**Summary**

Analysis: Using linear regression to study the relationship between state-level mortality among juveniles and four indicators of number of gun circulation, respectively.

Data set: StLevelData dataset, when states have multiple year values, the average was used.

Four crude models: predictor = each of the four continuous variables (ATFRegWeapon, ATFFirearmLicense, GiffordsRank, GOwnerRates) and outcome = Age 0-24 Mortality Age Adjusted Rate (per 100,000) (Mort24lsAdj).

Four adjusted model: adding covariates (Poverty, Unemploy, PoorMHO, PoorMH14ls, PoorMH14gt, StPoP) into the crude models, and selected a reduced model with most relevant covariates based on the statistical significant level (p<0.05).

**Results:**

ATFRegWeapon was not linear correlated with mortality in the crude model, but was a significant predictor in the full model and reduced model.

ATFFirearmLicense was not linear correlated with mortality in the crude model, and was not a significant predictor in the full model or reduced model.

GiffordsRank was linear correlated with mortality in the crude model, and was a significant predictor in the full model.

GOwnerRates was linear correlated with mortality in the crude model, and was a significant predictor in the full model.

**Result summary - Crude model:**

Significant positive linear correlation was found between age-adjusted mortality and both Giffords Center Rankings (R-squared:  0.2519; p-value: 0.000325 significant) and Gun Ownership rates (R-squared: 0.3011; p-value: 6.51e-05 significant).

No linear relationship was found between age-adjusted mortality and ATFRegWeapon (R-squared: 0.000542; p-value: 0.877) or ATFFirearmLicense (R-squared: 0.01254; p-value: 0.454).

**Result summary - Adjusted model:**

Mort=f (ATFRegWeapon, StPoP) (R-squared: 0.1153; p-value: 0.06755). Two variables were significant predictors of mortality p-value= 0.0480 and 0.0213, respectively.

Mort=f (GiffordsRank, Poverty, Unemploy, PoorMH0, PoorMH14ls, PoorMH14gt, StPoP) explained 35.66% of the variability in All Firearm Mortality, however, none of the predictor is significant.

Mort=f (GOwnerRates, Poverty, Unemploy, PoorMH0, PoorMH14ls, PoorMH14gt, StPoP) explained 39.77% of the variability in All Firearm Mortality, however, there is no significant covariate values.

**Beta coefficients from different models.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Exposure variable** | Beta coefficient | p-value | Model |
| ATFRegWeapon | 8.177e-07 | 0.877 | Crude |
| ATFRegWeapon | 1.657e-05 | 0.05293 | Full |
| ATFRegWeapon | 1.733e-05 | 0.0480 | Reduced |
|  |  |  |  |
| ATFFirearmLicense | -0.0001398 | 0.454 | Crude |
| ATFFirearmLicense | 1.220e-04 | 0.7446 | Full |
| ATFFirearmLicense | -0.0001398 | 0.454 | Reduced (Crude) |
|  |  |  |  |
| GiffordsRank | 0.08541 | 0.000325 | Crude |
| GiffordsRank | 7.882e-02 | 0.0135 | Full |
| GiffordsRank | 0.08541 | v 0.000325 | Reduced (Crude) |
|  |  |  |  |
| GOwnerRates | 0.10194 | 6.51e-05 | Crude |
| GOwnerRates | 9.092e-02 | 0.00329 | Full |
| GOwnerRates | 0.10194 | 6.51e-05 | Reduced (Crude) |
|  |  |  |  |

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| --- | --- | --- | --- |
| Description | **Variable Name** |  |  |
| **All Firearm Mortality - Age Adjusted Rate (per 100,000)** | **Mort24lsAdj** | **Outcome** | **Y** |
| ATF Registered Weapons | **ATFRegWeapon** | Exposure 1 | X |
| % Poverty | **Poverty** | **Covariates** |  |
| % Unemployment | **Unemploy** |  |
| % Poor mental health (0 days) | **PoorMH0** |  |
| % Poor mental health (1-14 days) | **PoorMH14ls** |  |
| % Poor mental health (> 14 days) | **PoorMH14gt** |  |
| Statewide population | **StPoP** |  |

1. **Crude model: Mort=f(ATFRegWeapon)**

**All firearm mortality- Age Adjusted Rate (per 100,000) and ATF Registered Weapons**

Residuals:

Min 1Q Median 3Q Max

-4.4845 -1.6984 -0.0115 1.4384 7.3906

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 7.051e+00 5.290e-01 13.329 <2e-16 \*\*\*

ATFRegWeapon 8.177e-07 5.234e-06 0.156 0.877

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.486 on 45 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.000542, Adjusted R-squared: -0.02167

F-statistic: 0.0244 on 1 and 45 DF, p-value: 0.8766

1. **Adjusted model: Mort=f (ATFRegWeapon, Poverty, Unemploy, PoorMH0, PoorMH14ls, PoorMH14gt, StPoP)**

Residuals:

Min 1Q Median 3Q Max

-3.183 -1.260 -0.326 1.082 7.603

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -5.664e+03 6.587e+03 -0.860 0.39508

ATFRegWeapon 1.657e-05 8.300e-06 1.996 0.05293 .

Poverty 3.193e-01 1.592e-01 2.006 0.05184 .

Unemploy 5.789e-01 3.604e-01 1.606 0.11627

PoorMH0 5.669e+01 6.586e+01 0.861 0.39465

PoorMH14ls 5.662e+01 6.590e+01 0.859 0.39547

PoorMH14gt 5.632e+01 6.586e+01 0.855 0.39768

StPoP -2.458e-07 8.856e-08 -2.776 0.00841 \*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.209 on 39 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.3161, Adjusted R-squared: 0.1934

F-statistic: 2.575 on 7 and 39 DF, p-value: 0.02779

**Global Null Hypothesis**

Residuals:

Min 1Q Median 3Q Max

-3.9117 -1.6204 -0.0177 1.2856 7.2503

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 7.164e+00 5.055e-01 14.171 <2e-16 \*\*\*

ATFRegWeapon 1.733e-05 8.521e-06 2.034 0.0480 \*

StPoP -2.014e-07 8.429e-08 -2.389 0.0213 \*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.365 on 44 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.1153, Adjusted R-squared: 0.07508

F-statistic: 2.867 on 2 and 44 DF, p-value: 0.06755

|  |  |  |  |
| --- | --- | --- | --- |
| Description | **Variable Name** |  |  |
| **All Firearm Mortality - Age Adjusted Rate (per 100,000)** | **Mort24lsAdj** | **Outcome** | **Y** |
| ATF Federal Firearm Licensees | **ATFFirearmLicense** | Exposure 2 | X |
| % Poverty | **Poverty** | **Covariates** |  |
| % Unemployment | **Unemploy** |  |
| % Poor mental health (0 days) | **PoorMH0** |  |
| % Poor mental health (1-14 days) | **PoorMH14ls** |  |
| % Poor mental health (> 14 days) | **PoorMH14gt** |  |
| Statewide population | **StPoP** |  |

1. **Crude model: Mort=f(ATFFirearmLicense)**

**All firearm mortality- Age Adjusted Rate (per 100,000) and ATF Federal Firearm Licensees**

Residuals:

Min 1Q Median 3Q Max

-4.4530 -1.8221 0.0797 1.3246 7.0971

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 7.4933963 0.6210691 12.065 1.06e-15 \*\*\*

ATFFirearmLicense -0.0001398 0.0001849 -0.756 0.454

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.471 on 45 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.01254, Adjusted R-squared: -0.009405

F-statistic: 0.5714 on 1 and 45 DF, p-value: 0.4536

1. **Adjusted model: Mort=f (ATFFirearmLicense, Poverty, Unemploy, PoorMH0, PoorMH14ls, PoorMH14gt, StPoP)**

Residuals:

Min 1Q Median 3Q Max

-3.6330 -1.1878 -0.4287 0.8097 7.6014

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -5.975e+03 6.926e+03 -0.863 0.3936

ATFFirearmLicense 1.220e-04 3.718e-04 0.328 0.7446

Poverty 3.134e-01 1.670e-01 1.876 0.0681 .

Unemploy 5.233e-01 3.775e-01 1.386 0.1736

PoorMH0 5.981e+01 6.924e+01 0.864 0.3930

PoorMH14ls 5.968e+01 6.929e+01 0.861 0.3943

PoorMH14gt 5.946e+01 6.925e+01 0.859 0.3957

StPoP -1.336e-07 1.083e-07 -1.234 0.2246

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.316 on 39 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.2483, Adjusted R-squared: 0.1134

F-statistic: 1.841 on 7 and 39 DF, p-value: 0.1068

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|  |

1. **Reduced model:**

* **Did not make reduced model.**

|  |  |  |  |
| --- | --- | --- | --- |
| Description | **Variable Name** |  |  |
| **All Firearm Mortality - Age Adjusted Rate (per 100,000)** | **Mort24lsAdj** | **Outcome** | **Y** |
| Giffords Center Rankings | **GiffordsRank** | Exposure 3 | X |
| % Poverty | **Poverty** | **Covariates** |  |
| % Unemployment | **Unemploy** |  |
| % Poor mental health (0 days) | **PoorMH0** |  |
| % Poor mental health (1-14 days) | **PoorMH14ls** |  |
| % Poor mental health (> 14 days) | **PoorMH14gt** |  |
| Statewide population | **StPoP** |  |

1. **Crude model: Mort=f(GiffordsRank)**

**All firearm mortality- Age Adjusted Rate (per 100,000) and Giffords Center Rankings**

Residuals:

Min 1Q Median 3Q Max

-2.8680 -1.6027 -0.0084 1.1819 6.4482

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 4.87947 0.65349 7.467 2.08e-09 \*\*\*

GiffordsRank 0.08541 0.02194 3.893 0.000325 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.151 on 45 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.2519, Adjusted R-squared: 0.2353

F-statistic: 15.15 on 1 and 45 DF, p-value: 0.0003252

1. **Adjusted model: Mort=f (GiffordsRank, Poverty, Unemploy, PoorMH0, PoorMH14ls, PoorMH14gt, StPoP)**

Residuals:

Min 1Q Median 3Q Max

-2.4864 -1.2704 -0.5693 0.8969 6.3261

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -5.047e+03 6.399e+03 -0.789 0.4351

GiffordsRank 7.882e-02 3.047e-02 2.587 0.0135 \*

Poverty 8.153e-02 1.790e-01 0.456 0.6513

Unemploy 7.185e-01 3.570e-01 2.013 0.0511 .

PoorMH0 5.051e+01 6.398e+01 0.790 0.4346

PoorMH14ls 5.040e+01 6.402e+01 0.787 0.4359

PoorMH14gt 5.023e+01 6.398e+01 0.785 0.4371

StPoP -3.828e-08 5.639e-08 -0.679 0.5012

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.142 on 39 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.3566, Adjusted R-squared: 0.2411

F-statistic: 3.088 on 7 and 39 DF, p-value: 0.01092

1. **Reduced model:**

* **Did not make reduced model.**

|  |  |  |  |
| --- | --- | --- | --- |
| Description | **Variable Name** |  |  |
| **All Firearm Mortality - Age Adjusted Rate (per 100,000)** | **Mort24lsAdj** | **Outcome** | **Y** |
| Gun Ownership Rates | **GOwnerRates** | Exposure 4 | X |
| % Poverty | **Poverty** | **Covariates** |  |
| % Unemployment | **Unemploy** |  |
| % Poor mental health (0 days) | **PoorMH0** |  |
| % Poor mental health (1-14 days) | **PoorMH14ls** |  |
| % Poor mental health (> 14 days) | **PoorMH14gt** |  |
| Statewide population | **StPoP** |  |

1. **Crude model: Mort=f(GOwnerRates)**

**All firearm mortality- Age Adjusted Rate (per 100,000) and Gun Ownership rates**

Residuals:

Min 1Q Median 3Q Max

-3.4088 -1.2198 -0.1818 1.0330 5.6587

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 3.69495 0.83301 4.436 5.86e-05 \*\*\*

GOwnerRates 0.10194 0.02315 4.403 6.51e-05 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.079 on 45 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.3011, Adjusted R-squared: 0.2856

F-statistic: 19.39 on 1 and 45 DF, p-value: 6.511e-05

1. **Adjusted model: Mort=f (GOwnerRates, Poverty, Unemploy, PoorMH0, PoorMH14ls, PoorMH14gt, StPoP)**

Residuals:

Min 1Q Median 3Q Max

-3.5803 -1.3779 -0.1993 0.7159 5.5087

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) -4.383e+03 6.204e+03 -0.707 0.48405

GOwnerRates 9.092e-02 2.904e-02 3.131 0.00329 \*\*

Poverty 5.359e-02 1.712e-01 0.313 0.75597

Unemploy 6.443e-01 3.394e-01 1.899 0.06504 .

PoorMH0 4.389e+01 6.202e+01 0.708 0.48335

PoorMH14ls 4.368e+01 6.207e+01 0.704 0.48575

PoorMH14gt 4.364e+01 6.202e+01 0.704 0.48584

StPoP -3.578e-08 5.341e-08 -0.670 0.50687

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.073 on 39 degrees of freedom

(3 observations deleted due to missingness)

Multiple R-squared: 0.3977, Adjusted R-squared: 0.2896

F-statistic: 3.678 on 7 and 39 DF, p-value: 0.003826

1. **Reduced model:**

* **Did not make reduced model.**

**Overview of the data**

|  |  |  |
| --- | --- | --- |
| Description | **Variable Name** |  |
| All firearm mortality | AllMortN | **Y=Outcomes;** multiple years with some missings |
| All Firearm Mortality - Crude Rate (per 100,000) | AllMortCrd |
| **All Firearm Mortality - Age Adjusted Rate (per 100,000)** | **AllMortAdj** |
| Age 0-24 Firearm Mortality | MortN24ls |
| Age 0-24 Mortality Crude Rate (per 100,000) | Mort24lsCrd |
| **Age 0-24 Mortality Age Adjusted Rate (per 100,000)** | **Mort24lsAdj** |
| ATF Registered Weapons | **ATFRegWeapon** | Multiple years |
| ATF Federal Firearm Licensees | **ATFFirearmLicense** |
| Giffords Center Rankings | **GiffordsRank** | 2018 data only |
| Gun Ownership Rates | **GOwnerRates** | 2013 data only |
| Handguns Carry Permit required (0 = No, 1 = Yes) | **HGCPermReq** | 2018 data only |
| Handguns Magazine size restriction (0 = No, 1 = Yes) | **HGMagRestrict** |
| Handguns Open carry allowed (0 = No, 1 = Yes) | **HGOCAllow** |
| Handguns Permit required (0 = No, 1 = Yes) | **HGPermReq** |
| Handguns Purchase permit required (0 = No, 1 = Yes) | **HGPurchPermReq** |
| Handguns Registration of firearm (0 = No, 1 = Yes) | **HGRegFirearm** |
| Background checks on private gun sales required (0 = No, 1 = Yes) | **CheckPGSReq** |
| Long guns Carry Permit required (0 = No, 1 = Yes) | **LGCPermReq** |
| Long guns Magazine size restriction (0 = No, 1 = Yes) | **LGMagRestrict** |
| Long guns Open carry allowed (0 = No, 1 = Yes) | **LGOCAllow** |
| Long guns Permit required (0 = No, 1 = Yes) | **LGPermReq** |
| Long guns Purchase permit required (0 = No, 1 = Yes) | **LGPurchPermReq** |
| Long guns Registration of firearm (0 = No, 1 = Yes) | **LGRegFirearm** |
| % Poverty | **Poverty** | **SES** |
| % Unemployment | **Unemploy** |
| % Poor mental health (0 days) | **PoorMH0** |
| % Poor mental health (1-14 days) | **PoorMH14ls** |
| % Poor mental health (> 14 days) | **PoorMH14gt** |
| Statewide population | **StPoP** |
| % population (age 0-24 years) | **PoP24ls** |
| State | **State** | **50 states** |
| Timeframe | **Year** | **1997-2018** |

**Check on missing data (red=have data; black=missing)**