The Psychology and Pharmacoepidemiology of Deaths and Homicide in Jamaica: An Empirical Assessment

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ABSTRACT

Introduction: Jamaica has been featured among the nations with the highest crime rates in the world, and despite this reality, homicide and other deaths have never been examined for their effect on attendance at Accident and Emergency (A&E) or admissions to government and quasi-government hospitals.

Objectives: This paper evaluates the cross-elasticities of hospitalizations in Jamaica for a 10-year period; the effects of homicide and death rates in predicting attendance rate at A&E departments in government and quasi-government hospitals in Jamaica for a 10-year period; evaluate homicide, death, and maternity rates as predictors of admissions rate to government and quasi-government hospitals in Jamaica for a 10-year period; evaluate homicide, death, and maternity rates as predictive factors of psychiatric admissions rate to a national psychiatric hospital in Jamaica for a 10-year period; and to evaluate if the ln attendance at A&E departments and ln admissions at government and quasi-government hospitals are significantly influenced by psychiatric, homicide, death, and maternity rates in Jamaica for a 10-year periods.

Methods and materials: The data for this study were taken from a Jamaica Government Publication; the Ministry of Health reported attendance to A&E departments and admissions to all government hospitals including the quasi-hospital, University Hospital of the West Indies. The timeline for this research is 2006 through to 2015.

Results: The average number of visits to A&E at public hospitals and the University Hospital of the West Indies for the studied period was 794,596 ± 86,177, 95%CI: 762,417 – 826,775 compared to 189,267 ± 7,863, 95%CI: 186,331 – 192,203 admissions. The OLS table showed that the death rate is not a factor of log attendance rate at government and quasi-government hospitals in Jamaica (P = 0.254 > 0.05). Furthermore, a positive significant statistical correlation existed between homicide rate per 100,000 and log attendance rate per 100, beta = 1.044, P = 0.019 < 0.05), with the goodness of fit for the model being significant linear one (F [2,6] = 5.927, P = 0.038). In addition, the correlation between the two aforementioned variable being a moderately strong one (adjusted R² = 0.555 or 55.5%).

Conclusion: Our findings support a disaggregation in screening patients who visit health care institutions based on exposure to homicide or other deaths as their impacts are different and must be addressed as such. We are prescribing that while the psychology of death is evident in this work, the matter goes beyond that to the pharmacoepidemiology of deaths.

Mesh Headings/Keywords: Attendance to A&E; Elasticity of hospitalization; Hospitalization; Probability of hospitalization; Mortality
Using mortality data for Jamaica from the 1990’s, Caribbean scholars have empirically established that this information is of a moderate to high quality for this country [23-26]. However, the WHO as well as McCaw-Binns, Mullings, and Holder opined that completeness of mortality data for Jamaica is low [26-28], which is high for other Caribbean nations such as Bahamas, Barbados, Cuba, Dominica, St. Vincent and the Grenadines, and Trinidad and Tobago. Completeness of data was said to be high if it was at least 90%; moderate, 70-90% and low if it was less than 70%. A review of epidemiological and demographic literature did not reveal a single study that has examined the responsibility of hospitalization at psychiatric and maternity institutions to homicide and other deaths. With various studies data illustrating that major crimes are high in Jamaica, especially homicide [29-32] and homicide and psychiatric hospitalization [33], a study on the responsibility of admissions to a psychiatric and maternity hospital would provide insightful information on the matter of homicide and other deaths.

The search to ascertain the responsivity of hospitalization at a psychiatric and maternity institution coupled with births to homicide or other deaths were expanded to PubMed, EBSCOhost, ProQuest, and other academic databases. This research is timely as it evaluates the influence of homicide or other deaths on admissions to a maternity or psychiatric hospital as well as on births. The objectives of this paper are to evaluate: the cross-elasticities of hospitalizations for Jamaica for a 10-year period; the effects of homicide and death rates in predicting attendance rate at A&E departments in government and quasi-government hospitals in Jamaica for a 10-year period; evaluate homicide, death, and maternity rates as predictors of admissions rate to government and quasi-government hospitals in Jamaica for a 10-year period; evaluate homicide, death, and maternity rates as predictive factors of psychiatric admissions rate to a national psychiatric hospital in Jamaica for a 10-year period; and, to evaluate if the In attendance at A&E departments and In admissions at government and quasi-government hospitals in Jamaica are significantly influenced by psychiatric, homicide, death and maternity rates in Jamaica for a 10-year period.

Theoretical Framework

Koppensteiner, et al. [34] forwarded an empirical model to establish factors that account for birthweight including homicide. They used a linear model to express that homicide and other factors explain birthweight, equation (1):

\[ Y_{iat} = \beta_h HOM_{at} + d_a + d_t + u_{iat} \]  

“where Yi at is the individual outcome variable (birthweight, gestational length, etc.) in area (municipality or neighbourhood) a, at time t, HOMat is the local homicide rate and da and dt are respectively mother’s area of residence and month of conception-fixed effects, while u is an error term” [34]. This paper employs a similar model to explain the manner in which homicide or death influences hospitalization at a maternity hospital (i.e., Victoria Jubilee Hospital).

Methods and Materials

The data for this study were taken from a Jamaica Government Publication; the Ministry of Health reported attendance to A&E departments and admissions to all government hospitals including the quasi-hospital, University Hospital of the West Indies. The timeline for this research is 2006 through to 2015. Data were recorded, stored and retrieved using the Statistical Packages for the Social Sciences (SPSS) for Windows, Version 24.0. 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 was used to ascertain the correlation of attendance, homicide, and other forms of deaths in Jamaica.

In order to assure the OLS application was appropriate for this study; all assumptions were tested before usage. In cases where variables were highly inter-correlated (r > 0.7), tolerance were checked and if multi-collinearity was discovered, one of the variables was dropped and used separately in a model without the highly correlated variable.

One of the assumptions of OLS were not met, linearity, and so this violation meant that the researchers log transform the variable, attendance [35-39] (Annex Figure 9). Whether it is medical research or otherwise, interpreting the correlation coefficients is important [40,41] and Evans provided a platform [42] for correlation coefficient interpretations. Evans outlined that for r [42], very weak is 0 – 0.19; weak is 0.20-0.39; moderate is 0.40-0.59; strong is 0.60-0.79 and very strong is 0.80-1.00 as well as for r2: very weak is 0 – 4%; weak is 4-16%; moderate is 16-36%; strong is 36-< 64% and very strong is 64-100%. For this study, Evans’ perspective will be used to interpret the strength of squared r values, which is in keeping with similar positions by Howell [43,44]; and Howitt, et al. [45].

In using the OLS to model the correlations for this study, it was revealed that they are best expressed by curvilinear relationships and so the models are based on curvilinear functions and their correlations are interpreted by way of Evans and others’ works. Outside of OLS, for this study additional statistical techniques were employed such as multivariate analysis of variance (MANOVA), reliability and factor analysis.

Cross-elasticities of hospitalization

<table>
<thead>
<tr>
<th>% Δ in admissions at national psychiatric hospital (i.e., Bellevue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Δ in admissions at national maternity hospital (i.e.Victoria Jubilee)</td>
</tr>
</tbody>
</table>

Or

\[ \frac{\text{Difference in Hospitalization at national psychiatric hospital (i.e., Bellevue)} \times 100}{\text{Hospitalization at national psychiatric hospital (i.e., Bellevue) at time t}} \]

\[ \frac{\text{Difference in Hospitalization at national maternity hospital (i.e., Victoria Jubilee)} \times 100}{\text{Hospitalization at national maternity hospital (i.e., Victoria Jubilee) at time t}} \]

Where η is the elasticity of hospitalization

% Δ denotes the percentage change in hospitalization at
t and \( t + 1 \), where time \( t \) is one year and \( t + 1 \) is the following year.

\[
\eta = \frac{\% \Delta \text{ in admissions at national maternity hospital (i.e., Victoria Jubilee)}}{\% \Delta \text{ in homicide}}
\]

Or

\[
\eta = \frac{\text{Difference in Hospitalization at national maternity hospital (i.e., Victoria Jubilee) at time } t + 1}{\text{Hospitalization at time } t}
\]

\[
\text{Homicide at time } t + 1 \times 100
\]

Or

\[
\eta = \frac{\text{Difference in Hospitalization at national psychiatric hospital (i.e., Victoria Jubilee) at time } t + 1}{\text{Hospitalization at time } t}
\]

\[
\text{Homicide at time } t \times 100
\]

Interpretations of elasticities results

\( \eta > 1 \): elastic hospitalization or highly responsive hospitalization meaning that a one percentage change in the denominator will result in a more than 1 percentage change in the numerator;

\( \eta < 1 \): inelastic hospitalization or lowly responsive hospitalization which denotes that a one percentage change in the denominator will result in a less than 1 percentage change in the numerator;

Interpreting signs of the elasticities

Negative sign means substitution effect or one product can operate outside of the other;

Positive sign means complementary effect or one product operates jointly with another

Substitution effect

\( \eta > -1 \): This is a substitution effect that is highly responsive

\( \eta < -1 \): This is a substitution effect this is lowly responsive

Complementary effect:

\( \eta > +1 \): This is a complementary effect that is lowly responsive

\( \eta < +1 \): this is a complementary effect that is highly responsive

Death rate

**Psychiatric hospitalization rate**

\[
\text{Death rate} = \frac{\sum \text{Death at time } t}{\text{Mid-year population at time } t} \times 1000
\]

**Homicide rate**

\[
\text{Homicide rate} = \frac{\sum \text{Homicide at time } t}{\text{Mid-year population at time } t} \times 1000
\]

Note: The rates are displayed in the Annex.

**Probability of Attendance**

\[
\frac{\sum \text{Attendance at hospital for time period } t}{\text{Mid-year population at time } t}
\]

**Probability of Admission**

\[
\frac{\sum \text{Admission at hospital for time period } t}{\sum \text{Attendance at hospital for time period } t}
\]

Results

Table 1 presents attendance and admissions to Accident and Emergency departments at government and quasi-government hospitals in Jamaica, 2006-2015, along with various descriptive statistics. The average number of visits to A&E at public hospitals and the University Hospital of the West Indies for the studied period was 794,596 ± 86,177, 95%CI: 762,417 – 826,775 compared to 189,267 ± 7,863, 95%CI: 186,331 – 192,203 admissions. The mean number of deaths was 18,549 ± 1,765, 95%CI: 17,890 – 19,208 compared to 1,324 ± 228, 95%CI: 1,239 – 1,409 reported cases of homicides. In the first five years (2006-2010), the mean number of visits to A&E at government hospitals including the University Hospital of the West Indies was 835,694±84,393, 95%CI: 722,510-948,878 compared to...
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753,499 ± 68,131, 95%CI: 662125 - 844,872 in the latter five years (2011-2015). The results signify that the number of people visiting the A&E departments at government hospitals and the University Hospital of the West Indies (i.e., UHWI) has fallen by 9.8%, which is the reverse for admissions to the same institutions. For the second 5-year period, the mean number of people admitted to A&E government hospitals including UHWI was 194,403 ± 3,663, 95%CI: 189,491-199,316, which represents a 5.6% increase over the first 5-year period (i.e., 184,131 ± 7,623, 95%CI: On the other hand, the mean number of homicide for the two periods (i.e., 2006-2010; 2011-2015) declined by 26.3%, which was the total reverse for other deaths, an increase of 3.5%.

Table 2 presents the probabilities of attendance and admissions to government hospitals including the University Hospital of the West Indies (i.e., quasi-government hospital, UHWI). The Table illustrates that probabilities of visits to accident and emergency departments at government hospitals and UHWI lies between and include 0.2464 to 0.3515 (i.e. 0.2464 ≤ P(A) ≤ 0.3515), indicating that at most 35.2% of people in Jamaica visit accident and emergency departments at various government and quasi-government hospitals. A graphical display of the probabilities of attendance at government and quasi-government hospitals in Jamaica is depicted on Figure 1.

Table 3 presents a cross-elasticity of attendance at government and quasi-government hospitals in Jamaica from 2006-2015. It can be deduced from the calculations that attendance at government and quasi-government hospitals is equally responsive and irresponsible to deaths. The negative values suggest that there is a corresponding effect between

<table>
<thead>
<tr>
<th>Year</th>
<th>Attendance (A)</th>
<th>Death (A)</th>
<th>% change in A</th>
<th>% change in D</th>
<th>Cross-elasticity of A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>7,24,030</td>
<td>15321</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2007</td>
<td>8,03,433</td>
<td>16614</td>
<td>10.967</td>
<td>8.439</td>
<td>1.299</td>
</tr>
<tr>
<td>2008</td>
<td>9,15,995</td>
<td>16371</td>
<td>14.01</td>
<td>-1.463</td>
<td>-9.579</td>
</tr>
<tr>
<td>2009</td>
<td>9,42,523</td>
<td>17467</td>
<td>2.896</td>
<td>6.695</td>
<td>0.433</td>
</tr>
<tr>
<td>2010</td>
<td>7,92,489</td>
<td>17007</td>
<td>-15.918</td>
<td>-2.634</td>
<td>6.044</td>
</tr>
<tr>
<td>2011</td>
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<td>16926</td>
<td>-5.483</td>
<td>-0.476</td>
<td>11.512</td>
</tr>
<tr>
<td>2012</td>
<td>8,59,666</td>
<td>16998</td>
<td>-8.715</td>
<td>-9.242</td>
<td>0.943</td>
</tr>
<tr>
<td>2013</td>
<td>7,84,748</td>
<td>15427</td>
<td>-14.576</td>
<td>17.625</td>
<td>-0.827</td>
</tr>
<tr>
<td>2014</td>
<td>6,70,360</td>
<td>18146</td>
<td>4.971</td>
<td>-100.00</td>
<td>-0.05</td>
</tr>
<tr>
<td>2015</td>
<td>7,03,683</td>
<td>18157</td>
<td>4.971</td>
<td>-100.00</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

Table 2: Probabilities of attendance and admission to government hospitals in Jamaica, 2006-2015.

Table 3: Cross-elasticity of attendance and death, 2006-2015.

P(A) denotes the probability of attendance to A&E at government and quasi-government hospitals

**Figure 1:** Frequency distribution of probabilities of attendance at accident and emergency departments at government and quasi-government hospitals, 2006-2015.
attending at government and quasi-government hospitals and deaths, which is mostly irresponsible (i.e., 2014, 2015) and responsive (i.e., 2008) to deaths.

Admissions at government and quasi-government hospitals in Jamaica are mostly responsive to death (i.e., 2007-2012) – Table 4, with minor complementary effects (i.e., operating at the same time) between admissions at government and quasi-government hospitals and other deaths.

Attendance at government and quasi-government hospitals in Jamaica is rarely jointly related with homicide; but most of the data are supporting responsibility of attendance at government and quasi-government hospitals with homicide (Table 5).

Admissions at government and quasi-government hospitals in Jamaica are mostly irresponsible to homicide, with there being equal number of cases of joint effect (i.e., complementary effect) as substitution effect. The joint effects suggest that admissions at government and quasi-government hospitals are operating in tandem with homicide (Table 6). From the data the likelihood is low that homicide is causing a more than 1% change in admissions at government and quasi-government hospitals.

The majority of the instances computed in this study support joint effect (i.e., complementary effect) between psychiatric admissions at government and quasi-government hospitals in reference to homicide. Although psychiatric admissions at government and quasi-government hospitals are mostly irresponsible to changes in homicide, statistical evidence emerge indicating substitution effect and inverse effect between both phenomena (Table 7).

Table 8 presents a summative description of admissions at government maternity hospital in Jamaica and homicide.

<table>
<thead>
<tr>
<th>Year</th>
<th>Admission (M)</th>
<th>Death (D)</th>
<th>% change in M</th>
<th>% change in D</th>
<th>Cross-elasticity of M</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>174,704</td>
<td>15,321</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2007</td>
<td>192,798</td>
<td>16,614</td>
<td>10.3569</td>
<td>8.4394</td>
<td>1.2272</td>
</tr>
<tr>
<td>2008</td>
<td>180,438</td>
<td>16,371</td>
<td>-6.4109</td>
<td>-1.4626</td>
<td>4.3831</td>
</tr>
<tr>
<td>2009</td>
<td>192,826</td>
<td>17,467</td>
<td>6.8655</td>
<td>6.6948</td>
<td>1.0255</td>
</tr>
<tr>
<td>2010</td>
<td>179,890</td>
<td>17,007</td>
<td>-6.7086</td>
<td>-2.6335</td>
<td>3.5474</td>
</tr>
<tr>
<td>2012</td>
<td>200,578</td>
<td>16,998</td>
<td>2.6064</td>
<td>0.4254</td>
<td>6.1271</td>
</tr>
<tr>
<td>2013</td>
<td>193,113</td>
<td>15,422</td>
<td>-3.3229</td>
<td>-9.2423</td>
<td>0.3595</td>
</tr>
<tr>
<td>2014</td>
<td>190,703</td>
<td>18,146</td>
<td>-1.6554</td>
<td>18.6070</td>
<td>-5.539</td>
</tr>
<tr>
<td>2015</td>
<td>191,340</td>
<td>18,157</td>
<td>0.3340</td>
<td>-100.000</td>
<td>-0.0033</td>
</tr>
</tbody>
</table>

Table 5: Cross-elasticity of attendance to government hospitals and homicide in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Attendance (A)</th>
<th>Homicide (H)</th>
<th>% change in A</th>
<th>% change in D</th>
<th>Cross-elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>724,030</td>
<td>1,340</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2007</td>
<td>803,433</td>
<td>1,574</td>
<td>10.9668</td>
<td>17.4627</td>
<td>0.628</td>
</tr>
<tr>
<td>2008</td>
<td>915,995</td>
<td>1,601</td>
<td>14.0101</td>
<td>1.7154</td>
<td>8.167</td>
</tr>
<tr>
<td>2009</td>
<td>942,523</td>
<td>1,680</td>
<td>2.8961</td>
<td>4.9344</td>
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</tr>
<tr>
<td>2010</td>
<td>792,489</td>
<td>1,428</td>
<td>-15.9183</td>
<td>-15.0000</td>
<td>1.061</td>
</tr>
<tr>
<td>2011</td>
<td>749,036</td>
<td>1,125</td>
<td>-5.4831</td>
<td>-21.2185</td>
<td>0.258</td>
</tr>
<tr>
<td>2012</td>
<td>859,666</td>
<td>1,095</td>
<td>14.7697</td>
<td>-2.6667</td>
<td>-5.539</td>
</tr>
<tr>
<td>2013</td>
<td>784,748</td>
<td>1,200</td>
<td>-8.7148</td>
<td>9.5890</td>
<td>-0.909</td>
</tr>
<tr>
<td>2014</td>
<td>670,360</td>
<td>1,005</td>
<td>-14.5764</td>
<td>-16.2500</td>
<td>0.897</td>
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<tr>
<td>2015</td>
<td>703,683</td>
<td>1,192</td>
<td>4.9709</td>
<td>18.6070</td>
<td>0.267</td>
</tr>
</tbody>
</table>

Table 6: Cross-elasticity of admission to government hospitals and homicide in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Admission (M)</th>
<th>Homicide (H)</th>
<th>% change in M</th>
<th>% change in D</th>
<th>Cross-elasticity</th>
</tr>
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<tr>
<td>2006</td>
<td>174,704</td>
<td>1,340</td>
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<td>-</td>
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<tr>
<td>2007</td>
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<td>1,574</td>
<td>10.3569</td>
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<td>0.593</td>
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<tr>
<td>2008</td>
<td>180,438</td>
<td>1,601</td>
<td>-6.4109</td>
<td>1.7154</td>
<td>-3.737</td>
</tr>
<tr>
<td>2009</td>
<td>192,826</td>
<td>1,680</td>
<td>6.8655</td>
<td>4.9344</td>
<td>1.391</td>
</tr>
<tr>
<td>2010</td>
<td>179,890</td>
<td>1,428</td>
<td>-6.7086</td>
<td>-15.0000</td>
<td>-0.447</td>
</tr>
<tr>
<td>2011</td>
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<td>1,125</td>
<td>8.6681</td>
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</tr>
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</tr>
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<td>2014</td>
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<td>1,005</td>
<td>-1.6554</td>
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</tr>
<tr>
<td>2015</td>
<td>191,340</td>
<td>1,192</td>
<td>0.3340</td>
<td>18.6070</td>
<td>0.018</td>
</tr>
</tbody>
</table>
from 2006-2015. Hospitalization at government maternity facility in Jamaica is primarily irresponsive to death, with infrequent cases of joint effect between both variables.

Hospitalization at the government maternity institution in Jamaica is substantially highly responsive to death, with infrequent incidences occurring when there is a joint irresponsive effect between admissions at the government maternity department and death (Table 9).

Table 7: Cross-elasticity of admission to national government psychiatric hospital and homicide in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Psychiatric (P)</th>
<th>Homicide (H)</th>
<th>% change in P</th>
<th>% change in H</th>
<th>Cross-elasticity</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2.398</td>
</tr>
<tr>
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<td>-15.0000</td>
<td>-0.042</td>
</tr>
<tr>
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<td>1125</td>
<td>-8.4211</td>
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<td>0.397</td>
</tr>
<tr>
<td>2012</td>
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<td>1095</td>
<td>3.9707</td>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>-1.0945</td>
<td>18.6070</td>
<td>-0.515</td>
</tr>
</tbody>
</table>

Table 8: Cross-elasticity of admission to national government maternity hospital and homicide in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Maternity (Z)</th>
<th>Homicide (H)</th>
<th>% change in Z</th>
<th>% change in H</th>
<th>Cross-elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>14,101</td>
<td>1340</td>
<td>-</td>
<td>17.4627</td>
<td>0.707</td>
</tr>
<tr>
<td>2007</td>
<td>15,841</td>
<td>1574</td>
<td>12.3396</td>
<td>17.4627</td>
<td>-0.040</td>
</tr>
<tr>
<td>2008</td>
<td>14,928</td>
<td>1601</td>
<td>-5.7635</td>
<td>1.7154</td>
<td>-3.360</td>
</tr>
<tr>
<td>2009</td>
<td>16,635</td>
<td>1680</td>
<td>11.4349</td>
<td>4.9344</td>
<td>2.317</td>
</tr>
<tr>
<td>2010</td>
<td>15,885</td>
<td>1428</td>
<td>-4.5086</td>
<td>-15.0000</td>
<td>0.301</td>
</tr>
<tr>
<td>2011</td>
<td>15,888</td>
<td>1125</td>
<td>0.0189</td>
<td>-21.2185</td>
<td>-0.001</td>
</tr>
<tr>
<td>2012</td>
<td>16,452</td>
<td>1095</td>
<td>3.5498</td>
<td>-2.6667</td>
<td>-1.331</td>
</tr>
<tr>
<td>2013</td>
<td>16,895</td>
<td>1200</td>
<td>2.6927</td>
<td>9.5890</td>
<td>0.281</td>
</tr>
<tr>
<td>2014</td>
<td>15,229</td>
<td>1005</td>
<td>-9.8609</td>
<td>-16.2500</td>
<td>0.607</td>
</tr>
<tr>
<td>2015</td>
<td>16,688</td>
<td>1192</td>
<td>9.5804</td>
<td>18.6070</td>
<td>0.515</td>
</tr>
</tbody>
</table>

Table 9: Cross-elasticity of admission to national government maternity hospital and death in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Maternity (Z)</th>
<th>Death (D)</th>
<th>% change in Z</th>
<th>% change D</th>
<th>Cross-elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>14,101</td>
<td>15321</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2007</td>
<td>15,841</td>
<td>16614</td>
<td>12.3396</td>
<td>8.4394</td>
<td>1.462</td>
</tr>
<tr>
<td>2008</td>
<td>14,928</td>
<td>16371</td>
<td>-5.7635</td>
<td>-1.4626</td>
<td>0.258</td>
</tr>
<tr>
<td>2009</td>
<td>16,635</td>
<td>17467</td>
<td>11.4349</td>
<td>6.6948</td>
<td>0.515</td>
</tr>
<tr>
<td>2010</td>
<td>15,885</td>
<td>17007</td>
<td>-4.5086</td>
<td>-2.6335</td>
<td>1.712</td>
</tr>
<tr>
<td>2011</td>
<td>15,888</td>
<td>16926</td>
<td>0.0189</td>
<td>-0.4763</td>
<td>-0.001</td>
</tr>
<tr>
<td>2012</td>
<td>16,452</td>
<td>16998</td>
<td>3.5498</td>
<td>0.4254</td>
<td>8.345</td>
</tr>
<tr>
<td>2013</td>
<td>16,895</td>
<td>15427</td>
<td>2.6927</td>
<td>-9.2423</td>
<td>-0.291</td>
</tr>
<tr>
<td>2014</td>
<td>15,229</td>
<td>18146</td>
<td>-9.8609</td>
<td>17.6249</td>
<td>-0.559</td>
</tr>
<tr>
<td>2015</td>
<td>16,688</td>
<td>18157</td>
<td>9.5804</td>
<td>0.0606</td>
<td>158.042</td>
</tr>
</tbody>
</table>

Hospitalization at a psychiatric government institution in Jamaica is highly responsive to death (Table 10), suggesting that death accounts for more than percentage change in admissions at the government psychiatric facility.

$$H_0 : \log A_1 \neq f(D_1, H_1)$$  \[1\]

Where $H_0$ is the null hypothesis of log attendance rate at government and quasi-government hospitals in Jamaica is
not a function of the death rate per 1,000 ($D_t$) in time period $t$ and the homicide rate per 100,000 ($H_t$) in time period $t$.

Table 11 presents the OLS for log attendance rate and explanatory variables for Jamaica. The OLS table showed that the death and homicide rates predictive factors of log attendance rate at government and quasi-government hospitals in Jamaica, supporting the best fit of a linear model $(F[1,24]=27.208, P < 0.0001).$ The explanatory factors (i.e., homicide and death rates) are moderately strongly associated with log attendance rate (adjusted $R^2 = 0.636$). Hence, we reject the null-hypothesis because collectively homicide and death rates are factors of attendance to government and quasi-government hospitals in Jamaica. As such, we will construct a function for log attendance rate at government and quasi-government hospital in Jamaica. We can conclude, therefore, from the robust statistical testing, that homicide and death rates are resulting in an exponential rise in attendance at government and quasi-government hospitals in Jamaica.

Furthermore, using the collinearity diagnostics, a homicide was strongly correlated with log attendance (0.76) compared to a weak correlation between death rate and log attendance (0.24), with the correlation between homicide and death rate being 59%. It can be deduced from the aforementioned that homicide rate is a significant predictor of attendance at A&E government and quasi-government hospitals in Jamaica, with some of the other deaths relating to homicide. Multicollinearity is not a problem in the examination of the aforementioned model (tolerance =1.9), and so we present the model that encapsulates attendance rate in Jamaica:

$$f(A_t) = 10^{(\beta_0 + \beta_1 H_t + \beta_2 D_t + \varepsilon)}$$  \[4\]

$$f(A_t) = 10^{(1.388 + 0.006H_t - 0.029D_t + \varepsilon_t)}$$  \[5\]

$H_0: \log Z_t \neq f(D_t, H_t, M_t)$  \[6\]

Where $H_0$ is the null hypothesis of log admissions rate at government and quasi-government hospitals in Jamaica ($\log Z$) is not a function of the death rate per 1,000 ($D_t$) in time period $t$ and the homicide rate per 100,000 ($H_t$) in time period $t$; and maternity rate per 1,000 ($M_t$).

It can be concluded from the statistical analysis that in admissions rate at government and quasi-government hospitals in Jamaica is significantly fitted by death, homicide, and maternity rates by a linear model $(F[2.23] = 5.111, P=0.007)$ as seen in Table 12. A moderately strong statistical correlation existed between explanatory variables and log admissions rate (adjusted $r^2 = 0.537$). Multicollinearity is not a problem in the examination of this model, because the highest tolerance was three (3). Both homicide and death rates contributed more to the model than maternity rate; the correlation between homicide and log admission was 35% as well as for the death rate and the correlation between log admission and maternity rate being 30%, with death and maternity rates have the strongest statistical correlation, 55%. Hence, we reject the null hypothesis. Furthermore, death rate has the greatest effect on log admissions rate followed by maternity rate. Thus, the hypothesis is captured in Equation (7):

$$f(Z_t) = 10^{(\beta_0 + \beta_1 D_t + \beta_2 H_t + \beta_3 M_t + \varepsilon)}$$  \[7\]

$$f(Z_t) = 10^{(0.84D_t - 0.013H_t - 0.00008M_t + \varepsilon_t)}$$  \[8\]

$$f(Z_t) = 10^{(0.84D_t - 0.013H_t - 0.00008M_t + \varepsilon_t)}$$  \[9\]

### Table 10: Cross-elasticity of admission to national government psychiatric hospital and death in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Year</th>
<th>Psychiatric</th>
<th>Death</th>
<th>% change A</th>
<th>% change D</th>
<th>Cross-elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1,110</td>
<td>15321</td>
<td>-13.0631</td>
<td>8.4394</td>
<td>-1.548</td>
</tr>
<tr>
<td>2007</td>
<td>965</td>
<td>16614</td>
<td>0.7254</td>
<td>-1.4626</td>
<td>-0.496</td>
</tr>
<tr>
<td>2008</td>
<td>972</td>
<td>16371</td>
<td>11.8313</td>
<td>6.6948</td>
<td>1.767</td>
</tr>
<tr>
<td>2009</td>
<td>1,087</td>
<td>17467</td>
<td>-3.8638</td>
<td>-2.6335</td>
<td>1.467</td>
</tr>
<tr>
<td>2010</td>
<td>1,045</td>
<td>17007</td>
<td>-8.4211</td>
<td>-0.4763</td>
<td>17.681</td>
</tr>
<tr>
<td>2011</td>
<td>957</td>
<td>16926</td>
<td>3.9707</td>
<td>0.4254</td>
<td>9.335</td>
</tr>
<tr>
<td>2012</td>
<td>995</td>
<td>16998</td>
<td>-0.4020</td>
<td>-9.2423</td>
<td>0.043</td>
</tr>
<tr>
<td>2013</td>
<td>991</td>
<td>15427</td>
<td>1.4127</td>
<td>17.6249</td>
<td>0.080</td>
</tr>
<tr>
<td>2014</td>
<td>1,005</td>
<td>18146</td>
<td>-1.0945</td>
<td>0.0606</td>
<td>-18.056</td>
</tr>
<tr>
<td>2015</td>
<td>994</td>
<td>18157</td>
<td>-1.388</td>
<td>0.116</td>
<td>11.99</td>
</tr>
</tbody>
</table>

### Table 11: OLS of log attendance on explanatory variables for Jamaica.

<table>
<thead>
<tr>
<th>Independent</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>p</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.388</td>
<td>0.116</td>
<td>11.99</td>
<td>&lt;0.0001</td>
<td>1.105 - 1.671</td>
</tr>
<tr>
<td>Death rate per 1,000</td>
<td>-0.292</td>
<td>0.011</td>
<td>-0.413</td>
<td>-2.523</td>
<td>0.019 -0.053 - 0.05</td>
</tr>
<tr>
<td>Homicide rate per 100,000</td>
<td>0.006</td>
<td>0.001</td>
<td>1.044</td>
<td>6.372</td>
<td>&lt;0.0001 - 0.004 - 0.008</td>
</tr>
</tbody>
</table>
Paul Andrew Bourne, Angela Hudson-Davis, Charlene Sharpe, Vincent Peterkin, Marsha Pabarue.

Using multivariate regression (Annex Table 12), collectively, there is a significant statistical correlation with the explanatory variables (i.e., homicide, death, maternity and psychiatric rates) and attendance at A&E as well as admissions at government and quasi-government hospitals in Jamaica, with the correlated being a relatively strong one (adjusted $r^2 = 0.666$). However, individually, Table 13 shows that admission to the national psychiatric hospital rate was not correlated with attendance rate at A&E departments ($P = 0.338$); death rate was not correlated with attendance rate at A&E departments ($P = 0.326$) as well as maternity rate was not correlated with attendance rate at A&E departments ($P = 0.158$). Individually, however, homicide rate has a significant correlation with attendance rate at A&E ($P < 0.0001$). Therefore, the general model is a linear one that expressed predictors of attendance rate at A&E in Jamaica, expressed in Equation [15]:

$$f(A_t) = \beta_0 + \beta_1 H_t + \beta_2 P_t + \beta_3 D_t + \beta_4 M_t + \varepsilon$$ \[15.2\]

where $f(A_t)$ is the function of attendance at A&E rate at government and quasi-government hospitals in Jamaica, $\beta_0$ is the constant and $\beta_1, \beta_2, \beta_3, \beta_4$ are coefficients for each variable, these are expressed in Equation 15.2:

$$f(Z_t) = \beta_0 + \beta_1 H_t + \beta_2 P_t + \beta_3 D_t + \beta_4 M_t + \varepsilon$$ \[15.2\]

Based on the multivariate regression analysis table (Annex Table 12), collectively, there is a significant statistical correlation with the explanatory variables (i.e., homicide, death, maternity and psychiatric rates) and attendance at A&E as well as admissions at government and quasi-government hospitals in Jamaica, with the correlated being a relatively strong one (adjusted $r^2 = 0.624$). However, individually, Table 13 shows that admission to the national psychiatric hospital rate was not correlated with admissions rate at government and quasi-government hospitals in Jamaica ($P = 0.971$) as well as homicide and admissions rate at government and quasi-government hospitals in Jamaica ($P = 0.522$). Death rate was correlated with admissions rate at government and quasi-government hospitals in Jamaica ($P = 0.045$) as well as maternity rate was not correlated with admission rate at A&E, while mortality the most to admissions and death

Multivariate analysis was used to examine the interactivity among the explanatory variables (i.e., homicide, psychiatric, death and maturity rates) and their effect on the dependent variables (attendance, $A_t$, and admission rate, $Z_t$).

**Table 12:** Parameter Estimates of selected explanatory variables on particular dependent variables.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>P</th>
<th>95% CI</th>
<th>Partial Eta squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Admission</td>
<td>Intercept</td>
<td>0.840</td>
<td>0.088</td>
<td>9.573</td>
<td>&lt;0.0001</td>
<td>0.657 - 1.024</td>
<td>0.821</td>
</tr>
<tr>
<td></td>
<td>Maternity rate</td>
<td>0.017</td>
<td>0.012</td>
<td>1.389</td>
<td>0.180</td>
<td>-0.008 - 0.0242</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td>Homicide rate</td>
<td>-7.665E-5</td>
<td>0.000</td>
<td>-0.217</td>
<td>0.831</td>
<td>-0.001 - 0.001</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>Death rate</td>
<td>-0.013</td>
<td>0.005</td>
<td>-2.536</td>
<td>0.020</td>
<td>-0.024 - -0.002</td>
<td>0.243</td>
</tr>
<tr>
<td>Psychiatric Rate</td>
<td>Intercept</td>
<td>-19.947</td>
<td>3.514</td>
<td>-3.567</td>
<td>.000</td>
<td>-27.362 - -12.533</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Maternity rate</td>
<td>7.042</td>
<td>0.483</td>
<td>14.579</td>
<td>.000</td>
<td>6.023 - 8.062</td>
<td>0.395</td>
</tr>
<tr>
<td></td>
<td>Homicide rate</td>
<td>0.094</td>
<td>0.013</td>
<td>6.987</td>
<td>.000</td>
<td>.066 - .123</td>
<td>0.041</td>
</tr>
<tr>
<td></td>
<td>Death rate</td>
<td>1.539</td>
<td>0.184</td>
<td>8.384</td>
<td>.000</td>
<td>1.152 - 1.926</td>
<td>0.313</td>
</tr>
</tbody>
</table>
having the second most impact on admissions. Therefore, the general model is a linear one that expressed predictors of admissions rate at government and quasi-government hospitals in Jamaica, which is captured in Equation [16]:

$$f(Z_t) = \beta_0 + \beta_1 H + \beta_2 P + \beta_3 D + \beta_4 M + \epsilon \quad [16.1]$$

where \(f(Z_t)\) is the function of admissions rate at government and quasi-government hospitals in Jamaica, \(\beta_0\) is the constant and \(\beta_1-4\) are coefficients for each variable, these are expressed in Equation 16.2:

$$f(Z_t) = -0.004 + 0.006 - 0.651 + 0.522 - 0.02 - 0.01 \quad [16.2]$$

The correlations of the explanatory factors (i.e. death, homicide, psychiatric and maternity rates) and dependent variables (i.e. attendance at A&E rate and admissions rate) are presented in Table 14. From Table 14, moderate-to-strong statistical correlation existed between death rate and homicide rate \((r=0.636, P<0.0001)\), homicide rate and attendance at A&E rate \((r=0.765, P<0.0001)\), psychiatric rate and homicide rate \((r=0.513, P=0.003)\), maternity rate and admission rate \((r=0.694, P<0.0001)\), and admission rate and death rate \((r=0.714, P<0.0001)\).

### Discussion

Mortality (or death) including homicide (or murder) is well studied in demography, public health, and criminology [2,10,30-33,46-50]. Although the afore mentioned phenomenon has been studied for decades, the effect of homicide or other deaths on health care utilization has never been empirically examined in the English-Speaking Caribbean. The present research offers an empirical base for understanding the role of homicide and other deaths on the psychology and pharmacoepidemiology of people, particularly Jamaicans, and by doing so it provides critical information to public health planners, demographers and other health specialists on a new theoretical perspective that could be used to guide their thoughts and actions from here onwards.

Health care utilization in government and quasi-government hospitals has been fluctuating for the studied period (2006-2015). It can be deduced from the probabilities...
of attendance at government and quasi-government hospitals in Jamaica that at least 1 in every 4 Jamaican visits the accident and emergency department (i.e., A&E) on an annual basis and 1 out of every 5 is admitted at the institution following medical examination on attendance at A&E. Homicide has a strong positive significance association with attendance at A&E in Jamaica, which offers some insights into the psychological and psychiatric impact of murders on the human’s physiology. Although Gairin et al., empirically establish a correlation [51] between attendance to A&E and suicide, which speaks to the psychiatric state of people who visit A&E. This research found that homicide accounts for increased number of people visiting A&E, and that other deaths have a psychiatric effect on people. This research went further than that of Gairin et al., establishing that while homicide will cause people to visit A&E [51], it will not account for them being admitted, unlike psychiatric issues and other deaths.

Clearly, violence is closely associated with visits to A&E department and this speaks to its influence on the physiology of people, which correlates with the established literature [29,52,53]. Even though violence, especially homicide, in Jamaica influences visitations to government and quasi-government health care institutions, which is the case as outlined by the World Health Organization [53], it accounts for long-term hospitalization compared to other death. In fact, other deaths and pregnancy have been associated with long-term effect on the psychiatric state of people. So, while data on attendance and admissions at hospitals provide an outlook of the health status of the population, it envelopes critical information for crime prevention policy framework, which is already recognized in the literature [54-56]. This reality broadens the discourse of health data from health to criminology, to sociology, to the psychology of human behaviour. This paper has empirically established that there is psychiatric effect of death on living humans that is profound, which is reflected in admissions to hospital after an A&E visit. This research found that homicide accounts for more than a one to one relationship with hospitalization, other deaths within the society have far reaching effect on the psychology and psychiatric state of living being. The findings from this study support a deduction that not all deaths affect living humans the same way and that all deaths should not be classified collectively in examining criminology, psychology, and the treatment of people who enter A&E for health care. The rationale for this conclusion is a clear case that deaths have a certain effect on the mind, which is already contextualized by Feifel [58] and Stillion, et al. [59].

Like Feifel opined [58], death can serve life as is clearly presented in this paper and as was demonstrated by the American Psychology Association [60] as it relates to coping strategies in addressing death, dying, and bereavement [61]. Although the psychology of death has been extensively studied [61-64], it is extremely difficult for humans to effectively accept death with its reality despite even ideas such as ‘staring at the sun: overcoming the terror of death by Yalom [64]. There is a negative psychology to death that cannot be denied and while we seek to mitigate its long-lasting effect on the mind of people, understanding it as presented herein is the first stage of Wong’s prescription on the therapeutic aspect in dealing with death [65]. Our findings support a disaggregation in screening patients who visit health care institutions based on exposure to homicide or other deaths as their impacts are different and must be addressed as such. We are prescribing that while the psychology of death is evident in this work the matter extends to the pharmacoepidemiology of deaths and bereavement.

**Conclusion**

The statistical evidence of this current work supports a rationale for the introduction of homicide and other deaths in the study of medicine, especially public and mental health. The deduction of the psychology and psychiatry of homicide and other deaths is valid and that homicide must be brought into medicine particularly from the vantage point of pharmacology, with equal emphasis on epidemiology to merge into pharmacoepidemiology.

**REFERENCES**


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Descriptive statistics for attendance at A&E and admissions to government as well as quasi-government hospitals in Jamaica for the period 2006-2015 are presented in Annex Table 1. Using descriptive values for attendance at A&E, based on the value for the skewness (0.379) and the large variance (742,642,4045.4), there are clear statistical evidence that errors are present in the data, but that these are contained and should be noted. Furthermore, the kurtosis value for attendance at A&E (-0.915) indicates a flattening of the values away from the centre. Despite this fact, enough statistical proof is there that the distribution is a relatively normal one (Figure 1). This means that the datapoints are relatively close to the mean value represented by the straight line in the graph. Nevertheless, we must be mindful of errors within the datapoints which is captured by the large variance and standard error of the mean. Likewise the same situation exists for admissions at government and quasi-government hospitals in Jamaica, with a higher skewness value suggesting more errors in this variable compared to that of attendance, which is also evident from the test of normality, in which the values are more away from the mean value represented by the straight line (Figure 2).

**Annex Table 1:** Descriptive statistics for attendance and admissions to government as well as quasi-government hospitals in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Statistic</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attendance</strong></td>
<td>794596.3</td>
<td>15733.6</td>
</tr>
<tr>
<td>Mean</td>
<td>762417.4</td>
<td>826775.2</td>
</tr>
<tr>
<td>95% Confidence Interval for Mean</td>
<td>788618.5</td>
<td>7.426424045.4</td>
</tr>
<tr>
<td>Lower Bound</td>
<td>670360.0</td>
<td>942523.0</td>
</tr>
<tr>
<td>Upper Bound</td>
<td>786176.7</td>
<td>61822437.7</td>
</tr>
<tr>
<td>Median</td>
<td>0.379</td>
<td>0.427</td>
</tr>
<tr>
<td>Variance</td>
<td>942523.0</td>
<td>0.833</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.915</td>
<td>-0.619</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>0.427</td>
<td>0.833</td>
</tr>
<tr>
<td><strong>Admission</strong></td>
<td>189267.3</td>
<td>1435.5</td>
</tr>
<tr>
<td>Mean</td>
<td>186331.3</td>
<td>192203.3</td>
</tr>
<tr>
<td>95% Confidence Interval for Mean</td>
<td>192069.0</td>
<td>7862.7</td>
</tr>
<tr>
<td>Lower Bound</td>
<td>174704.0</td>
<td>200578.0</td>
</tr>
<tr>
<td>Upper Bound</td>
<td>192069.0</td>
<td>61822437.7</td>
</tr>
<tr>
<td>Median</td>
<td>-0.619</td>
<td>-0.758</td>
</tr>
<tr>
<td>Variance</td>
<td>0.427</td>
<td>0.833</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.427</td>
<td>0.833</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.619</td>
<td>-0.758</td>
</tr>
</tbody>
</table>
Annex Table 2 summarizes the descriptive statistics for homicide and other deaths in Jamaica for the periods 2006-2015. A relatively high standard error of the mean indicates errors with the datapoints, which is supported by the high variance. However, the skewness value was relatively close to zero for other deaths indicating the almost normal distribution of this variable (Annex Figure 3). The skewness for homicide, while being relatively close to zero, was greater than that for homicide, suggesting less normality of the distribution (Annex Figure 4). Furthermore, even though other deaths reflect a relative normal distribution, it had more errors therein compared to homicide, which is noted in the larger variance and standard error of the mean. Based on the skewness, the errors are noted; but they are tolerable for usage.
Annex Table 2: Descriptive statistics of homicide and other deaths in Jamaica, 2006-2015.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Homicide</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1324.0</td>
<td>74.8</td>
</tr>
<tr>
<td>95% Confidence Interval for Mean</td>
<td>Lower Bound 1154.8</td>
<td>Upper Bound 1493.2</td>
</tr>
<tr>
<td>Median</td>
<td>1270.0</td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>55960.0</td>
<td></td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>236.6</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>1005</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>1680</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>675</td>
<td></td>
</tr>
<tr>
<td>Skewness</td>
<td>0.248</td>
<td></td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-1.469</td>
<td>1.334</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Deaths</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>18548.8</td>
<td>578.3</td>
</tr>
<tr>
<td>95% Confidence Interval for Mean</td>
<td>Lower Bound 17240.5</td>
<td>Upper Bound 19857.1</td>
</tr>
<tr>
<td>Median</td>
<td>18506.0</td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>3344805.5</td>
<td></td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>1828.9</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>15427</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>21503</td>
<td></td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.041</td>
<td>0.687</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.359</td>
<td>1.334</td>
</tr>
</tbody>
</table>

Testing the Normality Assumption

Annex Figure 3: Testing of normality of the distribution for admission.
Annex Figure 4: Testing of normality of the distribution for admissions.

Testing the Linearity Assumption
Based on the squared r value, there is a weak linear distribution of attendance and admission, which is more than that for admission. It can be deduced from attendance and by extension admissions that these variables required transformation.

Annex Figure 5: Linearity of Attendance.
Annex Figure 6: Linearity of Admission.

Annex Figure 7: Linearity of Homicide.

Annex Figure 8: Linearity of Other Deaths.

Transformation of Attendance

By way of transformation, it can be deduced that attendance when transformed it is ideal for ordinary least square regression.
Annex Figure 9: log Attendance rate and superimposed function.

Annex Figure 10: Log Admission rate and superimposed function.
### Annex Table 11: Multivariate Tests

<table>
<thead>
<tr>
<th>Source</th>
<th>Dependent Variable</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>Attendance at A&amp;E Rate</td>
<td>229.492^a</td>
<td>4</td>
<td>57.373</td>
<td>13.958</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>1.360^b</td>
<td>4</td>
<td>0.340</td>
<td>11.792</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Intercept</td>
<td>Attendance at A&amp;E Rate</td>
<td>2.003</td>
<td>1</td>
<td>2.003</td>
<td>0.487</td>
<td>0.492</td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>0.514</td>
<td>1</td>
<td>0.514</td>
<td>17.833</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Homicide rate per 100,000</td>
<td>Attendance at A&amp;E Rate</td>
<td>130.607</td>
<td>1</td>
<td>130.607</td>
<td>31.774</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>0.012</td>
<td>1</td>
<td>0.012</td>
<td>0.423</td>
<td>0.522</td>
</tr>
<tr>
<td>Psychiatric rate per 100,000</td>
<td>Attendance at A&amp;E Rate</td>
<td>3.938</td>
<td>1</td>
<td>3.938</td>
<td>0.958</td>
<td>0.338</td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>3.891E-5</td>
<td>1</td>
<td>3.891E-5</td>
<td>0.001</td>
<td>0.971</td>
</tr>
<tr>
<td>Death rate per 1,000</td>
<td>Attendance at A&amp;E Rate</td>
<td>4.145</td>
<td>1</td>
<td>4.145</td>
<td>1.008</td>
<td>0.326</td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>0.130</td>
<td>1</td>
<td>0.130</td>
<td>4.523</td>
<td>0.045</td>
</tr>
<tr>
<td>Maternity Rate</td>
<td>Attendance at A&amp;E Rate</td>
<td>8.772</td>
<td>1</td>
<td>8.772</td>
<td>2.134</td>
<td>0.158</td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>0.311</td>
<td>1</td>
<td>0.311</td>
<td>10.793</td>
<td>0.003</td>
</tr>
<tr>
<td>Error</td>
<td>Attendance at A&amp;E Rate</td>
<td>90.431</td>
<td>22</td>
<td>4.110</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>0.635</td>
<td>22</td>
<td>0.029</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Attendance at A&amp;E Rate</td>
<td>23529.145</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>1314.616</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>Attendance at A&amp;E Rate</td>
<td>319.922</td>
<td>26</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Admission Rate</td>
<td>1.995</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. $R^2$ Squared = 0.717 (Adjusted $R^2$ Squared = 0.666)
b. $R^2$ Squared = 0.682 (Adjusted $R^2$ Squared = 0.624)

### Annex Table 12: Tests of Between-Subjects Effects.