**A REGRESSION MODEL FOR PREDICTING ROAD TRAFFIC FATALITIES IN GHANA**

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Abstract

The knowledge of accident rates in a country provides a useful tool for a comprehensive analysis of their causes as well as for their prevention. Smeed (1949) gave a regression model for estimating road traffic fatalities. This paper gives a modified form of Smeed’s regression formula for estimating road traffic fatalities in Ghana. The modified regression model was found to be relatively more accurate for estimating road traffic fatalities in Ghana, than Smeed’s (1949) formula.

Key Words: Fatality, Regression and Estimation

1. Introduction

Road traffic fatality rates of a country are known to depend on the factors such as population, the number of vehicles in use, the total length of roads, the population density and economic conditions, among others (Smeed, 1964, 1968). Two of these factors are of prime importance, namely population \( (P) \) and number of vehicles in use \( (N) \).

In his paper, Smeed (1949) showed that the formula

\[
\frac{D}{N} = 0.0003 \left( \frac{N}{P} \right)^{-\frac{2}{3}}
\]

\[
\text{…………………………………………………………………..(1)}
\]

gave a fairly good fit to the data from 20 countries, including European countries, USA, Canada, Australia and New Zealand.

It should be pointed out that the European Economic Commission (EEC) and the World Health Organization (1979) have recommended a definition for road traffic accident fatalities which includes only deaths which occur within 30 days following the accident, since 93 – 97\% of these fatalities take place within a one month period. A number of countries have not yet adopted this definition (see WHO, 1979). For example, in some countries, a road traffic fatality is recorded only if the victim dies at the site or is dead upon arrival at the hospital. In order to make comparison of

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accident statistics between countries reasonable, figures obtained from countries which have not adopted the 30-day fatality definition, should be properly adjusted. No adjustment is required for figures from countries such as Ghana, U.S.A and Great Britain, which have adopted the standard fatality definition.

Using methods similar to those used by Smeed, Bener and Ofosu (1991) applied regression analysis to derive a relationship for estimating road traffic fatalities in Saudi Arabia. Their finding shows that Smeed’s formula leads to a remarkably low estimation of road traffic fatalities in Saudi Arabia. A more realistic formula for estimating road traffic fatalities in Saudi Arabia was given by

\[
\frac{D}{N} = 0.00021 \left( \frac{N}{P} \right)^{-0.72} \quad \text{..........................................................(2)}
\]

In a study carried out by Jacobs and Bardsley (1977) for 32 developing countries, the fatalities per 10 000 persons and the number of fatalities per 10 000 vehicles were calculated and compared. They obtained a relationship, similar to that of Bener and Ofosu (1991), which is expressed by the equation:

\[
\frac{D}{N} = 0.000742 \left( \frac{N}{P} \right)^{-0.43} \quad \text{..........................................................(5)}
\]

In a related study, Fouracre and Jacobs (1977) obtained the following relationship using 1 965 data for a selection of more than 30 developing countries.

\[
\frac{D}{N} = 0.000331 \left( \frac{N}{P} \right)^{-0.70} \quad \text{..........................................................(6)}
\]

Similar analysis was conducted by Ghee, et al. (1997) for Asian, African and South American countries using 1 990 data. They obtained the expression,

\[
\frac{D}{N} = 0.000275 \left( \frac{N}{P} \right)^{-0.619} \quad \text{..........................................................(7)}
\]

The object of this study was to estimate road traffic fatalities in Ghana using a derived regression model and to compare the results with those derived using Smeed’s equation for estimating fatalities. The questions to be addressed are:

- How accurate is the Smeed (1949) formula for estimating road traffic fatalities, in Ghana?
- How accurate is the proposed regression model of this study, in Ghana and how does the modified regression model compare to that of Smeed (1949) in their performance?

The significance of this study is that, a predictive model for estimating fatalities could be obtained. This model could assist in determining what policy interventions or safety mechanisms must be put in place to reduce or minimize fatalities and casualties for a given year. For example, if the total number of registered vehicles and the population size could be estimated in advance for a given year, the expected number of fatalities and casualties could be obtained, using the derived regression equation or the equation of Smeed (1949), whichever is found to be relatively more accurate for Ghana.

The data used in this study were obtained from the following sources.

(a) The data on the number of road traffic fatalities were obtained from the National Road Safety Commission (NRSC) of Ghana
(b) The Driver and Vehicle Licensing Authority (DVLA) of Ghana provided the data on the number of registered vehicles in Ghana.
(c) The estimated population figures were obtained from Ghana Statistical Service 2010 Population and Housing Census, Summary Report of Final Report.
The relevant data for this study are given in Table 1.

Table 1: Estimated Population and the number of motor vehicles, fatalities and casualties in Ghana (1991-2012)

<table>
<thead>
<tr>
<th>No.</th>
<th>Year</th>
<th>Population (P)</th>
<th>Motor Vehicles (N)</th>
<th>Fatalities (D)</th>
<th>No.</th>
<th>Year</th>
<th>Population (P)</th>
<th>Motor Vehicles (N)</th>
<th>Fatalities (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1991</td>
<td>14821000</td>
<td>132051</td>
<td>920</td>
<td>12</td>
<td>2002</td>
<td>19811000</td>
<td>613153</td>
<td>1665</td>
</tr>
<tr>
<td>2</td>
<td>1992</td>
<td>15222000</td>
<td>137966</td>
<td>914</td>
<td>13</td>
<td>2003</td>
<td>20508000</td>
<td>643824</td>
<td>1716</td>
</tr>
<tr>
<td>3</td>
<td>1993</td>
<td>15634000</td>
<td>157782</td>
<td>901</td>
<td>14</td>
<td>2004</td>
<td>21093000</td>
<td>703372</td>
<td>2186</td>
</tr>
<tr>
<td>4</td>
<td>1994</td>
<td>16056000</td>
<td>193119</td>
<td>824</td>
<td>15</td>
<td>2005</td>
<td>21694000</td>
<td>767067</td>
<td>1776</td>
</tr>
<tr>
<td>5</td>
<td>1995</td>
<td>16491000</td>
<td>234962</td>
<td>1026</td>
<td>16</td>
<td>2006</td>
<td>22294000</td>
<td>841314</td>
<td>1856</td>
</tr>
<tr>
<td>6</td>
<td>1996</td>
<td>16937000</td>
<td>297475</td>
<td>1049</td>
<td>17</td>
<td>2007</td>
<td>22911000</td>
<td>922748</td>
<td>2043</td>
</tr>
<tr>
<td>7</td>
<td>1997</td>
<td>17395000</td>
<td>340913</td>
<td>1015</td>
<td>18</td>
<td>2008</td>
<td>23544000</td>
<td>942000</td>
<td>1938</td>
</tr>
<tr>
<td>8</td>
<td>1998</td>
<td>17865000</td>
<td>395225</td>
<td>1419</td>
<td>19</td>
<td>2009</td>
<td>24196000</td>
<td>1030000</td>
<td>2237</td>
</tr>
<tr>
<td>9</td>
<td>1999</td>
<td>18349000</td>
<td>458182</td>
<td>1237</td>
<td>20</td>
<td>2010</td>
<td>24223000</td>
<td>1122700</td>
<td>1986</td>
</tr>
<tr>
<td>10</td>
<td>2000</td>
<td>18845000</td>
<td>511063</td>
<td>1437</td>
<td>21</td>
<td>2011</td>
<td>25099000</td>
<td>1225754</td>
<td>2199</td>
</tr>
<tr>
<td>11</td>
<td>2001</td>
<td>19328000</td>
<td>567780</td>
<td>1660</td>
<td>22</td>
<td>2012</td>
<td>25726000</td>
<td>1328808</td>
<td>2249</td>
</tr>
</tbody>
</table>

2. Estimating road traffic fatalities in Ghana

2.1 Method

In order to obtain a formula for estimating \( D \), the number of road traffic fatalities in Ghana, a relation of the form

\[
D/P = \alpha (N/P)\beta u
\]

was adopted, where \( \alpha \) and \( \beta \) are parameters to be estimated. As defined in the previous section, \( N \) is the number of registered vehicles while \( P \) represents the population size. The nonlinear model in Equation (8) can be transformed to a linear model by using a special transformation. Taking logarithms, to base \( e \), of both sides of Equation (8), we obtain

\[
\ln (D/P) = \ln(\alpha) + \beta \ln(N/P) + \ln u_i \quad \text{or} \quad y_i = \alpha_0 + \beta x_i + \varepsilon_i,
\]

where \( \alpha_0 = \ln(\alpha) \), \( x_i = \ln\left(\frac{N_i}{P_i}\right) \), \( y_i = \ln\left(\frac{D_i}{P_i}\right) \) and \( \varepsilon_i = \ln u_i, \ i = 1, 2, \ldots, n \). This transformation requires that \( \varepsilon_1, \varepsilon_2, \ldots, \varepsilon_n \) are normally and independently distributed with mean 0 and variance \( \sigma^2 \). The least squares estimates of \( \alpha_0 \) and \( \beta \) are the values of \( \alpha_0 \) and \( \beta \) which minimize

\[
Q = \sum_{i=1}^{n} (y_i - \alpha_0 - \beta x_i)^2.
\]

The partial derivatives of \( Q \) with respect to \( \alpha_0 \) and \( \beta \), are given by

\[
\frac{\partial Q}{\partial \alpha_0} = -2 \sum_{i=1}^{n} (y_i - \alpha_0 - \beta x_i) \quad \text{and} \quad \frac{\partial Q}{\partial \beta} = -2 \sum_{i=1}^{n} (y_i - \alpha_0 - \beta x_i)x_i.
\]

Equating these partial derivatives to zero (because the partial derivatives are equal to zero at the minimum point) and replacing \( \alpha_0 \) and \( \beta \) by \( \hat{\alpha}_0 \) and \( \hat{\beta} \), we obtain

\[
n\bar{y} = n\hat{\alpha}_0 + \hat{\beta}n\bar{x} \quad \text{and} \quad \sum_{i=1}^{n} x_i y_i = n\hat{\alpha}_0 \bar{x} + \hat{\beta} \sum_{i=1}^{n} x_i^2 .
\]

These equations can be solved to obtain

\[
\hat{\beta} = \frac{n \sum_{i=1}^{n} x_i y_i - \left( \frac{n}{n} \sum_{i=1}^{n} x_i \right) \sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i^2 - \left( \frac{n}{n} \sum_{i=1}^{n} x_i \right)^2}
\]
The least squares estimate of $\beta$ is given by

$$\hat{\beta} = \frac{S_{xy}}{S_{xx}}, \quad \text{.................................(11)}$$

where $S_{xy} = \sum_{i=1}^{n} x_i y_i - \frac{1}{n} \left( \sum_{i=1}^{n} x_i \right) \left( \sum_{i=1}^{n} y_i \right)$ and $S_{xx} = \sum_{i=1}^{n} x_i^2 - \frac{1}{n} \left( \sum_{i=1}^{n} x_i \right)^2$.

Using Equation (9), we obtain

$$\hat{\alpha}_0 = \bar{y} - \hat{\beta} \bar{x}. \quad \text{.................................(12)}$$

Using the equation $\alpha_0 = \ln \alpha$, we obtain the least squares estimate of the parameter $\alpha$ as

$$\hat{\alpha} = e^{\hat{\alpha}_0}. \quad \text{.................................(13)}$$

where $\hat{\alpha}_0$ is given by Equation (12). Thus, in terms of the original variables, we have

$$D/P = \hat{\alpha} (N/P)^{\hat{\beta}}. \quad \text{.................................(14)}$$

### 2.2 Estimation of road traffic fatalities in Ghana, using Smeed’s equation

Equation (1) was used to calculate the number of fatalities for each year in the 19-year period 1991 – 2009, using the data given in Table 1. The results of this application are given in Table 2, where: $D = \text{annual road deaths}$ and $\hat{D} = \text{estimate of } D$ from Smeed's equation.

<table>
<thead>
<tr>
<th>No.</th>
<th>Year</th>
<th>$D$</th>
<th>$\hat{D}$</th>
<th>Error</th>
<th>Error %</th>
<th>No.</th>
<th>Year</th>
<th>$D$</th>
<th>$\hat{D}$</th>
<th>Error</th>
<th>Error %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1991</td>
<td>920</td>
<td>922</td>
<td>2</td>
<td>0.2</td>
<td>11</td>
<td>2001</td>
<td>1660</td>
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<td>129</td>
<td>7.8</td>
</tr>
<tr>
<td>2</td>
<td>1992</td>
<td>914</td>
<td>952</td>
<td>38</td>
<td>4.2</td>
<td>12</td>
<td>2002</td>
<td>1665</td>
<td>1866</td>
<td>201</td>
<td>12.1</td>
</tr>
<tr>
<td>3</td>
<td>1993</td>
<td>901</td>
<td>1014</td>
<td>113</td>
<td>12.5</td>
<td>13</td>
<td>2003</td>
<td>1716</td>
<td>1941</td>
<td>225</td>
<td>13.1</td>
</tr>
<tr>
<td>4</td>
<td>1994</td>
<td>824</td>
<td>1104</td>
<td>280</td>
<td>34.0</td>
<td>14</td>
<td>2004</td>
<td>2186</td>
<td>2037</td>
<td>-149</td>
<td>6.8</td>
</tr>
<tr>
<td>5</td>
<td>1995</td>
<td>1026</td>
<td>1199</td>
<td>173</td>
<td>16.9</td>
<td>15</td>
<td>2005</td>
<td>1776</td>
<td>2136</td>
<td>360</td>
<td>20.3</td>
</tr>
<tr>
<td>6</td>
<td>1996</td>
<td>1049</td>
<td>1321</td>
<td>272</td>
<td>25.9</td>
<td>16</td>
<td>2006</td>
<td>1856</td>
<td>2243</td>
<td>387</td>
<td>20.9</td>
</tr>
<tr>
<td>7</td>
<td>1997</td>
<td>1015</td>
<td>1407</td>
<td>392</td>
<td>38.6</td>
<td>17</td>
<td>2007</td>
<td>2043</td>
<td>2356</td>
<td>313</td>
<td>15.3</td>
</tr>
<tr>
<td>8</td>
<td>1998</td>
<td>1419</td>
<td>1502</td>
<td>83</td>
<td>5.8</td>
<td>18</td>
<td>2008</td>
<td>1938</td>
<td>2416</td>
<td>478</td>
<td>24.7</td>
</tr>
<tr>
<td>9</td>
<td>1999</td>
<td>1237</td>
<td>1609</td>
<td>372</td>
<td>30.1</td>
<td>19</td>
<td>2009</td>
<td>2237</td>
<td>2535</td>
<td>298</td>
<td>13.3</td>
</tr>
<tr>
<td>10</td>
<td>2000</td>
<td>1437</td>
<td>1699</td>
<td>262</td>
<td>18.2</td>
<td></td>
<td></td>
<td>Total</td>
<td>27819</td>
<td>32048</td>
<td></td>
</tr>
</tbody>
</table>

It can be seen from Table 2 that, the application of Smeed’s equation leads to over-estimation of the number of road fatalities in Ghana. The result shows that on average, the expected fatalities as estimated by Smeed’s formula exceeded the observed by 17%. Given the relatively large deviations between observed and expected values of $D$ in Table 2, Smeed’s equation has proved to be an imperfect predictive tool of road fatalities in Ghana.

### 2.3 Estimation of road traffic fatalities in Ghana, using regression analysis

In the previous sub-section, we showed that the application of Smeed’s equation to data in Ghana leads to a remarkably high over-estimation of road traffic fatalities. In order to obtain a more realistic formula for the estimation of $D$, the number of road traffic fatalities, we estimate the parameters $\alpha$ and $\beta$ in Equation (8) using the data in Table 3, which shows the values of $y_i = \ln(D/P)$ and $x_i = \ln(N/P)$ for the 19-year period 1991 – 2009.
Table 3: Value of \( y_i = \log(D/P) \) and \( x_i = \log(N/P) \) from 1991 – 2009

<table>
<thead>
<tr>
<th>( i )</th>
<th>Year</th>
<th>( y_i )</th>
<th>( x_i )</th>
<th>( x_i y_i )</th>
<th>( x_i^2 )</th>
<th>( y_i^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1991</td>
<td>-9.69</td>
<td>-4.72</td>
<td>45.73</td>
<td>22.28</td>
<td>93.84</td>
</tr>
<tr>
<td>2</td>
<td>1992</td>
<td>-9.72</td>
<td>-4.70</td>
<td>45.72</td>
<td>22.12</td>
<td>94.49</td>
</tr>
<tr>
<td>3</td>
<td>1993</td>
<td>-9.76</td>
<td>-4.60</td>
<td>44.86</td>
<td>21.12</td>
<td>95.29</td>
</tr>
<tr>
<td>4</td>
<td>1994</td>
<td>-9.88</td>
<td>-4.42</td>
<td>43.66</td>
<td>19.54</td>
<td>97.56</td>
</tr>
<tr>
<td>5</td>
<td>1995</td>
<td>-9.69</td>
<td>-4.25</td>
<td>41.17</td>
<td>18.07</td>
<td>93.80</td>
</tr>
<tr>
<td>6</td>
<td>1996</td>
<td>-9.69</td>
<td>-4.04</td>
<td>39.16</td>
<td>16.34</td>
<td>93.89</td>
</tr>
<tr>
<td>7</td>
<td>1997</td>
<td>-9.75</td>
<td>-3.93</td>
<td>38.34</td>
<td>15.46</td>
<td>95.04</td>
</tr>
<tr>
<td>8</td>
<td>1998</td>
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<td>-3.82</td>
<td>36.03</td>
<td>14.56</td>
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<tr>
<td>9</td>
<td>1999</td>
<td>-9.61</td>
<td>-3.69</td>
<td>35.44</td>
<td>13.62</td>
<td>92.25</td>
</tr>
<tr>
<td>10</td>
<td>2000</td>
<td>-9.48</td>
<td>-3.61</td>
<td>34.20</td>
<td>13.01</td>
<td>89.90</td>
</tr>
</tbody>
</table>

From Table 3, 
\[
S_{xx} = \frac{19}{19} \sum_{i=1}^{19} x_i^2 - \left( \frac{19}{19} \sum_{i=1}^{19} x_i \right)^2 = 5.03764 \quad \text{and} \quad S_{xy} = \sum_{i=1}^{19} x_i y_i - \frac{1}{19} \left( \sum_{i=1}^{19} x_i \right) \left( \sum_{i=1}^{19} y_i \right) = 1.60457.
\]

Thus, from Equation (11), 
\[
\hat{\beta} = \frac{1.60457}{0.30764} = 0.318516.
\]

Using Equation (12), we obtain 
\[
\hat{\alpha} = -9.9.517263 - 0.318516 \times (-3.781632) = -8.31275.
\]

Therefore, from Equation (13), the least squares estimate of \( \alpha \) is 
\[
\hat{\alpha} = e^{-8.31275} = 0.000245.
\]

2.4 Validation of the linear regression assumptions

Regression relation

The significance of the regression relationship can be assessed by using analysis of variance techniques to test the null hypothesis \( H_0: \beta_1 = 0 \) against the alternative hypothesis \( H_1: \beta_1 \neq 0 \) at 0.05 level of significance. The sum of squares due to linear regression is given by
\[
SSR = \frac{S_{xy}^2}{S_{xx}} = \frac{(1.60457)^2}{5.03764} = 0.5110806.
\]

The total corrected sum of squares is given by
\[
SST = S_{yy} = \sum_{i=1}^{19} y_i^2 - \frac{1}{19} \left( \sum_{i=1}^{19} y_i \right)^2 = 0.6887237.
\]

Therefore, the residual sum of squares is 
\[
SSE = SST - SSR = 0.034558398.
\]

The calculations can be summarized in the following ANOVA table.

Table 4: Analysis of Variance table

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of squares</th>
<th>Degrees of freedom</th>
<th>Mean square</th>
<th>( F )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear regression</td>
<td>0.5110806</td>
<td>1</td>
<td>0.511081</td>
<td>48.90913</td>
</tr>
</tbody>
</table>
| Residual | 0.1776431 | 17 | 0.01045 | 219 19 2 1
| Total | 0.6887237 | 18 | | |

The test statistic is \( F = \frac{\text{regression mean square}}{\text{residual mean square}} \). When \( H_0 \) is true, \( F \) has the \( F \)-distribution with 1 and 17 degrees of freedom. We reject \( H_0 \) at significance level 0.05 if the computed value of \( F \) is greater than \( F_{0.05, 1, 17} = 4.45 \). Since 48.9, the calculated value of \( F \), is greater than 4.45, the test is significant at the 5% level. There is enough evidence to conclude that there is a linear relationship between the expected value of \( y = \ln(D/P) \) and \( x = \ln(N/P) \).
Validation of the normality assumption

The observations \( y_i, i = 1, 2, ..., 19 \), are first ordered from the smallest to largest. The ranked values \( y_{(i)}, i = 1, ..., 19 \), the corresponding percentage cumulative \( p_i = 100(i-3/8)/(n+1/4) \) and

standardized residuals \( d_i = e_i / \sqrt{\hat{\sigma}^2}, i = 1, 2, ..., 19 \) are given in Table 5, where \( e_i = y_i - \hat{y}_i \), \( i = 1, 2, ..., 19 \) and \( \hat{\sigma}^2 = 0.01045 \) is the estimate of the population variance.

Table 5: Data for probability plot and residual analysis

<table>
<thead>
<tr>
<th>( i )</th>
<th>( y_{(i)} )</th>
<th>( \hat{y}_i )</th>
<th>( p_i )</th>
<th>( e_i )</th>
<th>( d_i )</th>
<th>( i )</th>
<th>( y_{(i)} )</th>
<th>( \hat{y}_i )</th>
<th>( p_i )</th>
<th>( e_i )</th>
<th>( d_i )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>-9.761</td>
<td>-9.777</td>
<td>8.442</td>
<td>0.016</td>
<td>0.158</td>
<td>12</td>
<td>-9.405</td>
<td>-9.338</td>
<td>60.390</td>
<td>-0.067</td>
<td>-0.674</td>
</tr>
<tr>
<td>4</td>
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<td>-9.811</td>
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Fig. 1 shows the probability plot of the observations. It can be seen from Fig. 1 that the observations are closed to normal because of how well the points follow the line.

It can be seen from Table 5 that of the 19 calculated standardized residuals, 18 are within the interval \((-1.96, 1.96)\), which represents about 95%.

It is frequently helpful to plot residuals against \( \hat{y}_i \) as shown in Fig. 2. Pattern in the plot represents the ideal situation satisfactory for normality (see Ofosu et al., 2013).

There is strong evidence to conclude that the errors are normally distributed.

Equation (8) therefore becomes

\[
D/P = 0.000245 (N/P)^{0.318516} . \]

The actual fatalities \( D \) together with the values of \( \hat{D} \) calculated from Equation (15) are given in Table 6. The differences between the calculated and actual values are also given.
It can be seen that of the 22 calculated figures, 16 are within 10% of the actual figure, 21 are within 20% and one is in error by 20.2% of its actual value. Thus, the modified regression model is relatively more accurate in estimating road traffic fatalities in Ghana than the Smeed (1994) equation. Averagely, estimates from the modified regression model exceeded the observed by 7.8% compared to 17% from Smeed’s equation.

3. Conclusion and recommendations

The results obtained in this study are consistent with other reported studies by Bener and Ofosu (1991), Jacobs and Bardsley (1977), Fouracre and Jacobs (1977), Ghee et al. (1997) in which an expression of the form

\[
D/N = \hat{\alpha} (N/P)^{\hat{\beta}}
\]

was used for the estimation of fatalities. The parameters \( \alpha \) and \( \beta \) are safety and hazard indices, respectively, of a country (Hakkert et al. 1976).

For the purpose of this study, the analysis was repeated for Ghana using a slightly different expression of the form

\[
D/P = \hat{\alpha} (N/P)^{\hat{\beta}}.
\]

The study has shown that population and number of registered vehicles are predominant factors affecting road traffic fatalities in Ghana. The effect of other additional factors on road traffic fatality such as human (the driver, passenger and pedestrian), vehicle (its condition and maintenance), environmental/weather and nature of the road cannot be ruled out. The result seems to suggest that road safety efforts by the National Road Safety Commission of Ghana are not yielding the desired results, since road deaths in Ghana can simply be predicted from population size and number of registered vehicles of the country. This may be due to a number of factors.

1. The age of vehicles and availability of modern safety mechanisms in vehicles plying the roads of Ghana have significant effect on consequences of road traffic accidents. Thus, if greater attention is paid on improving road safety mechanisms in cars such as anti-lock braking systems (ABS), air bags, better design of cars and increased wearing of seatbelts, there could be substantial benefits in reducing injuries and fatalities with respect to road traffic accidents in Ghana. Currently, the preventive measures of the National Road Safety Commission of Ghana are predominantly directed towards regulating the behaviour road users. However, human behaviour, in a complex traffic environment, is uncertain and therefore effort to regulate human behaviour in an indiscipline traffic environment usually achieves little results. Vehicle engineering measures must therefore be integrated to have maximum effect in reducing the high spate of road traffic fatalities in Ghana. Enforcement of seat-belt wearing by bus and car occupants, standard crash helmet wearing by motor-cycle riders and passengers and ensuring the crashworthiness of vehicles, must be strictly pursued and sustained. Crashworthiness is the

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<th>( D )</th>
<th>( \hat{D} )</th>
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ability of a vehicle to protect its occupants during an impact. It is a measure of how well a vehicle performs during a collision.

One country that has been successful in enforcing crashworthiness regulation of vehicles plying its roads is Northern Ireland (NI). The Department of the Environment (DOE) reports that the number of people killed on Northern Ireland’s roads in 2010 was the lowest since records began in 1931. The figures reported show that the number of people killed in accidents in NI fell from 115 in 2009 to 55 in 2010, representing a 50% fall in fatalities and a 20% reduction in serious injuries. Of the 55 people killed in 2010, 10 were pedestrians, 10 on motorcycles and the rest in other vehicles. This success, among other things, was attributed to the Crashworthiness of vehicles plying the road of NI.

According to the world report on road traffic injury prevention (2004), for car occupants, wearing seat-belts in well-designed cars can provide protection to a maximum of 70 km/h in frontal impacts and 50 km/h in side impacts. Higher speeds could be tolerated if the interface between the road infrastructure and vehicle were to be well-designed and crash-protective – for example, by the provision of crash cushions on sharp ends of roadside barriers. However, most infrastructure and speed limits in existence today allow much higher speeds without the presence of crash-protective interfaces between vehicle and roadside objects, and without significant use of seat-belts. This is particularly the case in many low-income and middle-income countries.

2. Another factor that could explain why population size and number of registered vehicles are predominant factors affecting road traffic fatalities in Ghana is the fact that a large proportion of road traffic accident trauma patients in Ghana do not have access to formal Emergency Medical Services. Moreover, in Ghana, majority of injured persons are transported to the hospital by some type of commercial vehicle, such as a taxi or bus. It has also been reported that taxi and bus drivers regularly arrive at traffic crash sites while either injured vehicle occupants or pedestrians are still present, and usually participate in the care and/or transport of such casualties (Tiska, et al., 2002). As commercial drivers play such a prominent part in the transport and care of crash casualties, it is important to investigate if they are properly trained in pre-hospital trauma care. It is speculated that improvements in pre-hospital care in Ghana, especially among commercial vehicle drivers, could potentially have an important impact on decreasing the mortality of critically injured road traffic casualties.

References


Northern Ireland’s road safety strategy to 2020. Annual Report on Northern Ireland’s Road Safety Strategy to 2020 (the Strategy) and covers the period 1 January 2011 to 31 December 2011


