



# SCHS Studies

A Special Report Series by the State Center for Health Statistics  
P.O. Box 29538, Raleigh, N.C. 27626-0538

No. 111

[www.schs.state.nc.us/SCHS](http://www.schs.state.nc.us/SCHS)

September 1998

## Health Consequences of Underage Alcohol Use in North Carolina\*

by

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### ABSTRACT

**Objectives:** Underage drinking has serious social, health, and economic consequences. This study uses available state-level data to portray the extent of problems associated with underage drinking in North Carolina.

**Methods:** Existing North Carolina sources of data are used to present descriptive statistics about the health consequences of underage alcohol use. Sources of data include: the Youth Risk Behavior Survey, Highway Safety Research Center, State Bureau of Investigation, death certificates, Medical Examiner data system, and hospital discharge data.

**Results:** Use of alcohol is common among persons under the age of 21. There are large numbers of arrests of underage persons each year in North Carolina for driving while impaired and for alcohol law violations. For a substantial number of motor vehicle crashes involving young drivers, there is evidence of drinking by the driver, and alcohol involvement is higher for fatal motor vehicle crashes. Diagnoses on death certificates are not adequate to assess the contribution of alcohol to deaths among youth. Medical Examiner data for 1995 show that 19 percent of persons under age 21 who died from injuries had some level of blood alcohol, and 9 percent had a high level. There were more than 200 hospitalizations of North Carolina youth in 1996 for primary alcohol-related diagnoses. Many other hospitalizations due to injury and other conditions are related to alcohol use by young persons, but the information needed to measure the extent of this problem is not available.

**Conclusions:** The available data substantially underestimate the health consequences of alcohol use among youth in North Carolina. New sources of information should be developed to better measure the extent of these problems. Educating young people about the problems of alcohol is important, but this must be accompanied by other approaches if significant progress is to be made in reducing underage drinking. Community controls of alcohol sales and availability are often more effective than attempts to convince individuals to voluntarily change their behavior. Effective policies would include reducing access to alcohol among youth by price increases and restrictions on retail outlets. A recent survey of North Carolina adults indicates significant public support for these and other policies to reduce underage drinking.

\*This is a cooperative study of the three organizations represented by the authors. Barbara Alvarez Martin is Project Director of the North Carolina Initiative to Reduce Underage Drinking, a project funded by The Robert Wood Johnson Foundation.

## Introduction

Despite laws requiring a minimum age for purchase of alcohol, young people continue to have access to alcohol and many of them drink. Underage drinking has serious social, health, and economic consequences. Motor vehicle crashes are the leading cause of death for teenagers, and alcohol use is a major contributor. Miller, et al.<sup>1</sup> found that almost 20 percent of the traffic crashes with a driver under the age of 21 involved alcohol. But motor vehicle injuries are not the only reason that drinking by youth is a problem.

Other problems associated with underage alcohol use are suicides, homicides, assaults, drownings, falls, and other traumatic injuries.<sup>2</sup> Heavy use of alcohol by youth can lead to fetal alcohol syndrome, alcohol poisoning, alcohol psychoses, and alcohol dependence and abuse.<sup>2</sup> Drinking increases the chances that a young person will fall victim to date rape, engage in unprotected sex, or become involved in relationship violence. Other consequences of underage drinking may occur later in life. A recent study found that young people who began drinking before age 15 were more than twice as likely to develop alcohol abuse as those who began drinking at age 21.<sup>3</sup> Alcohol abuse is a maladaptive drinking pattern that repeatedly causes life problems, and is associated with an increased risk of cirrhosis and other liver disease, various cancers, and other illnesses.

This study examines health consequences of drinking by persons under age 21, using data available for North Carolina. The study is limited to **alcohol** use among youth for several reasons:

- alcohol is used by many more youth than illegal drugs;
- alcohol causes far more health and other problems than does use of illegal drugs;
- there is better information available on problems related to alcohol use; and
- interventions to reduce the problems are different for alcohol as compared to illegal drugs.

Use of illegal drugs among youth is a serious issue, and should be the subject of a separate study.

The economic costs of underage alcohol use are substantial. A national study estimates that the total 1995 costs of alcohol-related youth problems in the United States were nearly \$45 billion.<sup>4</sup> These costs include medical care, lost work and other monetary costs, and quality of life costs. Due to the complex data requirements and methods of analysis, a detailed calculation of the economic costs associated with youth alcohol use in North Carolina is beyond the scope of the present study. However, by allocating a portion of the national cost to North Carolina based on population size, it is estimated that the economic costs of underage alcohol use in this state were \$1.2 billion in 1995.

## Methods

This study uses existing North Carolina sources of data to present descriptive statistics about health consequences of underage alcohol use. We have used only direct North Carolina data, and have not attempted to extrapolate to North Carolina using data from national or other studies.

Data from the Youth Risk Behavior Survey for North Carolina portray the extent of drinking among middle school and high school students. Information from the Highway Safety Research Center of the University of North Carolina shows the extent of alcohol involvement in motor vehicle crashes among youth. Data from the State Bureau of Investigation indicate the number of alcohol-related arrests among young persons. Death certificate files show the number of deaths attributed to diagnoses suggesting chronic alcohol use. Data from the Medical Examiner information system indicate alcohol involvement in injury deaths among youth. Hospital discharge data show the number of hospitalizations among youth attributed to alcohol-related diagnoses and the associated hospital charges.

There are several limitations of the data presented. The available data from some sources substantially underestimate the health consequences of

alcohol use among youth. Alcohol involvement is seriously under-reported on death certificates (for all ages), in part due to the stigma of mentioning on a public document that alcohol contributed to the death.<sup>5</sup> Due to the serious under-reporting, we have not used secondary diagnoses from death certificates to show alcohol involvement in injury and other deaths. For the primary alcohol-related diagnoses on death certificates that we did examine, in most cases death follows years of chronic alcohol use, so there are very few deaths among youth attributed to these diagnoses. The Medical Examiner system investigates all deaths due to injury, violence, and poisoning and is much more suited to showing alcohol involvement in these causes of death, since alcohol tests (usually blood alcohol) are done on most decedents. However, for several reasons, the Medical Examiner data presented here probably understate somewhat the true influence of alcohol on fatal injuries. The hospital discharge data are also very limited in indicating the involvement of alcohol through the recording of diagnoses. The primary alcohol conditions that we examined are most often seen in older persons after years of alcohol abuse.

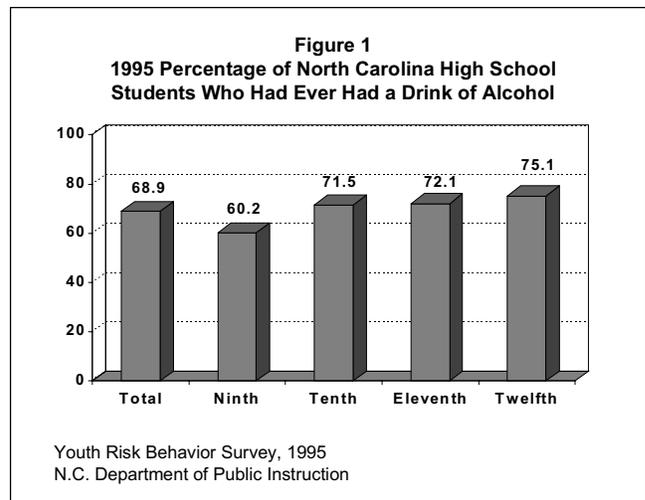
Therefore, the data presented here indicate a **minimum** level of the health consequences of alcohol use among youth. The true involvement of alcohol is likely much higher, but unfortunately we do not presently have the data we need to measure the full extent of the problem.

## Results

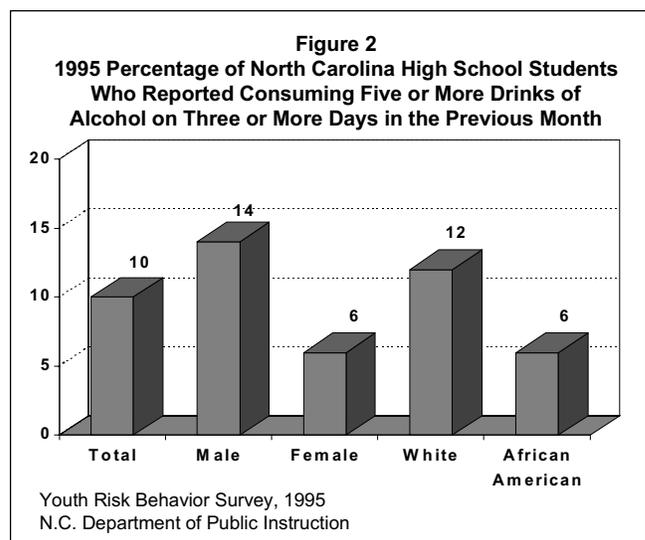
### *Prevalence of Drinking*

Survey data show that alcohol use is pervasive among youth in North Carolina. Early alcohol use is not only associated with health consequences in the young ages, but is also a strong risk factor for developing chronic alcohol-related problems as an adult.

In a sample of North Carolina middle school students who participated in the 1995 Youth Risk Behavior Survey, 58.5 percent reported that they had



ever had a drink of alcohol. There was little difference in this percentage across gender and racial groups. Almost 70 percent of North Carolina high school students reported that they had ever had a drink of alcohol, and this percentage increased with each high school grade level (Figure 1). About one-fourth of the high school students reported having their first drink of alcohol, “other than a few sips,” before the age of 13. Twenty-three percent reported drinking five or more drinks in a row during the previous 30 days. One out of 10 reported consuming five or more drinks on three or more days in the month prior to the survey (Figure 2). About five percent of the high school students reported having drunk alcohol on school property in the previous 30 days.



### Alcohol-Related Arrests

Table 1 shows alcohol-related arrests of youth by age, as reported by the State Bureau of Investigation. In 1996, there were more than 6,000 DWI arrests of persons under the age of 21 and almost 4,800 alcohol law arrests of underage persons (there may be more than one charge and conviction per arrest). These are, of course, only the cases where the person was apprehended by a law enforcement officer. The true incidence of driving while impaired and violation of alcohol laws among youth is certainly much higher.

### Motor Vehicle Crashes

The Highway Safety Research Center of the University of North Carolina tracks motor vehicle crashes in North Carolina. Table 2 shows the numbers of crashes in 1996 for drivers ages 15-20

| Age   | Alcohol Law Violations<br>(liquor, wine, or beer) |       |
|-------|---|-------|
|       | DWI   |       |
| 11-12 | 0   | 15    |
| 13-14 | 8   | 90    |
| 15    | 10  | 107   |
| 16    | 317   | 505   |
| 17    | 659   | 718   |
| 18    | 1,161   | 1,087 |
| 19    | 1,777   | 1,278 |
| 20    | 2,146   | 989   |
| Total | 6,078   | 4,789 |

Note: There may be more than one charge and conviction per arrest.  
Source: State Bureau of Investigation

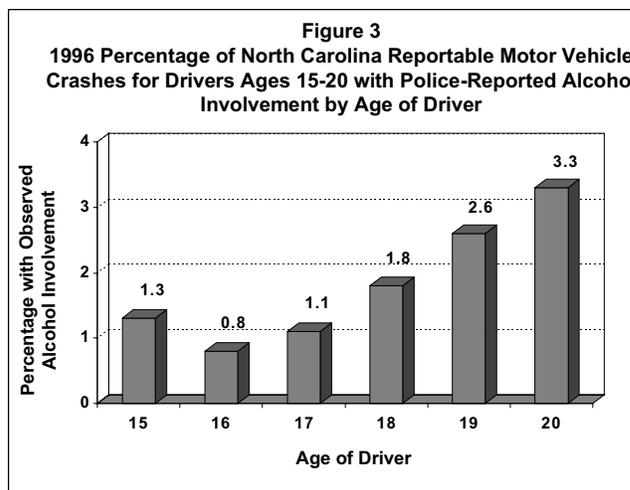
| Age of Driver |         | Crash Severity* |                      |                     |                           |                       | Fatal Crash |
|---------------|---------|-----------------|----------------------|---------------------|---------------------------|-----------------------|-------------|
|               |         | All Crashes     | Property Damage Only | No Visible Injury** | Non-Incapacitating Injury | Incapacitating Injury |             |
| 15            | Total   | 769             | 356                  | 212                 | 146                       | 47                    | 8           |
|               | Alcohol | 10              | 4                    | 1                   | 3                         | 1                     | 1           |
| 16            | Total   | 12,418          | 6,653                | 3,753               | 1,538                     | 414                   | 60          |
|               | Alcohol | 98              | 41                   | 22                  | 25                        | 6                     | 4           |
| 17            | Total   | 13,202          | 7,187                | 4,119               | 1,442                     | 393                   | 61          |
|               | Alcohol | 139             | 38                   | 30                  | 50                        | 14                    | 7           |
| 18            | Total   | 12,934          | 6,915                | 3,985               | 1,514                     | 463                   | 57          |
|               | Alcohol | 239             | 74                   | 59                  | 58                        | 46                    | 2           |
| 19            | Total   | 13,303          | 7,165                | 4,122               | 1,445                     | 509                   | 62          |
|               | Alcohol | 341             | 121                  | 75                  | 89                        | 48                    | 8           |
| 20            | Total   | 12,535          | 6,808                | 3,873               | 1,361                     | 434                   | 59          |
|               | Alcohol | 410             | 148                  | 89                  | 109                       | 48                    | 16          |
| Total         | Total   | 65,161          | 35,084               | 20,064              | 7,446                     | 2,260                 | 307         |
|               | Alcohol | 1,237           | 426                  | 276                 | 334                       | 163                   | 38          |

\*Most serious injury in the crash.  
\*\*But complaint of pain or momentary unconsciousness.  
Source: University of North Carolina Highway Safety Research Center

by crash severity and alcohol involvement. An indication of alcohol involvement means that the law enforcement officer saw **evidence** of drinking by the driver; no measurement of blood alcohol content was obtained in the vast majority of the cases. Therefore, these data probably understate the extent of drinking by young drivers involved in motor vehicle crashes in North Carolina. There were more than 65,000 crashes reported that involved a driver ages 15-20, and for 1,237 or 1.9 percent of these there was evidence of alcohol involvement. The percentage of crashes with evidence of alcohol involvement generally increases as age of driver increases (see Figure 3). Also, the percentage with evidence of alcohol involvement increases with crash severity. For ages 15-20 combined, more than 12 percent of fatal crashes showed evidence of drinking by the driver.

### ***Injury and Death***

Death certificates show only two persons under age 21 dying of alcohol-related underlying (primary) causes of death in the five-year period 1992-96 (Table 3). Many of these diagnoses are chronic conditions that do not usually result in death until older ages. Alcohol diagnoses are rarely recorded on the death certificates as secondary causes of death for injury and other primary causes, so we did not attempt to assess the contribution of alcohol to



other causes of death using the death certificate data.

As mentioned above, the Medical Examiner data system covers all deaths due to injury, violence, and poisoning, and includes blood alcohol tests for most decedents. Table 4 shows information on deaths for major types of injury for persons ages 10-20. For purposes of comparison, Table 5 shows the same information for persons of all ages. For persons ages 10-20, 19 percent of injury deaths with an alcohol test were positive for alcohol, and 9 percent had a blood alcohol concentration of .10% or greater. For all ages, 31 percent of injury deaths with an alcohol test were positive for alcohol, and

**Table 3**  
**1992-1996 North Carolina Resident Deaths with an Alcohol-Related Underlying Cause, by Major Diagnosis Categories by Age**

|                                 | <b>10-14</b> | <b>15-17</b> | <b>18-20</b> | <b>21-44</b> | <b>45-64</b> | <b>65+</b> |
|---------------------------------|--------------|--------------|--------------|--------------|--------------|------------|
| Alcoholic Liver Disease         | 0            | 0            | 0            | 444          | 979          | 369        |
| Alcohol Dependence Syndrome     | 0            | 0            | 0            | 271          | 616          | 210        |
| Accidental Poisoning by Alcohol | 0            | 0            | 1            | 78           | 75           | 20         |
| Alcoholic Psychoses             | 0            | 0            | 0            | 36           | 48           | 32         |
| Alcohol Abuse                   | 0            | 0            | 1            | 80           | 149          | 38         |
| Alcoholic Cardiomyopathy        | 0            | 0            | 0            | 33           | 91           | 44         |
| Alcoholic Gastritis             | 0            | 0            | 0            | 1            | 4            | 5          |
| <b>Total</b>                    | <b>0</b>     | <b>0</b>     | <b>2</b>     | <b>943</b>   | <b>1,962</b> | <b>718</b> |

**Table 4**  
**1995 North Carolina Medical Examiner Cases with Alcohol Testing**  
**by Cause of Death for Ages 10-20**

| <b>Injury Type</b>         | <b>Total Deaths</b> | <b>Percent Tested</b> | <b>Percent with Any Alcohol*</b> | <b>Percent with <math>\geq .10\%</math> Blood Alcohol Concentration*</b> |
|----------------------------|---------------------|-----------------------|----------------------------------|--|
| Drowning                   | 18                  | 88.9                  | 12.5                             | 0.0  |
| Fires                      | 5                   | 100.0                 | 0.0                              | 0.0  |
| Motor Vehicle              | 272                 | 89.0                  | 18.2                             | 10.3   |
| Homicide                   | 114                 | 93.9                  | 25.2                             | 8.4  |
| Suicide                    | 92                  | 90.2                  | 10.8                             | 3.6  |
| All Other Injury/Poisoning | 54                  | 81.5                  | 25.0                             | 15.9   |
| <b>Total</b>               | <b>555</b>          | <b>89.5</b>           | <b>18.7</b>                      | <b>8.9</b>   |

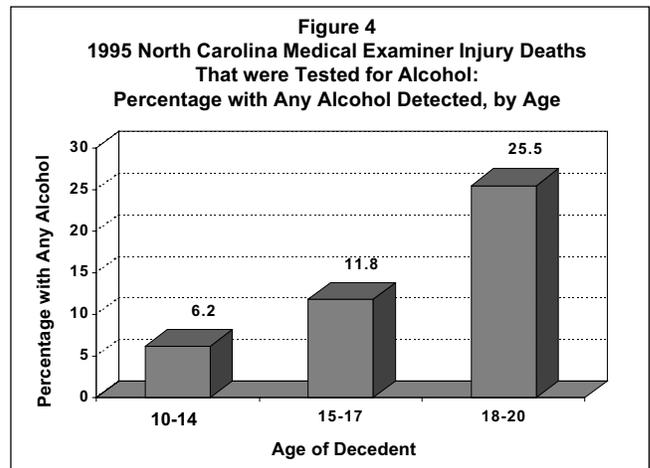
\*Of those tested.

**Table 5**  
**1995 North Carolina Medical Examiner Cases with Alcohol Testing**  
**by Cause of Death for All Ages**

| <b>Injury Type</b>         | <b>Total Deaths</b> | <b>Percent Tested</b> | <b>Percent with Any Alcohol*</b> | <b>Percent with <math>\geq .10\%</math> Blood Alcohol Concentration*</b> |
|----------------------------|---------------------|-----------------------|----------------------------------|--|
| Drowning                   | 148                 | 89.2                  | 34.1                             | 26.5   |
| Fires                      | 141                 | 74.5                  | 35.2                             | 24.8   |
| Motor Vehicle              | 1,557               | 86.3                  | 28.7                             | 21.7   |
| Homicide                   | 717                 | 93.4                  | 40.9                             | 27.0   |
| Suicide                    | 940                 | 88.9                  | 30.7                             | 19.4   |
| All Other Injury/Poisoning | 891                 | 66.4                  | 25.0                             | 18.6   |
| <b>Total</b>               | <b>4,394</b>        | <b>83.7</b>           | <b>31.2</b>                      | <b>21.9</b>  |

\*Of those tested.

22 percent had a blood alcohol concentration of .10% or greater. The percentage of youth with positive alcohol increases substantially with increasing age (Figure 4). The percentage with alcohol involvement is for persons who died only. Other drivers in a motor vehicle crash or the perpetrator in a homicide, for example, may have been influenced by alcohol, but this would not be reflected in the Medical Examiner data.



**Table 6**  
**1996 North Carolina Hospital Discharges with a Primary Alcohol-Related Diagnosis**  
**by Major Diagnosis Categories by Age**

|                                 | 10-14 | 15-17 | 18-20 | 21-44 | 45-64 | 65+   |
|---------------------------------|-------|-------|-------|-------|-------|-------|
| Alcoholic Dependence Syndrome   | 2     | 29    | 106   | 4,302 | 2,306 | 441   |
| Alcoholic Liver Disease         | 0     | 0     | 0     | 559   | 758   | 242   |
| Alcoholic Psychoses             | 1     | 1     | 6     | 1,106 | 1,050 | 266   |
| Alcohol Abuse                   | 6     | 20    | 19    | 264   | 141   | 30    |
| Alcoholic Gastritis             | 0     | 2     | 2     | 150   | 190   | 44    |
| Toxic Effect of Alcohol         | 2     | 3     | 3     | 43    | 16    | 0     |
| Other Alcohol-Related Diagnosis | 0     | 0     | 0     | 17    | 26    | 5     |
| Total                           | 11    | 55    | 136   | 6,441 | 4,487 | 1,028 |

***Hospitalization***

Table 6 shows 1996 hospital discharges of North Carolina residents from North Carolina hospitals with a primary alcohol-related diagnosis, by age. There are relatively few discharges of persons under age 21 for these conditions. As with the death certificate data, most of these diagnosis groups reflect chronic conditions that would not usually be manifested until after years of drinking. Also, alcohol use is rarely recorded as a secondary diagnosis, so the hospital discharge data are not very

useful in profiling the involvement of alcohol in other causes of hospital admission, such as injuries.

The total hospital charges in 1996 for the discharges shown in Table 6 were \$70,600,000. The hospital charges for primary alcohol-related diagnoses for persons under age 21 were nearly \$1,000,000 in 1996 (Table 7). This understates the contribution of alcohol to hospital costs among young persons, particularly since the costs of treatment of injuries due to alcohol use are not included.

**Table 7**  
**1996 Hospital Discharges with a Primary Alcohol-Related Diagnosis**  
**by Major Diagnosis Categories by Age: Amount Charged by Hospitals**

|                                 | 10-14    | 15-17     | 18-20     |
|---------------------------------|----------|-----------|-----------|
| Alcohol Dependence Syndrome     | \$35,754 | \$202,131 | \$401,594 |
| Alcoholic Liver Disease         | 0        | 0         | 0         |
| Alcoholic Psychoses             | 16,583   | 6,667     | 23,206    |
| Alcohol Abuse                   | 21,530   | 86,360    | 98,429    |
| Alcoholic Gastritis             | 0        | 5,848     | 9,907     |
| Toxic Effect of Alcohol         | 4,215    | 15,008    | 11,192    |
| Other Alcohol-Related Diagnosis | 0        | 0         | 0         |
| Total                           | \$78,082 | \$316,014 | \$544,328 |

## Discussion

In general, the data do not exist to fully measure the extent to which alcohol contributes to health problems among young persons in North Carolina. We do not know the level of alcohol involvement in juvenile crime, violence, mental health problems, or irresponsible sexual activity. Nor can we determine the extent to which alcohol contributes to injuries that do not result in death. Nonetheless, the data presented in this study do permit the following observations.

Use of alcohol is common among persons under the age of 21. There are large numbers of arrests of underage persons each year in North Carolina for driving while impaired and for alcohol law violations. For a substantial number of motor vehicle crashes involving young drivers, there is evidence of drinking by the driver, and alcohol involvement is higher for fatal motor vehicle crashes. Death certificates show a small number of deaths attributed to chronic alcohol diagnoses, but initiation of drinking at an early age is associated with a higher risk of developing chronic alcohol conditions as an adult. Medical Examiner data for 1995 show that 19 percent of persons under age 21 who died from injuries had some level of blood alcohol, and 9 percent had a blood alcohol concentration of .10% or greater. There were more than 200 hospitalizations of North Carolina youth in 1996 for primary alcohol-related diagnoses. Many other hospitalizations due to injury and other conditions are related to alcohol use by young persons, but the information needed to measure the extent of this problem is not available.

Better data would help us to ascertain more fully the health consequences of alcohol use. Two strategies to improve the available data on the effects of alcohol use are: (1) obtain a breath or blood alcohol measurement on all drivers involved in a motor vehicle crash; and (2) do a screening for alcohol on everyone age 15 and older seen in an emergency department for an injury-related problem. Systematic implementation of these strategies in North Carolina would require state legislative action.

## Prevention Strategies

Given that underage alcohol use in North Carolina is a large problem with serious health consequences, consideration should be given to strategies to reduce underage drinking and its consequences. Educating young people about the problems of alcohol consumption is important, but this must be accompanied by other approaches if significant progress is to be made. Community controls of alcohol sales and availability, making it harder for youth to get alcohol, are often more effective than programs that try to reduce youth demand for alcohol only by targeting individual knowledge and attitudes.<sup>6,7,8,9</sup>

To effectively reduce underage drinking, there must be programs to reduce the supply of alcohol for youth, as well as efforts to reduce the demand for alcohol among youth. In 1997 in North Carolina, there were only 749 convictions of merchants in criminal court for selling alcohol to underage persons, compared to 6,824 convictions of underage persons for purchase or possession of alcohol (there can be more than one conviction per person).<sup>10</sup> This suggests that it is easier to catch underage persons with alcohol than it is to catch those who sell alcohol to them. There needs to be more emphasis on reducing the sources of alcohol for youth. A recent study<sup>11</sup> found that 35 percent of 100 retail outlets in five North Carolina counties sold beer to a young woman without checking for age identification, pointing to a clear need for greater efforts to prevent the sale of alcohol to underage persons.

One effective method of reducing alcohol consumption is to raise its price through increases in excise taxes.<sup>12</sup> The effect of price increases is particularly strong for young drinkers, most likely because they have less disposable income.<sup>12,13,14</sup> An increase in excise tax of five cents a drink for beer would result in an eight to nine percent increase in price. A recent study<sup>15</sup> estimated that raising the price of beer by 10 percent would, by reducing consumption, result in a 5 percent reduction in the number of incidents of violent behavior among college

students. Inflation has reduced the effective tax on alcohol for decades, both nationally and in North Carolina. The North Carolina excise tax of 53 cents per gallon of beer established in 1969, when adjusted for inflation, is now the equivalent of 13 cents per gallon. Alcohol, and particularly beer, is now relatively inexpensive.

Alcohol consumption can be reduced by restrictions on the number, location, and density of retail outlets and by restrictions on the hours and days of sale.<sup>16,17</sup> Restricting or countering alcohol advertising may be an effective prevention strategy by making drinking less appealing. However, the research on the effects of advertising restrictions on alcohol consumption and related problems is incomplete and inconsistent, and there has been little research on the effect of advertising restrictions on consumption of alcohol by youth.<sup>18</sup>

A recent survey of North Carolina adults<sup>19</sup> indicates substantial public support for policies to reduce underage drinking. Selected findings from this survey are:

- 77 percent of respondents said that they were very concerned about the problem of teenage drinking;
- 83 percent agreed that stores are not careful enough in preventing teens from buying alcohol;
- 68 percent strongly favored penalties for older persons who illegally give alcohol to teens;
- 82 percent of all respondents supported a five cents a drink tax increase on alcohol to pay for programs to prevent underage persons from drinking and to expand alcohol treatment programs; 76 percent of regular drinkers supported such a tax increase.

Raising the minimum age for purchase of alcohol in the United States to 21 has been an extremely effective public health policy that has saved lives, averted suffering, and reduced public and private costs. There is strong evidence that raising the

drinking age for alcohol has reduced alcohol-related motor vehicle crashes among young people, and that it has reduced deaths due to suicide, pedestrian injuries, and other unintentional injuries.<sup>20,21</sup> In North Carolina during the period 1980-84, just before the minimum age for purchase of alcohol was raised to 21, 18 percent of persons ages 15-17 who died from injury or poisoning had a blood alcohol concentration of .10% or greater.<sup>5</sup> In 1995 in North Carolina, the comparable figure was 7 percent. It is important that laws against selling alcohol to underage persons are strengthened, enforced, and obeyed.

While this discussion of interventions has emphasized prevention of underage drinking, an important complement is to ensure available and accessible alcohol treatment programs for young persons who abuse alcohol. In a 1995 survey of North Carolina high school students, eight percent reported a need for services for their alcohol use.<sup>22</sup> Treatment for alcohol problems in this age group can help prevent future negative consequences for both the individual and society.

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For more information about this data:  
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