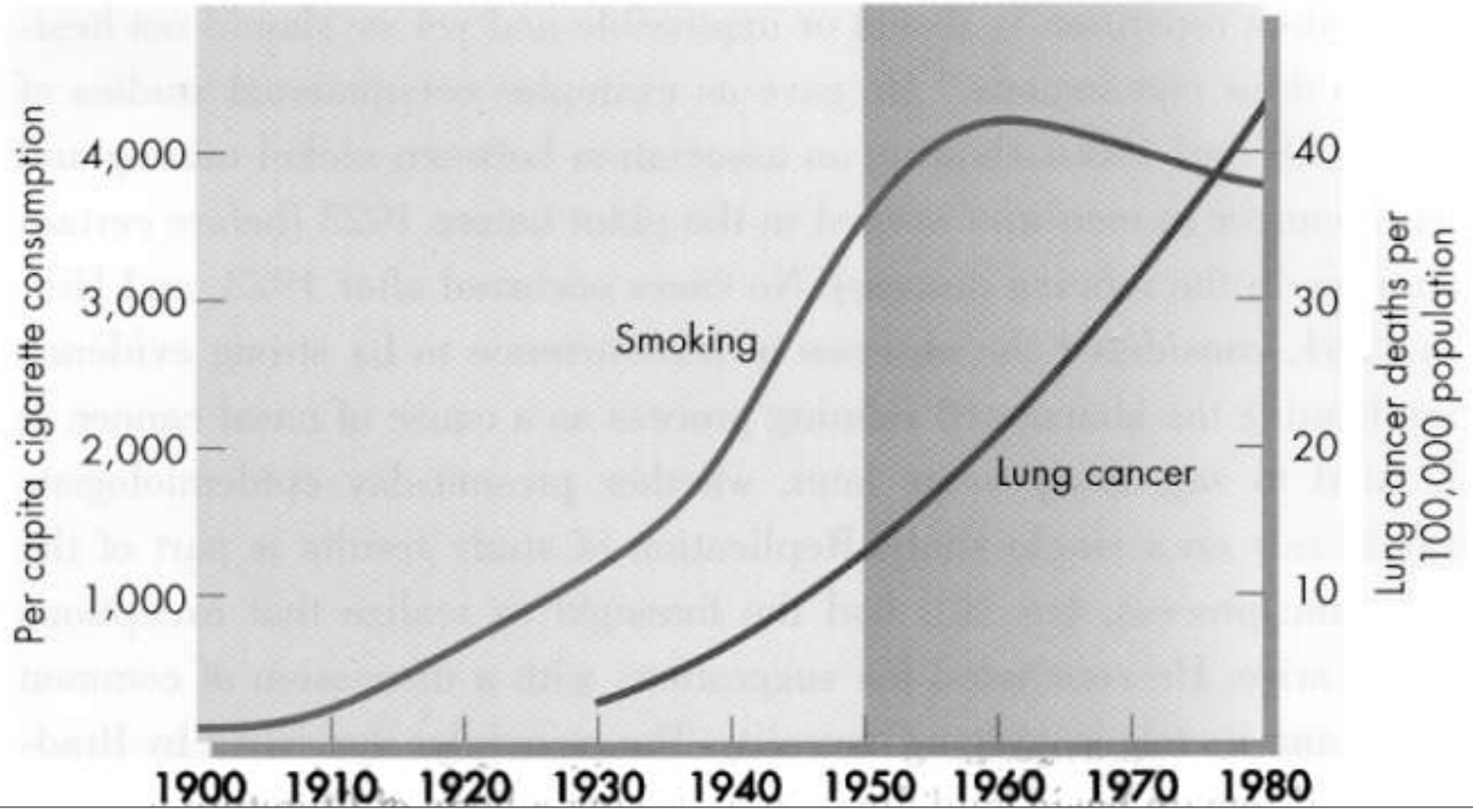
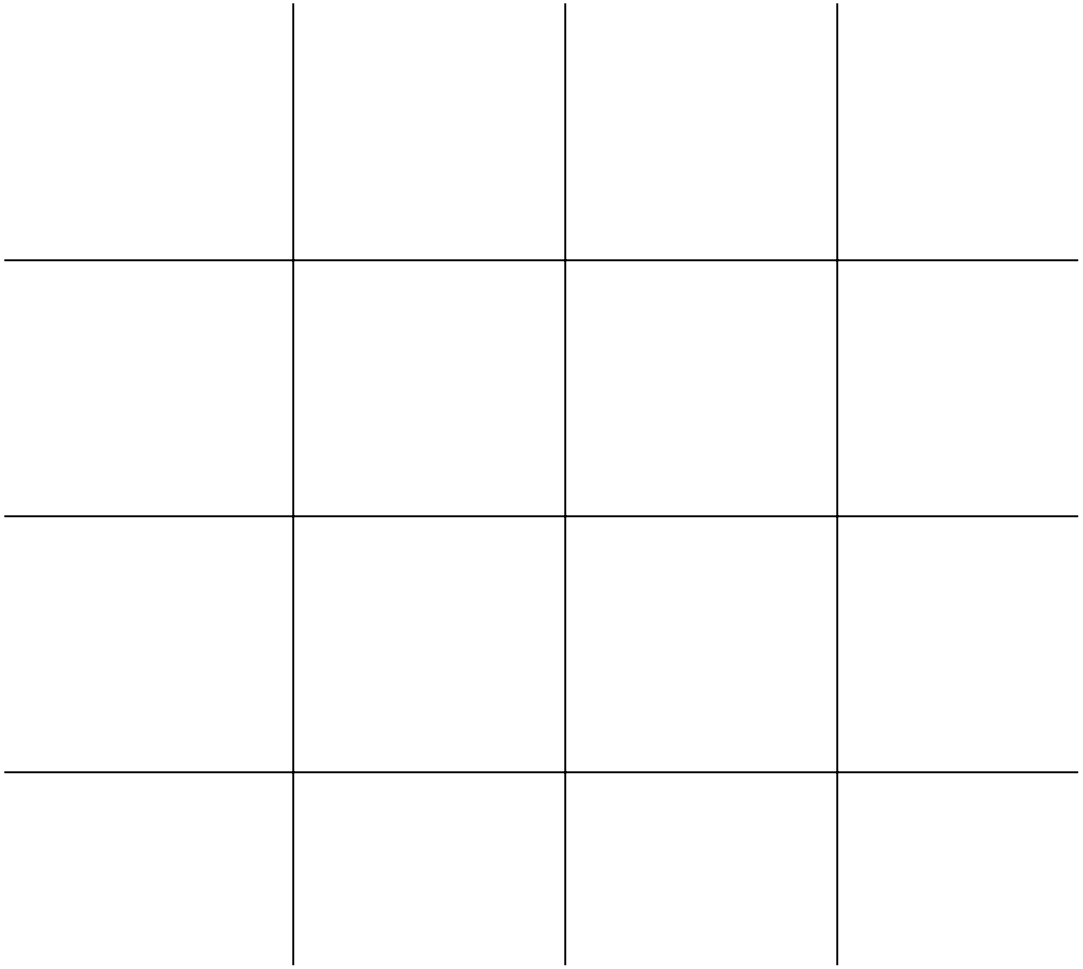


Ecologic Study

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

2 x 2 Table



2 x 2 Table

	Lung Cancer	No Lung Cancer	
Cigarette Smoking			
No Cigarette Smoking			

Hypothetical Ecologic Study

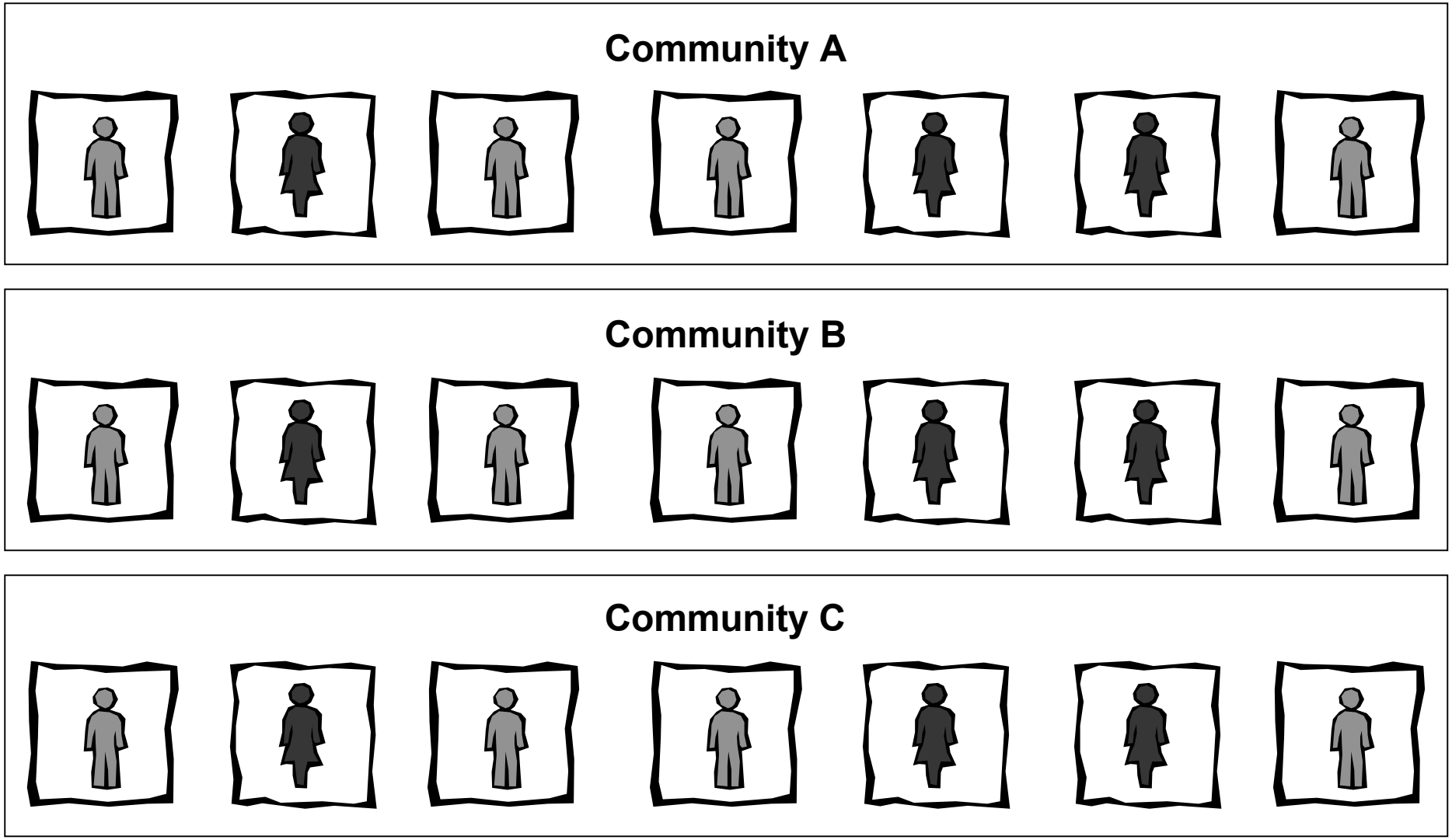
Relationship Between

Income and Auto Accident

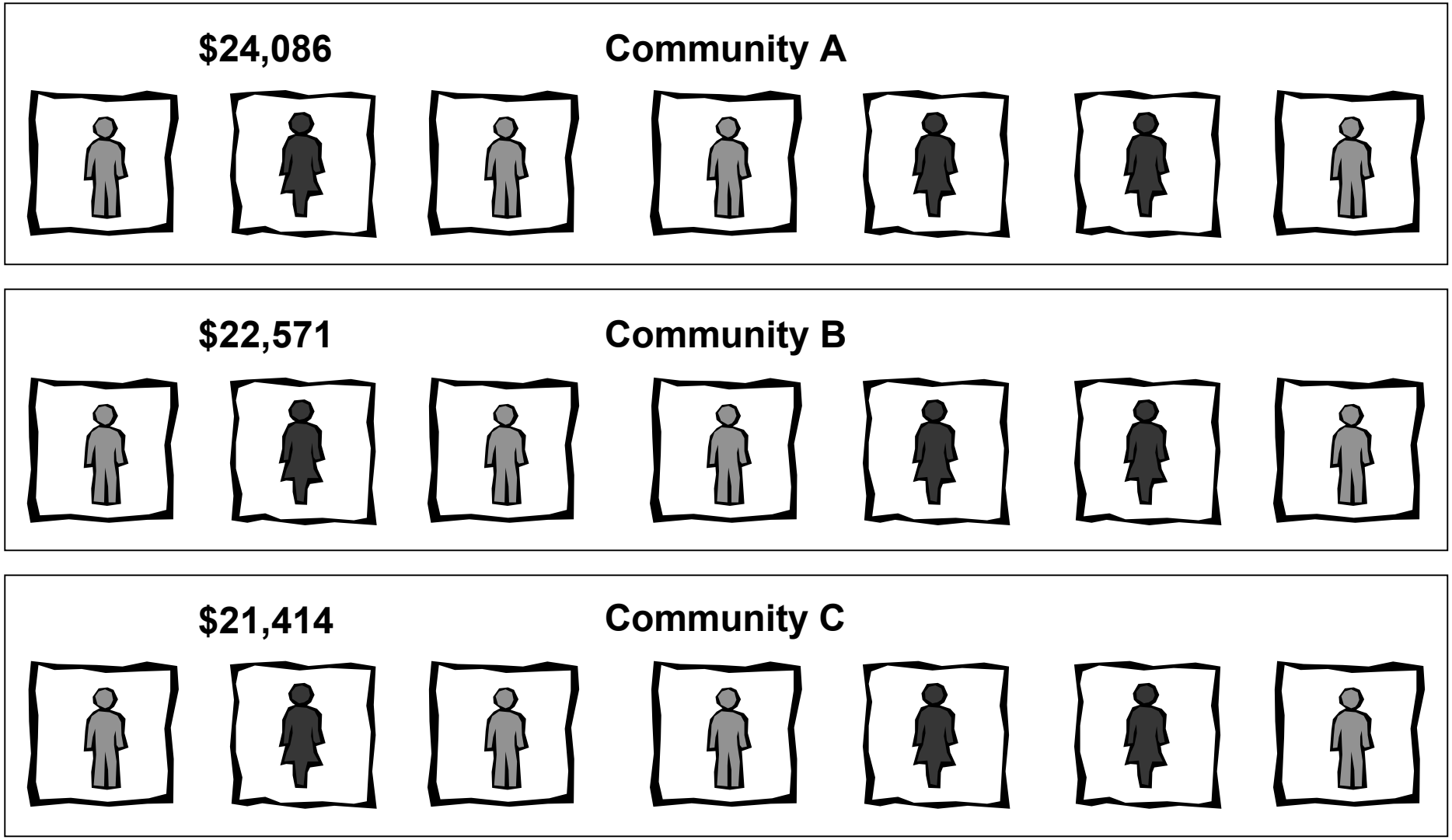
3 communities
each with a population of 7 people

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.

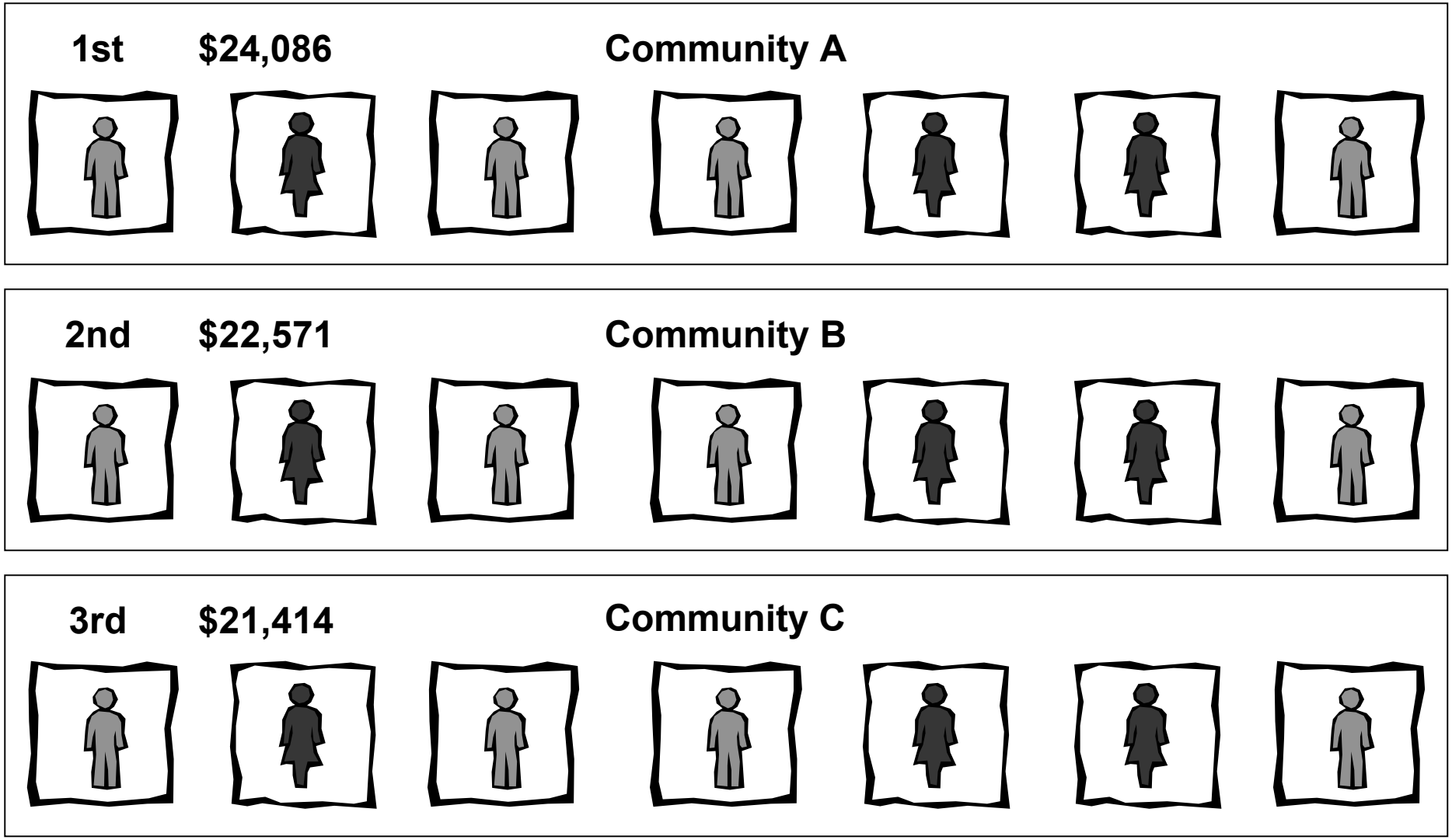
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



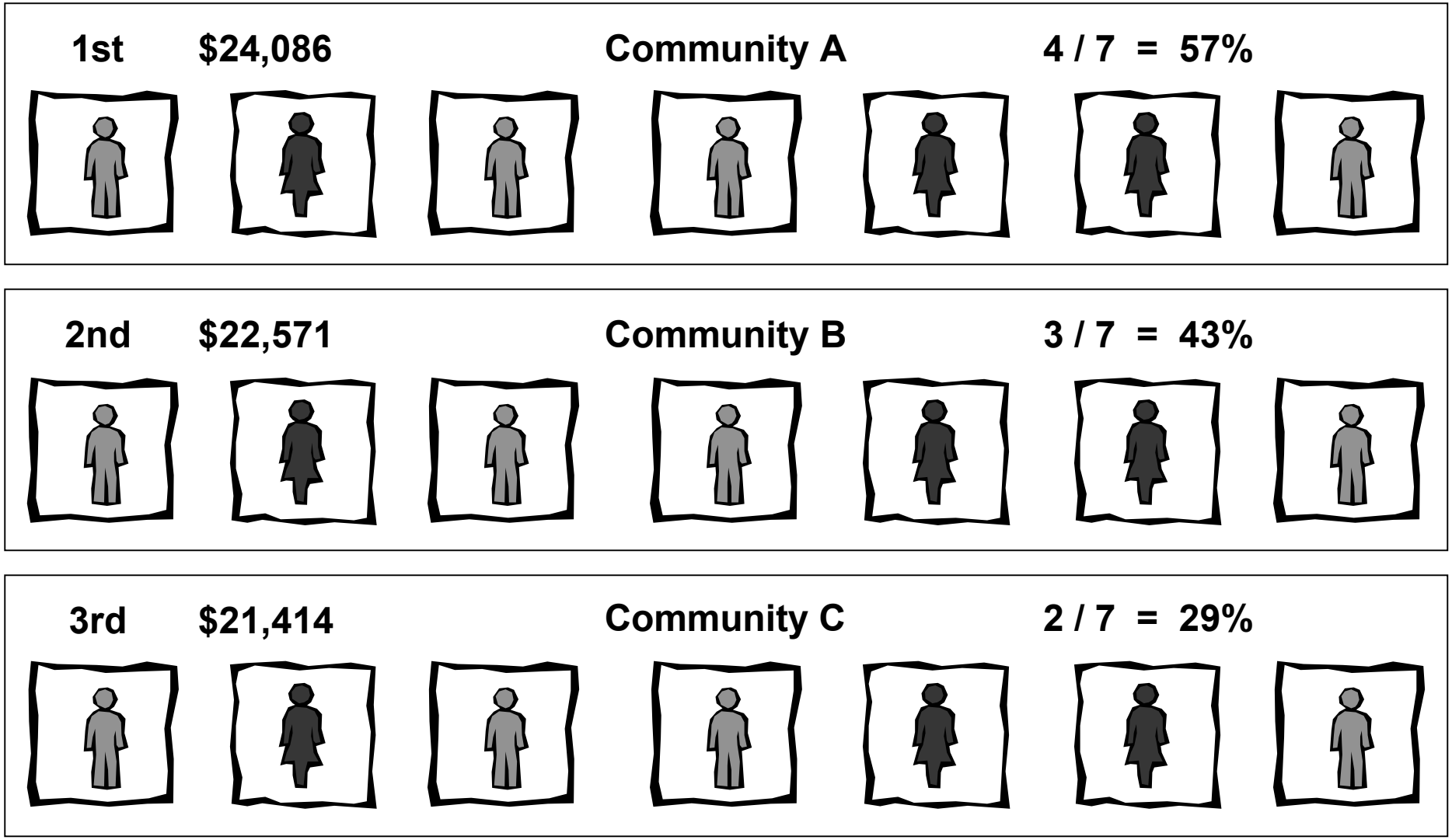
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



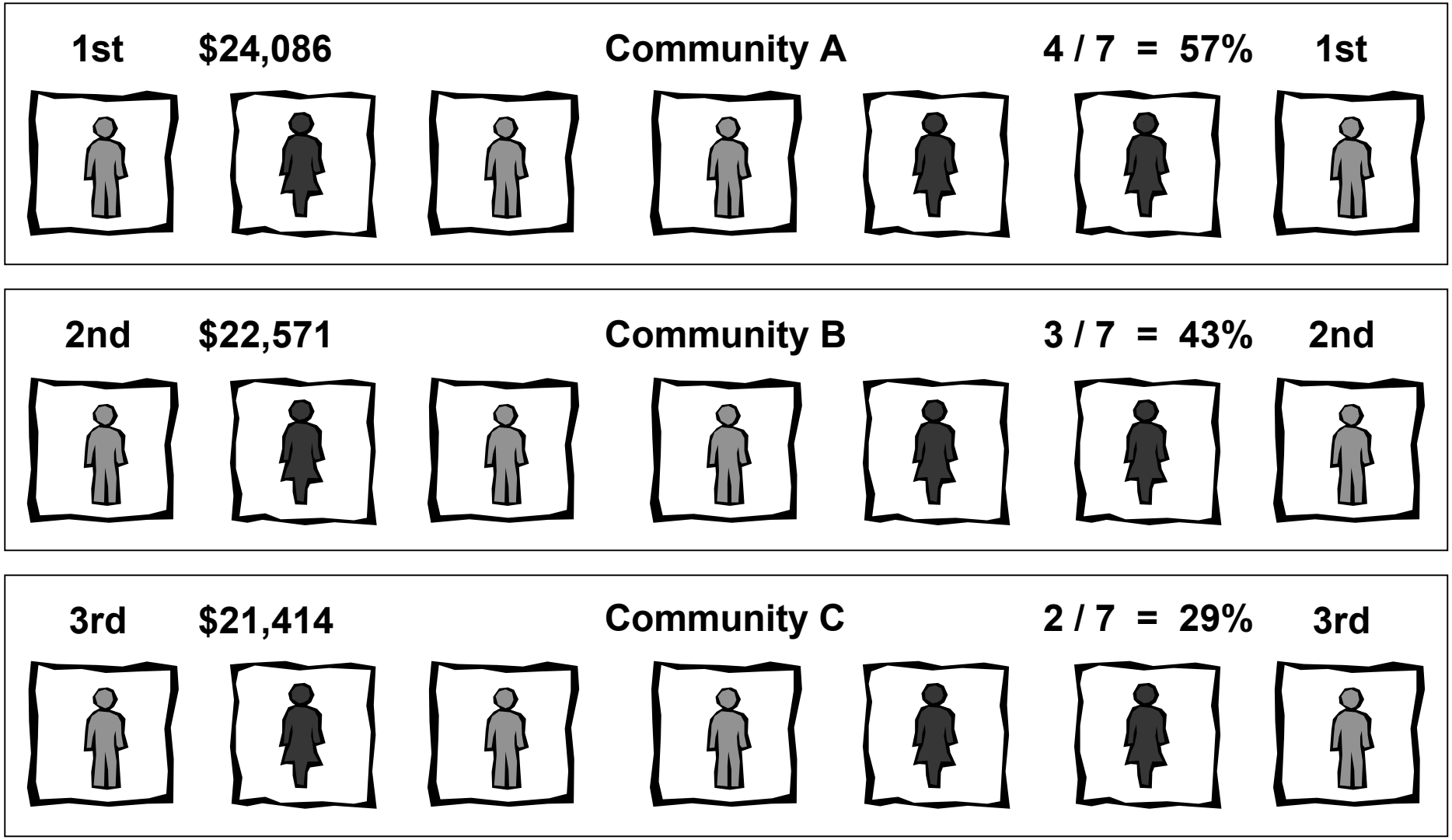
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



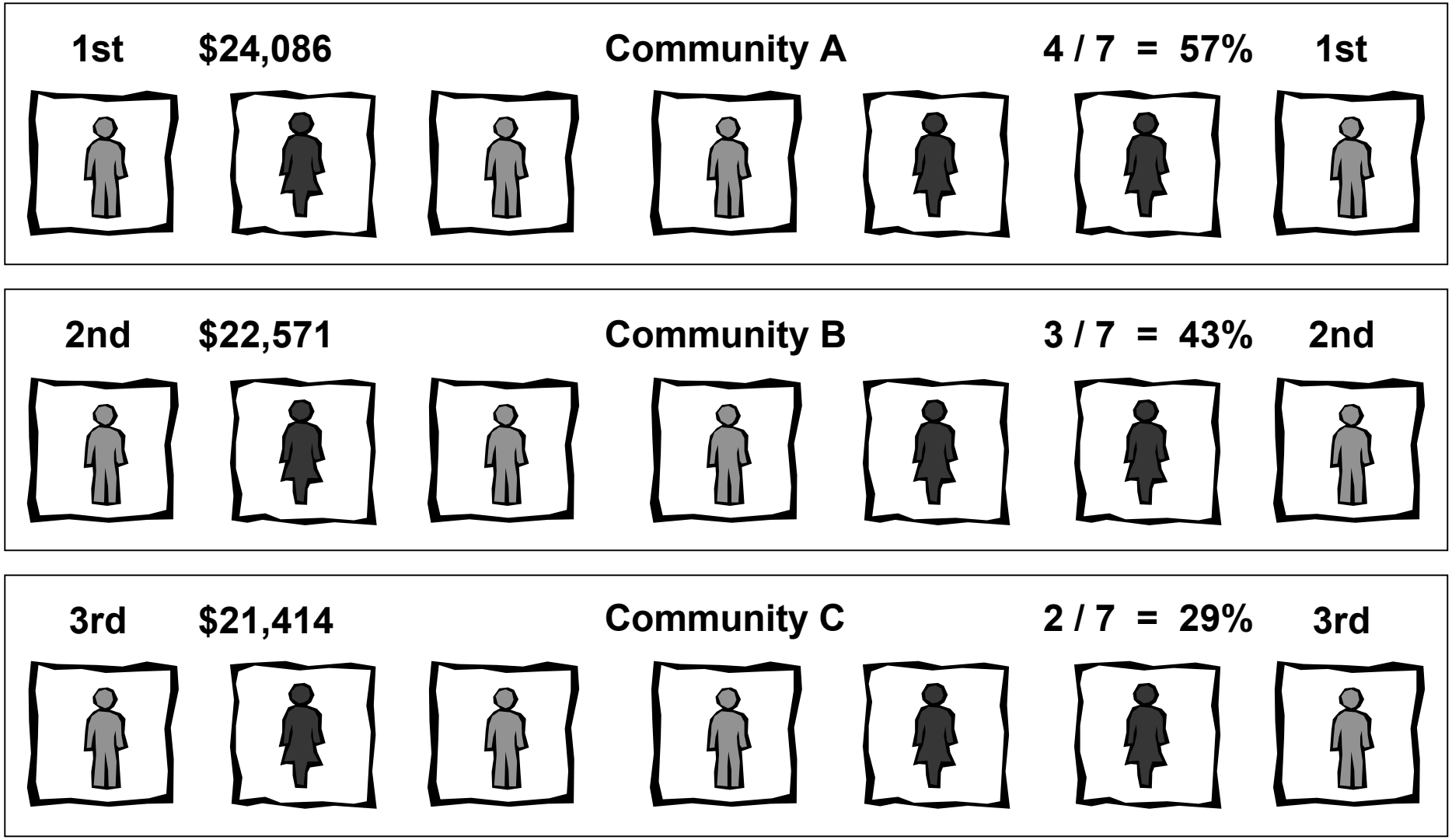
Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



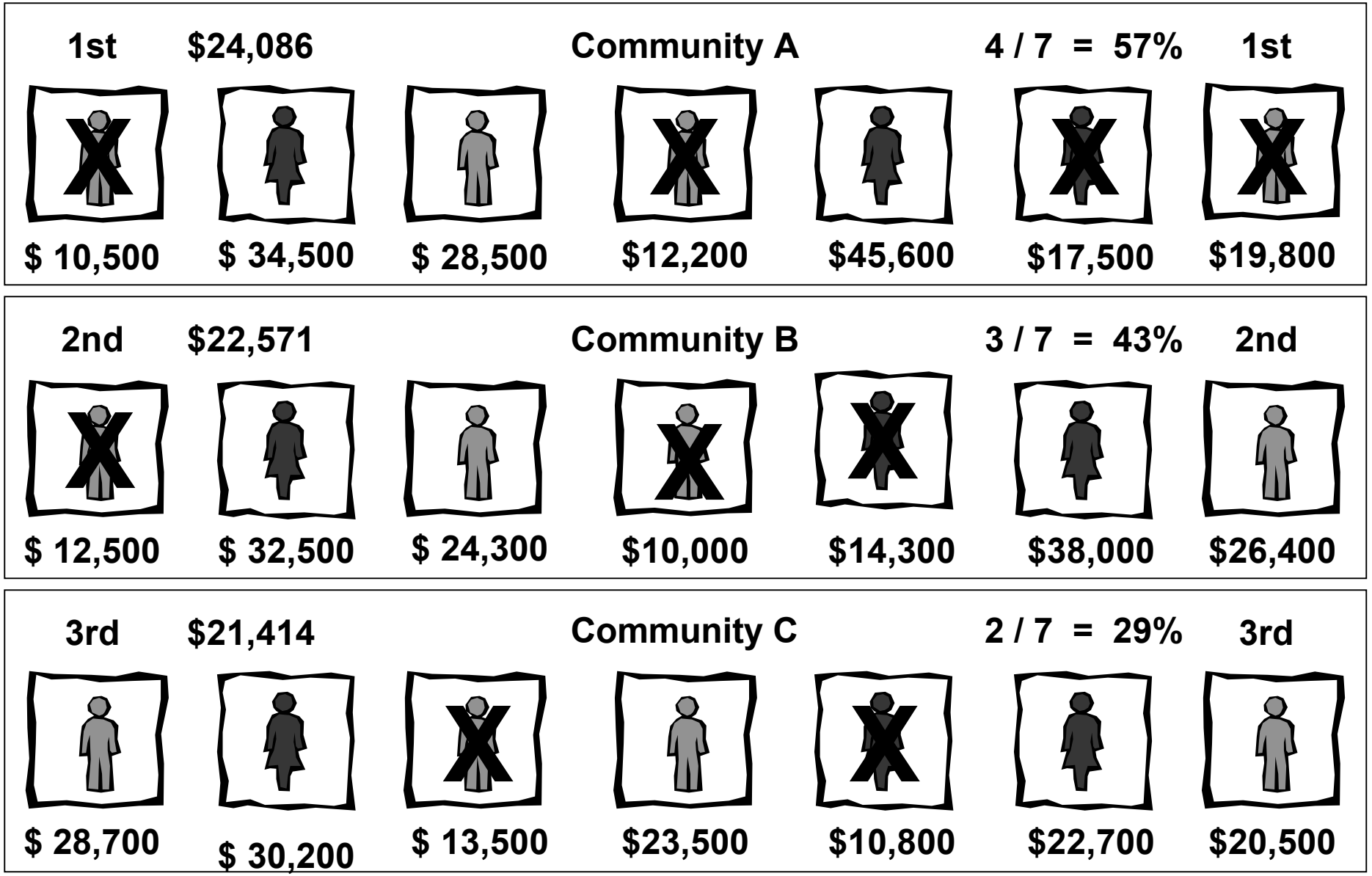
2 x 2 Table

	Auto Accident	No Auto Accident	
More than $20,000			
Less than $20,000			

Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



Hypothetical Ecologic Study — Relationship Between Income and Auto Accident



2 x 2 Table

	Auto Accident	No Auto Accident	
More than $20,000	**0**	**12**	**12**
Less than $20,000	**9**	**0**	**9**

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

This ecological study is described in H. Morgenstern's article,
"Ecologic Studies in Epidemiology: Concepts, Principles, and Methods,"
in the *Annual Review of Public Health*, 1995;16: 61–81 and
in E. Durkheim's book, *Suicide: A Study in Sociology*, published by Free Press in 1951.

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

Methods of Interviewing

- Mailed questionnaires
- Personal interviews subjects/relatives
- Personal interviews controls: professional
- Personal interviews controls

Tobacco-Use History

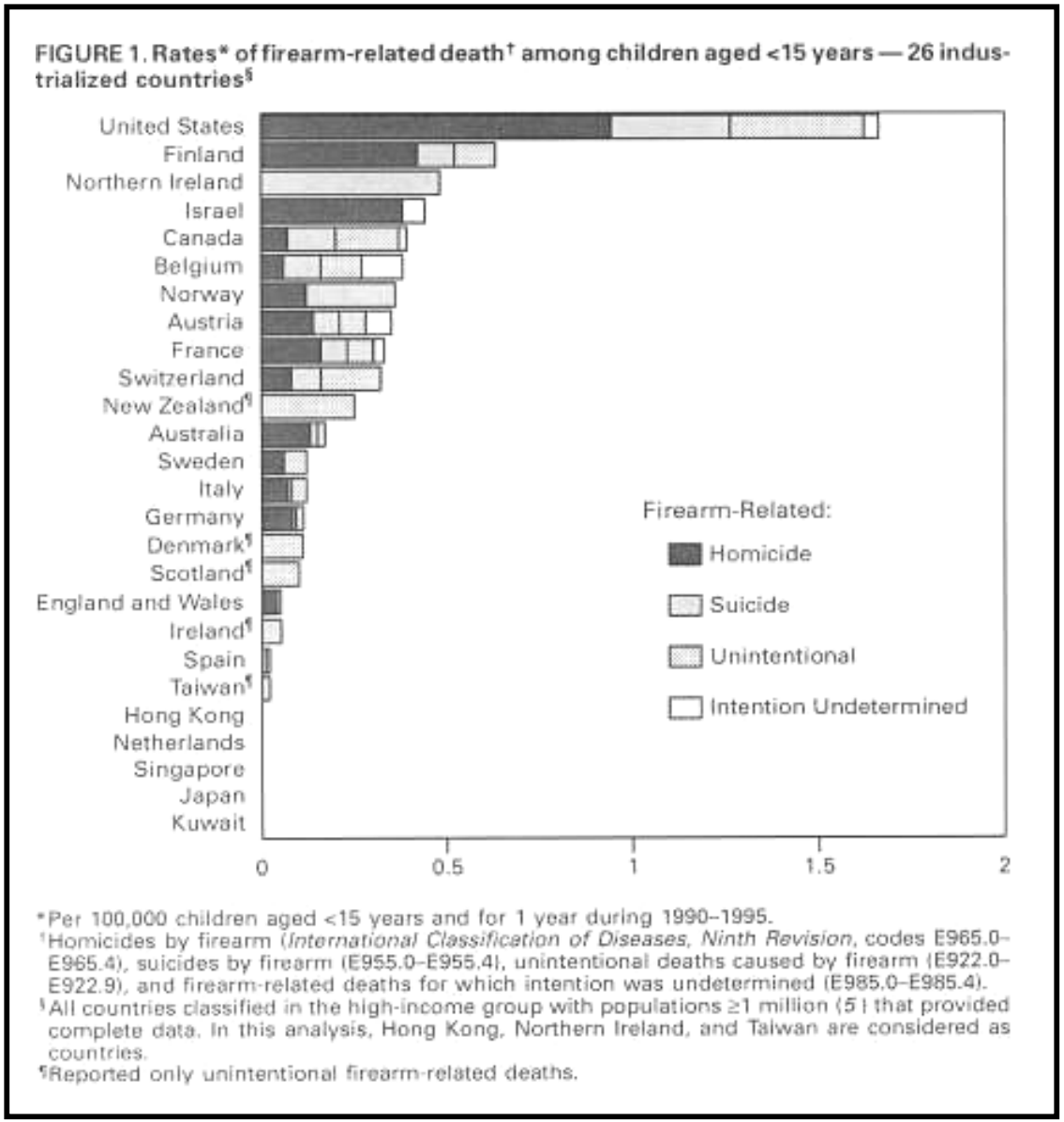
- Type of smoking
- Amount and type
- Amount, type and duration
- Inhalation practices

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

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



"Rates of Homicide, Suicide, and Firearm-Related Death Among Children — 26 Industrialized Countries, " *Morbidity and Mortality Weekly Report,* February 7, 1997:101–105.

Harvard Injury Control Research Center

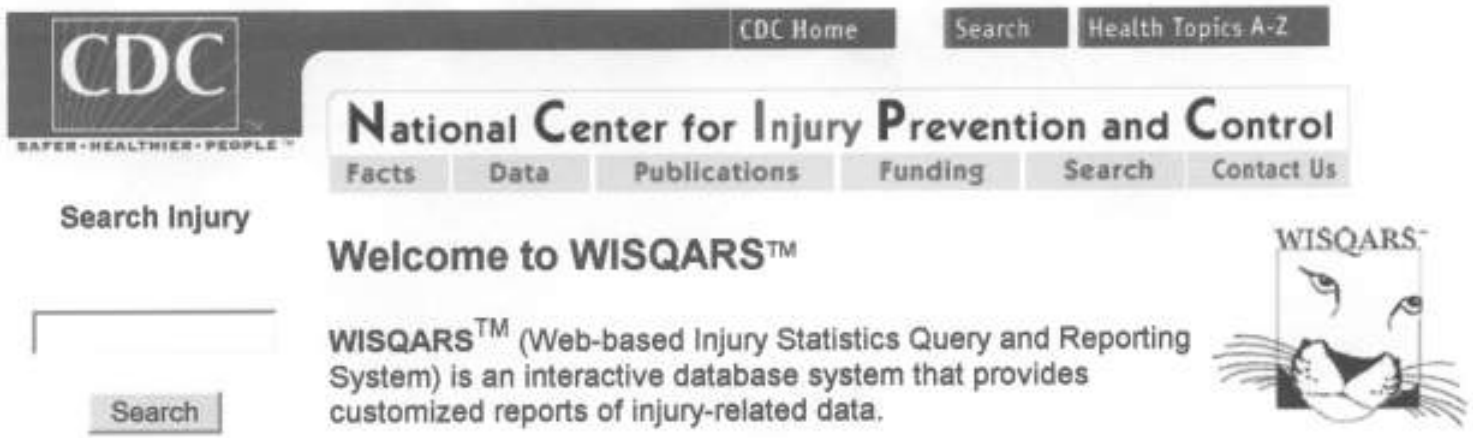
Matthew Miller, MD, MPH, Sc.D., a general internist and medical oncologist, received his Doctor of Science degree in Health Policy and Management from the Harvard School of Public Health. He is currently an associate director of the Harvard Injury Control Research Center where his research has focused on gun availability at colleges, the association of cigarette smoking to suicide, and the relationship between firearms availability and violent death.

Harvard Injury Control Research Center

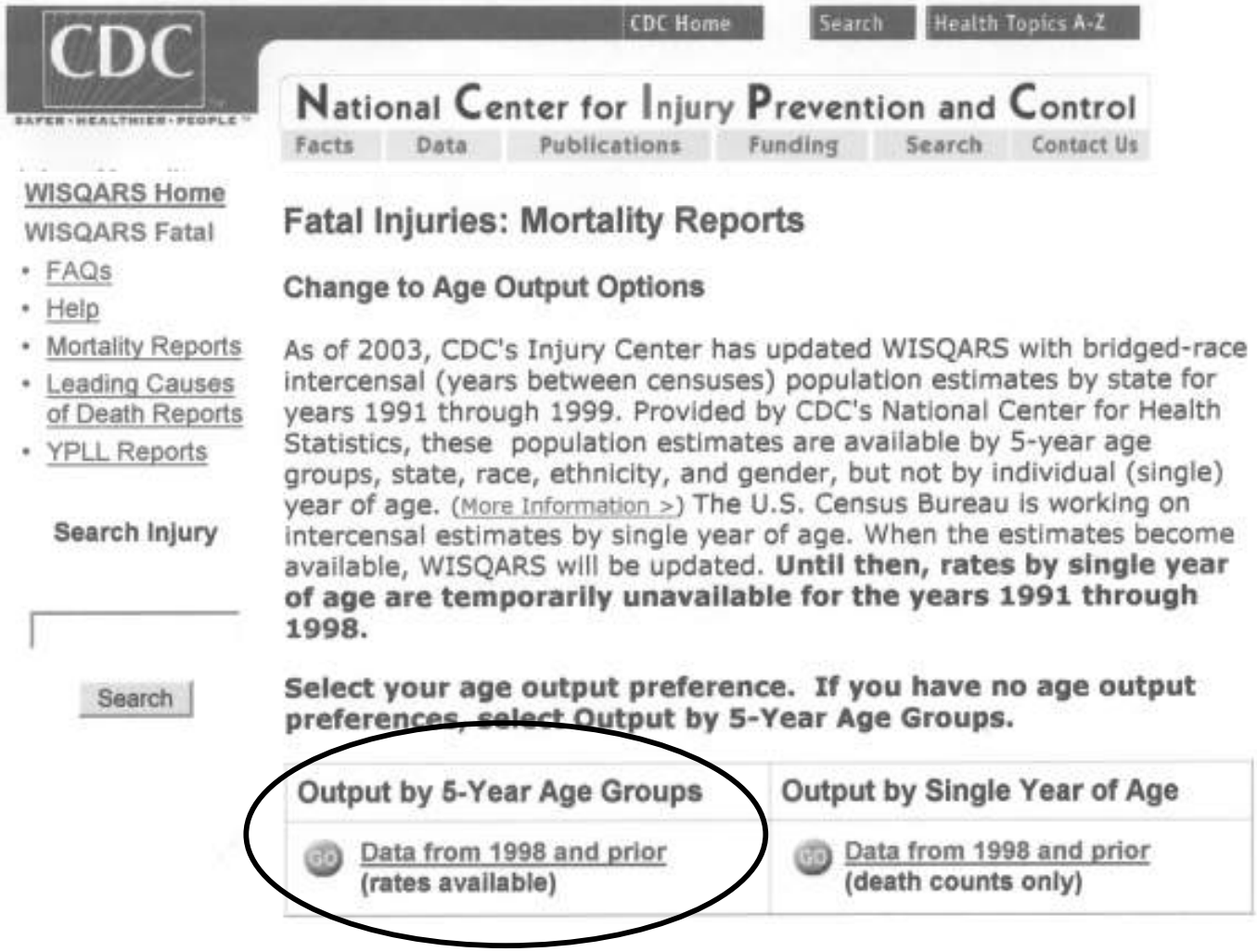
The rates of unintentional firearm deaths would be highest in places where firearms were most available and lowest in places where firearms were least available.

WISQARS Provides Customized Reports of Injury-Related Data

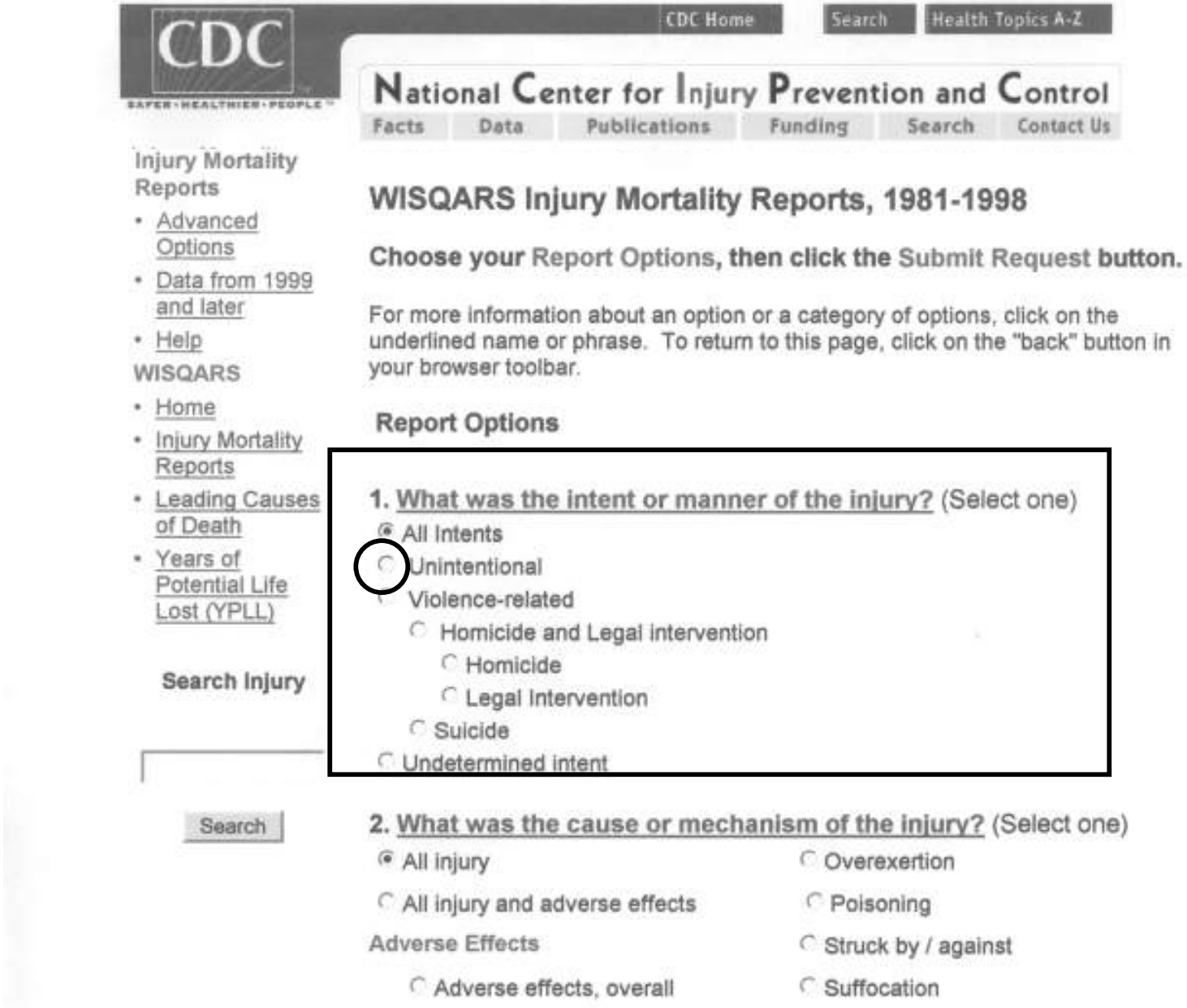
http://www.cdc.gov/ncipc/wisqars/

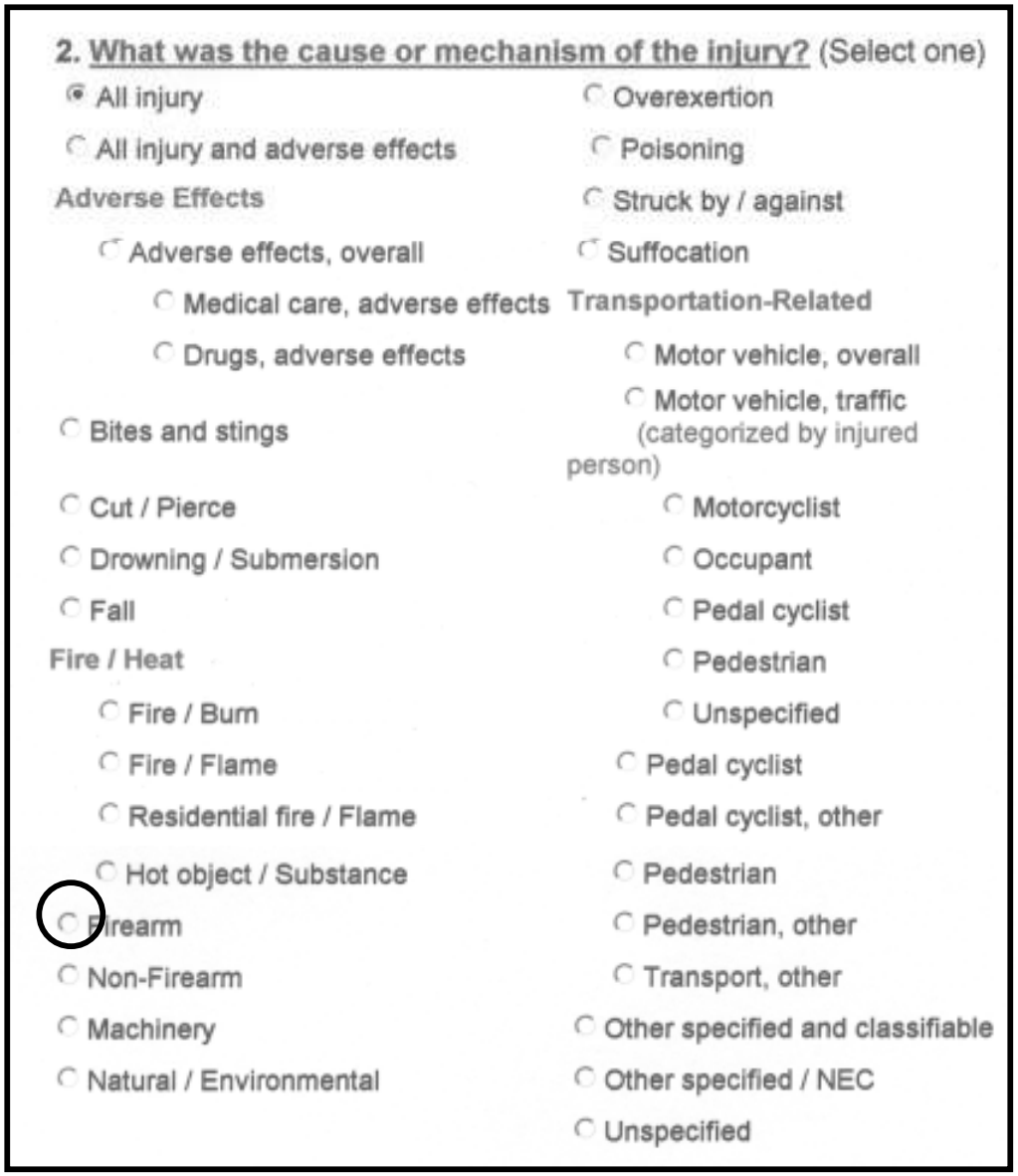


http://www.cdc.gov/ncipc/wisqars



Transparency 29





Search

2. What was the cause or mechanism of the injury? (Select one)

- All injury
- All injury and adverse effects

Adverse Effects

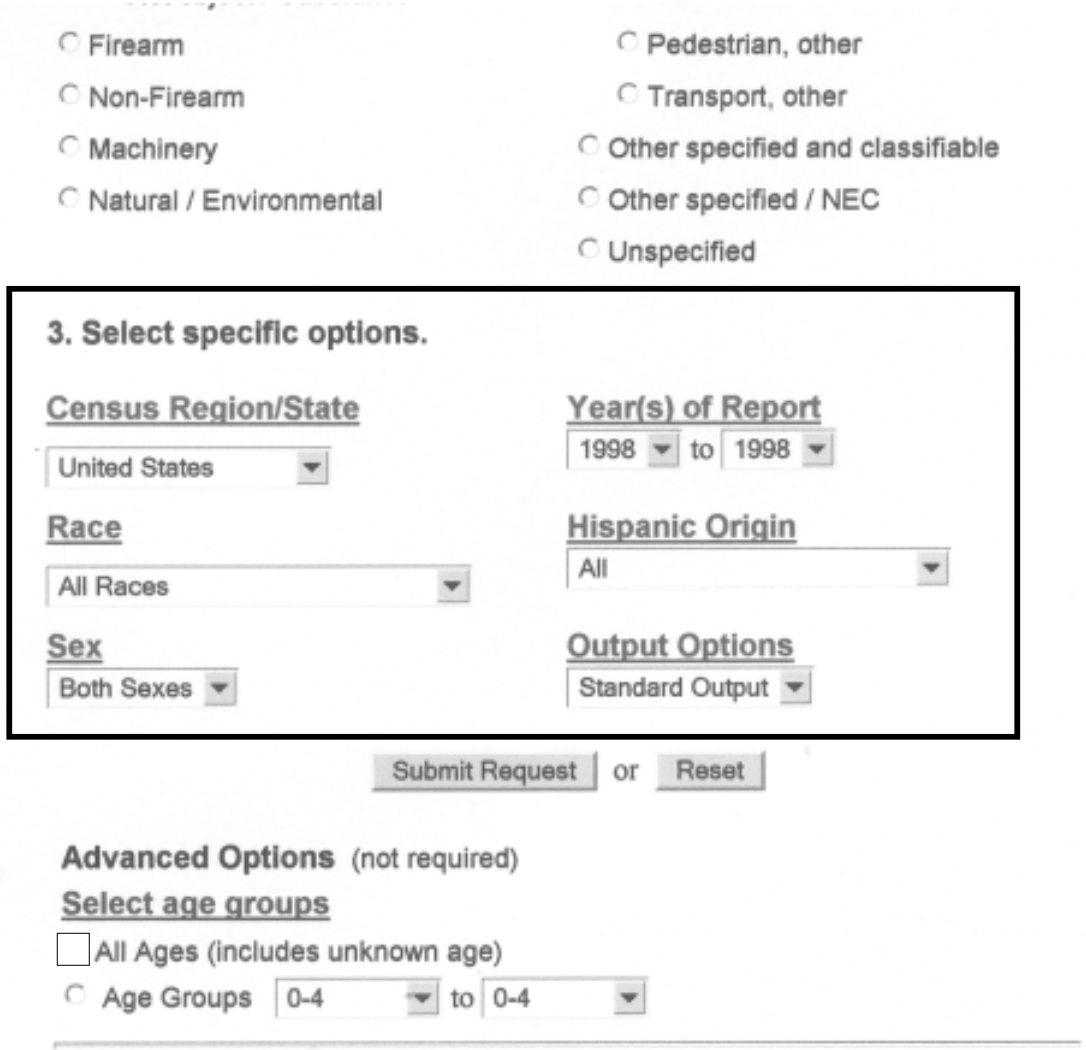
- Adverse effects, overall
  - Medical care, adverse effects
  - Drugs, adverse effects
- Bites and stings
- Cut / Pierce
- Drowning / Submersion
- Fall

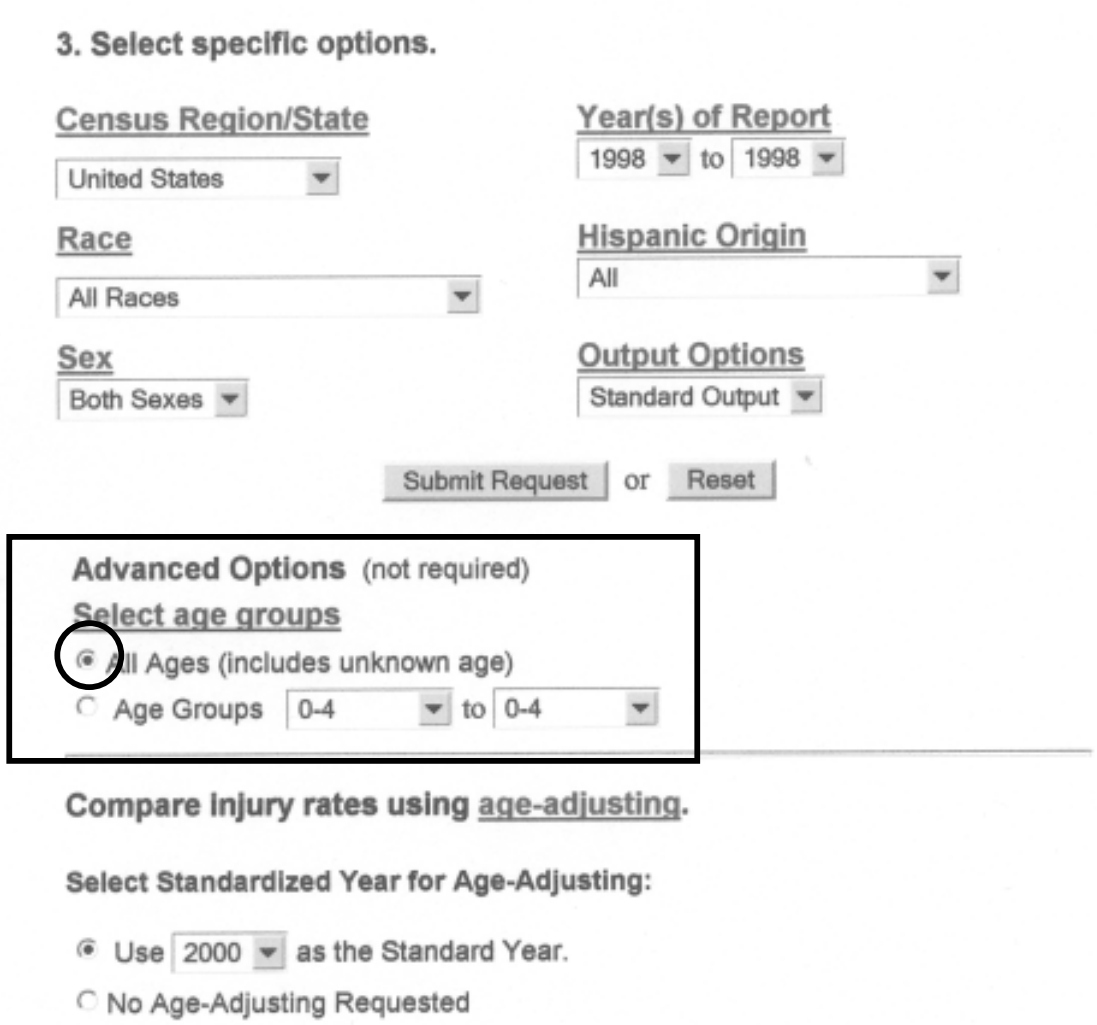
Fire / Heat

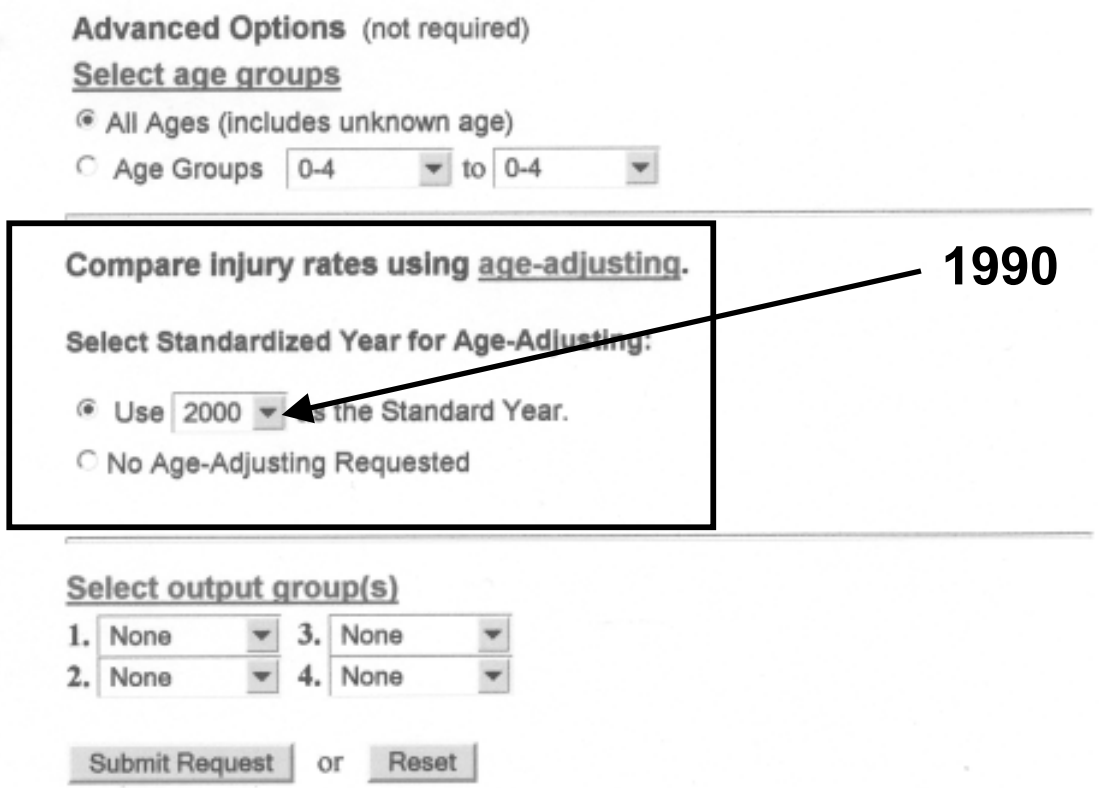
- Fire / Burn
- Fire / Flame
- Residential fire / Flame
- Hot object / Substance
- Firearm
- Non-Firearm
- Machinery
- Natural / Environmental
- Overexertion
- Poisoning
- Struck by / against
- Suffocation

Transportation-Related

- Motor vehicle, overall
- Motor vehicle, traffic (categorized by injured person)
  - Motorcyclist
  - Occupant
  - Pedal cyclist
  - Pedestrian
  - Unspecified
- Pedal cyclist
- Pedal cyclist, other
- Pedestrian
- Pedestrian, other
- Transport, other
- Other specified and classifiable
- Other specified / NEC
- Unspecified







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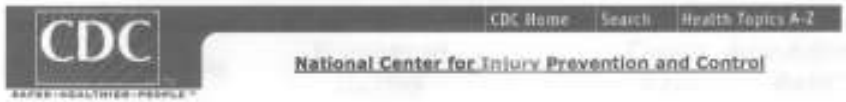

National Center for Injury Prevention and Control

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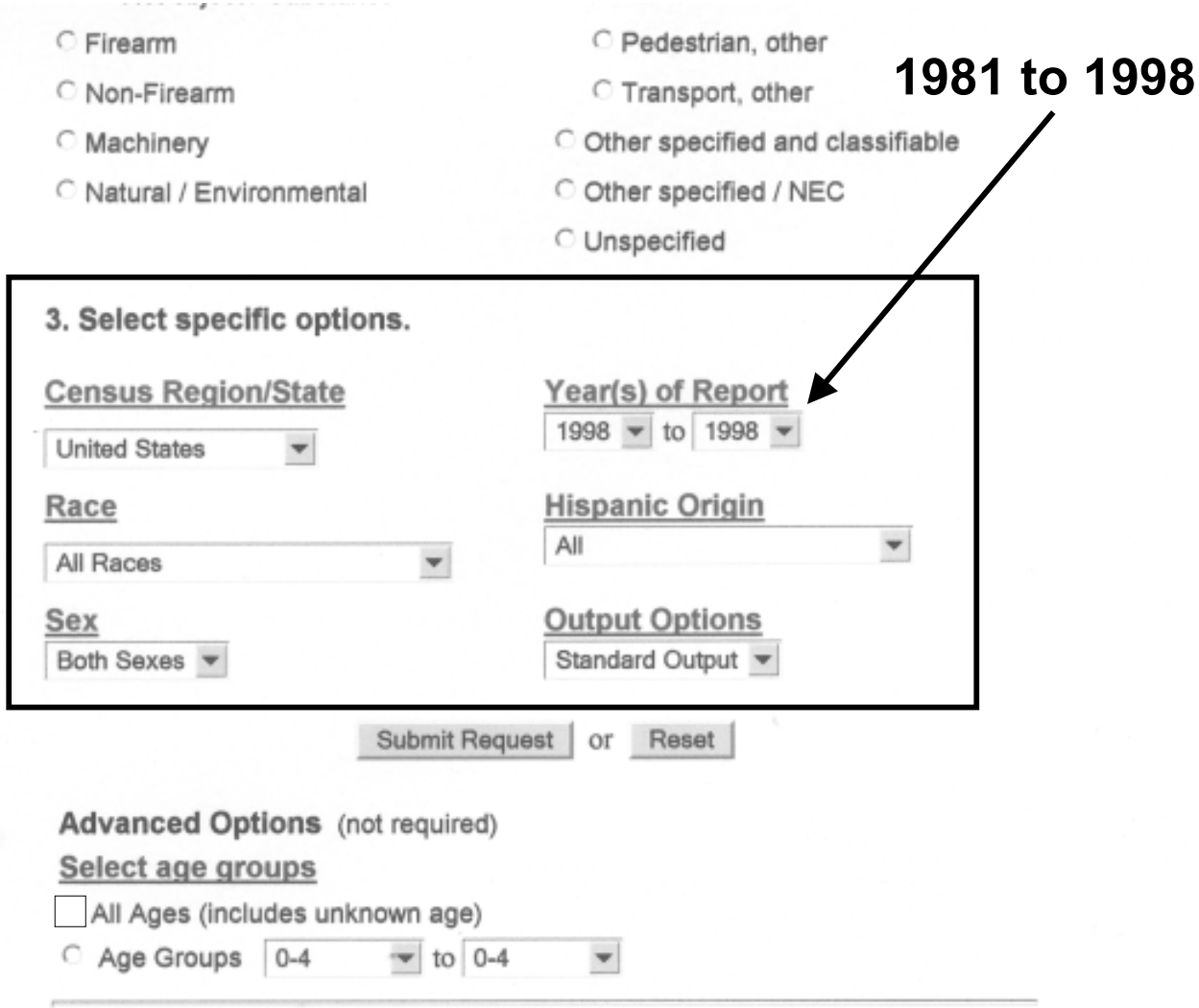
1998, United States
Unintentional Firearm Deaths and Rates per 100,000
All Races, Both Sexes, All Ages
ICD-9 Codes: E922

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

*** Rates based on 20 or fewer deaths may be unstable. Use with caution.**



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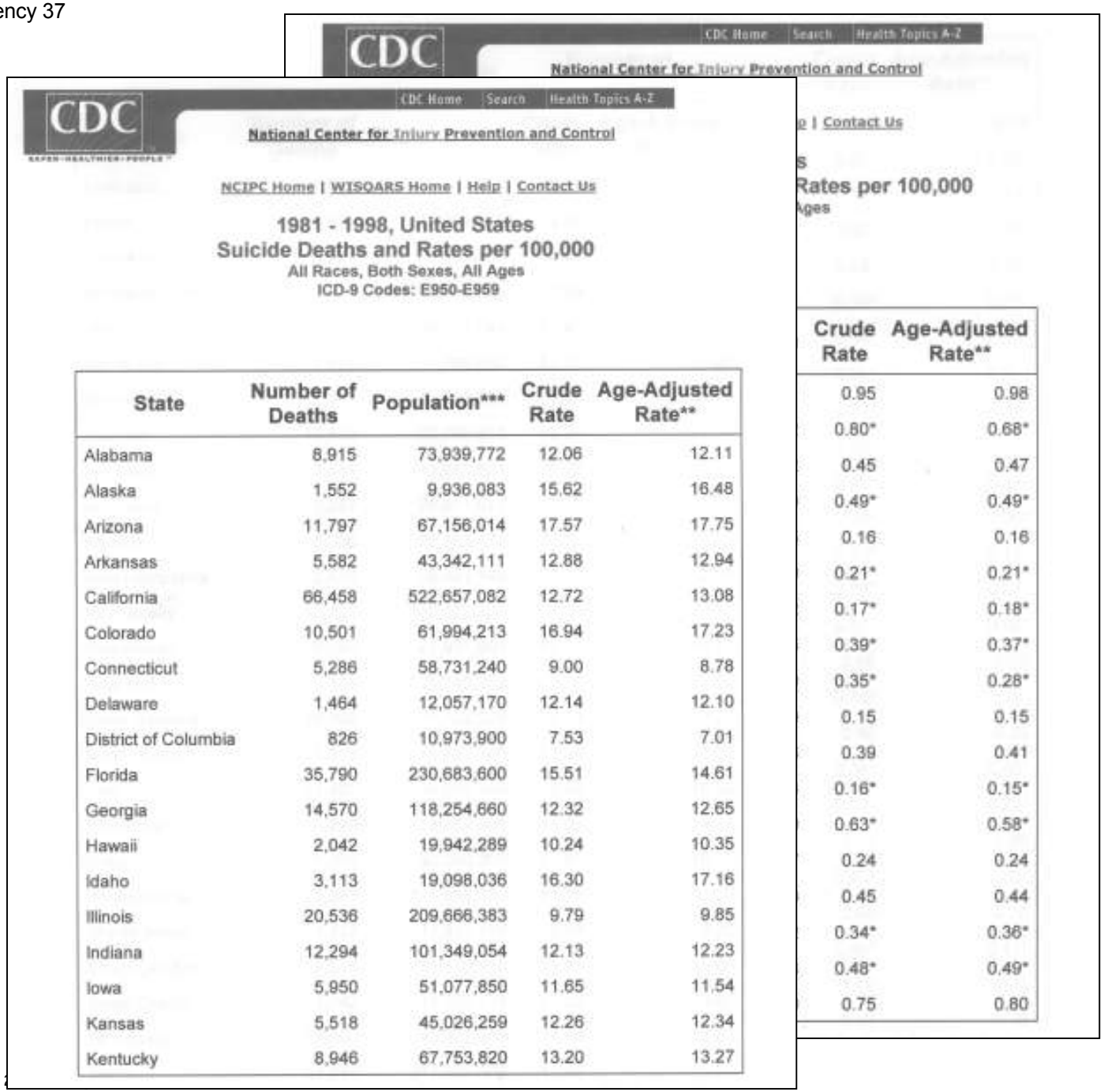

CDC

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National Center for Injury Prevention and Control

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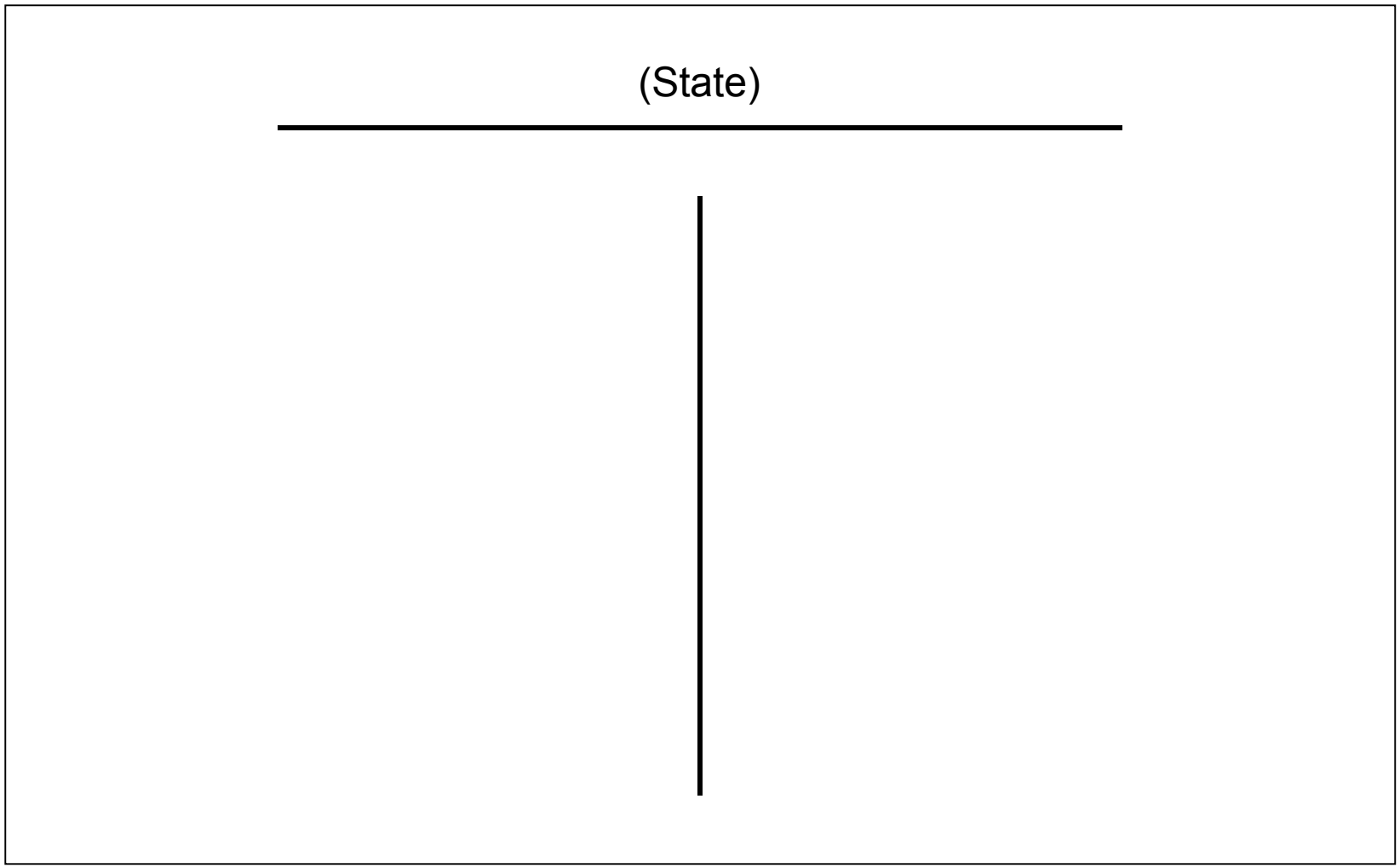
1981 - 1998, United States
Suicide Deaths and Rates per 100,000

All Races, Both Sexes, All Ages
ICD-9 Codes: E950-E959

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



(State)

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

Georgia

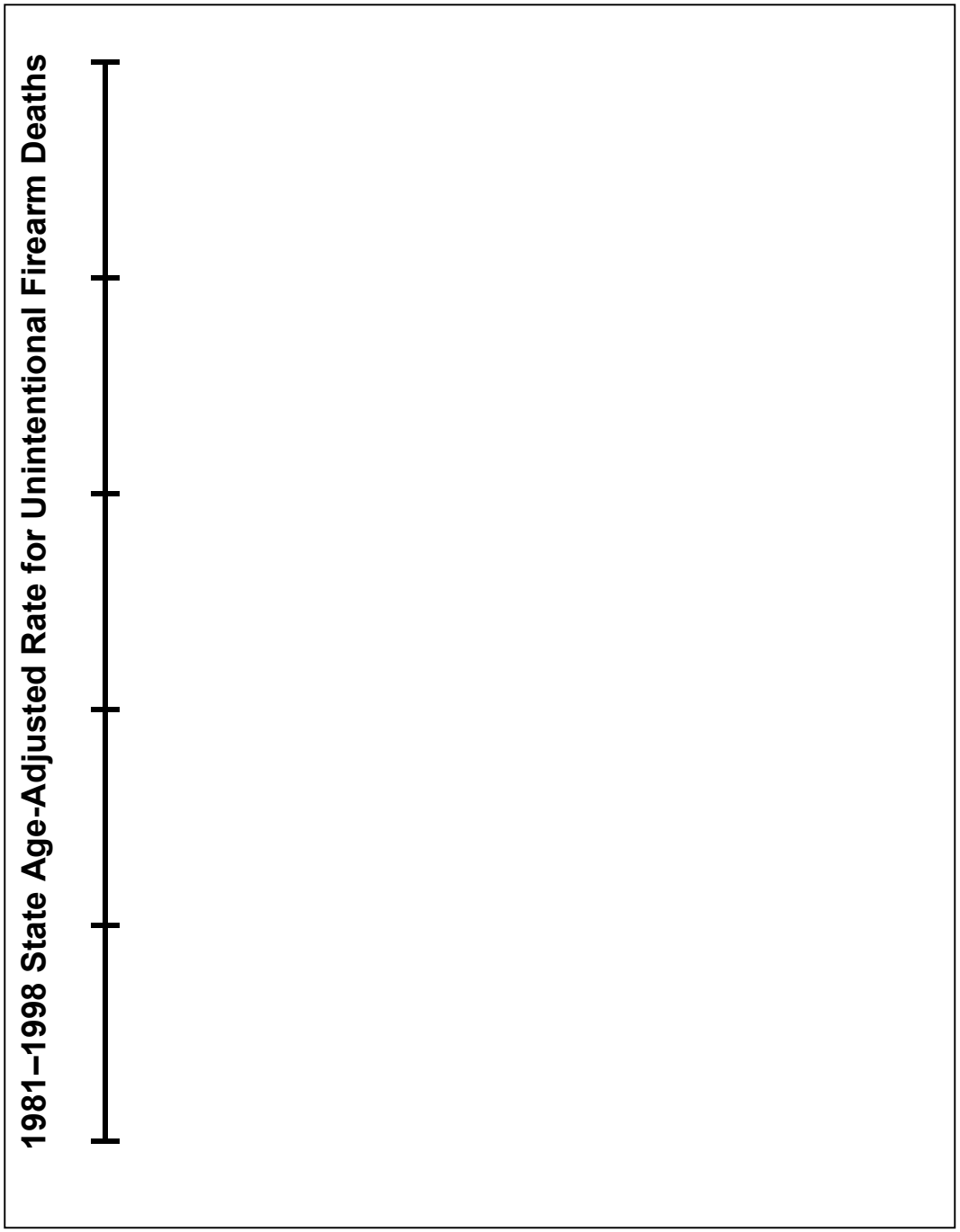
0.76

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

Transparency 41

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

Transparency 42



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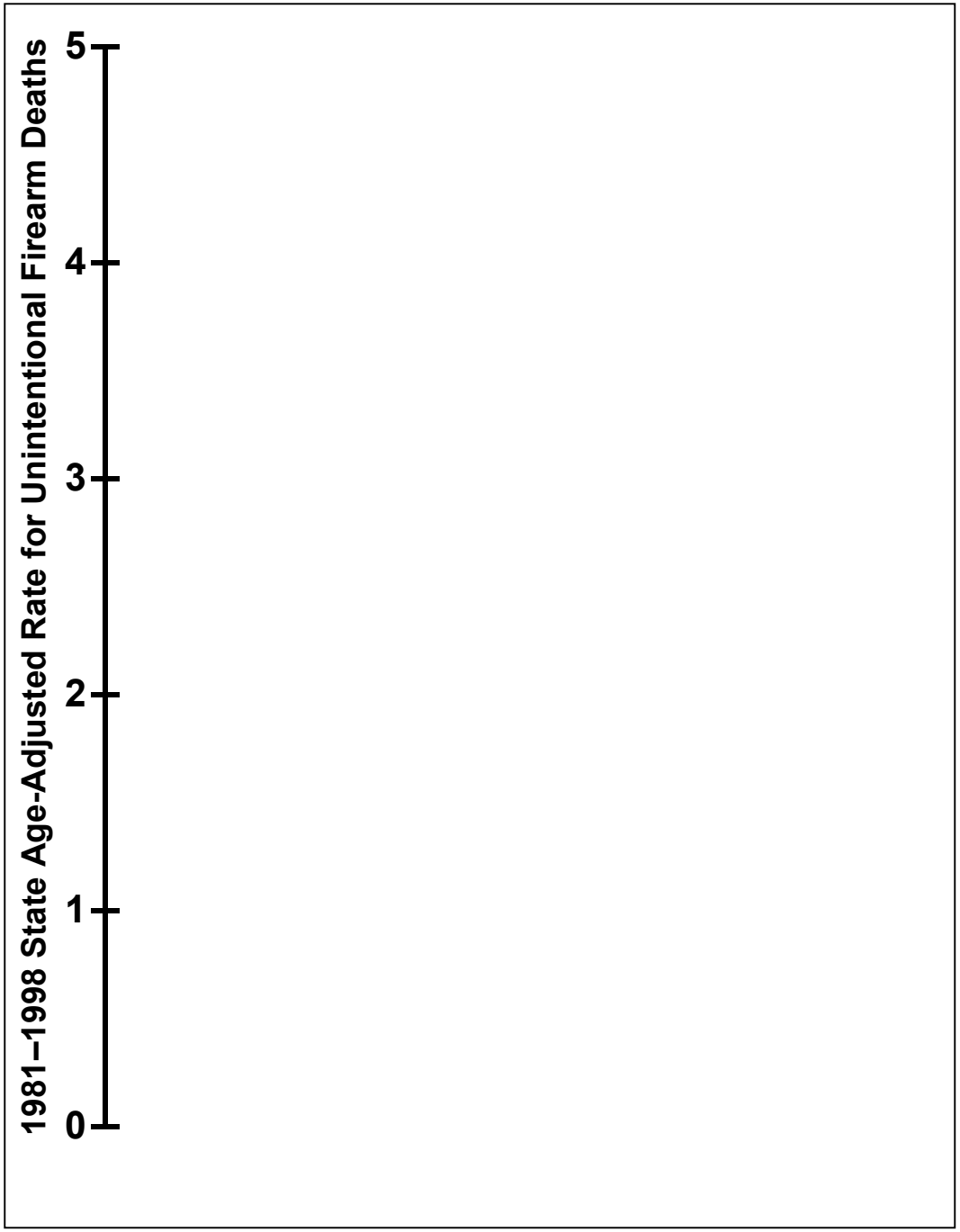

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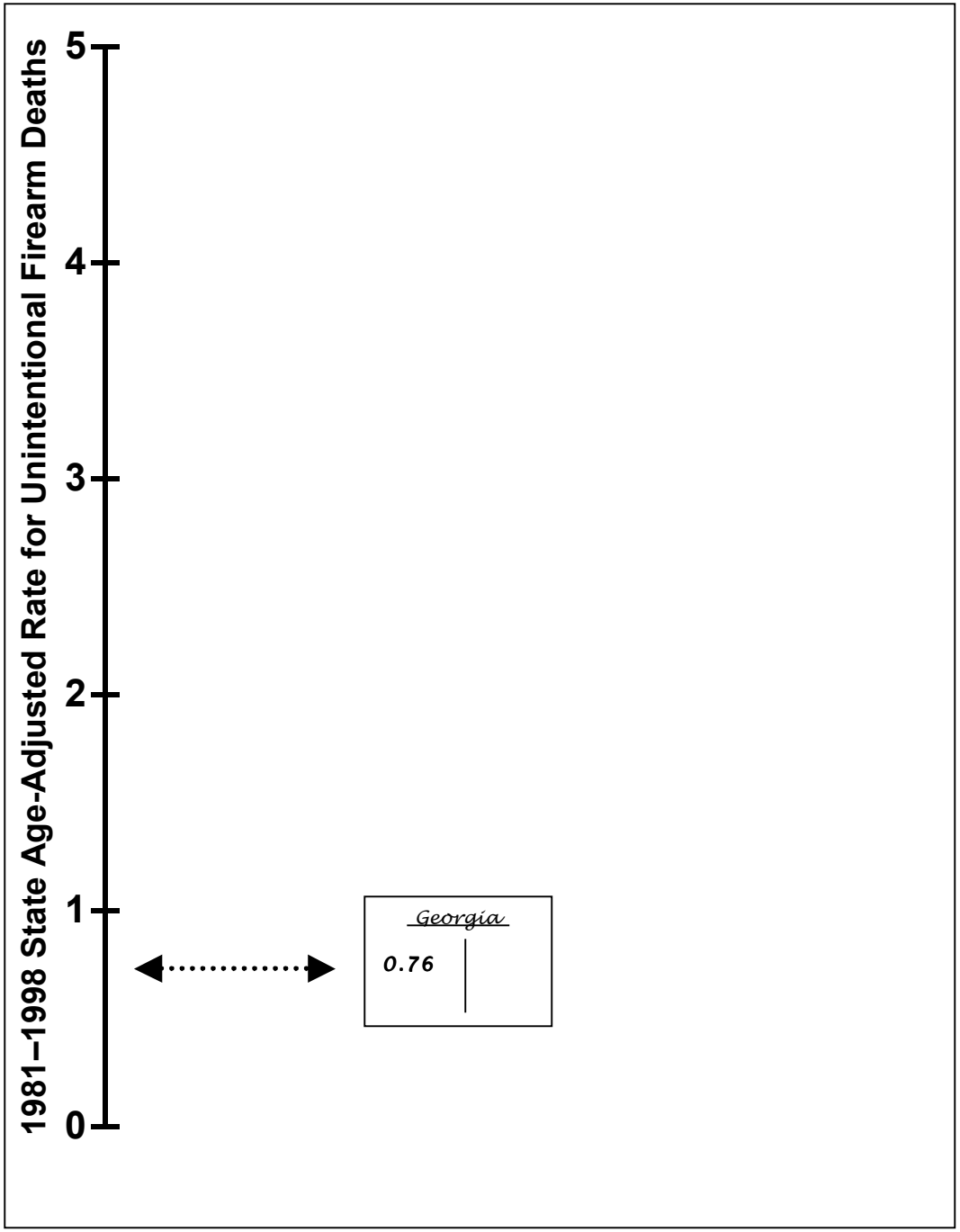


Outlier

“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.”

Harvard Injury Control Research Center

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.

Transparency 49

Did not have "… any particular intuitive value."

Cook's Index

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

Transparency 50

Did not have "… any particular intuitive value."

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).

Did not have "… any particular intuitive value."

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 .87

Behavioral Risk Factor Surveillance System

Did not have "… any particular intuitive value."

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 .87

Behavioral Risk Factor Surveillance System .83

Cook's Index

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

Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\text{Total number of suicides committed with a firearm}}{\text{Total number of suicides from all causes}}}$$

% of all *suicides* committed with a firearm

WISQARS Provides Customized Reports of Injury-Related Data

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

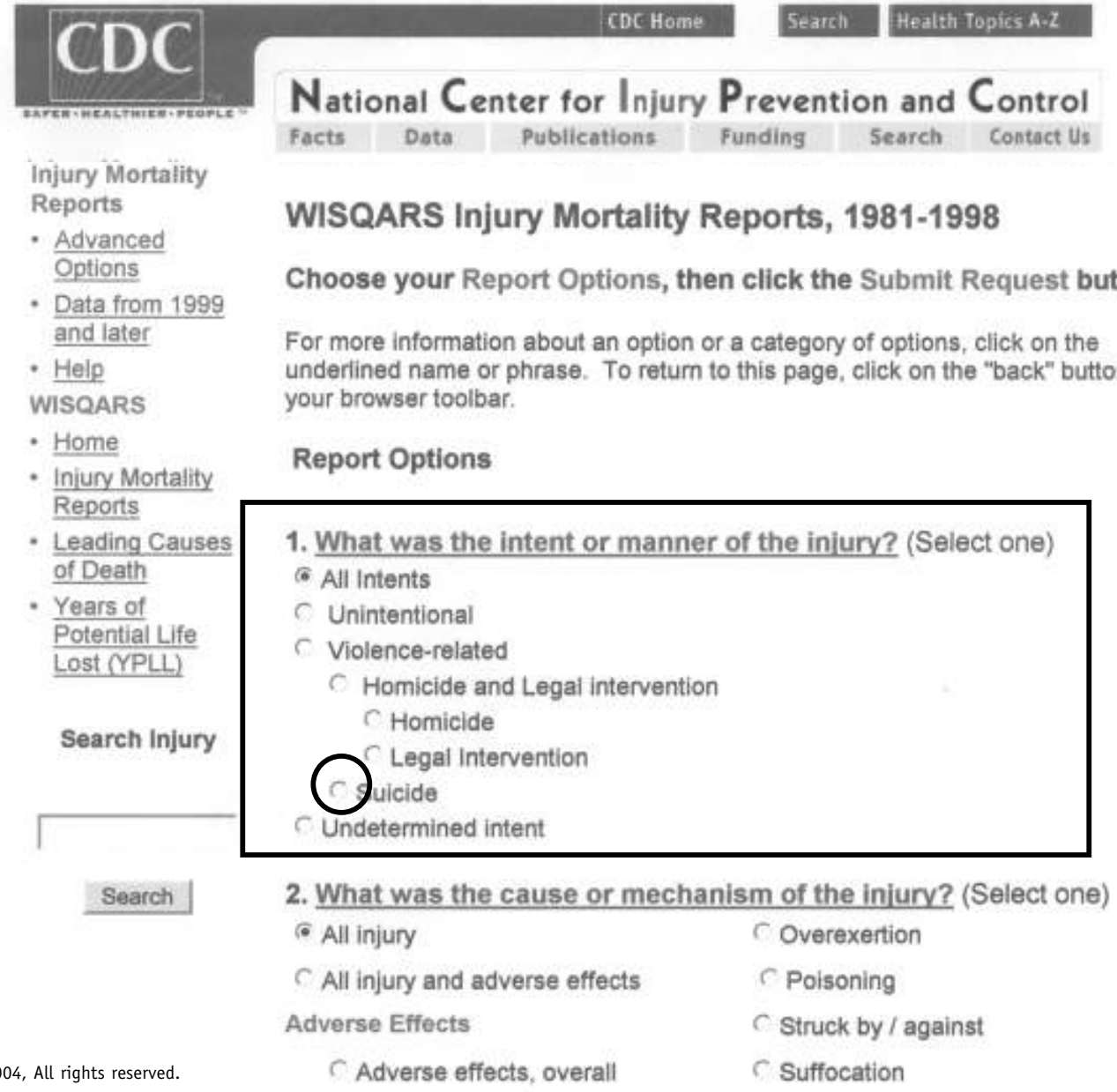
http://www.cdc.gov/ncipc/wisqars

Cook's Index

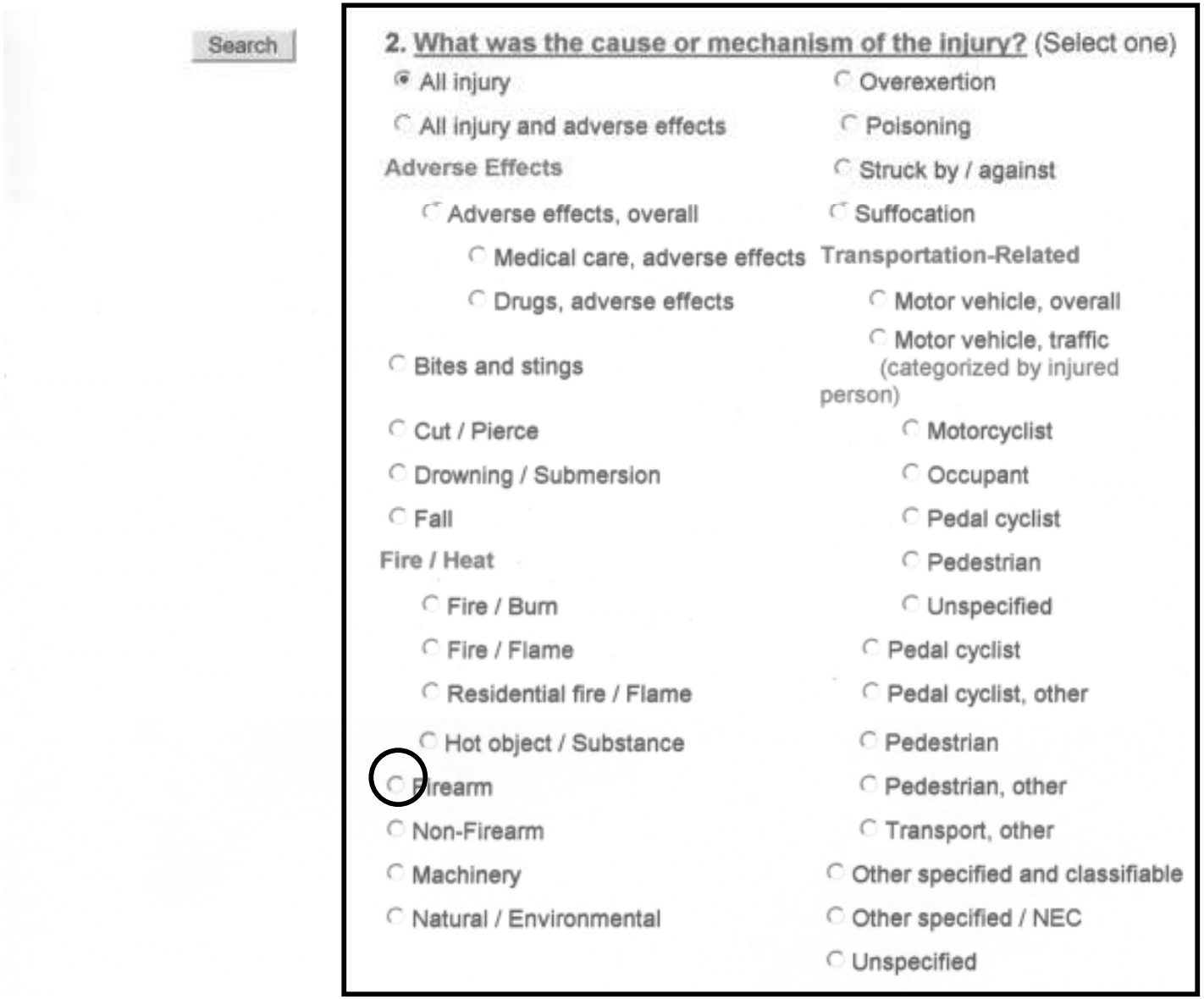
$$\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}$$

$$\frac{\text{Total number of suicides committed with a firearm}}{\text{Total number of suicides from all causes}}$$

Total number of suicides committed *with a firearm*



Total number of suicides committed *with a firearm*



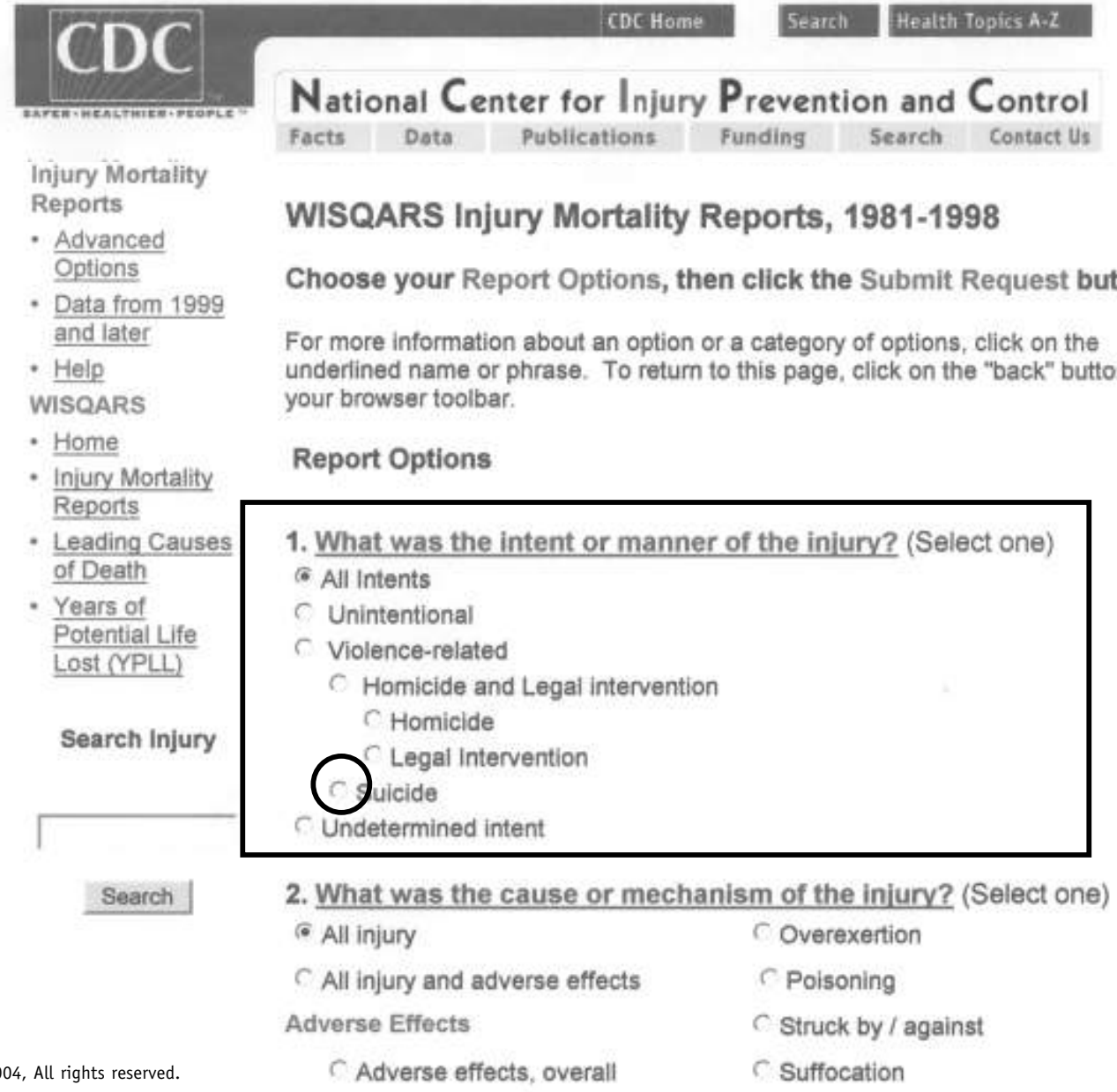
Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\textbf{Georgia}\ \textbf{10,945}\ \text{Total number of suicides committed with a firearm}}{\text{Total number of suicides from all causes}}}$$

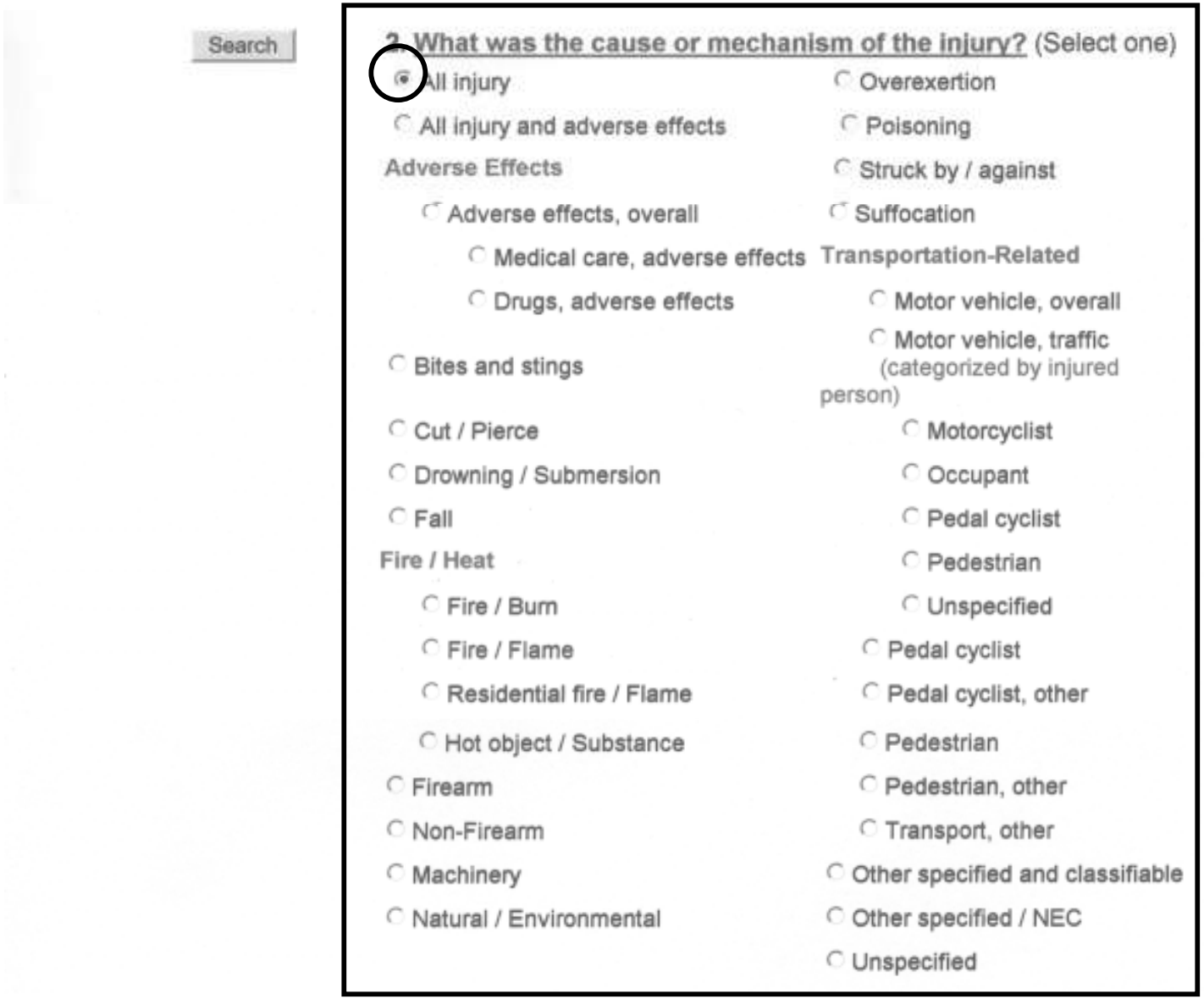
Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\text{Total number of suicides committed with a firearm}}{\text{Total number of suicides from all causes}}}$$

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

$$\frac{\text{Total number of suicides committed with a firearm}}{\textbf{14,570}}$$

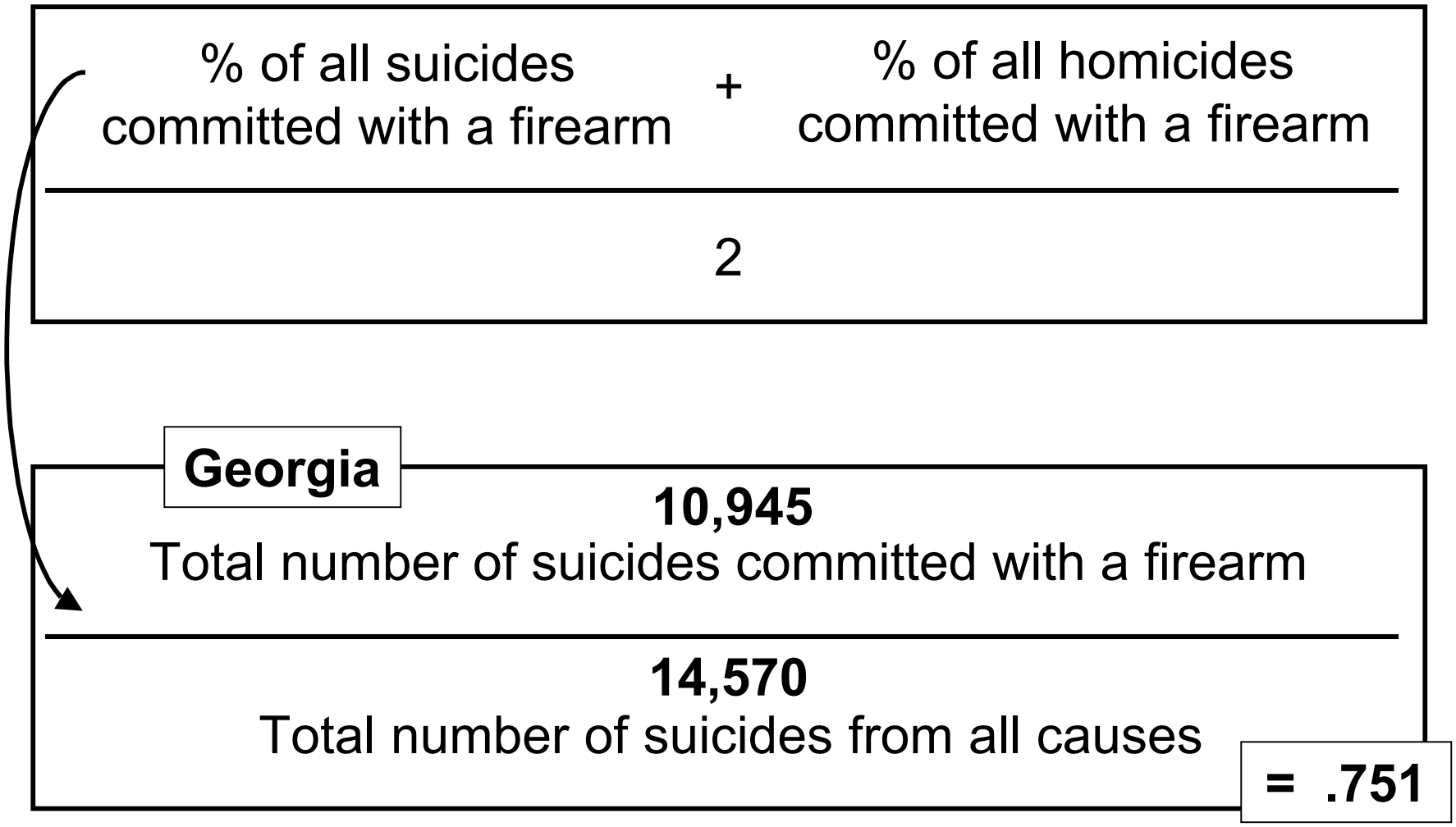
Total number of suicides from all causes

Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\textbf{10,945}\ \text{Total number of suicides committed with a firearm}}{\textbf{14,570}\ \text{Total number of suicides from all causes}}}$$

Georgia

Cook's Index



Cook's Index

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

75.1%

Georgia

$$\frac{\textbf{10,945}\ \text{Total number of suicides committed with a firearm}}{\textbf{14,570}\ \text{Total number of suicides from all causes}}$$

= .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)

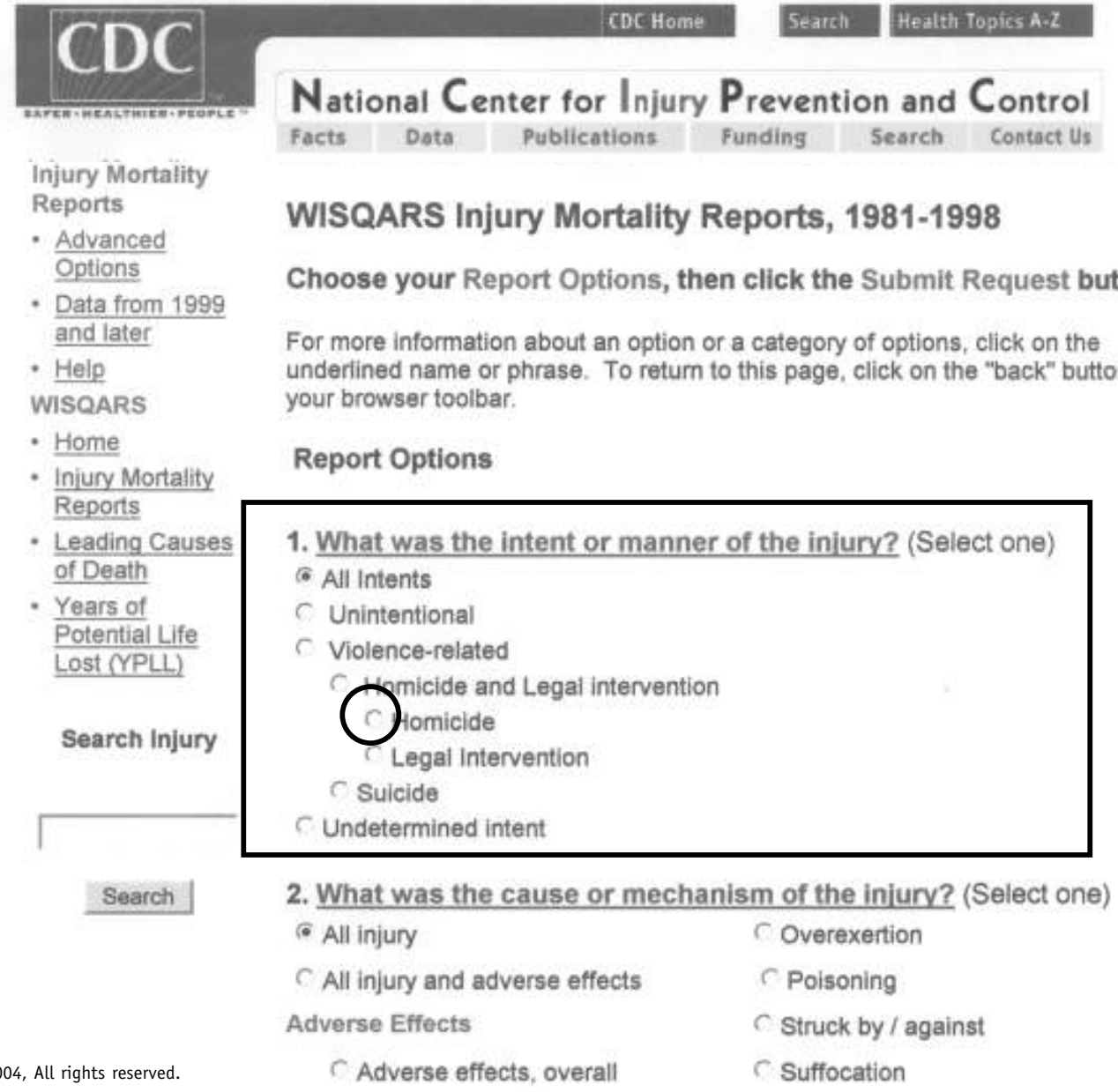
Cook's Index

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

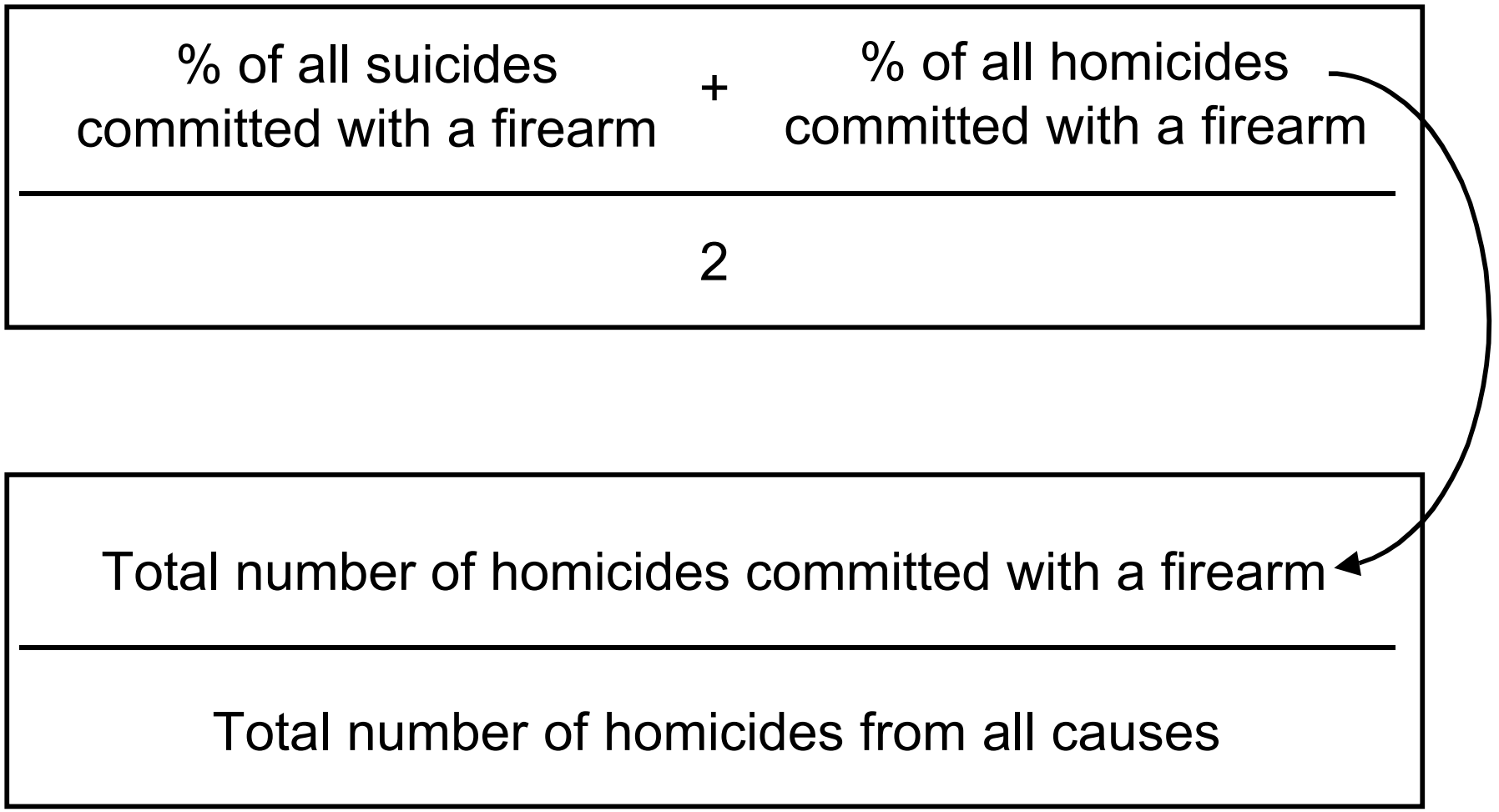
Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\text{Total number of homicides committed with a firearm}}{\text{Total number of homicides from all causes}}}$$

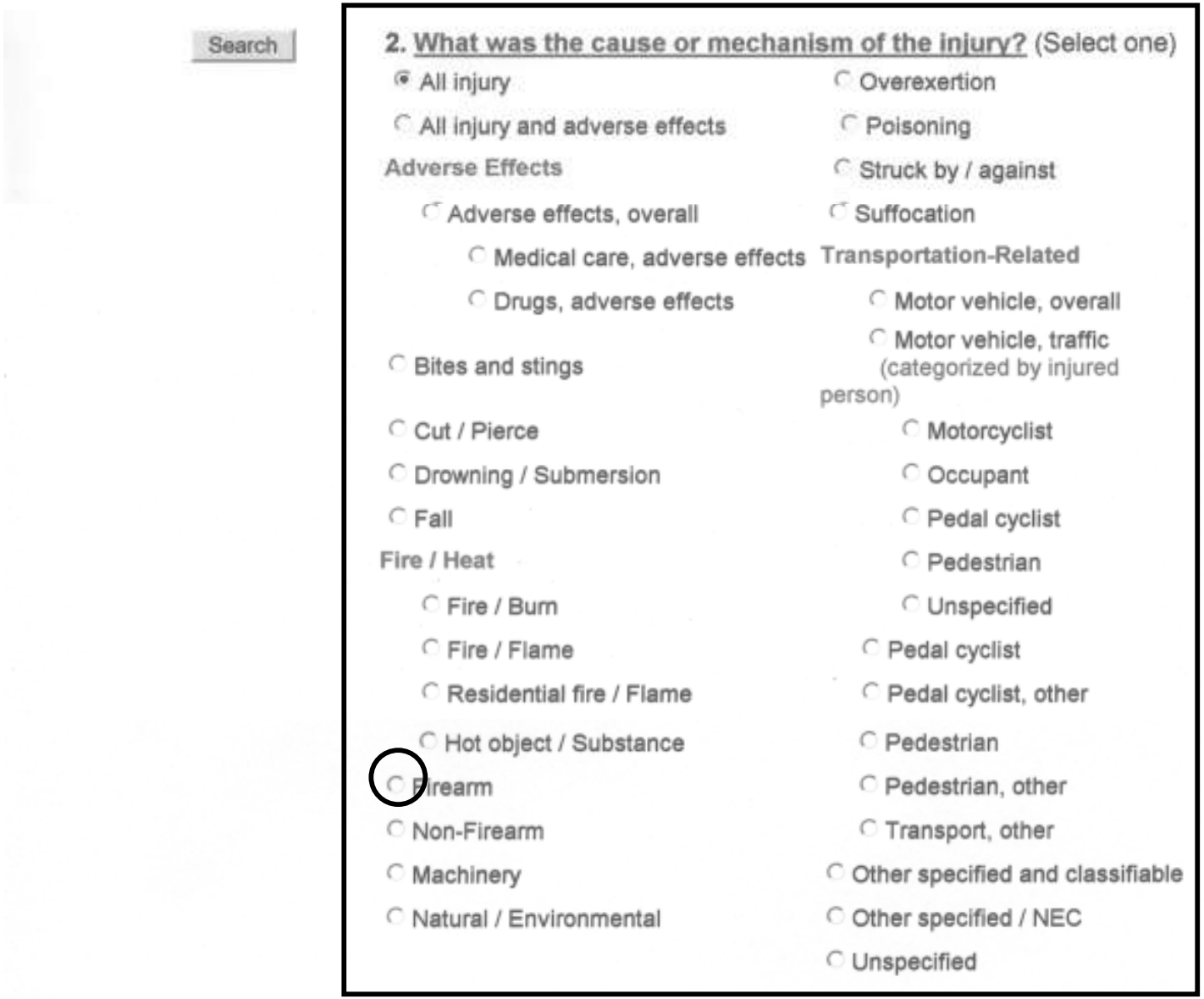
Total number of homicides committed *with a firearm*



Cook's Index



Total number of homicides committed *with a firearm*



Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\text{Total number of homicides from all causes}}$$

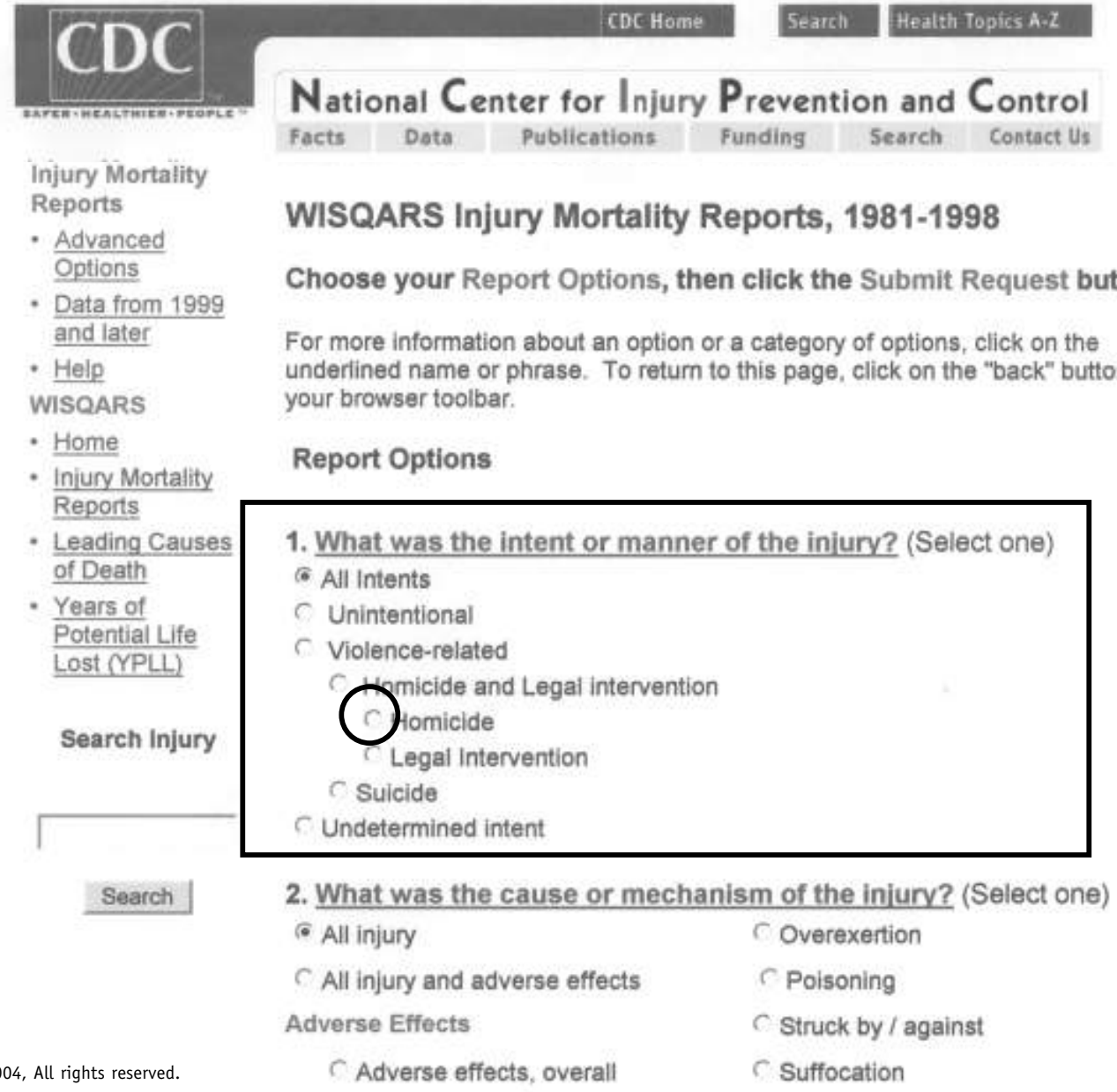
Georgia

$$\frac{\textbf{9,408}}{\text{Total number of homicides from all causes}}$$

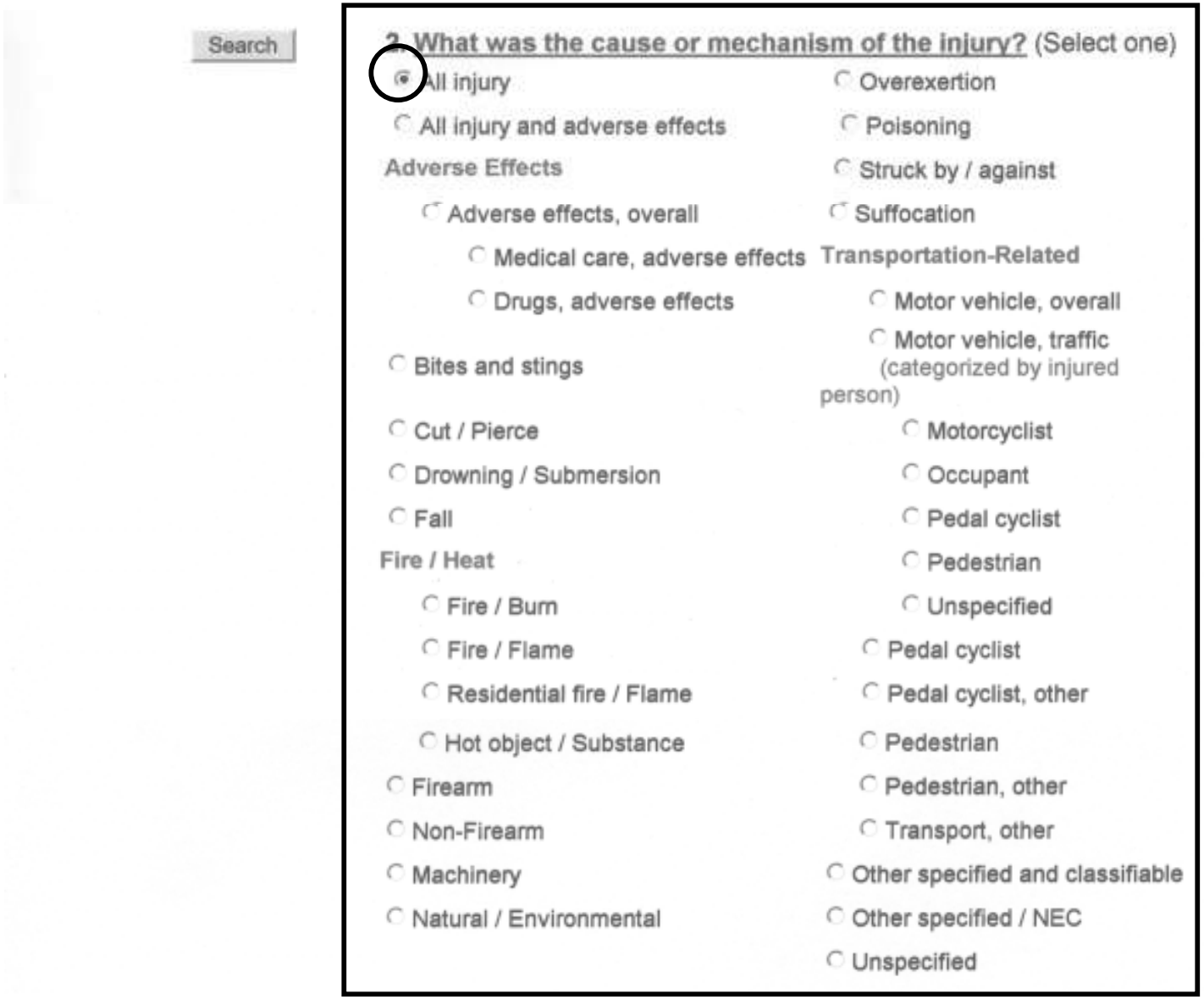
Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\text{Total number of homicides committed with a firearm}}{\text{Total number of homicides from all causes}}}$$

Total number of homicides *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

$$\frac{\text{Total number of homicides committed with a firearm}}{\textbf{13,930}}$$

Total number of homicides from all causes

Cook's Index

$$\frac{\frac{\text{\% of all suicides committed with a firearm} + \text{\% of all homicides committed with a firearm}}{2}}{\frac{\textbf{9,408}\ \text{Total number of homicides committed with a firearm}}{\textbf{13,930}\ \text{Total number of homicides from all causes}}}$$

Georgia

Cook's Index

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

Georgia

$$\frac{\textbf{9,408}\ \text{Total number of homicides committed with a firearm}}{\textbf{13,930}\ \text{Total number of homicides from all causes}} = \textbf{.675}$$

Cook's Index

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

67.5%

Georgia

$$\frac{\textbf{9,408}\ \text{Total number of homicides committed with a firearm}}{\textbf{13,930}\ \text{Total number of homicides from all causes}}$$

= .675

% of all *homicides* committed with a firearm

Georgia

0.76	*75.1%* *67.5%*
(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths)	(Cook's Index)

Cook's Index

$$\frac{\text{\% of all suicides committed with a firearm } \mathbf{75.1\%} + \text{\% of all homicides committed with a firearm } \mathbf{67.5\%}}{2}$$

Cook's Index

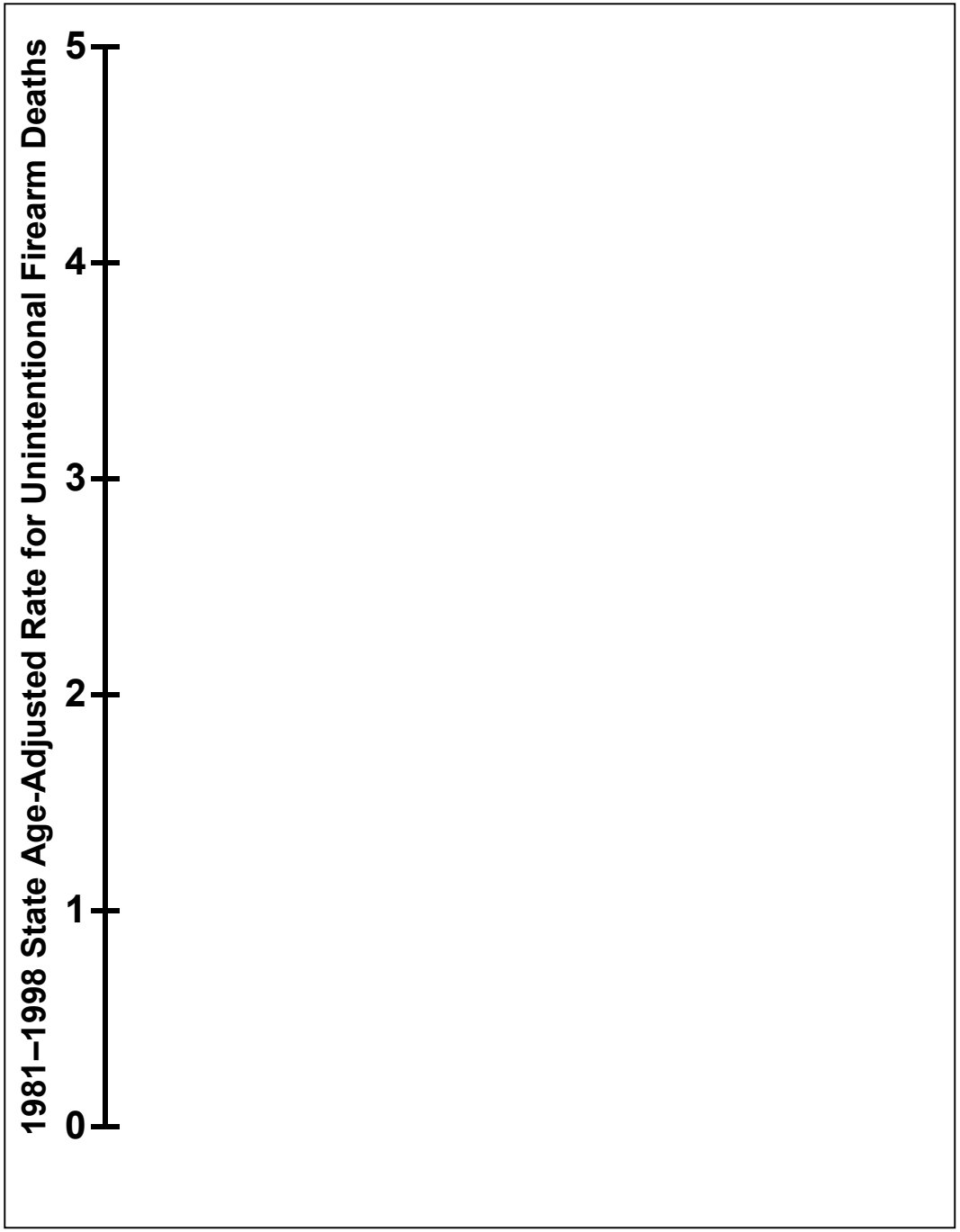
Georgia

0.76	*67.5%* + *75.1%* *142.6 /2 = 71.3*
(1981–1998 State Age-Adjusted Rate for Unintentional Firearm Deaths)	(Cook's Index)

Teacher's Cook's Index Sheet (Alphabetical Order)

State	A "% of All Suicides Committed with a Firearm"	B "% of All Homicides Committed with a Firearm"	C Cook's Index (Column A + Column B) / 2
Alabama	78.0%	70.4%	74.2
Alaska	70.5%	61.3%	65.9
Arizona	67.3%	62.9%	65.1
Arkansas	76.4%	69.2%	72.8
California	52.6%	66.8%	59.7
Colorado	57.2%	56.4%	56.8
Connecticut	43.1%	63.7%	53.4
Delaware	48.4%	47.9%	48.2
D.C.	34.5%	72.4%	53.5
Florida	60.6%	66.0%	63.3
Georgia	75.1%	67.5%	71.3
Hawaii	29.3%	40.3%	34.8
Idaho	69.6%	59.8%	64.7
Illinois	45.6%	64.1%	54.9
Indiana	61.7%	68.3%	65.0
Iowa	54.5%	52.5%	53.5
Kansas	64.3%	64.8%	65.0
Kentucky	74.6%	69.9%	72.3
Louisiana	76.6%	74.5%	75.6
Maine	59.0%	52.4%	55.7
Maryland	55.1%	68.6%	61.9
Massachusetts	30.5%	46.8%	38.7
Michigan	55.8%	67.4%	61.6
Minnesota	49.9%	49.7%	49.8
Mississippi	34.7%	68.3%	51.5
Missouri	63.6%	68.4%	66.0
Montana	66.9%	58.4%	62.7
Nebraska	58.2%	59.0%	58.6
Nevada	67.3%	60.5%	63.9
New Hampshire	55.9%	48.5%	52.2
New Jersey	35.1%	48.6%	41.9
New Mexico	64.3%	54.6%	59.5
New York	37.5%	64.8%	51.2
North Carolina	71.4%	67.0%	69.2
North Dakota	58.4%	51.9%	55.2
Ohio	58.1%	63.0%	61.0
Oklahoma	69.9%	60.6%	65.3
Oregon	61.8%	55.0%	58.4
Pennsylvania	54.4%	60.7%	57.6
Rhode island	32.4%	47.9%	40.2
South Carolina	72.5%	65.3%	68.9
South Dakota	60.6%	35.4%	48.0
Tennessee	74.0%	69.8%	71.9
Texas	69.3%	68.6%	69.0
Utah	61.0%	51.7%	56.4
Vermont	65.7%	59.6%	62.7
Virginia	66.8%	68.4%	67.6
Washington	56.1%	55.8%	56.0
West Virginia	74.9%	68.8%	71.9
Wisconsin	52.7%	59.3%	56.0
Wyoming	74.1%	55.6%	64.9

Transparency 86



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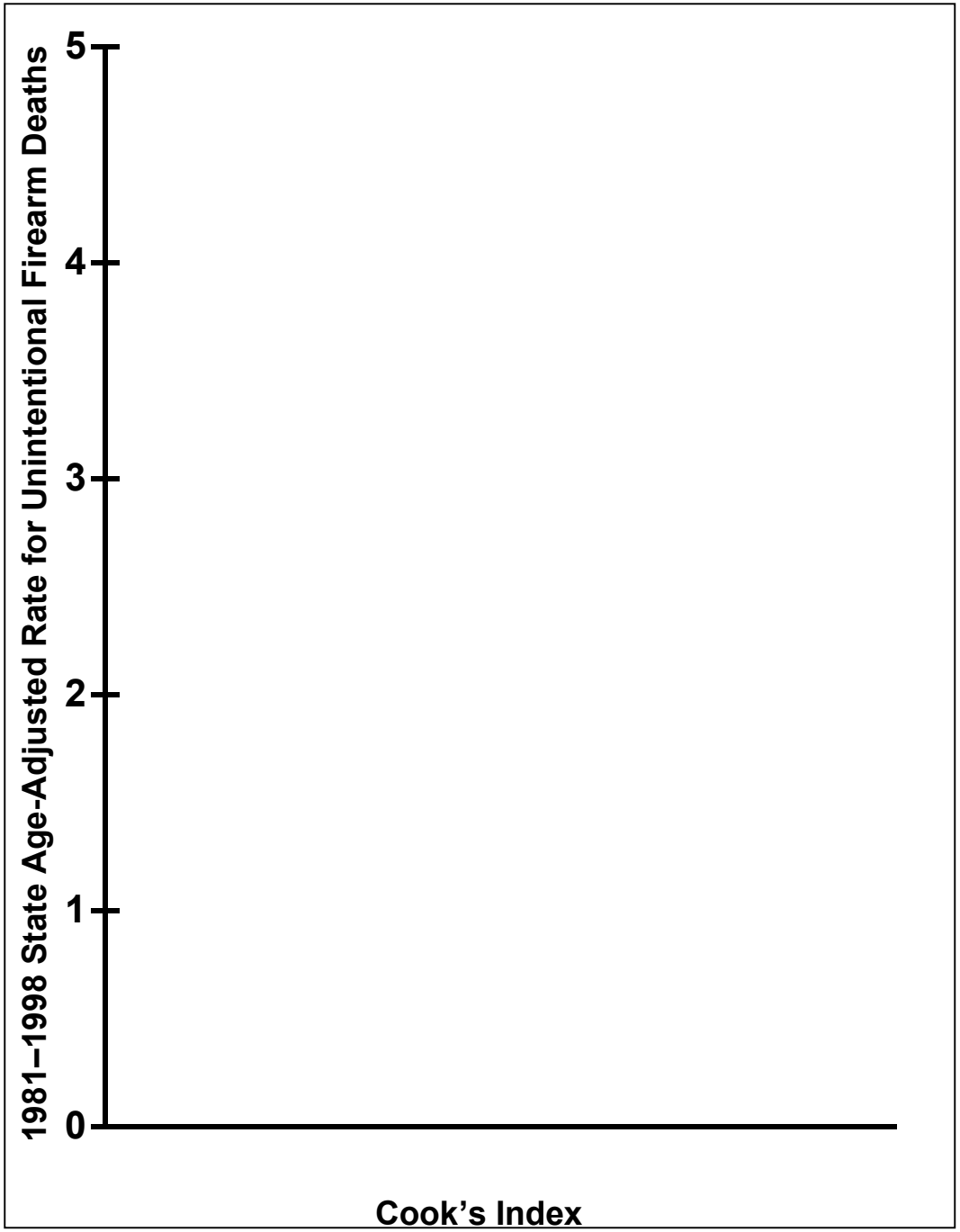

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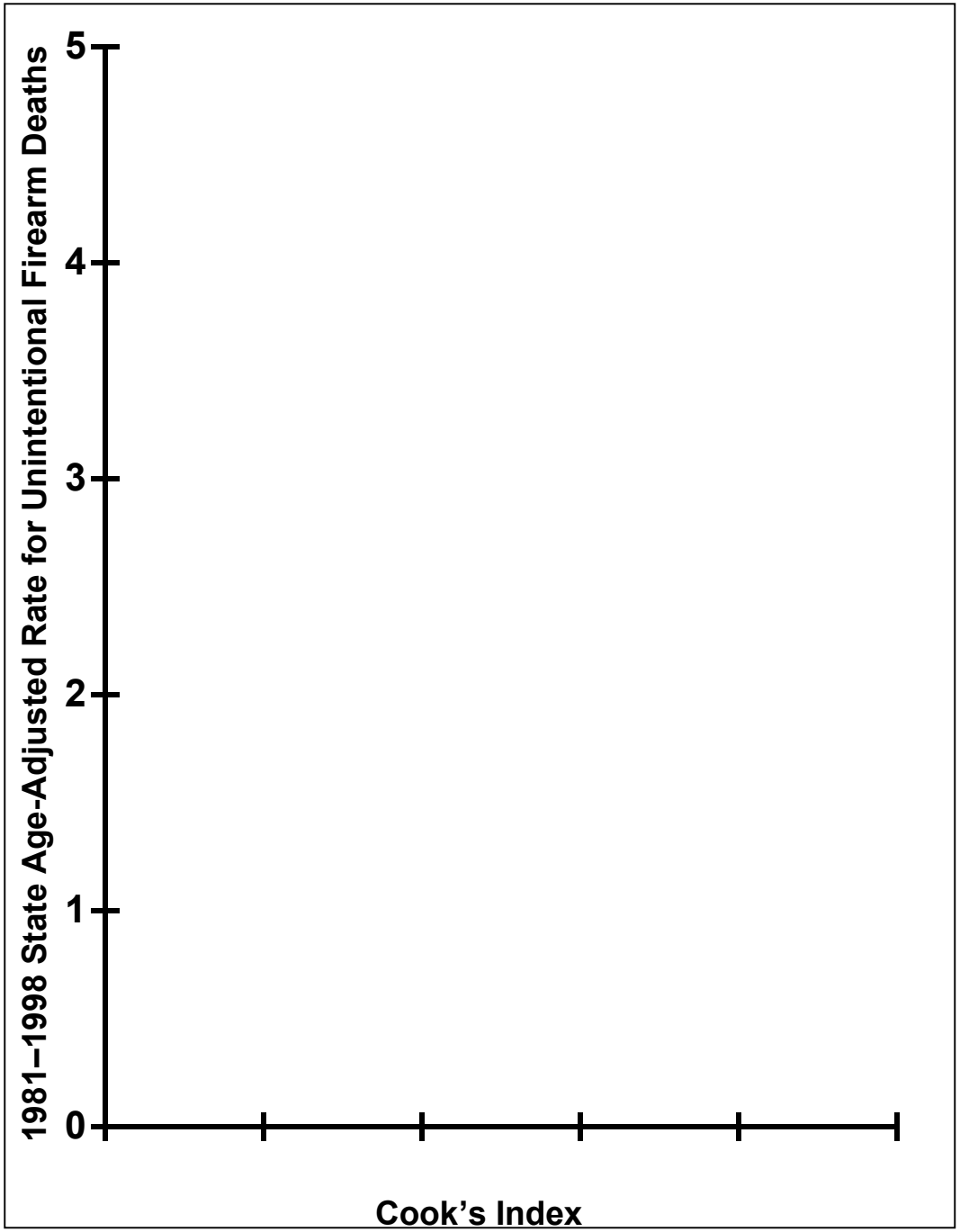
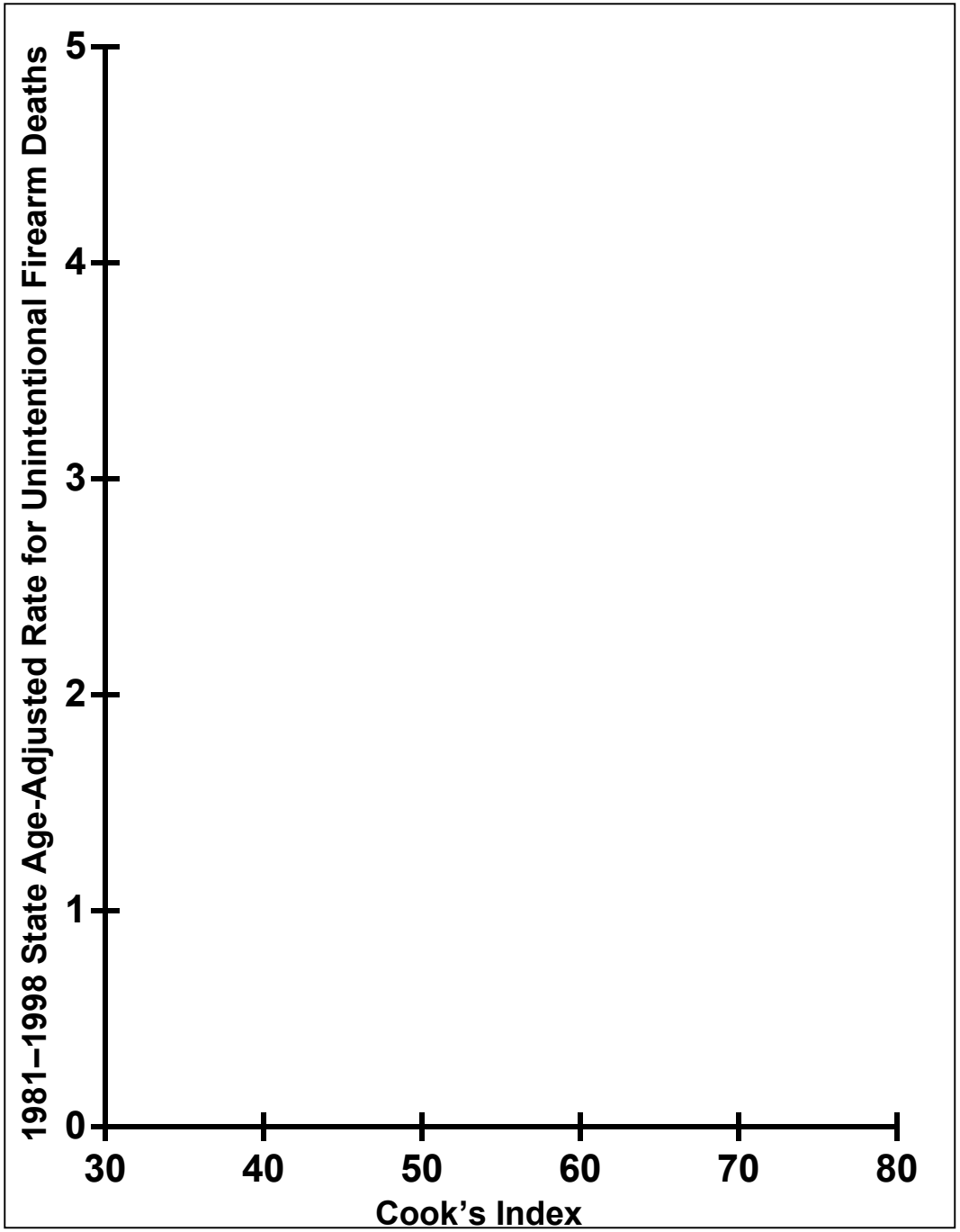


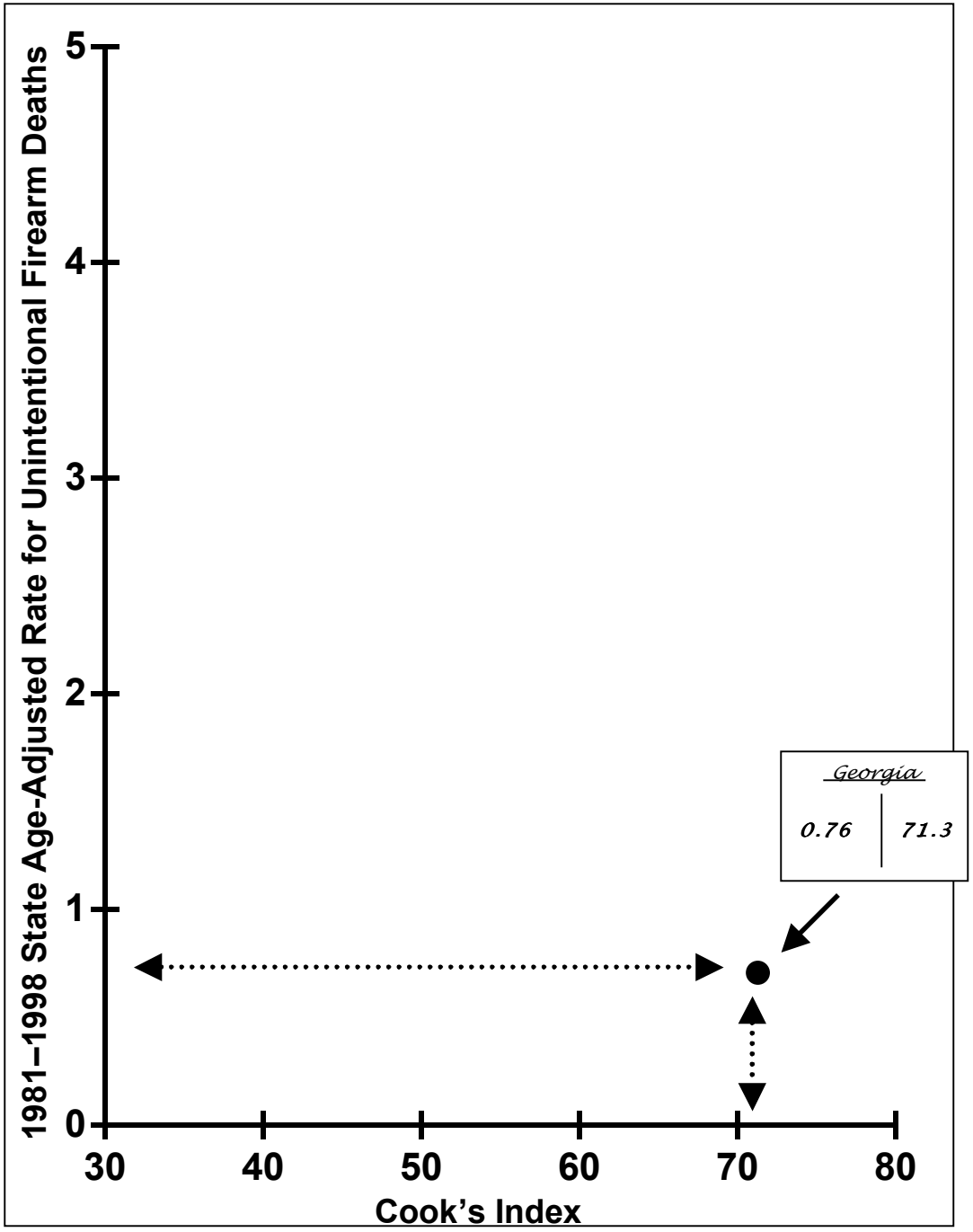
Transparency 89



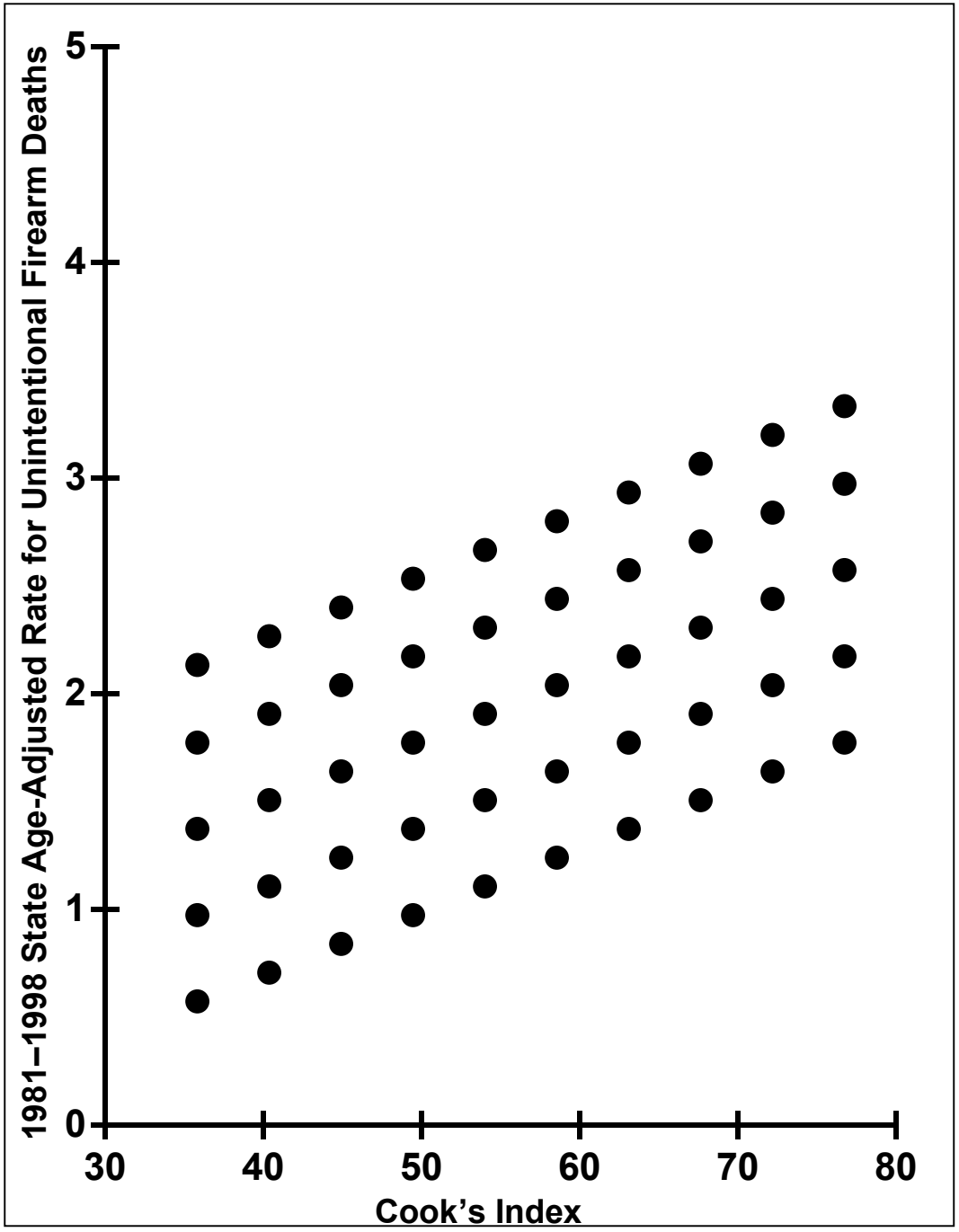
Harvard Injury Control Research Center

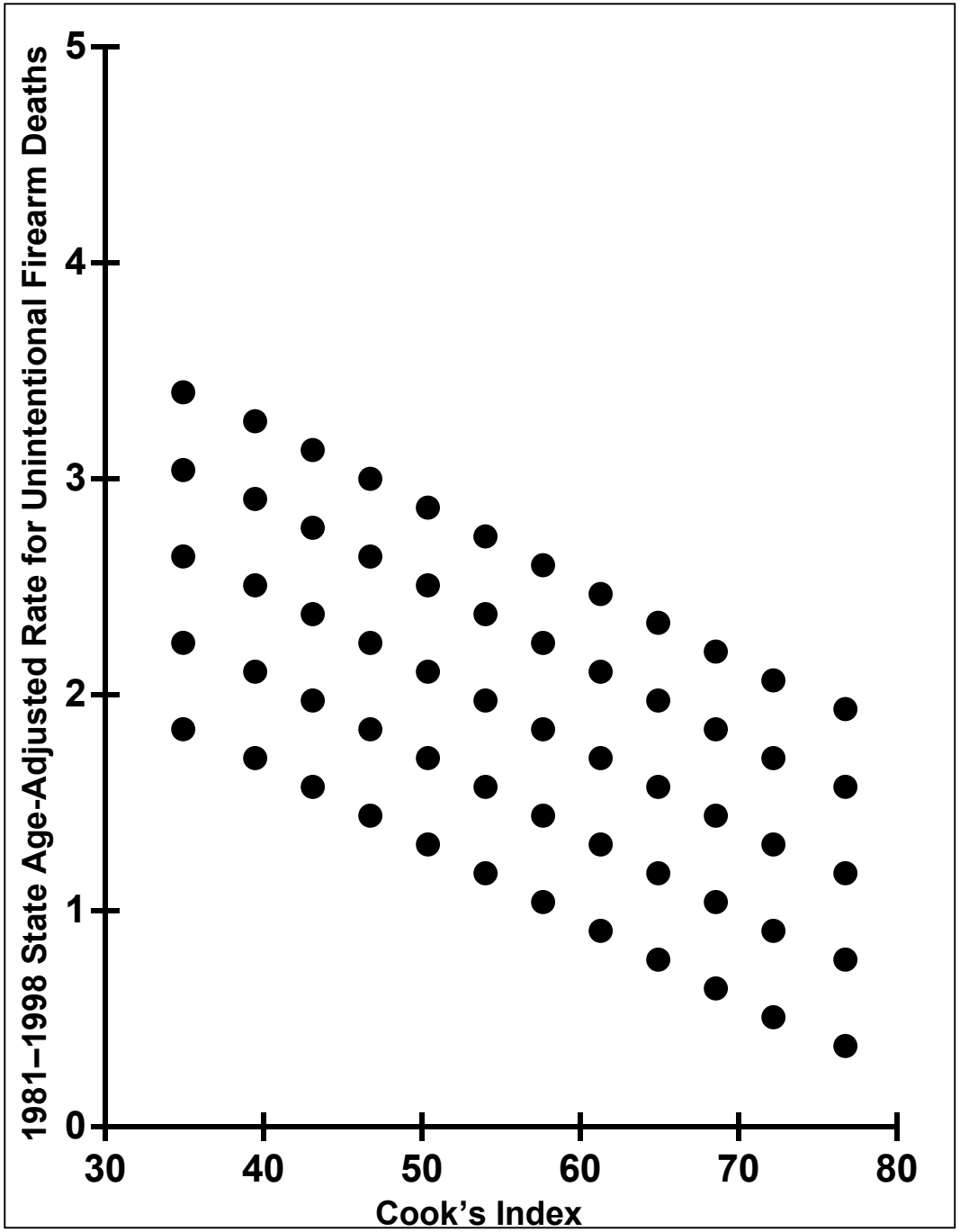
The rates of unintentional firearm deaths would be highest in places where firearms were most available and lowest in places where firearms were least available.

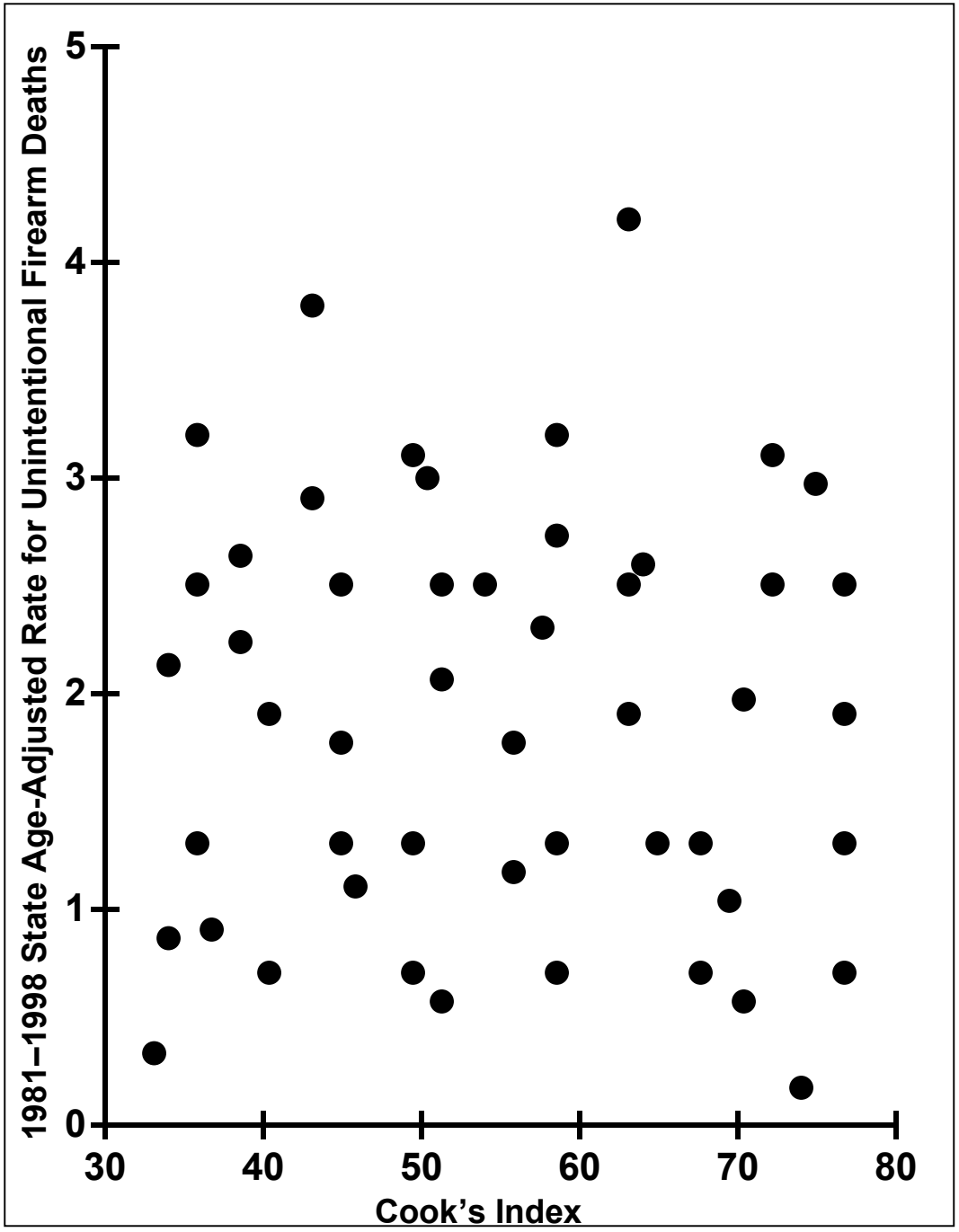
Transparency 91



Transparency 92







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.

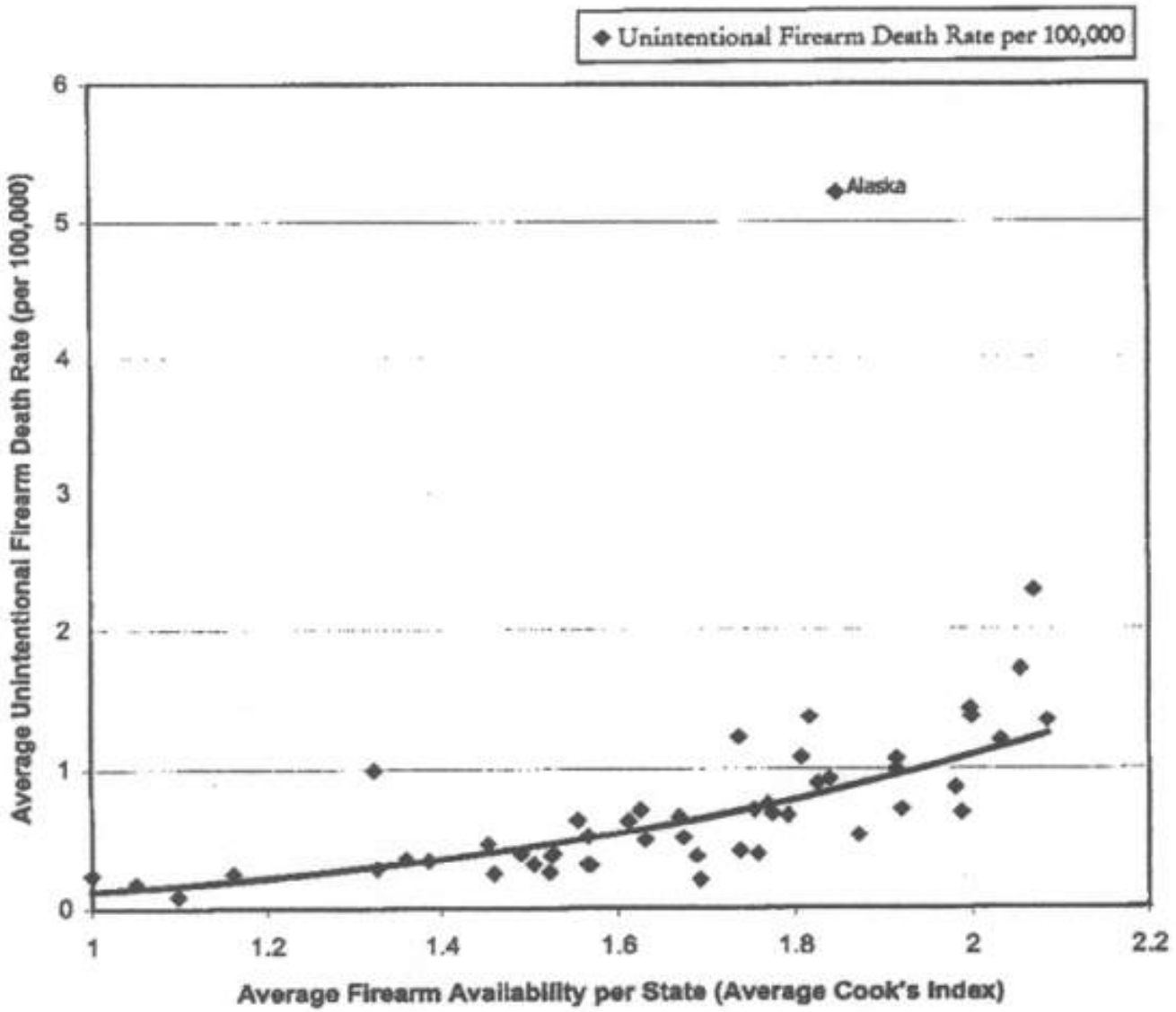
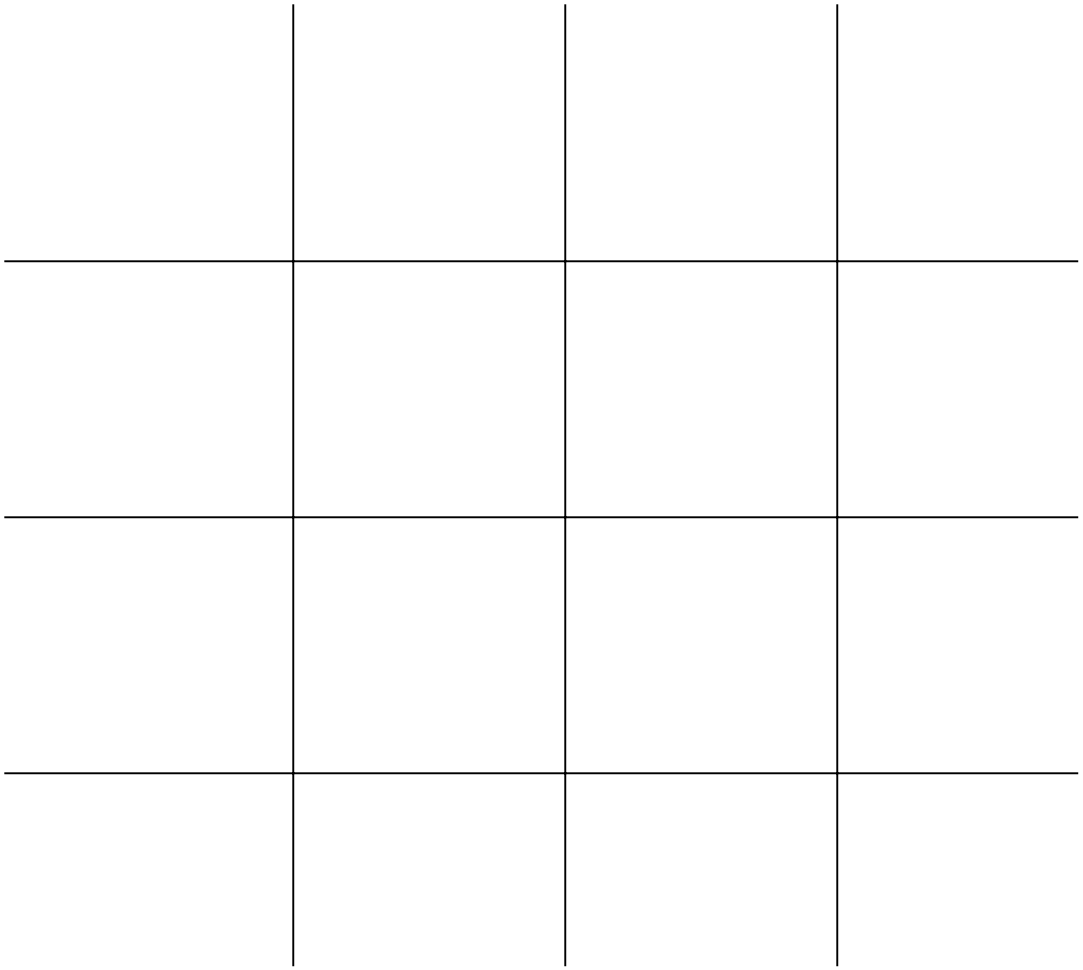


Fig. 1. Average state level unintentional firearm death rate by average state level firearm availability, all ages (1979-1997).

Ecologic Study

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

2 x 2 Table

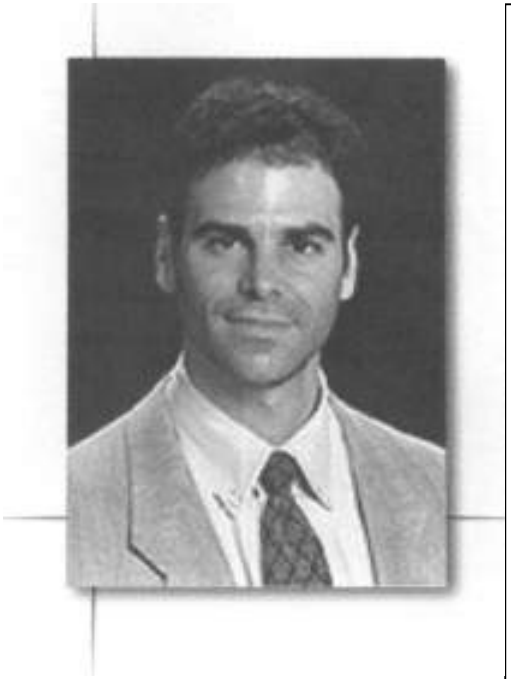


2 x 2 Table

	Unintentional Firearm Death	Not an Unintentional Death by Firearm	
High Firearm Availability			
Low Firearm Availability			

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.”



PERGAMON

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Firearm availability and unintentional firearm deaths

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Abstract

Background: Between 1979 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 guns are more prevalent. The results suggest that the increased risk of unintentional violent death among all age groups is not entirely explained by a state's level of poverty, urbanization, or regional location.

Keywords: Firearms; 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 Pattetta, 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; Sinauer 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.

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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?