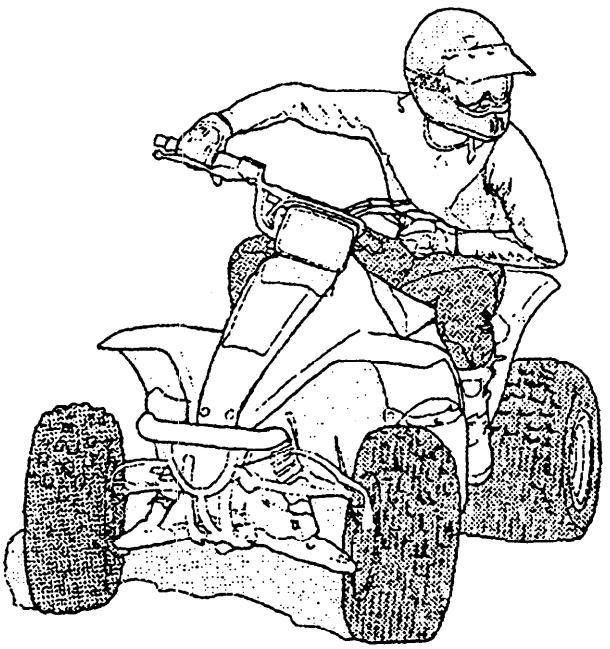
All-Terrain Vehicle
Exposure, Injury, Death, and Risk Studies

April 1998



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OVERVIEW AND SUMMARY OF RESULTS

This overview describes and summarizes the results of four all-terrain vehicle (ATV) studies recently conducted by the U.S. Consumer Product Safety Commission: an exposure survey, an injury survey, a death study, and a risk analysis.

Background

The U.S. Consumer Product Safety Commission (CPSC) initiated a regulatory proceeding in the 1980s to evaluate the hazards associated with ATVs. Results of the staff evaluation were presented to the Commission in November 1986 and formed the basis for the consent decrees between the CPSC and ATV distributors that became effective in April 1988. The consent decrees included agreements by distributors not to sell three-wheel ATVs, to implement an extensive nationwide training program, and to develop a voluntary standard to make ATVs safer. The distributors also agreed, among other things, to'put into effect age restrictions on the ATVs they sell and to provide extensive safety warnings to prospective buyers.

ATV-related emergency department (ED) injuries have declined from an estimated 106,000 in 1986 to about 54,500 in 1997. Similarly, estimated deaths have declined from about 350 in 1986 **to** an estimated 269 in 1996. However, about 40% of ATV-related injuries and over 35% of the deaths are to children under the age of 16, and this has remained relatively constant since 1985.

The consent decrees expire on April 28, 1998; the Commission will decide if further actions should be taken to address the ongoing hazards of ATV riding. To make an informed decision, the Commission sponsored two national surveys during 1997 -- an injury survey and an exposure survey. The injury survey provided detailed information about ATV-related injuries, and the characteristics and ATV use patterns. of those who were injured. The exposure survey collected information about the characteristics and use patterns of the general population of ATV drivers.

These surveys are useful in several ways. First, they provide a description of current hazard and usage patterns, information that is critical in determining what further actions might be warranted. Second, the results can be compared to the results of the 1985 and 1989 injury and exposure surveys, to evaluate trends in use and hazard patterns. Finally, as in the 1985 and 1989 ATV studies, the characteristics and use patterns of drivers who are involved in injury incidents (as inferred from the injury survey) can be compared against those who are not (as inferred from the exposure survey) to determine the factors associated with risk.

The remainder of this overview includes a brief description of the injury and exposure studies and a summary of the findings. The technical reports and analyses are attached. Part I presents the results of the exposure survey, Part II presents the results of the injury survey, Part III provides a description of ATV-related deaths, and Part IV contains the ATV risk analysis.

Summary of Findings

Exposure Survey

The exposure survey collected information on the characteristics and use patterns of the general population of ATV users (see Part I). The survey excluded occupational exposure to ATVs outside of the household. The survey was a national telephone probability survey of U.S. households owning ATVs; it employed a single stage list-assisted random-digit-dialing (RDD) sample design.

The survey was conducted between September 15 and November 18, 1997. Eligible households included those owning one or more ATVs in which at least one of the ATVs had been used by a household member during the preceding 12 months. When eligible households were reached, one driver was selected randomly to be interviewed. Interviews were completed with 464 ATV drivers.

Based on the survey results, there are an estimated 5.85 million ATV drivers in about 2.4 million ATV-owning households. These households own about 3.91 million ATVs, but had operated only about 3.66 million during the 12 month time period before the survey.

Some of the exposure survey highlights follow:

- 14% of the drivers are children under the age of 16 years (compared with about 23% in 1989);
- almost two-thirds of drivers are males;
- the mean level of driver experience was 9.6 years (about 4.5% of drivers had less than one year of experience);
- 11% of drivers reported participating in an organized training program; another 12% said they had received some training by ATV dealers or sales people;
- 23% of drivers reported *never* carrying passengers;
- 35% of drivers reported *always* wearing a helmet; 32% reported never wearing a helmet;
- 74% of drivers reported some nonrecreational use, including farming or ranching, household chores, and

occupational or commercial tasks;

- about 22% of the ATVs are the three-wheel models (this compares with about 54% in 1989);
- *26%* of the four-wheel models are four-wheel drive vehicles, most with engines greater than 300 cc;
- *36%* of the ATVs were reported to have engines with 300 cc or more (compared with about 10% in 1989);
- 51% of the ATVs had been purchased as used vehicles; *42% (82%* of those purchased used) had been purchased from the previous owner, rather than from an ATV dealer.
- about half of the ATVs in use were originally sold after the 1988 consent decrees went into effect.

Injury Survey

The injury survey collected information on injuries treated in hospital emergency departments between May 1 and August 31, 1997, and reported through the CPSC's National Electronic Injury Surveillance System (NEISS) (see Part II)., NEISS is a stratified national probability sample of hospitals in the U.S. that have at least six beds and provide 24-hour emergency service.

CPSC followed up on initial NEISS injury reports with telephone interviews with injured persons or their representatives (usually a parent or spouse) to collect detailed information on the characteristics of drivers, their ATV use patterns, the characteristics of the ATVs they drove, and injury scenarios.

The injury survey completed interviews with a total of 319 injury victims or their representatives. Of this total, 227 victims were drivers and 85 victims were passengers. These victims were involved in a total of 295 injury incidents; *23* included injuries to both the driver and at least one passenger.

Highlights from the injury study (including both 1997 emergency department injury estimates from NEISS and the injury survey) follow:

- *47%* of the injuries occurring during the study period involved children under the age of 16; this was comparable to the percentage in 1985 *(46%);*
- Despite the large proportion of children injured, the number of injuries involving children under age 16 declined from about *42,700* in 1985 to about 21,300 in 1997;

- 95% of injured children were driving ATVs larger than recommended for their age;
- an estimated 54,500 ATV-related injuries were treated in hospital emergency departments during 1997;
- the rate of ATV-related injury declined from 5.4 per hundred ATVs in use in 1985 to 2.5 in 1989 and to about 1.5 per hundred ATVs in 1997, an overall rate reduction of about 72%;
- 25% of the injuries were to passengers;
- 75% of the injuries occurred to males;
- 22% of the injuries involved the head; most of the head injuries were concussions or internal organ (i.e., brain) injuries; at least 65% of the persons suffering head injuries were not wearing helmets;
- the largest injury diagnosis categories were contusions and abrasions (27%), and fractures and dislocations (26%);
- 37% of the injuries involved the arm region; 28% involved the leg region;
- 13% of the emergency department injuries were hospital admitted (compared with 4% of all NEISS product-related injuries);
- about 4% of drivers involved in injury incidents reported formal ATV training or training by a dealer or sales person;

Report *on Deaths*

The CPSC has closely monitored deaths involving ATVs since the mid-1980s and estimates that there have been over 3,200 ATV-related deaths since 1985. Part III provides a description of the characteristics of drivers and ATVs that have been involved in fatal injuries, and fatality trends since 1985. Some of the findings are:

- over 35% of the deaths involved children under age 16;
- 87% of the deaths since 1985 were to males;
- 85% of those killed were drivers, 14% passengers (1% were drivers or passengers of other types of vehicles);
- the percentage of three-wheel ATVs involved in deaths declined from **80%** in 1985 to less than 20% in 1996;

- incidents reported as collisions accounted for 56% of the deaths; overturns accounted for about 28% of all deaths.

Risk Analysis

The risk analysis was conducted as a *case-control study.* In this type of study, the factors associated with risk are determined by comparing the characteristics of those who are injured with those who are not injured. In the instance of the ATV risk analysis, the characteristics and use patterns of drivers involvedin ATV-related injury incidents (drivers from the injury survey) were compared with those who were not involved in injury incidents (drivers from the exposure survey).

The statistical methodology used to make the comparison was a multiple-regression technique known as "logit analysis." This is a special type of regression analysis used to evaluate the relationship between a dichotomous outcome variable, such as whether or not an injury resulting in emergency department treatment has occurred, and a set of independent explanatory variables. This type of analysis is especially useful when, as in the case of ATVs, a large number of factors simultaneously affect the injury risk.

Although the overall risk of ATV-related injury has declined substantially since the 1980s (as indicated in the injury analysis), the factors associated with risk are consistent with those quantified in the earlier 1985 and 1989 risk analyses. As in the earlier analyses, risk patterns are related to the characteristics and use patterns of the drivers, and the types of ATVs that they drive. The results suggest that:

- risk declines with age (the younger the driver the higher the risk);
- risk for children is about 2.5 times the risk for drivers aged 16 to 34, and about 4.5 times the risk for drivers aged 35 to 54;
- risk declines with driving experience;
- risk declines with the percentage of time that ATVs are used in nonrecreational (as opposed to recreational) activities;
- risk is higher for males than for females (all else equal, risk is about 3 times higher for males than for females);
- risk is 2.5 to 3 times higher on three-wheel ATVs than on four-wheel ATVs.

PART I
Report on 1997 ATV Exposure Survey

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INTRODUCTION

This report presents the methodology and results of the U.S. Consumer Product Safety Commission's (CPSC) 1997 all-terrain vehicle (ATV) exposure survey. The survey was conducted to collect information about t'he general population of ATV drivers and the ATVs they use. In addition to providing up-to-date information on the characteristics and use patterns of ATV drivers, the survey results are compared to an earlier 1989 ATV exposure survey to evaluate changes in ATV use patterns over time (Rodgers, 1990a). Second, in a separate report, the exposure survey results are integrated with those of a parallel survey of ATV-related injuries reported through the CPSC's National Electronic Injury Surveillance System (NEISS) to determine and quantify the factors associated with the injury risk.

SURVEY METHODOLOGY

Sample Design

The survey was conducted for the CPSC by Abt Associates (Abt), a social science research and survey firm located in Cambridge, MA. Abt designed the survey to provide a national probability sample of about 500 households owning ATVs and located in the 48 contiguous states and the District of Columbia (Stoner and Srinath, 1998).

The ATV survey employed a single stage list-assisted random-digit-dialing (RDD) sample design. The list-assisted RDD sample was selected using the latest version of the Marketing Systems Group's (MSG) proprietary list-assisted RDD system, called the GENESYS Sampling System (Kulp, 1995; MSG, 1997). This system provides a program for selecting the equivalent of a simple random sample of ten-digit telephone numbers. It uses the AT&T master tape of combinations of area codes and central office system codes (i.e., telephone exchanges) as the basis for constructing a sampling frame of banks of 100 consecutive telephone numbers.

Following the creation of these 100-number banks, MSG used the most recent release of the Donnelly Marketing Information Services (DMIS) data file of directory-listed, residential telephone numbers to delete from the sampling frame banks of 100 consecutive telephone numbers that have a low probability of containing actual working residential numbers. The MSG list-assisted RDD system also screened out a portion of the nonworking phone numbers and business numbers.

The population of telephone exchanges was stratified by census region (i.e., Northeast, Midwest, South, West) and, within each census region, by the population size of metropolitan and nonmetropolitan areas (i.e., less than 100,000, 100,000-499,999, 500,000-1,999,999, 2,000,000 and over) in which the exchanges were located. The regional stratification ensured a representative sample from each of the four census regions.

Additionally, given the low incidence of household ownership of ATVs (estimated at less than three percent), the cross-classification of exchanges by region and population size allowed Abt to exploit existing information on the differential incidence of **ATV** ownership by region and population density to reduce the number of households that needed to be screened. The total number of screenings needed to complete 500 interviews was allocated to the four census regions, and to the population size groups within each region, using Neyman allocation to minimize the variance of the estimated overall eligibility rate (Cochran, 1977). For this allocation, rough estimates of eligibility rates in each stratum derived from earlier studies were used.

The initial sample of telephone numbers ordered from GENESYS was segmented into replicates of approximately equal size. Replicates can be viewed as providing a miniature national sample of residential numbers. After the numbers in the first replicate were called, Abt reallocated the total remaining telephone numbers to strata based on the actual eligibility rates determined in the first phase of interviewing. Abt also ordered from GENESYS an additional sample of telephone numbers in some of the strata with high-eligibility rates to achieve the desired number of interviews.

Questionnaire Development and Interviewing Procedures

The survey questionnaire was developed by CPSC staff in consultation with Abt, and was designed to collect information on **the** characteristics and use patterns of ATV drivers and on the types of ATVs they use. The CPSC solicited comments on the survey methodology and the questionnaire in a public notice of the proposed survey (CPSC, 1997). Comments received from various industry and consumer groups resulted in several changes to the questionnaire. Several minor revisions were also made following a pretest conducted by Abt on July 29-30, 1997 (Abt, 1997).

The survey began on September 15, 1997, with the training of the interviewers, and was completed on 18 November. Eligible households included those owning one or more ATVs, with at least one of the ATVs having been used by a household member during the preceding 12 month time period. The initial respondent in each household was asked how many ATVs were owned and how many drivers had used the ATVs during the last year. If there was more than one driver, the driver who had the most recent birthday was selected to be interviewed. If the selected driver was a child under age 16, **a** parent or guardian was asked to respond on the child's behalf. Screenings and data collection were done via computer-assisted telephone interviews (CATI).

Information was collected about the respondent's use of ATVs and about the characteristics of up to four ATVs owned by the household. The results of the pretest suggested that a relatively large proportion of respondents might not recall the engine size of the **ATV** (or ATVs) owned by the household. Because

of the importance of this variable, respondents who did not know an ATV's engine size were asked to try to obtain the information. The interviewer suggested asking someone else in the household, or looking up the engine size. Of the 62 respondents who originally did not know the engine size, 42 agreed to the callback. The callbacks resulted in the retrieval of engine size for 48 ATVs.

Survey Response

A total of 36,232 telephone numbers were called. up to eight attempts were made to obtain an answered call for each sampled telephone number. The disposition of the telephone calls is described in Table 1.

The overall response rate is the product of the screening response rate (i.e., the proportion of numbers successfully screened to determine household eligibility) and the interview response rate (i.e., the proportion of eligible respondents who completed interviews). The screening response rate can be calculated in two ways. The *minimum* screening response rate, defined as the number of telephone numbers successfully screened (rows 1 and 2 of Table 1) divided by the total of the successfully screened plus unresolved numbers (rows 1, 2, and 3), was 76.6%. This is a *minimum* response rate because some unknown proportion of the unresolved numbers described at row 3 are likely to have been nonhousehold (i.e., business) numbers. Alternatively, if we assume that the proportion of household numbers in row 3 is equal to the proportion of all resolved numbers that were household numbers (the sum of rows 1 and 2 divided by the sum of rows 1, 2, and 4b), then the screener response rate would have been about 80.4%.

The interview response rate, defined as the 464 completed interviews divided by the 561 numbers screened-in, was 82.7%. Thus, the overall *minimum* response rate, defined as the product of the minimum screening response rate (76.6%) and the interview response rate (82.7%), was 63.3%. Assuming an 80.4% screener response rate, the overall response rate increases to 66.5%.

Weighting

After the survey data were collected the sample was weighted to make population based estimates of households, drivers, and ATVs. As a first step, each of the 464 households sampled received a weight relating to the household. This weight combined a base weight reflecting the probability of selection of a household from each of 'the strata,' an adjustment for households with multiple telephone numbers, and an adjustment for unit nonresponse. A final adjustment for the household weight

[1]A stratum was defined as the cross-classification of the four census regions and the four population-size groups, resulting in 16 independent strata.

brought the total weight in each stratum into agreement with the known number of households in the stratum.

To produce estimates relating to individuals or ATV drivers, the household weight was adjusted in a two step procedure. First, since only one driver per household was interviewed, the household weight was multiplied by the number of drivers in the household, This procedure yielded a driver-population weight that reflects the total number of ATV drivers in the U.S. (Kish, 1965).

The second step took advantage of further driver information collected in the survey. While the interview focused on the characteristics of the 464 respondents, it also collected information on the age and gender of all ATV drivers in the respondents' households. This enabled further refinement of the' weighting process by accounting for the apparent over- or underrepresentation of some of the age and gender categories in the sample of 464 respondents. To do this, the data on the age and gender of all 1,225 household ATV drivers were distributed into 16 age and gender categories, based on the household weights. The individual weight that applied to each of the 464 respondents was then adjusted by a factor equal to the ratio of the estimated number in each cell of the larger sample to the estimated number based on the smaller respondent sample.

Survey Limitations

The survey results are subject to some nonsampling errors. The survey excluded the approximately 6% of U.S. households that have no telephone. Alaska and Hawaii were excluded from the survey. Inferences from the survey are therefore limited to the 48 contiguous states and the District of Columbia. Additionally, some households with telephones may have been omitted from the sampling frame due the elimination of zero banks. However, because the number of such households is small, the resulting bias in the estimates, if any, is expected to be small.

Statistical Analysis

Because of the complex survey design, SUDAAN software was used to calculate the reported standard errors (Shah, Barnwell, and Bieler, 1997). Variance estimation was based on the Taylor linearization methods.

SURVEY RESULTS

Drivers and Ownership of ATVs

Based on the survey results there are an estimated 5.85 (se=0.51) million ATV drivers in about 2.39 (se=0.14) million

ATV-owning households.[2] While these households own an estimated 3.91 (se=0.32) million ATVs, they had operated only about 3.66 (se=0.30) million during 12 month time period before the survey.

Table 2 summarizes household data on drivers and ATV ownership, and calls attention to the large proportion of ATV-owning households with multiple drivers and ATVs. Almost 70% of the owning households have more than one driver, and almost 40% have more than one ATV. The average ATV-owning household has 2.44 (se=0.18) drivers and owns 1.63 (se=0.10) ATVs, or about 1.50 drivers per ATV. Since only about 94% of the vehicles had been used in the 12 months prior to the survey, there were about 1.53 ATVs in use per ATV-owning household, and about 1.59 drivers per ATV in use.

At the national level, there were an additional 2.78 (se=1.16) million drivers from outside of the owning households. The national estimate is based on information from survey respondents in 36.4% (se=5.3) of the owning households. They reported that from 1 to 30 drivers from outside the household used the household ATV during the month before the survey interview.[3] For nearly three out of every four households reporting outside users, nonowners were estimated to account for no more than 15% of total household ATV use.

Household Demographics

ATV owning households differ somewhat from the general population of households. (Table 3). The majority (59.5%) of ATV-owning households is located in low-density areas, compared with 22.9% of all U.S. households. Regional variations appear to correlate with the population density results. They show that the northeastern states are underrepresented among ATV-owning households, and the midwest and south are overrepresented.

Owning-households tend to have higher education levels and incomes than the US norm. Over 35% of owning households have at least one college graduate:, compared with about 23.6% of all US households. Additionally, while the median income in US households is about $34,000, the median income in ATV households is over $45,000.

Characteristics of ATV Drivers

Selected characteristics of the rider population are shown in Table 4. While driver age varies widely, from 4 to 85 years,

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[2]The standard error of the estimate (se), shown in parentheses here and subsequently in this report, can be used to construct confidence intervals (CI) around the statistic. For example, for any statistic "β" the 95% CI is $\beta \pm (1.96 \times se)$.

[3]Of households reporting outside users during the previous month, only 22.5% reported more than three.

more than three of every four drivers (77.7%) are between the ages of 16 and 54 years. About 14.3% (se=3.7) are under age 16,[4] and only 7.8% (se=1.80) are over age 54. Almost two-thirds of drivers (65.7%, se=4.72) are male. Most drivers have been using ATVs for a long time. The mean experience level (i.e., years that the drivers have been operating ATVs) is about 9.6 (se=0.6) years: only 17.0% (se=3.3) have less than three years of driving experience.

While the age distribution of males and females is about the same, males tend to be somewhat more experienced (10.4 years, se=0.8) than females (8.2 years, se=0.8). Not surprisingly, experience increases with age. The mean years of driving experience increases from 4.1 years (se=1.0) for children under age 16, to 8.5 years (se=0.7) for 16 to 24 year olds, to 11.4 years (se=0.8) for drivers over age 24.

Driver Use Patterns

ATV Usage

The survey collected a substantial amount of information on driver practices, including the frequency of vehicle use, riding surfaces, and specific riding activities. The estimated amount of time spent riding an ATV, measured in hours per month or year, was based on responses to a series of questions intended to determine, for each rider, the number of months of ATV use during the previous 12 month time span, and the number of hours of driving an ATV in a average month of usage. According to the Table 5 results, drivers use ATVs an average of about 7.9 (se=0.53) months per year and ride an average of about 26.9 (se=3.0) hours per month..

As Table 6 shows, the estimated mean and median annual usage is about 252 (se=35) hours and 111 (se=18) hours, respectively. The fact that the mean estimate is substantially higher than the median indicates that annual usage is positively skewed; that is, some drivers reported substantially more hours of use than most, thereby increasing the mean value relative to the median.[5] Although approximate, these riding times imply aggregate annual ATV usage on the order of 0.6-1.5 billion hours annually. Estimated driving times vary substantially from individual to individual. About 31% (se=4.0) of drivers report usage of under

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[4]Drivers outside of ATV-owning households appear to be somewhat younger than drivers from households owning ATVs. Of the estimated 2.78 million drivers from outside of the owning households, an estimated 0.71 (se=0.16) million are under age 16 years,

[5]If the observations for which the estimated riding time is greater than 1,000 hours per year are excluded (n=23) as outlyers, the mean annual riding time decreases to 170.9 hours (se=21.2) per year.

50 hours annually. At the other extreme, almost 16.8% (se=3.4) reported 400 hours or more of annual driving.

Driving times appear to vary somewhat by driver age, with usage decreasing for older drivers. However, the differences are not statistically significant. Similarly, while the estimated driving time for males (266.1 hours, se=49.1) was somewhat higher than for females (229.6 hours, se=47.9), the difference was not statistically significant.

Driving times do not vary meaningfully for three- and four-wheel ATVs, but are directly (and significantly) related to engine size. The survey results show a mean annual riding time of about 101 hours (se=24.8) for ATVs with engines no larger than 125 cc, to 241 hours (se=48.5) for 160 to 250 cc models, and 328 (se=72.0) for models over 250 cc.

Rider Use Patterns

Table 7 provides information on selected driver practices and riding surfaces. The survey asked respondents to estimate how often they engaged in various driving practices (e.g., doing various maneuvers, racing, and frequency of use of selected driving terrains and roadways). Responses were on a four-point scale ranging from "never" to "frequently." About 25.3% (se=5.2) of drivers frequently do difficult maneuvers, such as "wheelies" or "jumping." Most of these drivers are males (84.1%, se=8.9) and most (67.3%, se=12.4) are in the 16 to 24 year old age group. More than half (56.8%) frequently drive on terrain that is especially hilly, uneven, or otherwise difficult. Only 6.7% (se=2.3) frequently or sometimes compete in organized racing, a small proportion compared with the 25.2% (se=5.0) who frequently or sometimes race informally.

About 53.7% (se=4.6) carry passengers frequently or sometimes, and another 23.3% (se=4.0) also do so on rare occasions. The mean reported carrying time, for the 77.0% who acknowledge carrying passengers at all, is about 2.45 (se=0.30) hours for every 10 hours of riding time. Additionally, almost half of all drivers (47.4%, se=4.6) frequently drive alone (rather than with other drivers on their ATVs), another practice that is generally warned against.

Common riding terrains include forests, woods, fields, pastures or ranges, and sand dunes. About 9.2% (se=2.3) of drivers frequently drive on paved roads, a practice strongly warned against; another 17.1% (se=3.6) sometimes drive on paved roads. Additionally, most riding takes place on private lands: 89.3% (se=5.5) of drivers ride on private lands at least some of the time and 27.4% (se=3.9) ride on private lands exclusively.

Safety Equipment

According to the survey, 51.8% (se=4.5) of drivers frequently wear helmets and another 15.8% (se=3.0) do so

sometimes or rarely. (Table 8) Because of the importance of helmets in reducing ATV-related injuries and deaths (Rodgers, 1990b), all respondents who wear helmets at least "rarely" were asked to estimate the number of hours of helmet use for every 10 hours of riding time. As shown in Table 8, helmet use is high at both ends of the distribution: of helmet users, 29.5% wear them for 3 or fewer of every 10 hours of riding time, and 63.2% wear them for 8 or more of every 10 hours. Among helmet users, 52.4% wear them all the time. Among all ATV drivers, 35.5% (se=4.6) wear helmets all of the time.

Helmet use is significantly lower for males, is inversely related to driver experience, and has a nonlinear relationship with driver age. While 50.4% (se=7.7) of women always wear helmets, only 27.9% (se=4.4) of men always do so. With respect to experience, the percentage of drivers who always wear helmets is 48.1% (se=9.2) for those with less than three years of experience, 38.9% (se=9.0) for those with 3 to 9 years of experience, and 30.0% (se=5.8) for those with more than 9 years of experience, With respect to age, 65.6% (se=12.6) of children under age 16 always use helmets, 19.4% (se=7.2) of 16 to 24 year olds always use helmets, and 35.7% (se=4.3) of drivers over age 24 always use helmets.

The results regarding the use of other safety equipment and clothing show that long heavy pants and ankle length boots are frequently used by drivers (78.3% and 53.4%, respectively). Other preferred articles of clothing, worn at least sometimes, are long sleeve shirts and gloves. However, just under half of drivers (46.4%) never wear goggles.

Nonrecreational ATV Use

Almost three of every four drivers (73.7%, se=4.0) use ATVs for at least one nonrecreational activity; 50.8% use ATVs for farming or ranching, 63.0% use them for household chores such as yard and garden work, and 7.7% use them for occupational or commercial tasks. (Table 9) Table 9 provides a frequency distribution of hours of nonrecreational use. Of those who use their ATV for nonrecreational activities, about half (49.6%) use their ATVs nonrecreationally 3 or fewer hours out of every 10 hours of total use, and about 24.2% use their ATVs nonrecreationally 8 or more hours out of every 10.

Drivers in the high nonrecreational use bands (80% or more of the time) may be characterized as those who use their ATVs exclusively or almost exclusively for nonrecreational activities. Over *83%* of these users report farming or ranching activity. Relative to other drivers, high use nonrecreational drivers tend to be older (36 years, se=3.5, vs. 29.5 years, se=1.4) and more experienced (11.6 years, se=1.4 vs. 9.1 years, se=0.6), but they ride less frequently *(184* hours per year, se=28.6 vs. 267 hours per year, se=43.6). Interestingly, 35.5% (se=4.6) of all drivers use helmets all of the time, compared with only 19.3% (se=8.6) of

high nonrecreational use drivers. High nonrecreational use drivers also wear helmets less frequently (2.8 hours out of every 10, se=0.8) than other drivers (5.2 hours, se=0.5).

ATV Driver Training

Table 10 shows how drivers learned to operate ATVs.[6] Nearly two-thirds of respondents (66.9%, se=4.5) said they taught themselves to ride, and half (50.5%, se=5.4) received training from friends or relatives: About 11% said they took an organized training program either arranged through a dealer as part of the ATV purchase (9.5%, se=5.5) or by some other means (1.6%). Additionally, 11.7% (se=5.4) said they received some training. from the dealer or salesperson.

Under the requirements of the 1988 consent decrees, distributors who are members of the Specialty Vehicle Institute' of America (SVIA) offer buyers of new ATVs "free training" as part of the purchase price of a new vehicle.[7] As added inducement, buyers who take the training get a $50 cash payment, a $100 U.S. Savings Bond, or (at the discretion of the distributors) a merchandise certificate in an amount no less than $50. Polaris Inc., which negotiated a separate consent decree, provides training at the point-of-sale. Buyers of the Polaris ATVs must take the point-of-sale training before the ATV warranty can go into effect. Trainings required by the Consent Decrees began in 1988.

A more detailed evaluation of the training responses (which accounts for factors such as the manufacturer, model year, number of wheels, and whether the ATV was purchased new or used), suggests that about 7.3% (se=5.5) of the drivers (about 425,000) may have taken the training program offered by members of the SVIA.[8] Additionally, the Polaris agreement may have led to training of about 3.6% (se=1.2), or about 210,000 drivers.

Nearly one-third of the respondents (32.6%) drove ATV models subject to the training provisions of the consent decrees (i.e.,

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[6]Multiple responses were permitted. About 31.7% of drivers used more than one method.

'The current members of the SVIA include Honda, Kawasaki, Suzuki, and Yamaha, and Arctic Cat (which recently entered the ATV market). Under the SVIA program, the training is also offered to the members of the buyer's immediate family.

[8]As suggested by the relatively large standard error, the estimated number of drivers who took the SVIA training is not precise. However, industry reports that about 323,000 ATV buyers and family members had participated in the SVIA training program as of December 1997, a figure that is well within the 95% confidence level for SVIA training (SVIA, 1998).

were newly purchased 1989 or later model year ATVs), but had not participated in the SVIA or Polaris training programs. Most of these respondents (62.1%, se=6.1) recalled that the dealer had offered free training at the time of purchase. Of those who did recall the offer, the most common explanation for not taking the training was that they already knew how to ride (32.1%). Others reasons cited for not taking the training was the inconvenience of location (11.1%) or time (21.8%), or the fact that a friend or relative had provided training (7.6%).

Characteristics of ATVs in 'Use

This section summarizes survey responses concerning an estimated 3.75 million ATVs owned by households. Because the survey collected information on no more than four ATVs per household, these 3.75 million ATVs represent about 95.9% of all. ATVs (3.91 million, se=0.32) owned by households.[9] Table 11 shows the breakdown of selected vehicle characteristics for three- and four-wheel ATVs.

Wheels and Engine Size

About 21.5% (se=4.2) of the ATVs have three wheels, 77.1% (se=4.2%) have four wheels, and 1.4% (se=0.5) have an unknown number of wheels. Although three-wheel ATVs have not been sold since 1988, they still account for one of every five ATVs owned. (Table 11) About 26.1% (se=5.2) of the ATVs with four wheels have four-wheel drive.

Engine sizes range from about 50 to over 400 cubic centimeters of engine displacement (ccs) . Engine size correlates highly with number of wheels. The great majority of three-wheel ATVs (84.4%, se=4.8) have engine sizes of 250 cc or less. In contrast, most four-wheel models (69.4%, se=6.7) have engines with 225 cc or more.[10]

Males and females tend to drive ATVs with the same range of engine sizes. However, males are more likely than females to drive the older three-wheel ATVs (19.0%, se=3.8 vs. 8.6%, se=3.4). On the other hand, while the number of wheels on the primary ATV driven is not generally related to the driver's age, engine size tends to rise somewhat with age. For example, the mean engine size increases from 231 ccs (se=13.6) for children under age 16, to 257 cc (se=36.8) for 16 to 24 year olds, and to 273 cc (se=9.7) for drivers over age 24.

While engine size tends to increase with age, few children

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[9]An estimated 3.54 million of the 3.75 million ATVs reported upon (94.4%) had been used during the previous 12 months.

[10]The mean engine size for three-wheel models is about 198 cc (se=11.2); the mean for four-wheel ATVs is about 266 cc (se=19.5).

ride the ATVs designed for their use. ATVs with engines greater than 90cc are intended for use by adults and are labeled as not intended for use by children under the age of 16. However, almost all children under the age of 16 (95.9%, se=2.02) ride the ATVs intended for adults.

Miscellaneous ATV Characteristics

The model year for almost half of the ATVs (48.6%, se=3.25) was reported as 1990 or later.[11] Additionally, almost half (45.9%, se=3.6) had been owned (by the current owner) for under three years. The absence of three-wheel models of recent vintage reflects the impact of the three-wheel ATV stop-sale in 1988.

Just over half (50.6%, se=3.1) of all ATVs were purchased in the secondary market for used vehicles. Additionally, most of the used ATVs (83.9%, se=4.3) were purchased from the previous owner rather than a franchised dealer (15.9%, se=4.3). This means that *42.4%* (se=3.3) of'all the ATVs in U.S. households were purchased outside of the franchised ATV dealer system.

Owners modified about 58.7% (se=4.7) of the ATVs since purchase. Over one-third (35.6%, se=5.2) have different tires or wheels, 17.1% (se=3.9) have new special exhaust systems, 6.8% (se=2.1) have modified engines, and about *7.6%* (se=1.7) have a modified suspension. The-proportion of modified three-wheel models did not differ significantly from four-wheel models (64.0% vs 57.7%, respectively).

Warning *Labels on ATVs*

The survey obtained information on the presence and consumer awareness of ATV warning labels required by the consent decrees. Table 12 shows the results for ATVs of model year 1989 or later vehicles that should have the warning labels.

About 80.9% of the drivers reported the presence of labels on their primary ATV. The most frequently recalled warning labels were (1) against carrying passengers (80.6%), and (2) against riding without a helmet *(77.3%).* Just over half, 51.2%, recalled a warning against using alcohol or drugs when riding, and 64.4%, who had adult sized ATVs (i.e., ATVs with engines of 90 cc or more), recalled a warning against the use of adult-sized ATVs by children. Less than half of the respondents recalled warnings against driving on public roads (47.4%), driving on paved surfaces (44.9%), or stunt riding *(41.7%).* The least frequently recalled warning was for riding too fast *(32.2%).*

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[11]ATVs of a particular model year are introduced into the market during the late summer or fall of the preceding year. Thus, for example, some 1990 model year ATVs would have been purchased in 1989.

Further analysis of responses to the warning label questions suggests that a large proportion of drivers who are aware of specific warnings disregard them. About 65.1% of drivers who frequently carry passengers and 75.9% of those who sometimes carry passengers are aware of the label warning against the practice. Similarly, 40.5% of the drivers who frequently ride on paved roads and 62.9% of those who sometimes do are aware of the label warning against the practice.

DISCUSSION

The results of the exposure survey provide a detailed description of the characteristics and use patterns of ATV drivers and the types of ATVs they use. Additionally, the survey methodology, based on interviews with a national probability sample of drivers from ATV-owning households, allows us to quantify the population of users and ATVs. Based on the survey results, there are an estimated 2.39 million U.S. households that own approximately 3.91 million ATVs. When the survey findings are viewed in conjunction with the results of an earlier ATV exposure survey conducted by the CPSC in 1989 (Rodgers, 1990a), when there were an estimated 2.75 million ATVs in use, the results also reveal some trends in ATV usage patterns.

Drivers and Use Patterns

As shown in Table 13, the profile of drivers has changed somewhat since the 1989 survey. While male drivers still comprise about two-thirds of all drivers, a smaller proportion of drivers are under age 16 [about 14.3% in 1997 vs. 23.2% in 1989). One possible explanation of the declining proportion of ATVs used by children is that the consent decrees, which do not allow sales to (or for the use of) children under age 16, and the concomitant labels and warnings have been helpful in reducing children's usage of adult-sized ATVs.

Alternatively, this finding could reflect some degree of underreporting of children respondents. Some parents may, for example, have been reluctant to acknowledge a child's usage of an adult-sized model, a practice warned against in the warning labels. However, there is no reason. to believe that such underreporting represents a substantial bias in the driver estimates. Such a bias, if it exists at all, would also have been present in the 1989 survey, which was conducted about 18 months after the consent decrees were signed and at a time in which ATVs and children's usage of ATVs had received a substantial amount of negative publicity. Moreover, as described in the survey methodology, information on the age and gender of each non-respondent was collected at the end of the survey in order to weight for the possible under- or over-reporting of respondents in the various age-gender categories.

While the available evidence suggests that the proportion of drivers who are children has decreased in recent years, few drivers under the age of 316 actually drive the ATVs intended for

their use. The great majority (95.9%) drive ATVs with engines of more than 90cc, ATVs which are intended for use by adults and are currently sold with labels explicitly warning against their use by children.

The survey results also suggest an increase in the nonrecreational use of ATVs, with activities ranging from yard and garden work to farming, ranching, and commercial activities. The proportion of drivers reporting nonrecreational use of their ATV increased from about 52.5% in 1989 to about 73.7% in 1997, with almost half saying that the ATVs were used in farming or ranching activities. The proportion of aggregate riding time that ATVs were used in nonrecreational applications also increased from just over one-quarter of total ATV use in 1989 to almost one-third of the total in 1997.

ATVs-In-Use

Most (93.6%) of the 3.91 million ATVs owned in 1997 had been used during the previous year. A disproportionate share of unused vehicles (about 42%-50%) were the older three-wheel models. Nevertheless, just over one-fifth of the ATVs in "recent" use are three-wheel models, which have not been sold in the new product market since the consent decrees became effective in 1988. Moreover, when compared to sales data, the results suggest that roughly one-third of the three-wheel ATVs produced and sold through 1987 remain in use.

The large number of three-wheel ATVs still in use attests to their durability as well as their popularity with some drivers. Nonetheless, based upon the vehicle characteristics upon which information was collected in the survey, the wheel and engine characteristics of all ATVs in use today are substantially different than in 1989. From 1989 through 1997, the share of four-wheel models increased from about 45.6% of all ATVs in use to almost 80%. Four-wheel drive models, which currently account for about 26% of all four--wheel ATVs in use, were just becoming popular in 1989 and accounted for a relatively small share of ATVs at that time. Additionally, the mean engine size of ATVs in use increased by roughly 30%, from an average of about 190 cubic centimeters of displacement (ccs) to 250 ccs.

While the market share of four-wheel ATV sales had been rising throughout the 1980s, the large share of four-wheel ATVs *now in* use is also related to the 1988 consent decree provisions stopping the sale of new three-wheel ATVs. The explanation for the increasing size of engines is less clear, but is related to an upward trend in size of engines for both three- and four-wheel ATVs that began in the early 1980s (Rodgers, 1996). The increase may have also been affected, to some extent, by the increasing sales of four-wheel-drive vehicles (which tend to have large engines) for nonrecreational applications.

The survey results also demonstrate the importance and size

of the secondary market for used ATVs. About half of the ATVs in use were purchased as used vehicles. Moreover, over 80% of the ATVs purchased as used vehicles were purchased from individual owners, as opposed to franchised ATV dealers. Thus, while point-of-sale information and warnings (such as those required by the consent decrees) reach the majority of ATV buyers, they may not reach a significant minority.

References

Abt Associates Inc. (14 August 1997). *ATV Exposure Survey:* Pretest Report. (Technical Report CPSC-C-94-1115, No. 4). Cambridge, MA: Author.

Cochran, W.G. (1977). *Sampling Techniques,* third *edition.* New York: John Wiley & Sons.

Consumer Product Safety Commission, U.S. (15 April 1997). Proposed Collection; Comment Request --All-Terrain Vehicle Exposure Survey. *Federal Register.* 62(72), 18333-18334.

Kish, Leslie. (1965). *Survey Sampling.* New York: John Wiley & Sons.

Kulp, Dale W. *Dynamics of "List-Assisted" Random Dialing (RRD) Frame Coverage.* Fort Washington, PA: Marketing Systems Group, 1995.

Marketing Systems Group. (August 1997). *GENESYS Sampling System Methodology.* Fort Washington, PA: Author.

Rodgers, Gregory B. (1990a). *Descriptive Results of the 1989 All-Terrain Vehicle Exposure Survey.* Washington, DC: U.S. Consumer Product Safety Commission.

Rodgers, Gregory B. (1990b). The Effectiveness of Helmets in Reducing All-Terrain Vehicle Injuries and Deaths. *Accident Analysis and Prevention, 22* (1), 47-58.

Rodgers, Gregory B. (1996). "Revisiting All-Terrain Vehicle Injury Risks: Response to Critique/ *Journal of Regulatory Economics,* 10, 201-216.

Shah, B.V., B.G. Barnwell, and G.S. Bieler. (1997). *SUDAAN User's Manual, Release 7.5.* Research Triangle Park, NC: Research Triangle Institute.

Special Vehicle Safety Institute. (January 1998). *ATV Rider Training Summary By* State. Irvine, CA: Author.

Stoner, Diane, and K.P. Srinath. (1998). *All-Terrain Vehicle* Exposure *Survey.* (Technical Report CPSC-C-94-1115, No 4). Cambridge, MA: Abt Associates, Inc.

TABLE 1
FINAL DISPOSITION OF SAMPLED TELEPHONE NUMBERS

Disposition	Total	Number
.. Total Screened-in	**561**	
a. Completed interview		464
b. Screened-in household, unable to complete interview with designated respondent		38
c. Screened-in household, refused interview		59
2. Total Screened-out	**17,318**	
3. Total Unresolved Numbers	5,451	
a. Busy, no answer, answering machine, general call back after 8 attempts		3,647
b. Hung up during introduction		33
c. Refused before screening interview completed		1,374
d. Language barrier		392
e. Other		5
4. Total Non-Household Numbers	12,902	
a. Non-working numbers		8,439
b. Non-household working numbers		4,463

TABLE 2
DRIVERS AND ATVS PER HOUSEHOLD

Drivers (per household)	Households (thousands)	Percent
1	764.7	32.0
2	723.7	30.2
3	412.8	17.3
4	230.4	9.6
5	124.0	5.2
6 or more	137.1	5.7
Total	2,392.7	100.0
Mean Number of Drivers:	2.44	
Standard Error:	0.18	

ATVs Owned (per household)	Households (thousands)	Percent
1	1,490.9	62.3
2	556.9	23.3
3	230.8	9.6
4	23.8	1.0
5 or more	90.3	3.7
Total	2,392.7	100.0
Mean Number of ATVs Owned:	1.63	
Standard Error:	0.10	

ATVs Used During Preceding Year (per household)	Households (thousands)	Percent
1	1,676.6	70.1
2	386.4	16.2
3	229.5	9.6
4	22.5	0.9
5	77.7	3.2
Total	2,392.7	100.0
Mean Number of ATVs Used:	1.53	
Standard Error:	0.10	

Totals may not add up to 100.0% due to rounding.

TABLE 3
HOUSEHOLD DEMOGRAPHICS

	Survey Results (%)		1996 Census Data (%)	
Geographic Region				
Northeast	5.3		19.5	
Midwest	28.6		23.7	
south	43.3		35.4	
West	22.8		21.1	
Population Density				
< 100,000	59.5		22.9	
100,000-499,999	14.2		17.4	
500,000-1,999,999	15.6	26.3		59.7
2,000,000 or more	10.7			
Highest Level of Education				
High school or less	28.6		51.9	
Trade or Vocational School	4.7		--	
Some College	30.0		24.5	
College Graduate	27.1		15.8	
Attended Graduate School	8.2		7.8**	
Unknown	1.4		0	
Total Household Income				
< $15,000	5.1		20.5	
$15,000-$29,999	14.8		22.5	
$30,000-$44,999	17.6		18.0	
$45,000-$59,999	19.3		1314	
≥ $60,000	26.0		25.7	
Unknown	17.2		--	

Totals may not add up to 100.0% due to rounding.
** Advanced degree obtained

TABLE 4
PROFILE OF ATV DRIVERS

Characteristics	Drivers (%)
Age (years)	
≤ 15	14.3
16-17	8.2
18-24	18.7
25-34	22.2
35-44	17.1
45-54	11.5
≥ 55	7.8
Unknown	0.3
Total	100.1
Gender	
Male	65.7
Female	34.1
Unknown	0.3
Total	100.1
Driving Experience (years)	
< 1	4.5
1 to < 3	12.5
3 to < 6	21.0
6 to < 9	9.1
9 to c 12	16.7
13 to c 15	12.0
15 or more	22.7
Unknown	1.6
Total	100.1
Mean Experience	9.6 years
Standard Error	0.6

* Totals may not add up to 100.0% due to rounding.

TABLE 5
MONTHLY' ATV USAGE ESTIMATES

Driving Time in an Average Month of Use (hours/month)	Drivers (%)
< 5	8.9
5-9	13.9
10-24	33.8
25-49	14.8
≥ 50	16.7
Unknown	2.0
Total	100.1
Mean	26.9
Std Error	3.0
Median	14.3
Std Error	1.74

Age Group (years)	Mean Monthly Driving Time (hours/month)
< 15	24.8
16-24	43.1
25-34	24.6
35-44	18.5
45-54	17.2
≥ 55	14.8

Gender	Mean Monthly Riding Time (hours/year)
Male	28.2
Female	24.7

Months of ATV Use During Preceding Year	Drivers (%)
≤ 1	7.0
2-4	23.2
5-7	14.7
8-10	7.1
11-12	46.2
Unknown	1.8
Total	100.0
Mean	7.9
Std Error	0.53

' Totals may not add up to 100.0% due to rounding.

TABLE 6
ANNUAL ATV USAGE ESTIMATES

Annual Driving Time (Hours/Year)	Drivers (%)
≤ 49	31.0
50-99	13.1
100-199	23.2
200-399	10.8
400-599	4.3
> 600	12.5
Unknown	5.0
Total	99.9
Mean	252.3 hours
Std Error	35.3
Median	110.9 hours
Std Error	17.5
Age Group (years)	**Mean Annual Driving Time (hours/year)**
≤ 15 years	294.1
16-24 years	351.1
25-34 years	254.2
35-44 years	184.2
45-54 years	140.9
≥ 55	150.0
Gender	**Mean Annual Riding Time (hours/year)**
Male	266.1
Female	229.6

Totals may not-add up to 100.0% due to rounding.

TABLE 7
DRIVER PRACTICES AND RIDING SURFACES

Driving Practices	Frequency				
	Frequently (%)	Sometimes (%)	Rarely (%)	Never (%)	Unknown (%)
Carry passengers	30.3	23.4	23.3	23.0	0
Do difficult maneuvers	25.3	9.2	7.1	58.4	0
Engage in organized trail rides	30.6	10.5	8.0	50.8	0
Compete in organized racing	3.7	3.0	4.1	89.1	0
Race informally	13.8	11.4	11.1	62.2	1.6
Drive on difficult terrain	56.8	20.6	10.4	12.2	0.1
Ride alone	47.4	24.6	7.5	20.5	0.
Check tire pressure	44.4	26.9	9.9	16.1	2.7
Driving Terrain					
Fields, pastures, ranges	50.5	14.6	14.3	20.5	0.1
Forest, woods	60.3	18.2	7.3	14.2	0
Yards, lawns	43.0	13.3	14.4	29.4	0
Desert, sand dunes	13.0	6.6	7.2	73.1	0
Roadways					
On paved roads	9.2	17.1	24.3	49.4	0
Crossing paved roads	22.9	20.1	22.0	34.9	0.1
On non paved roads	73.6	10.6	7.6	8.2	0
Crossing non paved roads	53.4	22.6	11.7	12.3	0
On public roads	11.4	13.0	16.8	58.7	0.1

* Totals may not add up to 100.0% due to rounding.

TABLE 8
SAFETY EQUIPMENT AND CLOTHING

Safety Equipment	Frequency				
	Frequently (%)	Sometimes (%)	Rarely (%)	Never (%)	Unknown (%)
Wearing:					
Helmets	51.8	12.0	3.8	32.3	0
Goggles	38.2	8.4	7.0	46.4	0
Gloves	34.4	21.9	7.0	36.5	0.3
Long sleeved shirts	47.5	35.4	5.8	10.8	0.5
Long-heavy pants	78.3	13.0	1.0	7.6	0.1
Ankle length boots	53.4	14.3	5.1	24.2	0

Reported helmet use (Hours out of every 10)	Drivers Who Wear Helmets (%)
≤1	15.5
2-3	14.0
4-5	6.0
6-7	1.3
8-9	10.8
10	52.4
Total	100.0
Mean	7.0
Standard Error	0.6

* Totals may not add up to 100.0% due to rounding.

'TABLE 9
NON-RECREATIONAL ATV USE

Non-recreational Activities (multiple responses possible)	Participation Yes (%)	No (%)	Unknown (%)
Farming or ranching	50.8	49.2	0
Chores, such as yard and garden work	63.0	37.0	0
Occupational or commercial tasks	7.7	92.3	0
Other non-recreational activities	11.4	88.5	0.1
Total (at least one nonrec activity)	73.7	26.3	0

Non-Recreational Use* Hours (Out of 10)	Percent (%)
≤1	24.5
2-3	25.1
4-5	16.2
6-7	7.9
8-9	15.9
10	8.3
Unknown	2.1
Total	100.0
Mean	4.42 hours
Std Error	0.30

*For Non-Ret Users

TABLE 10
ATV TRAINING

Part I. For all drivers:

How drivers learned to operate ATVs (multiple responses possible)

Organized training, arranged through dealer as part of ATV purchase	9.5
Other organized training	1.6
Trained by Dealer/Salesperson	11.7
Received training firom friend or relative	50.5
Self-taught	66.9
Other	1.2

Part II. For drivers whose households purchased a model year 1989 or later ATV from a dealer, but did not participate in an organized training program:

Dealer offered "free" training as part of ATV purchase	Drivers (%)
Yes	62.1
No	29.0
Unknown	8.9
Total	100.0

Reason for not taking free lesson (multiple responses possible)	Drivers (%)
Inconvenient location	11.1
Inconvenient time	21.8
Did not need/Already know	32.1
Friend or relative provided	7.6
Other	27.1

* Totals may not add up to 100.0% due to rounding.

TABLE 11
VEHICLE CHARACTERISTICS

Characteristics	Total (%)	Three-wheel (%)	Four-wheel (%)
Number of Wheels			
Three	21.5	100.0	
Four	77.1		100.0
- four-wheel drive	(20.1)	-	(26.1)
- two-wheel drive	(78.2)		(73.5)
Unknown	1.4		
Total	100.0	100.0	100.0
Engine Size Groups. (cc's)			
< 90	7.3	8.5	7.0
90-125	12.3	20.9	9.0
160-200	12.0	27.5	7.9
225-250	25.4	27.6	25.2
300	12.5	2.9	15.3
350	14.6	5.6	17.3
400 or more	9.4	1.5	11.6
Unknown	6.6	5.6	6.7
Total	100.0	100.1	100.0
Model Year			
1979 or before	0.2	0.5	0.1
1980-84	12.8	35.0	6.8
1985-89	28.0	46.6	23.4
1990-94	29.3	2.1	37.4
1995 or after	19.3	0	24.8
Unknown	10.4	15.9	7.5
Total	100.0	100.1	100.0
How Acquired			
Purchased New	48.0	31.5	53.4
Purchased Used	50.6	68.5	46.3
- from dealer	(8.0)	(3.5)	(9.3)
- from previous owner	(42.4)	(65.0)	(36.9)
Unknown	1.4	0	0.3
Total	100.0	100.0	100.0
Years Owned			
< 3	45.9	28.7	50.9
3 to<6	20.5	25.3	19.5
6 to < 9	10.7	9.5	11.2
9 to < 12	16.2	15.7	16.6
≥ 12	4.9	18.3	1.2
Unknown	1.8	2.5	0.6
Total	100.0	100.0	100.0
Modifications (mult. response)			
Different tires or wheels	35.6	44.1	33.9
Special Exhaust System	17.1	18.9	16.9
Suspension Modifications	7.6	7.2	7.8
Engine High Performance Kit	6.8	7.7	6.7
Utility Rack	11.7	13.4	11.4
Gun Rack	5.4	3.4	6.0
Other Modification	24.4	12.4	28.2
Total (at least 1 mod)	58.7	64.0	57.7

Totals may not add up to 100.0% due to rounding.

TABLE 12
ATV WARNING LABELS*

	Yes (%)	No (%)	Don't Know (%)
Are there warning labels on the ATV?	80.9	19.1	0
ATV has labels warning against: (for drivers who reported the presence of warning labels)			
Carrying passengers	80.6	10.9	8.5
Driving on public roads	47.4	34.7	17.9
Driving on paved surfaces	44.9	36.5	18.6
Driving without a helmet	77.3	14.5	8.2
Riding too fast	32.2	49.3	18.5
Drug and alcohol use when riding	51.2	35.8	13.1
Stunt riding	41.7	46.6	11.7
Use of adult sized ATVs by children**	64.4	21.0	14.6

* Questions asked of the estimated 49.2% of drivers whose primary ATV was produced after the effective date of the ATV consent decrees (1989 or later models).

** Asked if the ATV engine size was 90cc or more.

TABLE 13
SELECTED DRIVER AND VEHICLE CHARACTERISTICS, 1989 AND 1997

Driver Characteristics	Drivers(%) 1989	1997*
Age (years)		
<15	23.2	14.3
16-24	16.7	27.0
25 or more	60.1	58.7
Gender		
Male	66.7	65.8
Female	33.3	34.2
Experience (years)		
<1 year	5.3	4.6
1 to <3	21.5	12.7
3 or more	73.2	82.7
Non-Recreational Use (at least some of the time)		
Yes	52.5	73.7
No	47.5	26.3
Vehicle Characteristics	**Vehicles(%) 1989**	**1997***
Wheels		
Three	54.4	21.8
Four	45.6	78.2
Engine Size Group (cc's)		
<90	7.7	7.8
90-125	25.9	13.2
160-200	28.3	12.8
225-250	29.0	27.2
300 or more	9.1	39.0
How Acquired		
Purchased New	61.1	48.7
Purchased Used	38.9	51.3

* The percentages for 1997 differ from those in Tables 4 and 11 because the unknown values have been distributed over the known categories for purposes of comparison to the 1989 data.

PART II
Report on 1997 ATV Injury Survey

April 1998

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Executive Summary

In 1997 there were an estimated 54,500 emergency department-treated injuries associated with all-terrain vehicles (ATVs) according to a special study of cases reported to the National Electronic Injury Surveillance System (NEISS) . This represents a rate of injury of 1.5 injuries per 100 ATVs in use. This rate is substantially lower than the 1985 rate of 5.4 injuries per 100 vehicles in use. The rate of injury for four-wheel ATVs declined from 3.9 in 1985 to 1.4 per 100 in 1997; and for three-wheel, from 5.8 to 1.8.

In 1997 the U.S. Consumer Product Safety Commission (CPSC) staff conducted a special study of ATV-related injuries. All non-occupational ATV-associated emergency department-treated injuries reported through NEISS from May 1, 1997, through August 31, 1997, were assigned for telephone follow-up survey. The survey response rate was 68% resulting in 319 completed cases being used for analysis in the study.

Almost one-half of the injured people in the special study were children under the age of 16. Almost two-thirds of the injuries were seemingly minor injuries such as contusions, abrasions, lacerations, and strains and sprains. However, the overall hospitalization rate for ATV-associated injuries was 13% which is high compared to the overall rate for product-related injuries reported through NEISS (4%).

Head injuries were approximately 20% of all injuries in the special study. A large portion (at least 65%) of those receiving head injuries were not wearing helmets.

Overall, 25% of the injured were passengers and 38% of drivers involved in incidents were carrying passengers. These were slight increases over 1985, when 20% of the injured were passengers and 31% of drivers were carrying passengers.

Drivers under 16 were generally not on smaller vehicles than older drivers. Overall, 95% of drivers under age 16 were on vehicles larger than recommended for their age.

Very few (approximately 4%) of the drivers involved in injury incidents had received any formal training in operating an ATV.

These results were generally consistent with earlier studies when the observed changes in the number of three-wheel versus four-wheel ATVs in use are taken into account.

Introduction

In April 1988 the U.S. Consumer Product Safety Commission (CPSC) entered into Consent Decrees of ten years' duration. with the manufacturers and/or distributors of all-terrain vehicles (ATVs) to institute several procedures to make the use of ATVs safer, These included:

- stop-sale of three-wheel ATVs
- providing warnings about dangerous riding practices
- providing a national training program
- restricting the sale of adult-sized ATVs for use by children under 16
- developing a voluntary standard to make ATVs safer to ride.

These agreements were based in part on studies completed by CPSC in 1985-1987 (Newman, 1985, 1987; Rodgers, 1986) which found, among other things, that the risk of injury was higher for three-wheel ATVs and that children under 16 years of age on an adult-sized ATV were particularly at risk for injury or death.

In 1989, similar studies of ATV deaths, injuries, and use were conducted (Scheers et al, 1991; Rodgers, 1989). Risk factors were found to have remained the same for 1985 and 1989. Increased risks were associated with males, younger drivers, larger engine sizes, unmodified ATVs, more recreational use, more hours of use, and less driving experience.

As the end of the period of the Consent Decrees approached, factors affecting the risk of injury and death associated with ATV use were again investigated to determine whether they had changed. Historical death and injury data were analyzed, and injury and exposure surveys were conducted in 1997. This report presents preliminary results concerning injuries associated with ATVs.

Methodology

This report includes injury data obtained from two sources: the National Electronic Injury Surveillance System (NEISS) and a special study conducted in the summer of 1997.

NEISS. CPSC's NEISS is a national probability sample of hospitals in the U.S. and its territories which have emergency departments (EDs). The NEISS sample is stratified by size of the ED (number of ED visits) so that all sizes of EDs are appropriately represented. NEISS has been in place since the early 1970's.

The 1997 NEISS data were collected using an updated hospital sampling frame. In this instance, a sampling frame refers to a

listing of the hospitals in the U.S. and its territories from which sample hospitals are selected. Data from 1989 to 1996 had been collected using a listing of hospitals which were in existence in 1985 (the 1985 sampling frame) and a group of hospitals selected from that frame. Since 1985, some hospitals have merged to create larger hospitals, while others, particularly small, rural hospitals, have closed. As a result, the distribution and types of hospitals around the country have changed, so that the sample of hospitals selected from the 1985 frame reflects the number and type of injuries treated in hospital EDs less accurately today than at the time the frame was created. To correct this, a new sampling frame was developed and the sample of hospitals used was updated to represent the new frame. There were 101 hospitals selected from the new sampling frame and used to develop the 1997 injury estimates.

Since the deterioration of the sampling frame is assumed to have occurred gradually over the entire period since 1985, annual estimates from 1997 back to 1985 have been adjusted retrospectively to correct for the deterioration.

The NEISS data collected from these 101 hospitals were used to provide national estimates of the number of ED-treated injuries associated with ATVs. These estimates are presented as weighted estimates, that is, the number of observations has been weighted to account for the NEISS sampling design. Standard errors[1], where reported, are given in parentheses following the estimate: for example, the estimated number of ED-treated injuries associated with ATVS in 1997 was 54,500 (55,100).

NEISS data include age and sex of the injured person, the nature of the injury (diagnosis and body part), and whether the individual was treated and released or admitted to the hospital (disposition).

Special Study In order to obtain more detailed information about the circumstances under which the ATV-associated injury occurred, a special study of NEISS ATV injuries was conducted in 1997. All non-occupational ATV-associated ED-treated injuries reported through NEISS from May 1, 1997, through August 31, 1997, were assigned for telephone follow-up using a survey questionnaire similar to that used in the 1985 and 1989 injury studies. The injured person was surveyed whenever possible. Other respondents included parents, spouses and other relatives. Information was obtained on the injured person, the ATV driver

[1]The interval between the estimate minus 2 standard errors and the estimate plus 2 standard errors is the 95% confidence interval. We can be 95% confident that the quantity being estimated falls somewhere in the interval.

and/or passenger (if different from the injured person), the characteristics of the ATV, and the injury scenario.

The survey response rate was 68%, resulting in a total of 319 completed cases which were used for analysis. See TAB A for a detailed accounting of how 319 analyzable cases resulted from the 487 cases assigned from NEISS. All numbers reported are weighted estimates. In addition to being weighted to account for the NEISS sampling design, the study estimates are also weighted to account for nonresponse to the survey. All tests for statistical significance were performed on the weighted estimates using SUDAAN software (Shah, Barnwell, and Bieler, 1997). A significance level of .05 was used for all statistical tests ($p<0.05$). Marginal differences ($0.05<p<0.10$) are also noted.

Results

The analysis of the injury data provided in this report focused on variables which had been shown to be important risk factors in previous studies or had particular relevance to provisions of the Consent Decrees.

Injury information from NEISS and the special study is presented to answer the following questions:

- How many people are being injured on ATVs and who is being injured?
- What types of injuries are occurring and how severe are they?
- What types of vehicles are involved?
- What are the interactions between driver, injured person, and vehicle?
- How are the injuries occurring?

How many people are being injured on ATVS and who is being injured?

Number of Iniuries. There were an estimated 55,400 (±5,500) injuries to all age groups associated with ATVs for the calendar year 1997 according to NEISS, using the 1997 sampling frame.

Total estimated injuries for the special study period May 1, 1997, through August 31, 1997, were 23,700 (±2,200). Based on the distribution of NEISS cases throughout the year, this time period represents 43.5% of the total annual injuries. Therefore, based on the injury study results, the estimated annual number of injuries for 1997 would be 54,500 (± 5,100). This number is somewhat lower than the NEISS estimate of 55,400 (±5,500) because the survey revealed that a few of the cases identified by NEISS were out of scope (some other product, etc.). The special study estimate is taken to be the most accurate.

NEISS estimates of the annual number of ED-treated ATV-associated injuries from 1982 through 1997 are presented in Figure 1 "Annual ATV Injury Estimates" (following page). The upper pair of lines represent injuries for all ages: the lower of the two lines shows estimates which have been adjusted retrospectively for the 199'7 sampling frame update; the upper line shows the original estimate based on the 1985 sampling frame. The lower pair of lines on the graph are the corresponding estimates of injures to children under age 16.

ATV-associated injuries peaked at 106,000 in 1986, declined steadily through 1993 and have remained relatively constant since then. Injuries to children under age 16 followed a similar pattern; also declining from a 1986 peak. In 1986, 45% (47,600) of ATV injuries were to children under 16. In 1993, 36% (17,900) were to children and in 1997, 39% (21,600) of the injuries were to children under age 16.

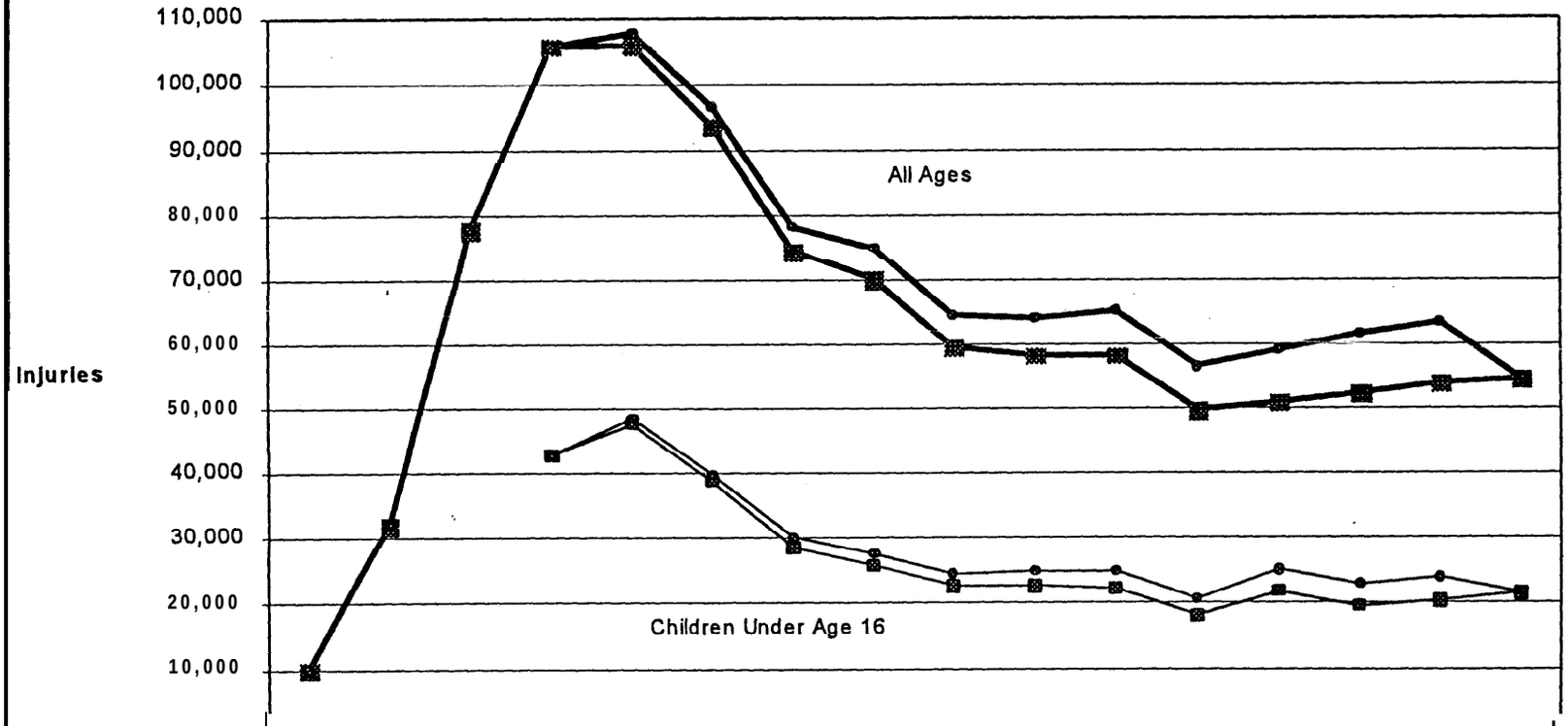
Rate of Injury. Table 1 presents information on ATV-associated injuries, numbers of ATVs in use, and the rate of injury per 100 ATVs in use for 1985, 1989, and 1997. The number of injuries for each time period has been adjusted for 1997 NEISS sampling frame changes and therefore differs from earlier published estimates (Scheers et al, 1989).

Table 1. Rate* of Injury - All Ages

		Total	4 Wheels	3 Wheels
1985	Injuries	105,700	14,300	91,400
	ATVs in Use	1,942,000	366,000	1,576,000
	Rate	5.4	3.9	5.8
1989	Injuries	70,300	35,700	34,600
	ATVs in Use	2,773,000	1,335,000	1,438,000
	Rate	2.5	2.7	2.4
1997	Injuries	54,500	39,900	14,600
	ATVs in Use	3,660,000	2,862,000	798,000
	Rate	1.5	1.4	1.8

* per 100 ATVs in use

Figure 1. Emergency Department-Treated ATV injuries



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1997 Frame	10,100	32,100	77,900	105,700	106,000	93,600	74,600	70,300	59,500	58,100	58,200	49,700	50,800	52,200	53,800	54,500
1985 Frame	10,100	32,100	77,900	105,700	107,700	96,600	78,200	74,900	64,500	64,000	65,200	56,700	59,200	61,700	63,400	54,500
1997 Frame <16				42,700	47,600	38,600	28,500	25,700	22,400	22,500	22,000	17,900	21,500	19,300	20,200	21,300
1985 Frame <16				42,700	48,400	39,800	29,900	27,400	24,300	24,800	24,700	20,400	25,000	22,800	23,900	21,300

Year

Between 1985 and 1997, the overall number of ATVs in use in a given year approximately doubled, while the annual number of injuries dropped by approximately half. As a result, the 1997 overall injury rate was about one-quarter that of 1985.

Four-wheel ATV-associated annual injuries increased approximately threefold, while the number of four-wheelers in use in a given year increased eightfold. As a result, the 1997 four-wheel injury rate was about one-third that of 1985.

Three-wheel ATV-associated injuries in 1997 were one-sixth as great as in 1985, while the number in use in a given year halved, i.e., the number of: injuries dropped three times as fast as the number of vehicles in use. The resultant injury rate was one-third that of 1985.

Despite the substantial decline in injury rates, the absolute number of injuries remained at more than 50,000 per year. Moreover, a rate of 1.5 injuries per 100 vehicles in use is high. For comparison, the injury rate for bicycles is 0.88 per hundred vehicles in use (Tinsworth, 1994).

Ase and Sex of In[illegible]d. Table 2 presents the distribution of injured persons in [illegible]special study by age and sex. Overall, 75% of the injured wer[illegible]les, 25% females.. This distribution was also found in the [illegible]S data for the entire year 1997.

Table 2. Sex of fnjur[illegible]erson by Age of Injured Person

Estimate Row % col %	Totals	Age Group <12	12-15	16-24	25&UP
Totals	23700 100% 100%	5090 22% 100%	6020 25% 100%	6000 25% 100%	6600 28% 100%
Sex **Male**	17850 100% 75%	3750 21% 74%	3900 22% 65%	4620 26% 77%	5570 31% 84%
Female	5850 100% 25%	1330 23% 26%	2110 36% 35%	1380 24% 23%	1020 17% 16%

In the special study, there were marginally significant differences within the overall age/sex distribution (p=0.0591).

This effect was due to the 12-15 year old age group's having a significantly higher proportion of injured females than did the 25&UP age group (p=0.0062).

The special study injuries were approximately equally divided among the four age groups shown, with roughly 25% in each age group, so that almost half the injuries in the special study were to children under the age of 16. In the NEISS estimate for the year, approximately 39% of the injuries occurred to children under 16. This difference may reflect more ATV usage by children in the summer months.

Summary The 1997 injury numbers were consistent with those reported in past studies. Absolute numbers of injuries have remained relatively stable after a sharp decline in the late 1980's and early 1990's. Since overall ATV use has increased substantially while injuries have remained constant, the overall rate of injury has declined. Children under 16 continued to represent a large portion of ATV-associated injuries.

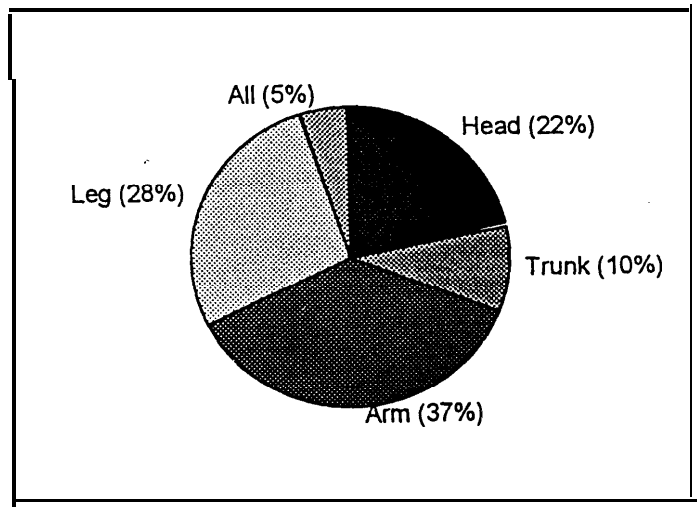
What types of injuries are occurring and how severe are they?

In 1985, the leg region was the most frequently injured part of the body, with 39% of the total injuries, followed by the arm region and the head region, each with 20% of the total injuries. The upper trunk sustained 14% of the injuries. Contusions/abrasions accounted for 29% of the injuries in 1985, while fractures were 24%, lacerations were 20% and strains/sprains were 15%. Overall, about 18% of injuries were hospitalized (Newman, 1985).

Body Part Injured and Type of Injury.

TAB B presents the distribution of 1997 special study injuries by body region and diagnosis, as well as by disposition and diagnosis. Injury distribution by body region is shown in Figure 2 and by diagnosis in Figure 3.

Figure 2. Body Region Injured

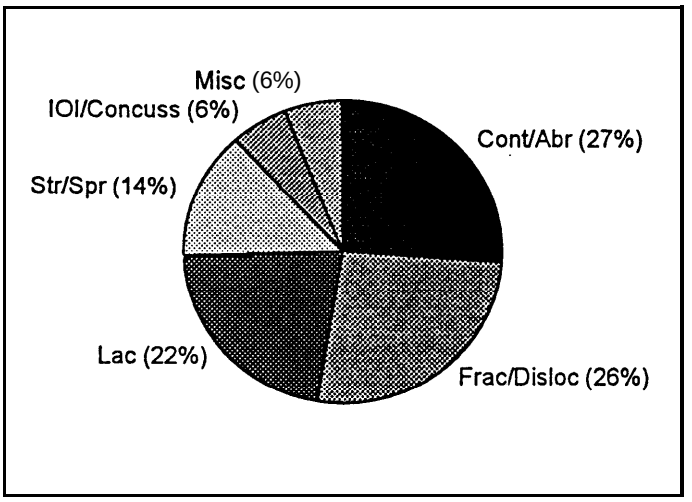


The head region included the head, face, eye, ear, mouth, and neck. The trunk region included the upper trunk, lower trunk, and pubic region. The arm region included the shoulder, upper arm, elbow, lower arm, wrist, hand,

and finger. The leg region included the upper leg, knee, lower leg, ankle, foot, toe. The "all" region included 25 to 100% of the body.

The NEISS data for the year differed slightly, with 15% of injuries to the trunk region and 31% to the arm region.

Figure 3. Injury Diagnosis



Injury diagnoses were grouped as contusions and abrasions (Cont/Abr), fractures and dislocations (Frac/Disloc), lacerations (Lac), strains and sprains (Str/Spr), internal organ injuries and concussions (IOI/Concuss). Amputations, dental injuries, hemorrhage, avulsion, thermal burns, dermatitis, conjunctivitis and other were combined into the miscellaneous group (Misc).

The special study showed approximately 4% more lacerations than did the NEISS data for the entire year (18% lacerations in NEISS, 22% in the special study).

The most frequent injury reported in the special study was fracture/dislocation of the arm region, which accounted for 17% of the total injuries. Of these arm region fracture/dislocations, 36% were to the shoulder, 25% to the lower arm, and 25% to the wrist (See TAB 13).

The second most frequent injury was laceration to the head region (9% of total injuries). Of these head lacerations, 44% were to the face, 37% were to the head itself, and 12% were to the mouth. In at least 65% of head region injuries, the injured person was not wearing a helmet.

The third most frequent injury was strain/sprain of the leg region (9% of total injuries). Of these injuries, 43% were to the knee, 38% to the ankle,, and 11% to the foot.

Disposition at Emersencv Department. Overall, 13% of the ATV injuries in the special study were hospitalized (including admitted, transferred to another facility, and fatalities). This was in good agreement with the NEISS annual 1997 data which showed 12% hospitalized. In general, 4% percent of all NEISS

product-related injuries are hospitalized. In 1996, 10% of bicycle-related injuries were hospitalized.

In the special study, the proportion of people hospitalized was not significantly different for the sexes, for the positions of the person in relation to the ATV (driver, passenger, bystander), for the age groups of the injured person, or for the driver age groups.

The proportion hospitalized did differ among the different injury diagnoses (see TAB B). In general, lacerations, contusions/abrasions, and strains/sprains had a smaller proportion hospitalized than the other diagnoses (6% or less). Internal organ injury, which was more than 90% head injury, had the highest proportion hospitalized (55%).

Summary Overall, there have been some changes in injury patterns since 1985. The body region most frequently injured in 1985 was the leg; in 1997 it was the arm. In 1997, the arm region included the shoulder, which was a frequent site of injury. In 1985, the shoulder may have been included in the upper trunk region. However, even if the entire 1985 trunk region injuries (14%) were added to the arm region (20%) they would still not equal the 1985 leg injuries (39%). This change may reflect different injury patterns between three- and four-wheel vehicles and/or the effect of guarding the rear wheel against inadvertent contact. Head injuries remained at approximately 20% of all injuries, with 80% of those receiving head injuries in 1997 not wearing helmets. The 1997 distribution of injuries across diagnoses was very similar to that seen in 1985.

The hospitalization rate in 1985 was 18% versus 13% in 1997. Without further analysis, it cannot be determined whether this difference represents a significant decrease or is due to random variation in hospitalization rate over time.

What are the characteristics of the vehicles involved?

In 1985 and 1989, three-wheel ATVs were found to have an increased risk of injury compared to four-wheel ATVs (Scheers et al, 1991). In 1985, 81% of the ATVs in use were three-wheel; in 1989, 52%.

In 1985 and 1989 engine size was also found to be an injury risk factor, i.e., risk of injury increased as engine size increased. Additionally, the Consent Decrees included restricting the sale of adult-sized ATVs for use by children under 16. Therefore the survey gathered information on the size of the vehicles driven by injured children.

Vehicle modification was found to decrease risk of injury in both 1985 and 1989, so this variable was also investigated.

Vehicle labelling was one of the provisions of the Consent Decrees which was intended to provide ATV riders with warnings about dangerous riding practices. Therefore, the survey sought information about labelling.

Number of Wheels. Overall, approximately 75% of the vehicles in the 1997 special study were four-wheel ATVs and 25% were three-wheel. This breakdown varied somewhat depending on which variable was inspected.

	% Four-Wheel Vehicles (± se)
Vehicles	**73%** (±4%)
Injured Riders	**73%** (±4%)
Drivers Overall	73% (±4%)
<12	78% (±6%)
12-15	87% (±4%)
16-24	67% (±6%)
25 **&UP**	64% (±6%)

In general, a higher proportion of younger drivers involved in incidents were using four-wheel ATVs than was the case for older drivers, but this was statistically significant only for the 12-15 age group drivers (12-15 driver age group significantly different from drivers 16-24 (p=0.0076), and 25&UP (p=0.0035)).

No significant differences between three- and four-wheel vehicles were found as far as whether the injured person was driver or passenger, or between the sexes.

Engine Size. Average engine size for all age groups, including both three- and four-wheel ATVs, was 256 cc.

Driver age	**Average Engine Size (± se)**
Overall	256.0 cc (± 8.3 cc)
<12	210.2 cc (± 26.4 cc)
12-15	261.7 cc (± 13.4 cc)
16-24	266.8 cc (± 11.0 cc)
25&UP	261.5 cc (± 11.5 cc)

Due to the wide variety of engine sizes in use by drivers under 12 years of age (standard error = 26.4 cc), their average engine size was statistically only marginally different from older drivers' engine sizes (12-15 (p=0.0926); 16-24 (p=0.0363); **and** 25&UP (p=0.0782)).

Modifications. Only 7% of vehicles in the 1997 injury survey were reported as having been modified, 60% were reported as not modified, and 33% were unknown or the data were missing. Of vehicles which were modified, 59% were three-wheel. This was a significant overrepresentation of three-wheel ATVs among modified vehicles (p=0.0101). The most frequently reported modification was "different tires or wheels? Sample sizes were too small to support further analysis.

Warning Labels. The survey respondent was asked whether there were warning labels on the ATV involved in the incident. The responses were as follows:

Don't know	41%
Yes	39%
No	12%
Data missing	8%

It should be noted that the survey respondent was frequently a parent of the injured child and may not have witnessed the incident.

Only half the respondents for injured riders were able to say whether or not labels were present. Either the respondent for the injured person did not know whether or not warning labels were present or the data were missing.

Respondents for injured riders under 16 were significantly (p=0.0431) less likely to know whether or not warning labels were present than were respondents for injured riders age 16 and up. Respondents for *passengers* who were injured were significantly (p=0.0431) less likely to know whether or not there were warning labels than were respondents for drivers who were injured. However, this effect was due mainly to the fact that only 2 of 21 respondents for passengers in the 12-15 age group knew whether or not labels were present.

Among respondents who knew whether or not warning labels were present, significantly (p=0.0005) more respondents for four-wheel ATV riders said that labels were present (91%) than did respondents for three-wheel ATV riders (30%), although three-wheel ATVs were labelled.

Because only half the respondents for injured riders were able to say whether or not labels were present, no further analysis of label content was performed.

Summary Approximately 25% of injury-associated incidents involved three-wheel ATVs in 1997, which continued the decline seen between 1985 and 1989. However, even though the Consent Decrees stopped the sale of three-wheel ATVs, the number in use in 1997 was still approximately half the number in use in 1985.

In 1997, injured children were driving ATVs with engine sizes which were only marginally smaller than those driven by injured adults.

Only 7% of the vehicles involved in the injury survey had been modified. This finding could be interpreted as being consistent with earlier results suggesting that drivers who modify their vehicles have more expertise with the vehicles or that the modifications themselves may increase safety.

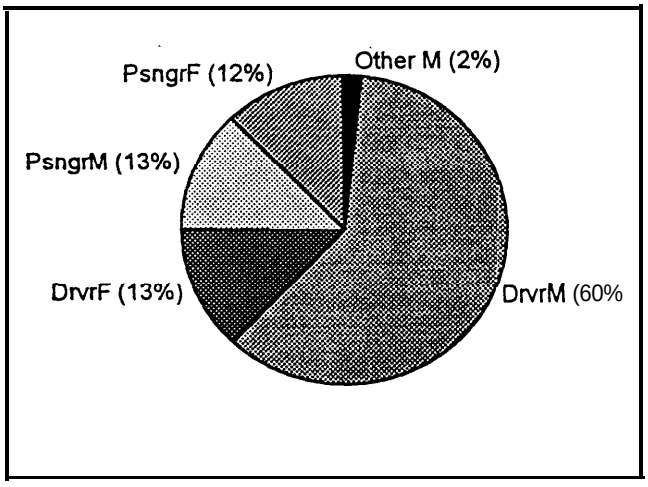
Only half the respondents in the current survey were able to say whether labels were present on the ATV. This may be due to the fact that respondents were not necessarily the injured person and may not have seen the ATV. Alternatively, it could suggest that any warning labels present were not particularly notable.

What are the interactions between injured person, driver, and vehicle?

Several additional variables were inspected because of their relevance to the Consent Decrees and their possible role as risk factors.

Injured Person's Position on the ATV. Of the injured, 60% were male drivers. Injured female drivers, injured male passengers and injured female passengers were about equally distributed (Figure 4). The "Other" category included injured bystanders, who were all male, and cases where whether the injured person was a driver or a passenger was unknown.

Figure 4. Injured Person's Position on the **ATV**



Overall 73% of the injured people were drivers, 25% were passengers. Injured drivers were 82% male. Injured passengers were 52% male. A higher proportion of injured males were drivers than passengers (80% versus 17%). Injured females were approximately equally divided between drivers and passengers (52% versus 48%).

This difference in distribution between injured males and females as to whether they were drivers or passengers was highly significant ($p=0.0002$).

Number of Riders on ATV. Overall, 38% of drivers in the injury survey were carrying at least one passenger. A significantly ($p=0.0352$) higher proportion of female (55%) than male (34%) drivers was carrying passengers.

Engine Size by Age of Driver. Table 3 presents the ATV engine size by age of the driver. Bold lines indicate engine sizes not recommended for the age group. (Recommended engine sizes are <70 cc for drivers ages 6-12, and 70-90 cc for drivers 12-15 year old).

Table 3. Percent of ATVs Driven in Each Engine Size Group by Driver Age Group

	Engine Size (cc)			
Driver Age Group (years)	**<70**	**70-90**	**>90-250**	**>250**
Overall	1%	5%	52%	41%
<6	77%	23%	0	0
6-11	5%	13%	50%	32%
12-15	0	5%	53%	42%
16&UP	0	3%	53%	43%

Overall 95% of drivers under the age of 16 were on vehicles which were larger than those recommended as appropriate for their age,

Driver Training. Survey respondents were asked how the driver learned to operate ATVs. Again, it should be noted that

the'respondent was not necessarily the injured person or the driver. Responses were as follows:

Friend/Relative Taught	40.5%
Self-Taught	40.5%
Unknown	15.5%
Organized Program	3.0%
Dealer/Salesman	0.6%

Approximately 4% of drivers involved in injury-associated incidents had received formal training of any kind, either from an organized program or a dealership.

Significantly more (p-0.0004) drivers under age 16 were taught by friends and relatives, whereas drivers 16 and up were. more frequently self-taught.

Alcohol Involvement. If the driver's age was reported as 16 *or* older, respondents were asked whether the driver had any alcoholic beverage prior to the incident. Drivers reported to be age 16 or older were 54% of total drivers. Responses about alcohol use were as follows:

no	73%
yes	12%
missing	11%
don't know	3%
refused	<1%.

Summary. The proportion of injured who were passengers and the proportion of drivers carrying passengers remained relatively constant between 1985 and 1997.

The engine size data presented in this section support the data presented earlier in this report showing that injured children are generally not on smaller ATVs. In this analysis, 95% of injured children under the age of 16 were on vehicles with larger-than-recommended engine sizes.

Very few drivers (4%) involved in incidents were reported to have had formal training in operating ATVs. Of drivers over 16 years of age, 12% were reported to have had alcohol prior to the incident.

How are the injuries occurring?

Finally, some analyses of hazard patterns were performed Tipover was of particular interest because vehicular stability has been a major focus of concern.

Initiating Event. Based on the respondent's narrative description of the incident and on a number of more specific

survey questions, CPSC analysts determined the initiating events in the incident series of events to be distributed as follows:

hit obstacle		36%
	terrain irregular	72%
	stationary object	21%
	moving object	7%
driver action		25%
	changed direction	51%
	changed speed	32%
	both	13%
	unknown	4%
miscellaneous		39%
	(no single group accounted for more than 6% overall) lost traction, lost balance, stalled, machine malfunction, inadvertent control contact, inadvertent foot contact with ground, with rear wheel, driver distracted, other miscellaneous	

Tipover. In 49% of the incidents the ATV tipped over at some point in the incident sequence of events. For three-wheel ATVs, 59% of incidents involved tipover, versus 45% for four-wheel. Statistically, this difference was marginally significant (p=0.0532).

Overall, 18% of tipovers were to the right, 19% were to the left, 27% were forward, 23% backward, and 13% were unknown. Among the tipovers where direction of tipover was known, 43% were lateral (right or left) and 57% were longitudinal (forward or backward) but this difference was not statistically significant. The proportion of lateral versus longitudinal tipover was not different between three- and four-wheel ATVs.

Summary The 1997 hazard pattern data presented were not directly comparable to that reported in 1985. For example, the 1997 tipover proportions include tipovers which also involved hitting an obstacle. The 1985 data do not. However, in this analysis, the proportion of lateral to longitudinal tipovers appeared to have reversed between 1985 (59% lateral and 41% longitudinal) and 1997 (43% lateral and 57% longitudinal). Further analysis would be necessary to determine whether the analyzed proportions were comparable.

Conclusions

Overall, the 1997 injury data were consistent with previously reported injury data. The absolute number of injuries has leveled off at more than 50,000 injuries after a sharp decline in the late 1980's and early 1990's.

The overall rate of injury associated with ATVs, 1.5 injuries per 100 ATVs in use in 1997, has declined substantially since 1985. The number of four-wheel ATV injuries has been cut in half since 1985 despite a more than doubling of the number in use. The 1997 number of three-wheel injuries'was about one-sixth that of 1985, even though the number of three-wheel ATVs in use is still about half that of 1985.

Injury patterns have changed somewhat since 1985, with the major body region being injured shifting from the leg region to the arm. Head injuries remained constant at about 20% of all injuries. Of those receiving head injuries in 1997, at least 65% were not wearing helmets. Hospitalization rate, 18% in 1985, remained high in 1997 at 13%, compared to 4% for NEISS injuries overall.

Almost 50% of the injured in the special study were children under the age of 16. This number was almost 40% for the entire year. Of the ATV drivers in the study who were under 16, 95% were on vehicles with larger-than-recommended engines.

Approximately 25% of injuries in 1997 involved three-wheel ATVs. This proportion is somewhat higher than their current share of ATVS in use (22%, see Table 1). Very few (7%) of the vehicles involved in the 1997 injury survey had been modified in any way, This was similar to the 10% modified 1985 injury survey vehicles.

Very few drivers involved in injury-associated incidents had received any formal training on how to ride an ATV. Drivers under age 16 generally had been taught by relatives or friends, while drivers over 16 had *more frequently been self-taught.

In 49% of the incidents, the ATV tipped over. A higher proportion of three-wheel ATV incidents involved tipover than did four-wheel incidents. However, the proportion of three-wheel ATVs which tipped laterally was not different from the proportion of four-wheel ATVs which tipped laterally. Further analysis is needed to determine how tipover patterns compare to 1985.

References

Newman, Rae. (December 1985). *Survey of All Terrain Vehicle Related Injuries (1985) (Preliminary Report).* Washington, DC: U.S. Consumer Product Safety Commission.

Newman, Rae. (September 1986). *Analysis of All Terrain Vehicle Related Injuries and Deaths.* Washington, DC: U.S. Consumer Product Safety Commission.

Rodgers, Gregory B. (September 1986). *Factors Affecting the Likelihood of All-Terrain Vehicle Accidents.* Washington, DC: U.S. Consumer Product Safety Commission.

Rodgers, Gregory B. (September 1989). *All-Terrain Vehicle Risk Analysis.* Washington, DC: U.S. Consumer Product Safety Commission.

Scheers, NJ., R. Newman, C. Polen, and D. Fulcher. (February 1991). *The Risk of Riding ATVs: A Comparison from 1985 to 1989.* Washington, DC: U.S. Consumer Product Safety Commission, Washington.

Shah, B.V., B.G. Barnwell,, and G.S. Bieler. (1997). *SUDAAN User's Manual, Release 7.5.* Research Triangle Park, NC: Research Triangle Institute.

Tinsworth, D.K., C. Polen, and S. Cassidy (June 1994). *Bicycle-Related Injuries: Injury, Hazard, and Risk Patterns* in "Bicycle Use and Hazard Patterns in the United States". Washington, DC: U.S. Consumer Product Safety Commission.

TAB A

Accounting for the 319 Cases Used for Analysis

529 cases were automatically selected by NEISS as being product codes 3285-3287 with a treatment date of May 1, 1997, through August 31, 1997, under the ATV study code TYAN411997

-42 were determined to be out of scope before being assigned for investigation
- 8 were not NEISS products (such as motorcycles)
- 6 were deleted by the entering hospital as incorrect
- 22 were purged as occupational cases, wrong product, or the second injured person in a given incident (only one investigation is assigned per incident, regardless of how many people were injured)
- 6 were found not to be NEISS products

487 In-Depth Investigations (IDIs) were assigned

335 of the assigned IDIs were completed

-34 were shown after investigation to be wrong product, not in operation, occupational use, etc., and were dropped

301 In-scope IDIs completed

+18 Additional NEISS cases were added back in
- 16 were companion cases - that is, two people were injured in one incident. The incident was investigated by talking with one of the injured parties. This incident information was matched with the second injured party's NEISS information to give an additional analyzable case
- 1 was initially coded as occupational use of the ATV but upon investigation was found to be recreational use of the ATV
- 1 had scant information from the investigation and was originally considered terminated but was added back in

319 Total Cases for Analysis

TAB B

Body Region by Diagnosis

Disposition by Diagnosis

Table B.1
Body Region by Diagnosis[2] (continued on following page)

Sample Size Estimate SE Estimate Row % Col % Tot %	Total	Concus-sion	Internal Organ Injury	Fracture /Disloc	Lacera-tion	Contus/ Abrasion	Strain/ Sprain	Other
Total	19 23700 2200 100.0 100.0 100.0	5 383 227 1.6 100.0 1.6	18 1143 363 4.8 100.0 4.8	95 6237 762 26.3 100.0 26.3	65 5085 702 21.5 100.0 21.5	80 6316 1047 26.7 100.0 26.7	37 3237 882 13.7 100.0 13.7	19 1295 367 5.5 100.0 5.5
Body Region Head	75 5084 819 100.0 21.5 21.5	5 383 227 7.5 1.0 1.6	17 1044 354 20.5 91.4 4.4	6 369 179 7.3 5.9 1.6	30 2216 530 43.6 43.6 9.4	8 570 227 11.2 9.0 2.4	2 129 103 2.5 4.0 0.6	7 372 158 7.3 28.7 1.6

[2]First cell entry is the number of observations:
for example there were 17 internal organ injuries (101) to the head region.
Second entry is the national estimate:
there were an estimated 1044 101 injuries to the head region.
Third entry is the standard error of the estimate:
the standard error was 354 for 101 injuries to the head region.
Fourth entry is the row percent:
20.5% of head region injuries were 101 injuries.
Fifth entry is the column percent:
91.4% of the 101 injuries were to the head region.
Sixth entry is the total percent:
4.4% of all injuries were 101 injuries to the head region.

Sample Size Estimate SE Estimate Row % Col % Tot %	Total	Concus-sion	Internal Organ Injury	Fracture /Disloc	Lacera-tion	Contus/ Abrasion	Strain/ Sprain	Other
Trunk	41 2394 513 100.0 10.1 10.1	0	1 98 98 4.1 8.6 0.4	13 645 231 27.0 10.4 2.7	3 152 105 6.3 3.0 0.6	18 1245 325 52.0 19.7 5.3	3 171 123 7.1 5.3 0.7	3 83 44 3.5 6.4 0.4
Upper Limb	110 8657 1169 100.0 36.5 36.5	0	0	57 4005 659 46.3 64.2 16.9	15 1341 350 15.5 26.4 5.7	23 1984 558 2.9 31.4 8.4	10 816 305 9.4 25.2 3.4	5 511 221 5.9 39.5 2.2
Lower Limb	78 6506 950 100.0 27.5 27.5	0	0	19 1218 299 18.7 19.5 5.1	17 1375 367 21.1 27.1 5.8	16 1463 412 22.5 23.2 6.2	22 2120 706 32.6 65.5 9.0	4 329 184 5.1 25.4 1.4
All Body Parts	15 1054 464 100.0 4.5 4.5	0	0	0	0	15 1054 464 100.0 16.7 4.5	0	0

Table B.2
Disposition by Diagnosis

Sample Size Estimate SE Estimate Row % Col % Tot %	Total	Diagnosis Concus-sion	Internal Organ Injury	Fracture/ Disloc	Lacera-tion	Contus/ Abrasion	Strain/ Sprain	Other
Total	318[3] 23600 2200 100.0 100.0 100.0	5 380 230 1.6 100.0 1.6	18 1140 360 4.9 100.0 4.9	95 6240 760 26.5 100.0 26.5	65 5080 700 21.6 100.0 21.6	80 6320 1050 26.8 100.0 26.8	37 3240 880 13.7 100.0 13.7	18 1180 350 5.0 100.0 5.0
Disposition Treated & Released	265 20400 1990 100.0 86.7 86.7	3 260 190 1.3 67.4 1.1	8 510 260 2.5 45.0 2.2	70 4860 700 23.8 77.9 20.6	61 4830 690 23.6 95.0 20.5	76 5940 1040 29.0 94.0 25.2	35 3180 410 15.6 98.2 13.5	12 870 300 4.2 73.6 3.7
Hospitalized	53 3130 1060 13.3 13.3	2 130 100 32.6 0.5	10 630 270 55.0 2.7	25 1380 410 22.1 5.8	4 250 80 5.0 1.1	4 380 120 6.0 1.6	2 60 40 1.8 0.2	6 310 150 9.9 26.4 1.3

[3]One observation with disposition unknown, diagnosis "other": estimate 117 (±117)