Ecologic Study

A study in which the units of analysis are populations or groups of people, not individuals.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 x 2 Table
# 2 x 2 Table

<table>
<thead>
<tr>
<th></th>
<th>Lung Cancer</th>
<th>No Lung Cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarette Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Cigarette Smoking</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hypothetical Ecologic Study

Relationship Between
Income and Auto Accident

3 communities
each with a population of 7 people

This hypothetical ecologic study is described in AV Diez-Roux’s article, “Bringing Context Back into Epidemiology: Variables and Fallacies in Multilevel Analysis,” in the American Journal of Public Health, 1998;88:216–222.
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

Community A

Community B

Community C
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

Community A

Income: $24,086

Community B

Income: $22,571

Community C

Income: $21,414
### Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

<table>
<thead>
<tr>
<th>Rank</th>
<th>Income</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>$24,086</td>
<td>Community A</td>
</tr>
<tr>
<td>2nd</td>
<td>$22,571</td>
<td>Community B</td>
</tr>
<tr>
<td>3rd</td>
<td>$21,414</td>
<td>Community C</td>
</tr>
</tbody>
</table>

[Diagram showing the distribution of income and auto accidents in each community.]

Copyright © 2004, All rights reserved.
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

<table>
<thead>
<tr>
<th>Place</th>
<th>Income</th>
<th>Community</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>$24,086</td>
<td>Community A</td>
<td>4 / 7 = 57%</td>
</tr>
<tr>
<td>2nd</td>
<td>$22,571</td>
<td>Community B</td>
<td>3 / 7 = 43%</td>
</tr>
<tr>
<td>3rd</td>
<td>$21,414</td>
<td>Community C</td>
<td>2 / 7 = 29%</td>
</tr>
</tbody>
</table>
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

<table>
<thead>
<tr>
<th>Rank</th>
<th>Income</th>
<th>Community</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>$24,086</td>
<td>Community A</td>
<td>4/7 = 57%</td>
</tr>
<tr>
<td>2nd</td>
<td>$22,571</td>
<td>Community B</td>
<td>3/7 = 43%</td>
</tr>
<tr>
<td>3rd</td>
<td>$21,414</td>
<td>Community C</td>
<td>2/7 = 29%</td>
</tr>
</tbody>
</table>
### 2 x 2 Table

<table>
<thead>
<tr>
<th></th>
<th>Auto Accident</th>
<th>No Auto Accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than $20,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $20,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

<table>
<thead>
<tr>
<th></th>
<th>1st</th>
<th>$24,086</th>
<th>Community A</th>
<th>4 / 7 = 57%</th>
<th>1st</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2nd</td>
<td>$22,571</td>
<td>Community B</td>
<td>3 / 7 = 43%</td>
<td>2nd</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>$21,414</td>
<td>Community C</td>
<td>2 / 7 = 29%</td>
<td>3rd</td>
</tr>
</tbody>
</table>
### Hypothetical Ecologic Study — Relationship Between Income and Auto Accident

<table>
<thead>
<tr>
<th></th>
<th>Community A</th>
<th>Community B</th>
<th>Community C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>$24,086</td>
<td>$22,571</td>
<td>$21,414</td>
</tr>
<tr>
<td></td>
<td>$10,500</td>
<td>$12,500</td>
<td>$28,700</td>
</tr>
<tr>
<td></td>
<td>$34,500</td>
<td>$32,500</td>
<td>$30,200</td>
</tr>
<tr>
<td></td>
<td>$28,500</td>
<td>$24,300</td>
<td>$13,500</td>
</tr>
<tr>
<td></td>
<td>$12,200</td>
<td>$10,000</td>
<td>$23,500</td>
</tr>
<tr>
<td></td>
<td>$45,600</td>
<td>$14,300</td>
<td>$10,800</td>
</tr>
<tr>
<td></td>
<td>$17,500</td>
<td>$38,000</td>
<td>$22,700</td>
</tr>
<tr>
<td></td>
<td>$19,800</td>
<td>$26,400</td>
<td>$20,500</td>
</tr>
</tbody>
</table>

- **Community A:** 4/7 = 57%
- **Community B:** 3/7 = 43%
- **Community C:** 2/7 = 29%
# 2 x 2 Table

<table>
<thead>
<tr>
<th></th>
<th>Auto Accident</th>
<th>No Auto Accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than $20,000</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Less than $20,000</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>
Ecologic Fallacy

“... an error in inference due to a failure to distinguish between units of analysis. An association between variables at the group unit of analysis may not exist at the individual unit of analysis.”
Real Ecologic Study

Relationship Between Religion and Suicide

Prussian Communities in the late 19th Century

Real Ecologic Study

Relationship Between Religion and Suicide

Prussian Communities in the late Nineteenth Century

The greater the percent of Protestants in a community, the greater the community’s suicide rate.
Real Ecologic Study

Relationship Between Religion and Suicide

Prussian Communities in the late Nineteenth Century

The greater the percent of Protestants in a community, the greater the community’s suicide rate.

Inferred that being Protestant was a risk factor for suicide.
Ecologic Fallacy

“. . . an error in inference due to a failure to distinguish between units of analysis. An association between variables at the group unit of analysis may not exist at the individual unit of analysis.”
Real Ecologic Study

Relationship Between Religion and Suicide

Prussian Communities in the late Nineteenth Century

The greater the percent of Protestants in a community, the greater the community’s suicide rate.

Inferred that being Protestant was a risk factor for suicide

Most of the suicides within a community were committed by Catholics who, when in the minority, felt socially isolated and were therefore at higher risk of suicide.
# Variables Used in Study of Smoking and Lung Cancer

## Subject Selection
- Males and/or females
- Occupational groups
- Hospitalized cases
- Autopsy series
- Total lung cancer deaths in an area
- National sampling lung cancer deaths

## Control Selection
- Age matched
- Healthy individuals
- Patients hospitalized for other cancers
- Patients hospitalized for other diseases
- Deaths from causes other than cancer
- Sampling of general population

## Methods of Interviewing
- Mailed questionnaires
- Personal interviews subjects/relatives
- Personal interviews controls: professional
- Personal interviews controls

## Other Variables Concurrently Studied
- Geographic distribution
- Occupation
- Marital status
- Coffee and alcohol consumption
- Other nutritional factors
- Parity
- War gas exposure
- Other pathologic conditions
- Hereditary factors
- Air pollution
- Previous respiratory conditions

## Tobacco-Use History
- Type of smoking
- Amount and type
- Amount, type and duration
- Inhalation practices
Matthew Miller, MD, MPH, Sc.D., a general internist and medical oncologist, received his Doctor of Science degree in Health Policy and Management from the Harvard School of Public Health. He is currently an associate director of the Harvard Injury Control Research Center where his research has focused on gun availability at colleges, the association of cigarette smoking to suicide, and the relationship between firearms availability and violent death.
The rates of unintentional firearm deaths would be highest in places where firearms were most available and lowest in places where firearms were least available.
WISQARS Provides Customized Reports of Injury-Related Data

http://www.cdc.gov/ncipc/wisqars/

Welcome to WISQARS™

WISQARS™ (Web-based Injury Statistics Query and Reporting System) is an interactive database system that provides customized reports of injury-related data.

http://www.cdc.gov/ncipc/wisqars
Welcome to WISQARS™

WISQARS™ (Web-based Injury Statistics Query and Reporting System) is an interactive database system that provides customized reports of injury-related data.

WISQARS Fatal

- Presents U.S. injury mortality data.
- Fatal Injury Reports
  - Tables of injury deaths and death rates by particular causes of injury mortality

WISQARS Nonfatal

- Provides national estimates of nonfatal injuries treated in U.S. hospital emergency departments.
- Nonfatal Injury Reports
  - Tables of national estimates of injuries and injury rates by particular injury causes

- Leading Causes of Death Reports
  - Charts of deaths by common causes of death

- Leading Causes of Nonfatal Injury Reports
  - Charts of national estimates of injuries by common causes of injury

- Years of Potential Life Lost (YPLL)
  - Charts of years of potential life lost (premature death) by specific causes of injury mortality and common causes of death
Fatal Injuries: Mortality Reports

Are you interested in data from 1999 and later or from 1998 and earlier? *

<table>
<thead>
<tr>
<th>Year(s) of Data Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data from 1999 and later</td>
</tr>
<tr>
<td>Data from 1998 and earlier</td>
</tr>
</tbody>
</table>
Fatal Injuries: Mortality Reports

Change to Age Output Options

As of 2003, CDC's Injury Center has updated WISQARS with bridged-race intercensal (years between censuses) population estimates by state for years 1991 through 1999. Provided by CDC's National Center for Health Statistics, these population estimates are available by 5-year age groups, state, race, ethnicity, and gender, but not by individual (single) year of age. (More Information >) The U.S. Census Bureau is working on intercensal estimates by single year of age. When the estimates become available, WISQARS will be updated. Until then, rates by single year of age are temporarily unavailable for the years 1991 through 1998.

Select your age output preference. If you have no age output preferences, select Output by 5-Year Age Groups.

### Output by 5-Year Age Groups

<table>
<thead>
<tr>
<th>Data from 1998 and prior (rates available)</th>
</tr>
</thead>
</table>

### Output by Single Year of Age

<table>
<thead>
<tr>
<th>Data from 1998 and prior (death counts only)</th>
</tr>
</thead>
</table>
WISQARS Injury Mortality Reports, 1981-1998

Choose your Report Options, then click the Submit Request button.

For more information about an option or a category of options, click on the underlined name or phrase. To return to this page, click on the “back” button in your browser toolbar.

Report Options

1. What was the intent or manner of the injury? (Select one)
   - All Intents
   - Unintentional
     - Violence-related
       - Homicide and Legal intervention
       - Homicide
       - Legal intervention
   - Suicide
   - Undetermined intent

2. What was the cause or mechanism of the injury? (Select one)
   - All injury
   - All injury and adverse effects
   - Adverse Effects
     - Adverse effects, overall
   - Overexertion
   - Poisoning
   - Struck by / against
   - Suffocation
2. What was the cause or mechanism of the injury? (Select one)

- All injury
- All injury and adverse effects

Adverse Effects
- Adverse effects, overall
  - Medical care, adverse effects
  - Drugs, adverse effects

- Bites and stings
- Cut / Pierce
- Drowning / Submersion
- Fall

Fire / Heat
- Fire / Burn
- Fire / Flame
- Residential fire / Flame
- Hot object / Substance

- Firearm
- Non-Firearm
- Machinery
- Natural / Environmental

- Overexertion
- Poisoning
- Struck by / against
- Suffocation

Transportation-Related
- Motor vehicle, overall
  - Motor vehicle, traffic (categorized by injured person)
  - Motorcyclist
  - Occupant
  - Pedal cyclist
  - Pedestrian
  - Unspecified
  - Pedal cyclist, other
  - Pedestrian, other
  - Transport, other
  - Other specified and classifiable
  - Other specified / NEC
  - Unspecified
3. Select specific options.

Census Region/State
United States

Race
All Races

Sex
Both Sexes

Year(s) of Report
1998 to 1998

Hispanic Origin
All

Output Options
Standard Output

Submit Request or Reset

Advanced Options (not required)

Select age groups
- All Ages (includes unknown age)
- Age Groups 0-4 to 0-4
3. Select specific options.

<table>
<thead>
<tr>
<th>Census Region/State</th>
<th>Year(s) of Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>1998 to 1998</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race</th>
<th>Hispanic Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Races</td>
<td>All</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>Output Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Sexes</td>
<td>Standard Output</td>
</tr>
</tbody>
</table>

Submit Request or Reset

---

**Advanced Options** (not required)

Select age groups

- **All Ages (includes unknown age)**
- **Age Groups** 0-4 to 0-4

**Compare injury rates using age-adjusting.**

Select Standardized Year for Age-Adjusting:

- Use 2000 as the Standard Year.
- No Age-Adjusting Requested
Compare injury rates using age-adjusting.

Select Standardized Year for Age-Adjusting:

- Use 2000 as the Standard Year.
- No Age-Adjusting Requested

Select output group(s):

1. None
2. None
3. None
4. None

Submit Request or Reset
### 1998, United States
#### Unintentional Firearm Deaths and Rates per 100,000
**All Races, Both Sexes, All Ages**

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Deaths</th>
<th>Population</th>
<th>Crude Rate</th>
<th>Age-Adjusted Rate**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>42</td>
<td>4,404,701</td>
<td>0.95</td>
<td>0.98</td>
</tr>
<tr>
<td>Alaska</td>
<td>5*</td>
<td>619,932</td>
<td>0.80*</td>
<td>0.68*</td>
</tr>
<tr>
<td>Arizona</td>
<td>22</td>
<td>4,883,342</td>
<td>0.45</td>
<td>0.47</td>
</tr>
<tr>
<td>Arkansas</td>
<td>13*</td>
<td>2,626,289</td>
<td>0.49*</td>
<td>0.49*</td>
</tr>
<tr>
<td>California</td>
<td>52</td>
<td>32,987,675</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Colorado</td>
<td>9*</td>
<td>4,116,639</td>
<td>0.21*</td>
<td>0.21*</td>
</tr>
<tr>
<td>Connecticut</td>
<td>6*</td>
<td>3,365,352</td>
<td>0.17*</td>
<td>0.18*</td>
</tr>
<tr>
<td>Delaware</td>
<td>3*</td>
<td>763,335</td>
<td>0.39*</td>
<td>0.37*</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>2*</td>
<td>565,230</td>
<td>0.35*</td>
<td>0.28*</td>
</tr>
<tr>
<td>Florida</td>
<td>24</td>
<td>15,486,559</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Georgia</td>
<td>31</td>
<td>7,863,536</td>
<td>0.39</td>
<td>0.41</td>
</tr>
<tr>
<td>Hawaii</td>
<td>2*</td>
<td>1,215,233</td>
<td>0.16*</td>
<td>0.15*</td>
</tr>
<tr>
<td>Idaho</td>
<td>8*</td>
<td>1,252,330</td>
<td>0.63*</td>
<td>0.58*</td>
</tr>
<tr>
<td>Illinois</td>
<td>29</td>
<td>12,271,847</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>Indiana</td>
<td>27</td>
<td>5,998,880</td>
<td>0.45</td>
<td>0.44</td>
</tr>
<tr>
<td>Iowa</td>
<td>10*</td>
<td>2,902,872</td>
<td>0.34*</td>
<td>0.36*</td>
</tr>
<tr>
<td>Kansas</td>
<td>13*</td>
<td>2,660,598</td>
<td>0.48*</td>
<td>0.49*</td>
</tr>
<tr>
<td>Kentucky</td>
<td>30</td>
<td>3,985,390</td>
<td>0.75</td>
<td>0.80</td>
</tr>
</tbody>
</table>

* Rates based on 20 or fewer deaths may be unstable. Use with caution.
3. Select specific options.

Census Region/State
- United States

Race
- All Races

Sex
- Both Sexes

Year(s) of Report
- 1998 to 1998

Hispanic Origin
- All

Output Options
- Standard Output

Advanced Options (not required)
Select age groups
- All Ages (includes unknown age)
- Age Groups 0-4 to 0-4

1981 to 1998
## 1981 - 1998, United States
Suicide Deaths and Rates per 100,000
All Races, Both Sexes, All Ages
ICD-9 Codes: E950-E959

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Deaths</th>
<th>Population***</th>
<th>Crude Rate</th>
<th>Age-Adjusted Rate**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>8,915</td>
<td>73,939,772</td>
<td>12.06</td>
<td>12.11</td>
</tr>
<tr>
<td>Alaska</td>
<td>1,552</td>
<td>9,936,083</td>
<td>15.62</td>
<td>16.48</td>
</tr>
<tr>
<td>Arizona</td>
<td>11,797</td>
<td>67,156,014</td>
<td>17.57</td>
<td>17.75</td>
</tr>
<tr>
<td>Arkansas</td>
<td>5,582</td>
<td>43,342,111</td>
<td>12.88</td>
<td>12.94</td>
</tr>
<tr>
<td>California</td>
<td>66,458</td>
<td>522,657,082</td>
<td>12.72</td>
<td>13.08</td>
</tr>
<tr>
<td>Colorado</td>
<td>10,501</td>
<td>61,994,213</td>
<td>16.94</td>
<td>17.23</td>
</tr>
<tr>
<td>Connecticut</td>
<td>5,286</td>
<td>58,731,240</td>
<td>9.00</td>
<td>8.78</td>
</tr>
<tr>
<td>Delaware</td>
<td>1,464</td>
<td>12,057,170</td>
<td>12.14</td>
<td>12.10</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>826</td>
<td>10,973,900</td>
<td>7.53</td>
<td>7.01</td>
</tr>
<tr>
<td>Florida</td>
<td>35,790</td>
<td>230,683,600</td>
<td>15.51</td>
<td>14.61</td>
</tr>
<tr>
<td>Georgia</td>
<td>14,570</td>
<td>118,254,660</td>
<td>12.32</td>
<td>12.65</td>
</tr>
<tr>
<td>Hawaii</td>
<td>2,042</td>
<td>19,942,289</td>
<td>10.24</td>
<td>10.35</td>
</tr>
<tr>
<td>Idaho</td>
<td>3,113</td>
<td>19,098,036</td>
<td>16.30</td>
<td>17.16</td>
</tr>
<tr>
<td>Illinois</td>
<td>20,536</td>
<td>209,666,383</td>
<td>9.79</td>
<td>9.85</td>
</tr>
<tr>
<td>Indiana</td>
<td>12,294</td>
<td>101,349,054</td>
<td>12.13</td>
<td>12.23</td>
</tr>
<tr>
<td>Iowa</td>
<td>5,950</td>
<td>51,077,850</td>
<td>11.65</td>
<td>11.54</td>
</tr>
<tr>
<td>Kansas</td>
<td>5,518</td>
<td>45,026,259</td>
<td>12.26</td>
<td>12.34</td>
</tr>
<tr>
<td>Kentucky</td>
<td>8,946</td>
<td>67,753,820</td>
<td>13.20</td>
<td>13.27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crude Rate</th>
<th>Age-Adjusted Rate**</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.95</td>
<td>0.98</td>
</tr>
<tr>
<td>0.80*</td>
<td>0.68*</td>
</tr>
<tr>
<td>0.45</td>
<td>0.47</td>
</tr>
<tr>
<td>0.49*</td>
<td>0.49*</td>
</tr>
<tr>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>0.21*</td>
<td>0.21*</td>
</tr>
<tr>
<td>0.17*</td>
<td>0.18*</td>
</tr>
<tr>
<td>0.39*</td>
<td>0.37*</td>
</tr>
<tr>
<td>0.35*</td>
<td>0.28*</td>
</tr>
<tr>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>0.39</td>
<td>0.41</td>
</tr>
<tr>
<td>0.16*</td>
<td>0.15*</td>
</tr>
<tr>
<td>0.63*</td>
<td>0.58*</td>
</tr>
<tr>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>0.45</td>
<td>0.44</td>
</tr>
<tr>
<td>0.34*</td>
<td>0.36*</td>
</tr>
<tr>
<td>0.48*</td>
<td>0.49*</td>
</tr>
<tr>
<td>0.75</td>
<td>0.80</td>
</tr>
</tbody>
</table>
(State)

(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths)
Georgia

0.76

(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths)
1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths
Outlier

“An observation differing so widely from the rest of the data as to lead one to suspect that a gross error may have been committed.”
The rates of unintentional firearm deaths would be highest in places where firearms were most available and lowest in places where firearms were least available.
Cook’s Index

Average of the percentage of all suicides committed with a firearm and the percentage of all homicides committed with a firearm.
Construct

An abstract or general idea inferred or derived from specific instances.
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{2} + \frac{\% \text{ of all homicides committed with a firearm}}{2}
\]
Cook’s Index

\[
\frac{\text{% of all suicides committed with a firearm} + \text{% of all homicides committed with a firearm}}{2}
\]

General Social Surveys
Behavioral Risk Factor Surveillance System
Correlation Coefficient

A measure of association that ranges from 1.0 (complete agreement) through 0.0 (no relation) to –1.0 (complete disagreement).
Cook’s Index

\[ \frac{\% \text{ of all suicides committed with a firearm}}{\% \text{ of all homicides committed with a firearm}} + 2 \]

Correlation? (The degree to which variables change together)

General Social Surveys

Behavioral Risk Factor Surveillance System

Did not have “... any particular intuitive value.”

Transparency 52
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{\% \text{ of all homicides committed with a firearm}} \times 2
\]

Correlation? (The degree to which variables change together)

General Social Surveys \( .87 \)

Behavioral Risk Factor Surveillance System \( .83 \)
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{2} + \frac{\% \text{ of all homicides committed with a firearm}}{2}
\]
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Total number of suicides committed with a firearm

\[
\frac{\text{Total number of suicides committed with a firearm}}{\text{Total number of suicides from all causes}}
\]
% of all *suicides* committed with a firearm

http://www.cdc.gov/ncipc/wisqars
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Total number of suicides committed with a firearm

Total number of suicides from all causes
Total number of suicides committed with a firearm
Total number of suicides committed *with a firearm*
Cook’s Index

\[
\text{\% of all suicides committed with a firearm} + \frac{\text{\% of all homicides committed with a firearm}}{2}
\]

Georgia

10,945

Total number of suicides committed with a firearm

Total number of suicides from all causes
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Total number of suicides committed with a firearm

\[
\frac{\text{Total number of suicides from all causes}}{2}
\]
Total number of suicides *from all causes*
Total number of suicides *from all causes*
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Georgia

Total number of suicides committed with a firearm

14,570

Total number of suicides from all causes
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{2} + \frac{\% \text{ of all homicides committed with a firearm}}{2}
\]

**Georgia**

Total number of suicides committed with a firearm: 10,945

Total number of suicides from all causes: 14,570
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2} = \frac{10,945}{14,570} = 0.751
\]
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{2} + \frac{\% \text{ of all homicides committed with a firearm}}{2} = .751
\]

Georgia

Total number of suicides committed with a firearm: 10,945
Total number of suicides from all causes: 14,570

\[
\frac{10,945}{14,570} = .751
\]
% of all *suicides* committed with a firearm

---

**Georgia**

| 0.76 | 75.1% |

(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths) (Cook’s Index)
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{2} + \frac{\% \text{ of all homicides committed with a firearm}}{2}
\]
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Total number of homicides committed with a firearm

\[
\frac{\text{Total number of homicides committed with a firearm}}{\text{Total number of homicides from all causes}}
\]
Total number of homicides committed *with a firearm*
Cook’s Index

% of all suicides committed with a firearm + % of all homicides committed with a firearm

\[ \frac{1}{2} \]

Total number of homicides committed with a firearm

\[ \frac{\text{Total number of homicides committed with a firearm}}{\text{Total number of homicides from all causes}} \]
Total number of homicides committed *with a firearm*
Cook’s Index

% of all suicides committed with a firearm + % of all homicides committed with a firearm

\[ \frac{1}{2} \]

**Georgia**

9,408

Total number of homicides committed with a firearm

Total number of homicides from all causes
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Total number of homicides committed with a firearm

\[
\frac{\text{Total number of homicides committed with a firearm}}{\text{Total number of homicides from all causes}}
\]
Total number of homicides \textit{from all causes}
Total number of homicides *from all causes*
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Georgia

Total number of homicides committed with a firearm

\[
\frac{13,930}{\text{Total number of homicides from all causes}}
\]
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm}}{2} + \frac{\% \text{ of all homicides committed with a firearm}}{2}
\]

Georgia

\[
\begin{align*}
9,408 & \quad \text{Total number of homicides committed with a firearm} \\
13,930 & \quad \text{Total number of homicides from all causes}
\end{align*}
\]
Cook’s Index

\[
\frac{\% \text{ of all suicides committed with a firearm} + \% \text{ of all homicides committed with a firearm}}{2}
\]

Georgia

9,408
Total number of homicides committed with a firearm

13,930
Total number of homicides from all causes

= .675
Cook’s Index

% of all suicides committed with a firearm + % of all homicides committed with a firearm

\[ \frac{67.5\%}{2} \]

Total number of homicides committed with a firearm = 9,408

Total number of homicides from all causes = 13,930

\[ \frac{9,408}{13,930} = 0.675 \]
% of all *homicides* committed with a firearm

<table>
<thead>
<tr>
<th>Georgia</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths)</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>75.1%</td>
</tr>
<tr>
<td></td>
<td>67.5%</td>
</tr>
</tbody>
</table>

(Cook’s Index)
Cook’s Index

\[
\frac{75.1\%}{\text{of all suicides committed with a firearm}} + \frac{67.5\%}{\text{of all homicides committed with a firearm}} = \frac{2}{2}
\]
## Cook’s Index

**Georgia**

<table>
<thead>
<tr>
<th>0.76</th>
<th>67.5% + 75.1%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>142.6 / 2 = 71.3</td>
</tr>
</tbody>
</table>

(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths) (Cook’s Index)
## Teacher's Cook's Index Sheet (Alphabetical Order)

<table>
<thead>
<tr>
<th>State</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>78.0%</td>
<td>70.4%</td>
<td>74.2</td>
</tr>
<tr>
<td>Alaska</td>
<td>70.5%</td>
<td>61.3%</td>
<td>65.9</td>
</tr>
<tr>
<td>Arizona</td>
<td>67.3%</td>
<td>62.9%</td>
<td>65.1</td>
</tr>
<tr>
<td>Arkansas</td>
<td>76.4%</td>
<td>69.2%</td>
<td>72.8</td>
</tr>
<tr>
<td>California</td>
<td>52.6%</td>
<td>66.6%</td>
<td>59.7</td>
</tr>
<tr>
<td>Colorado</td>
<td>57.2%</td>
<td>56.4%</td>
<td>56.8</td>
</tr>
<tr>
<td>Connecticut</td>
<td>43.1%</td>
<td>63.7%</td>
<td>53.4</td>
</tr>
<tr>
<td>Delaware</td>
<td>48.4%</td>
<td>47.9%</td>
<td>48.2</td>
</tr>
<tr>
<td>D.C.</td>
<td>34.5%</td>
<td>72.4%</td>
<td>53.5</td>
</tr>
<tr>
<td>Florida</td>
<td>60.6%</td>
<td>66.0%</td>
<td>63.3</td>
</tr>
<tr>
<td>Georgia</td>
<td>75.1%</td>
<td>67.5%</td>
<td>71.3</td>
</tr>
<tr>
<td>Hawaii</td>
<td>29.3%</td>
<td>40.3%</td>
<td>34.8</td>
</tr>
<tr>
<td>Idaho</td>
<td>69.6%</td>
<td>59.8%</td>
<td>64.7</td>
</tr>
<tr>
<td>Illinois</td>
<td>45.6%</td>
<td>64.1%</td>
<td>54.9</td>
</tr>
<tr>
<td>Indiana</td>
<td>61.7%</td>
<td>68.3%</td>
<td>65.0</td>
</tr>
<tr>
<td>Iowa</td>
<td>54.5%</td>
<td>52.5%</td>
<td>53.5</td>
</tr>
<tr>
<td>Kansas</td>
<td>64.3%</td>
<td>64.6%</td>
<td>65.0</td>
</tr>
<tr>
<td>Kentucky</td>
<td>74.6%</td>
<td>69.5%</td>
<td>72.3</td>
</tr>
<tr>
<td>Louisiana</td>
<td>76.6%</td>
<td>74.5%</td>
<td>75.6</td>
</tr>
<tr>
<td>Maine</td>
<td>59.0%</td>
<td>52.4%</td>
<td>55.7</td>
</tr>
<tr>
<td>Maryland</td>
<td>55.1%</td>
<td>68.6%</td>
<td>61.9</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>30.5%</td>
<td>46.8%</td>
<td>38.7</td>
</tr>
<tr>
<td>Michigan</td>
<td>55.8%</td>
<td>67.4%</td>
<td>61.6</td>
</tr>
<tr>
<td>Minnesota</td>
<td>49.9%</td>
<td>49.7%</td>
<td>49.8</td>
</tr>
<tr>
<td>Mississippi</td>
<td>34.7%</td>
<td>68.3%</td>
<td>51.5</td>
</tr>
<tr>
<td>Missouri</td>
<td>63.6%</td>
<td>68.4%</td>
<td>66.0</td>
</tr>
<tr>
<td>Montana</td>
<td>66.9%</td>
<td>58.4%</td>
<td>62.7</td>
</tr>
<tr>
<td>Nebraska</td>
<td>58.2%</td>
<td>59.0%</td>
<td>58.6</td>
</tr>
<tr>
<td>Nevada</td>
<td>67.3%</td>
<td>60.5%</td>
<td>63.9</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>55.9%</td>
<td>48.5%</td>
<td>52.2</td>
</tr>
<tr>
<td>New Jersey</td>
<td>35.1%</td>
<td>48.6%</td>
<td>41.9</td>
</tr>
<tr>
<td>New Mexico</td>
<td>64.3%</td>
<td>54.6%</td>
<td>59.5</td>
</tr>
<tr>
<td>New York</td>
<td>37.5%</td>
<td>64.8%</td>
<td>51.2</td>
</tr>
<tr>
<td>North Carolina</td>
<td>71.4%</td>
<td>67.0%</td>
<td>69.2</td>
</tr>
<tr>
<td>North Dakota</td>
<td>58.4%</td>
<td>51.9%</td>
<td>55.2</td>
</tr>
<tr>
<td>Ohio</td>
<td>58.1%</td>
<td>63.0%</td>
<td>61.0</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>69.9%</td>
<td>60.6%</td>
<td>65.3</td>
</tr>
<tr>
<td>Oregon</td>
<td>61.8%</td>
<td>55.0%</td>
<td>58.4</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>54.4%</td>
<td>60.7%</td>
<td>57.6</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>32.4%</td>
<td>47.9%</td>
<td>40.2</td>
</tr>
<tr>
<td>South Carolina</td>
<td>72.5%</td>
<td>65.3%</td>
<td>68.9</td>
</tr>
<tr>
<td>South Dakota</td>
<td>60.0%</td>
<td>35.4%</td>
<td>48.0</td>
</tr>
<tr>
<td>Tennessee</td>
<td>74.0%</td>
<td>69.8%</td>
<td>71.9</td>
</tr>
<tr>
<td>Texas</td>
<td>69.3%</td>
<td>68.6%</td>
<td>69.0</td>
</tr>
<tr>
<td>Utah</td>
<td>61.0%</td>
<td>51.7%</td>
<td>56.4</td>
</tr>
<tr>
<td>Vermont</td>
<td>65.7%</td>
<td>59.6%</td>
<td>62.7</td>
</tr>
<tr>
<td>Virginia</td>
<td>68.8%</td>
<td>68.4%</td>
<td>67.6</td>
</tr>
<tr>
<td>Washington</td>
<td>56.1%</td>
<td>55.8%</td>
<td>56.0</td>
</tr>
<tr>
<td>West Virginia</td>
<td>74.9%</td>
<td>68.8%</td>
<td>71.9</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>52.7%</td>
<td>59.3%</td>
<td>56.0</td>
</tr>
<tr>
<td>Wyoming</td>
<td>74.1%</td>
<td>55.6%</td>
<td>64.9</td>
</tr>
</tbody>
</table>
1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths
The rates of unintentional firearm deaths would be highest in places where firearms were most available and lowest in places where firearms were least available.
1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths

Cook's Index
Scatterplot Diagram

A graphic method of displaying the distribution of two variables in relationship to each other, with the values of one variable measured on the vertical axis and the values of the other on the horizontal axis.
Fig. 1. Average state level unintentional firearm death rate by average state level firearm availability, all ages (1979-1997).
Ecologic Study

A study in which the units of analysis are populations or groups of people, not individuals.
2 x 2 Table

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# 2 x 2 Table

<table>
<thead>
<tr>
<th></th>
<th>Unintentional Firearm Death</th>
<th>Not an Unintentional Death by Firearm</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Firearm Availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Firearm Availability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ecologic Fallacy

“. . . an error in inference due to a failure to distinguish between units of analysis. An association between variables at the group unit of analysis may not exist at the individual unit of analysis.”
Firearm availability and unintentional firearm deaths

Mathew Miller *, Deborah Azrael, David Hemenway

Department of Health Policy and Management, 677 Huntington Avenue, Boston, MA 02115, USA

Received 15 March 2000; received in revised form 5 July 2000; accepted 4 July 2000

Abstract

Background: Between 1970 and 1997, almost 30000 Americans died from unintentional firearm injuries, half of whom were under 25 years of age and 4600 of whom were less than 15 years old. Purpose: To explore the association between state firearm levels and rates of unintentional firearm deaths by age group, accounting for several potential confounders. Methods: The study used a proxy for firearm availability and pooled cross-sectional time-series data on unintentional firearm deaths for the 50 United States from 1979 to 1997. Negative binomial models were used to estimate the association between firearm availability and unintentional firearm deaths. Results: A statistically significant and robust association exists between gun availability and unintentional firearm deaths for the US as a whole and within each age group. Multivariate analysis found that, compared to states with the lowest gun levels, states with the highest gun levels had, on average, 9 times the rate of unintentional firearm deaths. These results hold among men and women, for Whites and African Americans. Conclusion: Of the almost 30000 people who died in unintentional firearm deaths over the 19-year study period, a disproportionately high number died in states where it is more likely to find guns. These findings suggest that increased firearm availability and violent death among all age groups is not entirely explained by a state's level of poverty, urbanization, or regional location. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Firearm; Guns; Children; Unintentional death; Accidents; Violence

1. Introduction

Between 1979 and 1997, almost 30000 Americans died from unintentional firearm injuries, 87% of whom were male, half of whom were under 25 years of age and 4600 of whom were less than 15 years old (NCHS, 1998). Among children in the US 14 years old or younger, only motor vehicle accidents and cancer claim more lives than do firearms; fully one third of these gun deaths are unintentional (NCHS, 1998).

By contrast, few children in other industrialized nations are dying from guns. Before a child in the US becomes a teenager, compared to children in other industrialized nations, he or she is 9 times as likely to die from an unintentional firearm injury (CDC, 1997). Adults in the US are also at increased risk of unintentional firearm death, compared to adults in other industrialized nations (Krug et al., 1998). Among adults, however, intentional gun deaths constitute over 95% of all firearm mortality.

Unintentional firearm deaths are only the tip of the iceberg. It has been estimated that for every person who dies from an unintentional gunshot injury each year, 13 others are treated in hospital emergency departments for unintentional, non-fatal gunshot wounds (Annest et al., 1995). Many of those who survive unintentional gunshot injury are subject to long-term physical impairment and permanent disability (Kennedy et al., 1993), often at great cost (Miller and Cohen, 1997). While many studies of firearm fatalities in the US have been conducted, only a moderate number have focused on unintentional firearm deaths. Those that have (Rushforth et al., 1974; Morrow and Hudson, 1986; Cole and Patetta, 1988; Wintemute et al., 1988, 1987, 1989; Carter, 1989; Waller et al., 1989; Lee et al., 1991; Martin et al., 1991; Dowd et al., 1994; Annest et al., 1995; Sinha et al., 1996), report valuable but limited descriptive information about the context in which the unintentional shootings, fatal and non-fatal, take place, and usually provide only correlates of injuries at one locality rather than statistical analyses of national data.
Ecologic Study Worksheet

Name: ___________________________ Date: ____ / ____ / ____

Ecologic Study Worksheet: Firearm Availability and Unintentional Firearm Death

1. How might the possibility that "... where there are more guns parents care less about their children's welfare ...." influence the inference one can reach from Dr. Miller's study?

2. Why did Dr. Miller "... control for state level of poverty, urbanization and regionalization?"

3. How does Dr. Miller address the possibility of the ecologic fallacy?