044
	lnNutritional Deficiency Rate	-24.310	0.983	-0.871	-24.737	<0.0001	-26.348	-22.202
	lnUnemployment Rate	181.905	6.471	1.759	28.112	<0.0001	168.485	195.324
	Divorce Rate per 100,000	0.632	0.043	0.785	14.811	<0.0001	0. 543	0. 720
	Suicide rate	7.109	0.522	0.572	13.624	<0.0001	6.020	8.191

Dependent variable: Homicide Rate
Model 1: F [1, 19] = 11.2, P<0.0001, R^2 = 0.310, Adjusted R^2 = 0.282
Model 2: F [2, 18] = 31.7, P<0.0001, R^2 = 0.726, Adjusted R^2 = 0.703
Model 3: F [3, 17] = 44.1, P<0.0001, R^2 = 0.852, Adjusted R^2 = 0.841
Model 4: F [4, 16] = 344.8, P<0.0001, R^2 = 0.984, Adjusted R^2 = 0.983

Table 6.
OLS Estimates of logged Nutritional Intake Deficiency Rate,

Model		Unstandardized Coefficients		Beta	t	P	95.0% Confidence Interval	
		B	Std. Error				Lower	Upper
1	Constant	2.596	0.322		8.063	<0.0001	1.933	3.259
	Homicide Rate per100,000	-.020	0.006	-0.557	-3.351	0.003	-0.032	-0.008
2	Constant	-3.117	0.938		-3.325	0.003	-5.052	-1.182
	Homicide Rate per 100,000	-.029	0.004	-0.810	-7.214	<0.0001	-.037	-0.021
	lnUnemployment Rate	2.597	0.416	0.701	6.242	<0.0001	1.739	3.456
3	Constant	-6.945	1.025		-6.775	<0.0001	-9.066	-4.825
	Homicide Rate per 100,000	-.028	0.003	-0.771	-9.589	<0.0001	-0.034	-0.022
	lnUnemployment Rate	3.821	0.387	1.031	9.876	<0.0001	3.020	4.621
	Suicide Rate	.225	0.046	0.505	4.924	<0.0001	.130	.319
4	Constant	-13.158	0.704		-18.697	<0.0001	-14.618	-11.699
	Homicide Rate per 100,000	-0.040	0.002	-1.108	-24.737	<0.0001	-0.043	-0.036
	lnUnemployment Rate	7.268	0.352	1.961	20.620	<0.0001	6.537	7.999
	Suicide Rate	0.290	0.019	0.651	14.963	<0.0001	0.250	0.330
	Divorce Rate per 100,000	0.025	0.002	0.853	10.915	<0.0001	0.020	0.029

Model 1: F [1, 19] = 11.2, P<0.0001, R^2 = 0.310, Adjusted R^2 = 0.282
Model 2: F [2, 18] = 33.6, P<0.0001, R^2 = 0.737, Adjusted R^2 = 0.715
Model 3: F [3, 17] = 52.2, P<0.0001, R^2 = 0.872, Adjusted R^2 = 0.855
Model 4: F [4, 16] = 200.0, P<0.0001, R^2 = 0.980, Adjusted R^2 = 0.976

between poverty and nutritional intake deficiency rate appears to be a causal one.

DISCUSSION AND CONCLUSION

A 2007 probability sampling survey, which was conducted by Powell, Bourne and Waller, found that crime and violence was the leading national problem faced by Jamaicans. This problem was evident in the 1990s and has gotten the attention of the World Bank. Levy (1996) outlined in a article entitled "They Cry Respect" that the crime and violence pandemic in the Caribbean, particularly Jamaica, accounted for the engagement of the World Bank in funding a research to examine the crime phenomenon in the Caribbean, which culminated in his book. Outside of Levy's ethnographic study on crime in the selected Caribbean islands, including Jamaica, Harriott (2003) concurred with Levy's theorizing and explain that the crime plague results in a conference on crime and violence in Trinidad and Tobago in the 1990s. Clearly the discussion of the crime phenemonenon in the Caribbean has a long history and the matter has become even more intense since in 1990s. Bourne et al. (2014)

opined that "There was a fluctuation of murder rates between the decades in the study period as evidenced by the fact that the average number of murders in Jamaica between 1970- 1979 was 266. The following decade saw an 85.3% increase which subsequently saw a 43.4% reduction by the third decade of the study period (1990-1999). The last decade saw a 93.5% increase in murder rates" (p. 145), which emphasises the exponentail increase in homicide and the continued crime pandemic. The continued rise in homicide has resulted in the matter being studied by Bourne and his colleagues from a public health perspective; but they have not included suicide, and nutritional intake.

Suicide, which is mental health disorder (Bertolote & Fleischmann, 2002a), has been empirically established as being high in Eastern European nations, moderate in North America and the Pacific states and low in Latin America (De Leo & Evans, 2004) including the Caribbean, which is welcoming news for Jamaica. But with evidence showing that statistical association between nutritional intake and homicide, Bourne et al. (2014) demonstration of the inverse relationship between murder and health, and studies by

Table 7.
OLS Estimate of Suicide

Model	Details	Unstandardized Coefficients		Beta	t	P	95.0% CI	
		B	Std. Error				Lower	Upper
1	Constant	17.241	2.215		7.783	<0.0001	12.774	21.709
	lnUnemployment rate	-5.671	0.928	-0.682	-6.112	.000	-7.542	-3.800
2	Constant	19.042	2.028		9.390	<0.0001	14.949	23.134
	lnUnemployment rate	-6.981	0.901	-0.839	-7.748	<0.0001	-8.799	-5.163
	lnNutritional Deficiency Rate	.866	0.243	0.386	3.564	0.001	0.376	1.357
3	Constant	24.132	1.926		12.526	<0.0001	20.241	28.023
	lnUnemployment rate	-11.365	1.146	-1.367	-9.918	<0.0001	-13.680	-9.051
	lnNutritional Deficiency Rate	2.282	0.347	1.017	6.575	<0.0001	1.581	2.983
	Homicide rate per 100,000	0.060	0.012	0.746	4.930	<0.0001	0.035	0.085
4	Constant	43.508	1.583		20.478	<0.0001	40.308	46.708
	lnUnemployment rate	-23.713	0.993	-2.851	-23.892	<0.0001	-25.719	-21.707
	lnNutritional Deficiency Rate	3.140	0.156	1.399	20.176	<0.0001	2.826	3.455
	Homicide rate per 100,000	0.126	0.007	1.563	18.370	<0.0001	0.112	0.140
	Divorce rate per 100,000	0.080	0.006	1.243	14.154	<0.0001	0.069	0.092
5	Constant	42.474	1.607		26.425	<0.0001	39.223	45.725
	lnUnemployment rate	-22.965	1.024	-2.761	-22.421	<0.0001	-25.036	-20.893
	lnNutritional Deficiency Rate	3.089	0.152	1.377	20.325	<0.0001	2.782	3.397
	Homicide rate per 100,000	0.124	0.007	1.542	18.656	<0.0001	0.111	0.137
	Divorce rate per 100,000	0.075	0.006	1.151	11.989	<0.0001	0.062	0.087
	Inflation rate	-0.016	0.008	-0.080	-2.033	0.049	-0.031	0.000
6	Constant	38.586	2.308		16.715	<0.0001	33.913	43.260
	lnUnemployment rate	-20.930	1.330	-2.517	-15.739	<0.0001	-23.622	-18.238
	lnNutritional Deficiency Rate	1.800	0.591	0.802	3.045	0.004	0.603	2.997
	Homicide rate per 100,000	0.131	0.007	1.620	18.642	<0.0001	0.117	0.145
	Divorce rate per 100,000	0.041	0.016	0.634	2.562	0.014	0.009	0.073
	Inflation rate	-0.022	0.008	-0.114	-2.823	0.008	-0.038	-0.006
	Poverty rate	0.182	0.081	0.847	2.249	0.030	0.018	0.347

Dependent variable: Suicide Rate
Model 1: $F_{[1, 19]} = 37.4$, P<0.0001, $R^2 = 0.465$, Adjusted $R^2 = 0.452$
Model 2: $F_{[2, 18]} = 30.1$, P<0.0001, $R^2 = 0.589$, Adjusted $R^2 = 0.570$
Model 3: $F_{[3, 17]} = 39.3$, P<0.0001, $R^2 = 0.742$, Adjusted $R^2 = 0.723$
Model 4: $F_{[4, 16]} = 222.9$, P<0.0001, $R^2 = 0.957$, Adjusted $R^2 = 0.953$
Model 5: $F_{[5, 15]} = 193.1$, P<0.0001, $R^2 = 0.961$, Adjusted $R^2 = 0.956$
Model 6: $F_{[6, 14]} = 179.5$, P<0.0001, $R^2 = 0.966$, Adjusted $R^2 = 0.960$

Zureik, et al. (1996); Dunnigan (1993); Ellison & Morrison (2001) found significant association between nutritional consumption and suicide. There is a clear gap in the literature on factors of homicides including nutritional intake, suicide and macroeconomic variables, and, equally so the factors that influence nutritional intake and suicide. The current finding concurs with the literature on the correlation between nutritional intake and homicide (see Hibbeln, 2001), and that it is a strong bivariate one (r>0.7). Hibbeln et al. (2004) found a strong positive correlation between the two aforementioned variables (r = 0.89) and such a finding denotes that increase consumption of linoleic acid from seed oils will result in a rise in homicides (Hibbeln et al, 2004). However, for this study, we found an inverse correlation between nutritional intake of foods and homicide (rxy = -0.777) which indicates that a rise in people who are nutritionally deficient will directly influence the homicide rates in Jamaica. Simply put, a rise in hunger will correspond to a reduction in homicides offering the reason that it is not hunger that is fueling the rise in the homicide pandemic in Jamaica. The current research went further than Hibbeln et al. (2004) by examining the following: factors of homicide rate, factors of suicide rate and factors of nutritional intake, and, it was discovered that nutritional intake, divorce and unemployment rate determine 82% of variability in homicide rate in Jamaica, with nutritional intake accounting for 60% of the total variance.

In Jamaica, the reality is, nutritional intake deficiency directly correlates with suicide as well as divorce, poverty, unemployment and homicides rates. The statistical association between nutrition and suicide in this study concurs with those conducted by Desseilles, Mikolajczak & Desseilles, (2012) and Zhang, Li, & Torres, (2005). In fact, the correlation between nutrition and suicide in Jamaica would support a perspective forwarded by Desseilles, et al. (2012) entitled "diet-related suicide" and we will argue that there is 'unemployment related suicide'. Clearly, job separation is responsible for a rise in the number of suicides in the nation or the general cost of living; but, it is population's interpretation of the general quality of life which is expressed in poverty, divorce, nutritional intake and murder rate. Not only is there is psychology of economics, which is expressed in the positive relationship between poverty and suicide, but the fall in the general living standard of people is able to create mental health issues that translate into the desire to attempt or commit suicide. People's interpretation of self in life compared to other people is evaluated based on economic resources that have a psychological impact on their actions, and it for this very reason why South's (1985) work showed that the divorce rates increases in times of recession. Furthermore, Musai et al. (2011) indicated that psychological spousal stressors rise in periods of economic recession because there is a psychology of economics that account for particular human behaviour. By merely being hungry will cause people to commit suicide, and it is the pscyhology of general of socio-economic deprivation that stimulates the sensors of mental health disorders that is acted upon and produce a suicidal action. This is reinforced in the present findings that found a negative statistical correlation between inflation and suicide, but the inverse between poverty and suicide. Suicide, which is an indicator of mental health disorder is difficult to

Table 8.
Pearson's Product Moment Correlations of Macroeconomic variables, nutritional intake deficiency rate, divorce, homicide, and suicide rates

	Details	lnNutritional Deficiency Rate	Divorce Rate per 100,000	lnUnemployment Rate	Homicide Rate per 100,000	Inflation Rate	Suicide Rate	lnPoverty Rate
Pearson Correlation	lnNutritional Deficiency Rate	1.000	.546	.408	-.557	-.306	.044	.917
	Divorce Rate per 100,000	.546	1.000	.831	-.054	-.360	-.449	.754
	lnUnemployment Rate	.408	.831	1.000	.361	-.048	-.682	.472
	Homicide Rate per 100,000	-.557	-.054	.361	1.000	.359	-.313	-.565
	Inflation Rate	-.306	-.360	-.048	.359	1.000	-.229	-.447
	Suicide Rate	.044	-.449	-.682	-.313	-.229	1.000	.481
	lnPoverty Rate	.917	.754	.472	-.565	-.447	.481	1.000
Sig. (1-tailed)	lnNutritional Deficiency Rate	.	.002	.017	.001	.060	.015	.000
	Divorce Rate per 100,000	.002	.	.000	.394	.032	.009	.000
	lnUnemployment Rate	.017	.000	.	.032	.406	.000	.007
	Homicide Rate per 100,000	.001	.394	.032	.	.033	.056	.001
	Inflation Rate	.060	.032	.406	.033	.	.125	.010
	Suicide Rate	.015	.009	.000	.056	.125	.	.010.
	lnPoverty Rate	.000	.000	.007	.001	.010	0.01	.
N	lnNutritional Deficiency Rate	20	20	20	20	20	20	20
	Divorce Rate per 100,000	20	20	20	20	20	20	20
	lnUnemployment Rate	20	20	20	20	20	20	20
	Homicide rate per 100,000	20	20	20	20	20	20	20
	Inflationn Rate	20	20	20	20	20	20	20
	Suicide Rate	20	20	20	20	20	20	20
	lnPoverty Rate	20	20	20	20	20	20	20

face psychologically by the individual when there is a change in their socio-economic status. It follows that people's coping mechanism is not able to withstand general social and economic marginalization for long. We can deduced from the current findings that prolong hunger will stimulate sensors of suicidal behavior as well as poverty because people interpret these events as personal failure, and this produces a state of uselessness in life.

Divorce which is an indication of failure in the life of the individual produces the stimulus of self-destruction as an economic failure and accounts for violence. Kouyoumdjian, et al. (2013) indicated that the risk factors related to intimate partner violence included "… sexual abuse in childhood or adolescence, earlier age at first sex, lower levels of education, and forced first sex" (p. 1), and the issue of divorce was excluded from this listing. In this research, we found that divorce positively relates to 1) suicide, 2) homicide, and, 3) nutritional intake deficiency. Divorce is, therefore, a negative psychological stimulus and therefore, those who are engaged in excessive eating must be closely observed as it is an indicator of mental health issues that may be buried or ignored.

Poverty is not a simple factor as it produces 1) behaviour towards suicide, and, 2) nutritional intake deficiency in people. It is more than an macroeconomic issue (i.e., poverty) as it stimulates negative thoughts, moods and behaviour that must be incorporated in the public health discourse. Poverty must be treated as a separate public health concern such as homicide, suicide, psychiatric disorders and violence, because this single force interrelates to undernutrition, suicide, and homicide making it a significant public health issue. With this study unearthing that 95% of the variability in undernutrition is determined by poverty, this single factor is causally relating to health and cannot be treated merely as a macroeconomic phenomenon. In fact, poverty is invoking mental health disorders, which is expressed in the association with suicide, and cannot be left only for economic analyses. The reality based on these findings is that poverty is changing people's mood, thinking, behaviour and actions in such a destructive matter that the findings speak to the

public health nature of this phenomenon. There is no denial that poverty is causing mental health issues in Jamaica as expressed by the strong correlation between poverty and suicide. In fact, according to Bertolote & Fleischmann (2002b), 9 out of every 10 people who committed suicide were diagnosed with a psychiatric disorder and with the current findings that poverty positively influence suicide, poverty must be brought into the discourse of suicide. Poverty is, therefore, influencing wellbeing and death and should be treated with the same degree of urgency in public health like suicide and violence.

In conclusion, divorce has an impact on nutritional intake, suicide and homicide rates in Jamaica. The legal separation of sexual partners (i.e., divorce) is a complex phenomenon as it destroys the psychological state of the individual involved, the person's nutritional intake of foods, an increase tendency to commit or attempt a suicidal act, a likeliness to become engage in violent acts, and reduced economic resources of the divorcee. Divorce is not the only factor that creating psychiatric disorders in people as we now know that unemployment, poverty, homicide and nutritional intake are psychosocial challenges and these are creating murderers. The homicide pandemic that is facing the Caribbean, especially Jamaica, is a product of the sexual separation, nutritional intake and suicides that were previously not included in the discipline of Caribbean criminology. Caribbean criminology must extend its scope of research to include suicide, divorce, nutritional intake; while public health must add to its focus homicide, macroeconomic variables (poverty, inflation, unemployment rates), divorce and nutritional intake as these issues are impacting on people's general well-being. The matter of nutrition is more than a physiological issue as it has the potential to cause murders and suicidal tendencies among certain members of the population.

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