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).

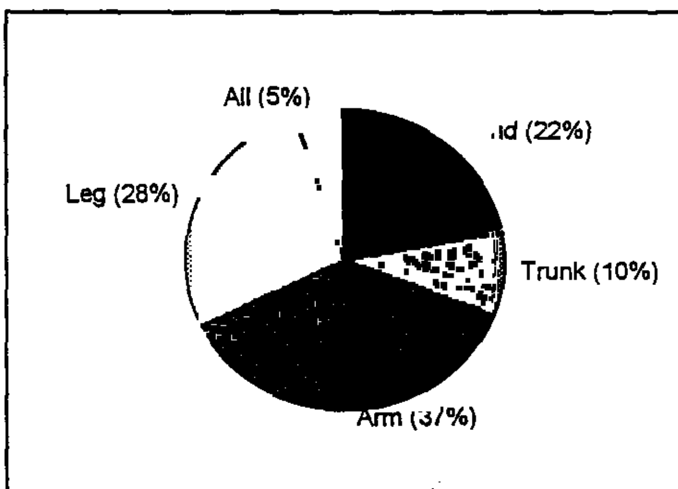
The special study injuries were approximately equally divided among the four age groups shown, with roughly 25% in each age group, so that almost half the injuries in the special study were to children under the age of 16. In the NEISS estimate for the year, approximately 39% of the injuries occurred 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).

Figure 2. Body Region Injured



Body Part Injured and Type of Injury.

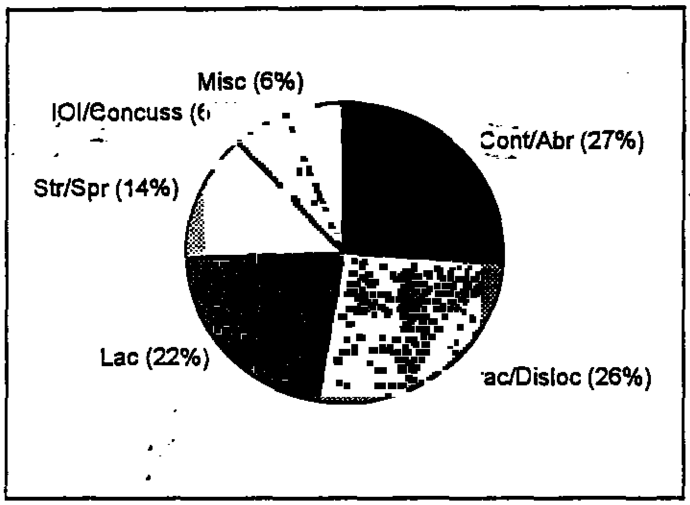
TAB B presents the distribution of 1997 special study injuries by body region and diagnosis, as well as by disposition and diagnosis. Injury distribution by body region is shown in Figure 2 and by diagnosis in Figure 3.

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 B).

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.

<u>Disposition at Emergency Department</u>. 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.

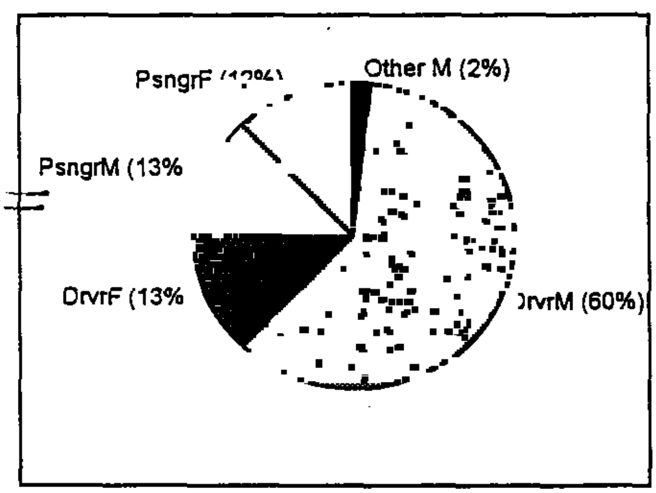
Only half the respondents in the current survey were able to say whether labels were present on the ATV. This may be due to the fact that respondents were not necessarily the injured person and may not have seen the ATV. Alternatively, it could suggest that any warning labels present were not particularly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

<u>Tipover</u>. 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.

<u>Summary</u>. 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, N.J., 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	Concussion	Internal Organ Injury	Fracture /Disloc	Laceration	Contus/ Abrasion	Strain/ Sprain	Other
Total	19	5	18	95	65	80	37	19
	23700	383	1143	6237	5085	6316	3237	1295
	2200	227	363	762	702	1047	882	367
	100.0	1.6	4.8	26.3	21.5	26.7	13.7	5.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	100.0	1.6	4.8	26.3	21.5	26.7	13.7	5.5
Body Region: Head	75	5	17	6	30	8	2	7
	5084	383	1044	369	2216	570	129	372
	819	227	354	179	530	227	103	158
	100.0	7.5	20.5	7.3	43.6	11.2	2.5	7.3
	21.5	1.0	91.4	5.9	43.6	9.0	4.0	28.7
	21.5	1.6	4.4	1.6	9.4	2.4	0.6	1.6

[2]First cell entry is the number of observations:
for example there were 17 internal organ injuries (IOI) to the head region.
Second entry is the national estimate:
there were an estimated 1044 IOI injuries to the head region.
Third entry is the standard error of the estimate:
the standard error was 354 for IOI injuries to the head region.
Fourth entry is the row percent:
20.5% of head region injuries were IOI injuries.
Fifth entry is the column percent:
91.4% of the IOI injuries were to the head region.
Sixth entry is the total percent:
4.4% of all injuries were IOI 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	Concus-sion	Internal Organ Injury	**Diagnosis** 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	3 260 150 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 1000 29.0 94.0 25.2	35 3180 880 15.6 98.2 13.5	12 870 300 4.2 73.6 3.7
Hospitalized	53 3130 640 100.0 13.3 13.3	2 130 100 4.0 32.6 0.5	10 630 270 20.1 55.0 2.7	25 1380 410 44.0 22.1 5.8	4 250 140 8.1 5.0 1.1	4 380 240 12.2 6.0 1.6	2 60 40 1.8 1.8 0.2	6 310 150 9.9 26.4 1.3

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

PART III
Report on All-Terrain Vehicle-Related Deaths
January 1, 1985 - December 31, 1996

April 1998

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Introduction

The U.S. Consumer Product Safety Commission (CPSC) began collecting All-Terrain Vehicle (ATV)-related death data in the mid-1980's, when the number of deaths was rising sharply. After April 1988, when consent decrees between the CPSC and the ATV distributors became effective, CPSC began publishing quarterly reports of injuries and deaths from ATV-related incidents. This report summarizes the details of the ATV-related deaths CPSC has compiled from January 1, 1985 through December 31, 1996.

Methodology

CPSC collects reports of ATV-related incidents resulting in death from a variety of sources. These include news clips, consumer complaints, medical examiner and coroner (MECAP) reports, and death certificates. The data upon which the quarterly reports are based have been carefully screened for duplicate and out-of-scope incidents and are maintained in a special data base designated for ATV-related death reports. Once a relevant case has been identified, it is assigned for an in-depth investigation by CPSC field staff. Field investigators contact the most knowledgeable person regarding the incident, generally the next of kin. Where states do not permit contact with next of kin, detailed information, including police reports and photos, is sought from the investigating law official. Other supporting documents are obtained from the coroner's office. These investigations provide more detail about the nature of the incidents and persons involved, including specific characteristics about the ATV involved.

Because CPSC does not receive 100 percent reporting on ATV-related incidents, a statistical estimating procedure, capture-recapture, is used to obtain a reasonably representative estimate of the number of ATV-related deaths that occur nationally. This procedure involves the use of data from two separate files in the data base:

(1) the Injury, Potential Injury Incident (IPII) file, which is primarily composed of news clips, paid and voluntary MECAP reports, consumer complaints, referrals, and data from other sources, and

(2) the Death Certificate (DCRT) file, which contains product-related death certificates from states and jurisdictions across the country.

The procedure for estimating ATV-related deaths has two parts. For public road fatalities, the count is the number of reports received. For fatalities occurring on terrain other than public roads, the capture-recapture estimating method is used by matching and determining the overlap between the two files (IPII) and (DCRT). The two parts are then combined to determine the estimate.

RESULTS

HOW MANY PEOPLE ARE DYING ON ATVS AND WHO IS DYING?

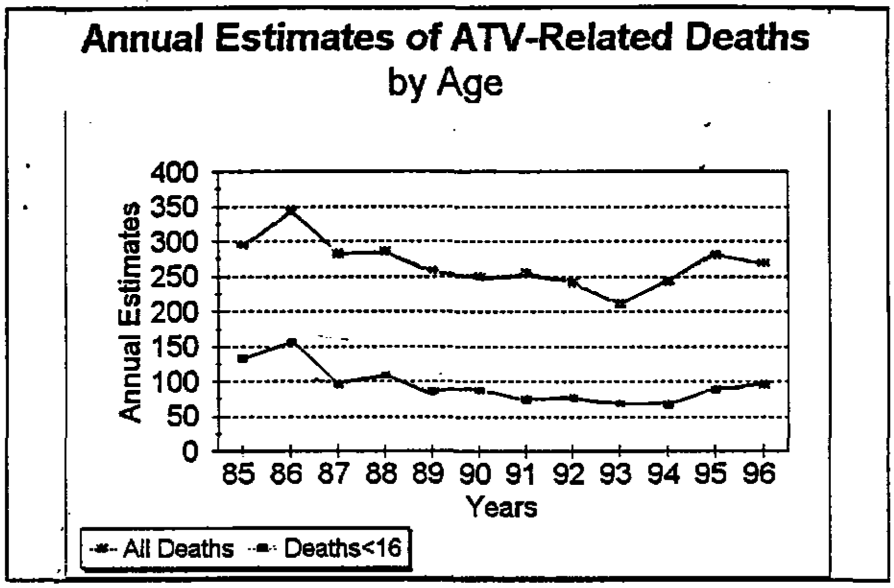
Based on 2,798 ATV related death reports received over the 12-year period January 1, 1985 through December 31, 1996 CPSC estimates that over 3,200 ATV-related deaths occurred. Table 1 below shows the number of ATV-related deaths by year of occurrence. The table shows both the reported and the estimated numbers. *Figure 1 shows the annual estimated number of deaths* overall and for children under age 16.

Table 1
Annual Estimated and Reported Number of ATV- Related Deaths

YEAR	REPORTED NUMBER OF DEATHS	ESTIMATED[1] NUMBER OF DEATHS
1996	242	269
1995	196	281
1994	198	244
1993	183	211
1992	221	241
1991	230	255
1990	234	250
1989	230	258
1988	250	286
1987	264	282
1986	299	347
1985	251	295
TOTALS	2,798	3,219

Source: U. S. Consumer Product Safety Commission (CPSC), Directorate for Epidemiology and Health Sciences (EH),Division of Hazard Analysis (EHHA), January 1, 1985- December 31, 1996.

Figure 1



What is the Rate of Death Associated With The Use of Four-Wheel All-Terrain Vehicles?

The rate of death associated with 4-wheel ATVs is shown to have decreased over the time period January 1, 1985 through December 31, 1996. The rate of death is based on calculations per 10,000 vehicles in use (based on sales and exposure data provided by industry).

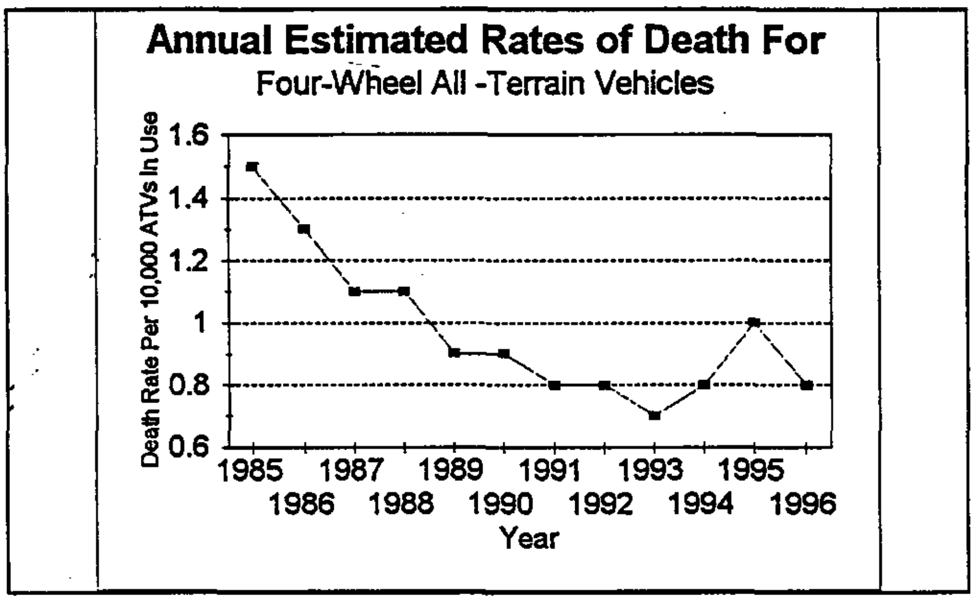
Figure 2 illustrates the decrease in the rate of death associated with four-wheel ATVs during this period. The rate of death was shown to have decreased from a high of 1.5 deaths per 10,000 ATVs in 1985 to a low of 0.7 in 1993. A trend test, using the Spearman rank correlation coefficient was conducted to evaluate the change in the rate of death over this 12-year period.

There was a statistically significant downward trend (p=0.019). However, the downward trend occurred mostly during the 1985-1991 period, after which the data show no evidence of trend behavior.

No trend analysis for the rate of death was performed for three-wheel ATVs because of limited or unavailable exposure data. However, reliable exposure data for three-wheel ATVs are available for three years during the 1985, 1986 and 1997 time period. CPSC conducted exposure studies in 1985, 1986 and 1997.

Based on these three years of exposure data and the number of deaths from 1985, 1986 and 1996, the death rate for three-wheel ATVs dropped from 1.5 per 10,000 ATVs in use in 1985 to 0.7 in 1989 and 1996. It should be noted that the 1996 rate estimate was calculated from the estimated number of three-wheel ATVs in use in 1997. Any error in the 1996 estimate would tend to overestimate the rate to the extent that there are fewer three-wheel ATVs in 1997 than in 1996.

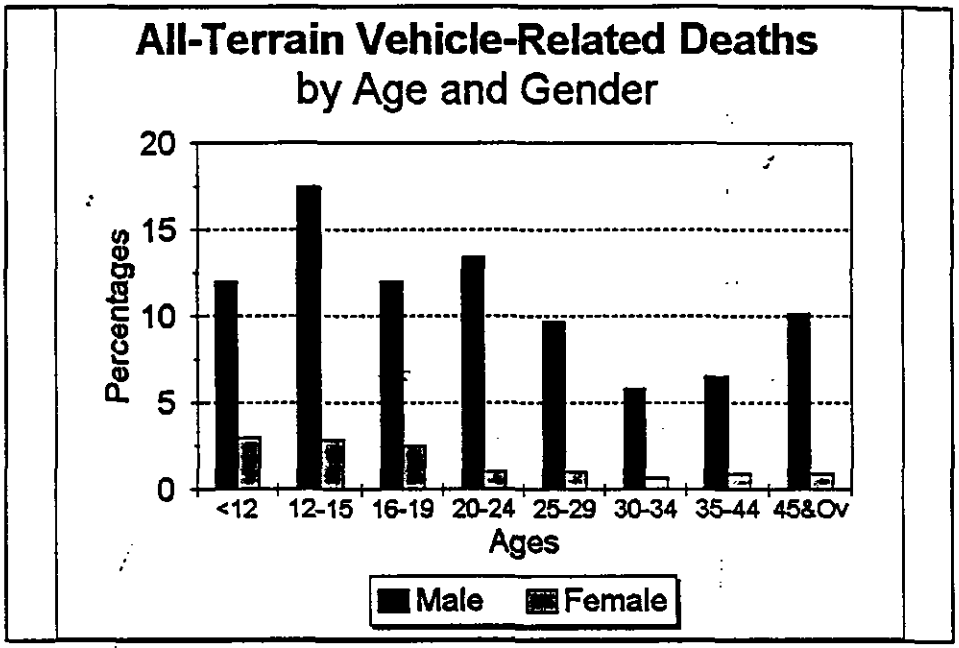
FIGURE 2



WHAT ARE THE CHARACTERISTICS OF THE VICTIMS ?

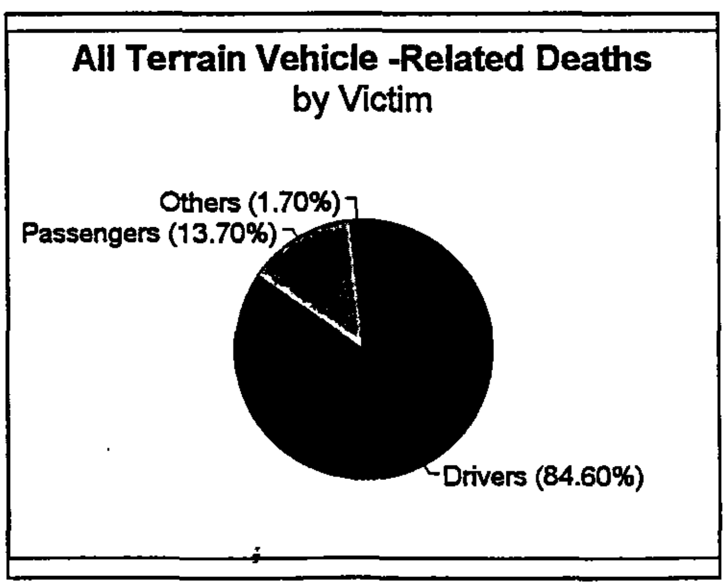
Figure 3 presents the percentage of ATV-deaths by age and gender. The greatest number of deaths occurred to males. Deaths to males accounted for 87 percent of the total estimated 3,200 deaths and were nearly seven times that of female deaths, which were 13 percent of the estimated total. The group most affected was young males between the ages of 12 and 19 years, who accounted for 30 percent of all deaths. Within this group, males between the ages of 13 and 15 proportionately suffered more deaths (about 18 percent of all deaths) than males of other ages.

FIGURE 3



More than 80 percent of the victims in these ATV incidents were drivers of the ATV involved (Figure 4). Passengers accounted for about 14 percent of the deaths, most of whom were ATV passengers. Passengers of other vehicles were less than one tenth of one percent of this group.

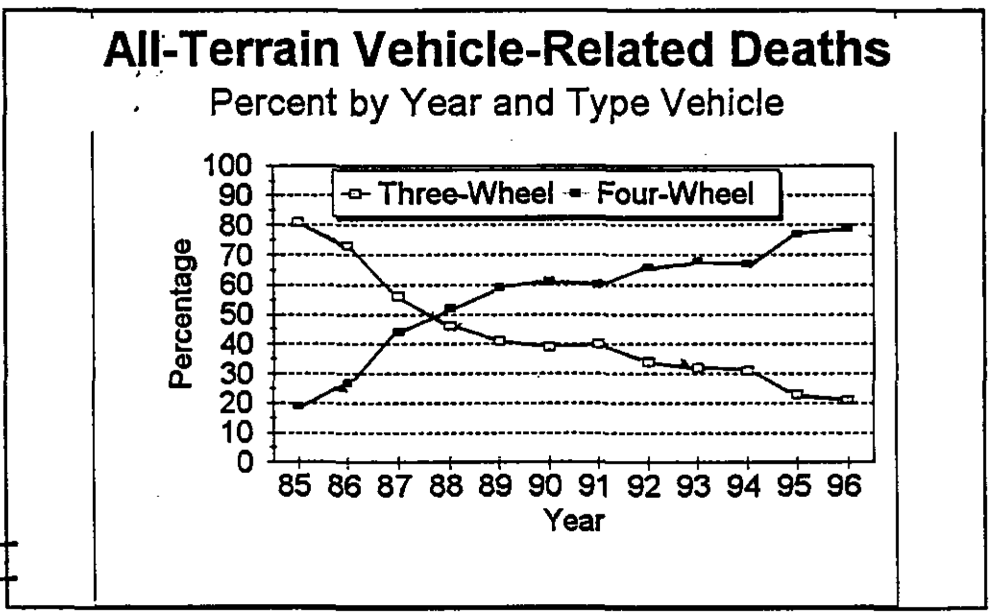
FIGURE 4



WHAT ARE THE CHARACTERISTICS OF VEHICLES INVOLVED IN DEATHS ?

Fifty-four percent of the vehicles involved in ATV deaths over the twelve year period.between 1985 and 1996 were four-wheel ATVs. For the last two years in this period, 1995 and 1996, four wheel ATVs were involved in about 80 percent of the deaths. This is not a surprising finding since the 1988 Consent Decrees contained a provision prohibiting the manufacture and sale of three-wheel ATVs. Forty-four percent of the vehicles involved in deaths during this twelve-year period were three-wheel ATVs, and two percent were ATVs with an unspecified number of wheels. The percentage of three-wheel ATVs involved in deaths declined from about 80 percent in 1985 to slightly less than 20 percent in 1996 (see figure 5).

Figure 5



About 83% of all ATVs involved in deaths had engine sizes of 200cc or greater. About half (48 percent) of all vehicles had engines 250cc or greater. ATVs with engine sizes greater than 250cc involved in deaths increased from about two percent of the total vehicles involved in deaths in 1985 to about 51 percent of those involved in deaths in 1996. ATVs with engines less than 200cc were involved in fewer deaths in 1996 (11%) compared to 1985 (30%).

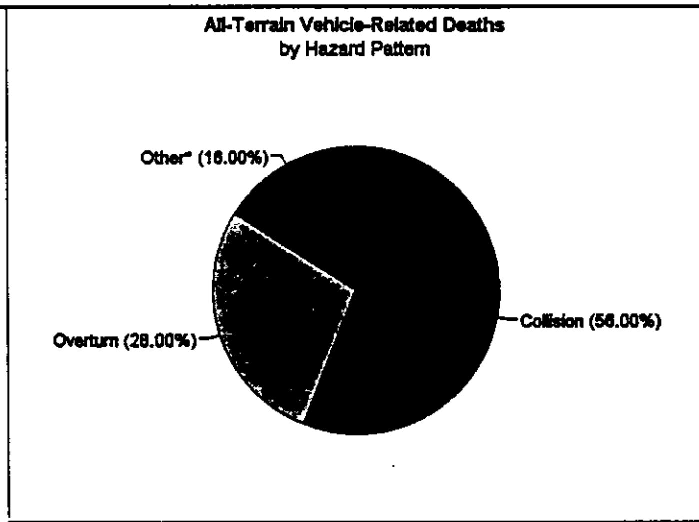
How are the Deaths Occurring ?

The two most frequently reported hazard patterns associated with the approximately 3,200 ATV-related deaths estimated by the Commission were collisions and overturns.

Incidents reported as collisions made up 56 percent of all ATV incidents. More than half of the collisions (about 54 percent) occurred with stationary objects, about 35 percent with motorized vehicles, and 11 percent with people or animals.

The second most frequently reported hazard pattern, overturns, accounted for 28 percent of all ATV-related deaths (Figure 6). Overturns usually occurred as a result of the operator losing control, or while riding up or down hill. Backward overturns occurred more frequently than forward overturns, and rollovers (sideward) occurred with the least frequency.

FIGURE 6



WHERE DID THE INCIDENTS OCCUR ?

Over half the incidents occurred on roadways. Approximately 29 percent occurred on paved roads, and 31 percent occurred on non paved roads. Most were public roads. Sixteen percent of the incidents occurred in fields. Four percent occurred in forested areas, 4 percent on beaches and sand dunes, and 3 percent on yards or lawns. Other types of terrain where incidents occurred include deserts, snow and ice areas, parking lots and railroad beds. These accounted for 15 percent. Only 1 percent of the incidents occurred on ATV tracks or trails.

WHAT ARE THE INTERACTIONS BETWEEN THE VICTIM, DRIVER, AND VEHICLE?

There was no apparent relationship between the age of the driver and the size or type of ATV used by a driver. Proportionately, as many younger (under 16 years of age) drivers used the larger sized ATVs as older drivers. The most notable finding with regard to driver-age and vehicle is that younger children typically did not use the size ATV (under 90cc) recommended as appropriate for their use. More than ninety percent of the child-driver fatalities involved an adult-sized ATV.

PART IV
Report on 1997 ATV Risk Analysis

April 1998

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INTRODUCTION

This report describes the preliminary results of the U.S. Consumer Product Safety Commission's (CPSC) 1997 ATV risk analysis. The analysis is based on the results of the injury and exposure surveys developed and sponsored by the CPSC in 1997. These surveys collected parallel information on the characteristics and use patterns of both drivers involved in injury incidents and the general population of drivers. Data from the surveys were evaluated in a logistic regression analysis to determine and quantify the factors associated with the injury risk.

The results of the analysis are generally consistent with those of the earlier 1986 and 1989 ATV risk analyses conducted by the CPSC (Rodgers, 1986, 1989, 1993; Scheers, Newman, Polen, and Fulcher, 1991). Risk is related to a number of driver and ATV characteristics, including the driver's age, gender, and driving experience, the extent to which ATVs are used for nonrecreational activities, and the number of wheels on the ATVs.

METHODS

Data Sources

Data for the analysis are from two national surveys: a survey of drivers involved in injury incidents that resulted in an emergency department (ED) medical treatment for themselves or their passengers (the *injury survey*) and a survey of the general population of ATV users (the *exposure survey*).

Injury Survey. The injury survey collected information on injuries treated in hospital EDs between May 1 and August 31, 1997, and reported through the CPSC's National Electronic Injury Surveillance System (NEISS). 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. The sample currently consists of 101 hospitals which range from large urban or inner-city hospitals with more than 41,000 ED visits to small rural hospitals with less than 17,000 visits annually.

The initial NEISS injury reports were followed up by 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.[1]

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[1]For a more detailed description of the injury survey and its results, see Kyle (1998).

Exposure Survey. The exposure survey collected parallel information on the characteristics and use patterns of the general population of ATV users. The survey was designed as a national telephone probability survey of U.S. households owning ATVs (Abt Associates, 1997). It 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 proprietary list-assisted RDD system, called the GENESYS Sampling System (MSG, 1997).

The survey was conducted between September 15 and November 18, 1997 (Stoner and Srinath, 1998). 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. After ATV-owning households were reached, the initial respondent 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. Interviews were completed with 464 ATV drivers.[2]

Data Adjustments. Several adjustments were made to the injury and exposure databases prior to the statistical analysis to avoid the possibility of bias. Because the exposure survey was limited to drivers from ATV-owning households, injury observations involving drivers from non-owning households were excluded from the risk analysis.

Observations from the exposure survey were excluded from the analysis if respondents reported that they had been involved in an ATV accident requiring medical treatment after May 1, 1997. The inclusion of such observations would have marred the comparison between injured drivers (from the injury survey) and uninjured drivers (from the exposure survey) because some of those labeled as uninjured from the exposure survey would have actually been injured drivers.

Finally, exposure survey respondents who reported that they used their ATV entirely for commercial or occupational tasks other than farming or ranching were excluded from the analysis because NEISS does not systematically collect data on those types of occupational injuries.

The final data set includes 133 injury observations and 457 exposure (i.e., noninjury) observations. Given the data adjustments just described, and the survey methodology, the injury and exposure databases are assumed to provide

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[2]For a more detailed description of the methodology and results of the ATV exposure survey, see Rodgers (1998).

representative national samples of drivers who are involved in injury incidents resulting in ED medical treatment, and drivers who are not.

Statistical Methodology

The statistical analysis is based on 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 (in this case) whether or not an injury resulting in ED treatment has occurred, and a set of independent variables. We conducted the analysis with SUDAAN software, a statistical package designed for the analysis of complex sample surveys (Shah, Barnwell, and Bieler, 1997).

The logit regression model can be used to determine the independent impact of each of several factors on the injury risk, and is especially useful when (as in the case of ATVs) a large number of factors simultaneously affect the injury risk. For example, we might wish to determine the impact of a driver's age on the injury risk. The logit model statistically "holds constant" the other variables to isolate the impact of the age on risk.

The Risk Model. The risk of ED injury is assumed to be a function of driver characteristics, use patterns, and vehicle characteristics. The primary variables evaluated in the analysis include the age, gender, driving experience, and riding time of the driver, the proportion of time ATVs are used in nonrecreational (as opposed to recreational) activities, the engine size and number of wheels on the primary ATV used, and whether or not the ATV had been substantially modified. These variables are defined in Table 1.

RESULTS

Table 2 presents the results of three regression models. The first (Model 1) is the base model. Models 2 and 3 are included for purposes of comparison. Note that some of the eligible injury and exposure observations were not included in the analysis due to missing information on variable values. However, a sensitivity analysis, conducted by replacing missing values with the mean value of the variable in question (Pindyck and Rubinfeld, 1991), indicated that the results were not substantially affected by the missing data.

The Model 1 results indicate that risk declines with age, driving experience, and the percentage of time that ATVs are used in nonrecreational activities. With respect to the dichotomous independent variables, risk is higher for those who ride three-wheel ATVs and for males. Risk is positively correlated with both engine size and monthly driving times, but neither relationship is statistically significant.

Model 2 excludes the nonsignificant driving time variable, a variable for which there was a relatively large number of unknown values. Its exclusion increases the number of observations used in the analysis, but does not substantially affect the coefficients for the remaining variables. Nor were the results substantially altered in Model 3, which (like the 1986 and 1989 risk analyses) included both the driving time and modification (*Mod*) variables. The coefficient for *Mod* is highly significant, suggesting that the presence of a major modification was negatively correlated with the injury risk. While it is possible that some modifications might increase the safety of ATVs (i.e., suspension modification or changing tires or wheels), this inverse relationship may be more likely to reflect an expertise on the part of ATV drivers who have modified their vehicles.

The risk implications of the Table 2 regression models are illustrated in Graphs 1 through 3. Model 1 is used as the basis for estimating the relationships in all three graphs. Unless otherwise indicated in the graph, the annual injury risks (i.e., the risk of emergency department medical treatment) are for a 30-year-old male driver with eight years of driving experience and who rides a four-wheel 250cc ATV recreationally for about 25 hours in an average month of driving.

The first graph illustrates the inverse relationship between age and risk, and the higher risks on three-wheel ATVs. Risk on a four-wheel ATV increases from .33% per year (i.e., one-third of one percent) for a 40-year-old male to about .48% per year for a 30-year old male driver, an increase of about 45%. On the other hand, if all other factors are held constant, the risk of nonfatal injury on a three-wheeler is about 2.85 times the risk on a four-wheeler. In our example, risk increases from about .48% for the 30-year-old four-wheel ATV driver to about 1.37% per year for the same driver on a three-wheeler.

Graph 2 shows the relationship between the injury risk and nonrecreational use. Risk declines as the proportion of total driving time devoted to nonrecreational use (as opposed to recreational use) increases. In other words, the nonrecreational use of ATVs is generally less risky than recreational use. For example, risk declines from about .39% per year for a 30-year-old male driver of a four-wheel ATV who engages in nonrecreational activities 10% of the time to about .13% per year for a similar driver who engages in nonrecreational activities 67% of the time.

Finally, Graph 3 illustrates the relationship between driver experience and risk and between the gender of the driver and risk. Risk declines rapidly as drivers first learn to drive ATVs, but the rate of decrease declines as drivers becomes more experienced. Additionally, the graph illustrates the higher risks for males. Holding all other factors constant, the risk for males is almost three times the risk for females.

Table 3 shows the results of three additional regression models which are similar to those in Table 2 except that the driver's age is included as a series of categorical variables relative to drivers 55 years of age and older. While the coefficients for the categorical age variables support the inverse relationship between age and risk found in Table 2, they also highlight the relatively high risks for children under the age of 16.

Based on the Model 4 results (and holding all other factors constant), the risk for children under the age of 16 is about 2.5 times higher than for drivers 16 to 34 years of age, and about 4.5 times higher than drivers 35 to 54 years of age. These relative risks are illustrated in Graph 5, using the risks for drivers aged 35-54 as the reference group.

The remainder of the results in the Table 3 risk models are, for the most part, similar to those of Table 2. Risk is higher on three-wheel ATVs, higher for males, higher for drivers who use their ATVs recreationally, and lower on modified ATVs. Driver experience remains negatively correlated with risk, but the coefficient is no longer statistically significant.

While engine size was positively correlated with the injury risk, neither the Table 2 nor Table 3 regression results show a significant general relationship between engine size and risk. However, the regression results shown in Table 4 (which allow the categorical age variables to interact with engine size) suggest a significant positive relationship between engine size and risk for one class of drivers, children under age 16. This is indicated by the positive and significant coefficient for variable denoted as "Age(<16)*Engine Size."

Graph 4 illustrates the relationship between engine size and risk for children. The risk for a male child on a four-wheel ATV, for example, rises from about .63% per year on an 80cc model, for example, to about 1.14% per year on a 180cc model, an increase of about 80%.

Finally, we evaluated the relationship between risk and organized training programs such as those sponsored by the Specialty Vehicle Institute of America (SVIA) under the requirements of the 1988 Consent Decrees.[3] About 3% of the injured drivers and about 11% of the uninjured drivers reported participating in an organized training program. The results, however, were inconclusive, possibly because of the small sample

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[3]Under the requirements of the 1988 Consent Decrees, SVIA members offer buyers of new ATVs "free training" as part of the purchase price of a new vehicle. 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.

of riders who had taken such training.

DISCUSSION

The results of the 1997 risk analysis are generally consistent with the CPSC's earlier 1986 and 1989 ATV risk analyses. It shows that the risks associated with ATVs are systematically related to driver characteristics, driver use patterns, and the characteristics of the ATVs driven.

As in the earlier analyses, risk is higher for younger drivers. As described earlier, the estimated risk for children under age 16 is about 2.5 times higher than for drivers 16 to 34 years of age, and about 4.5 times higher than drivers 35 to 54 years of age -- risk differentials that are somewhat higher than in earlier analyses.

Also as in the earlier analyses, the risk on three-wheel ATVs remains significantly higher than on four-wheel models. Current estimates suggest that the risks on a three-wheel model are roughly 2.5 to 3 times the risk on a similar sized four-wheel model, a somewhat larger differential than in earlier risk analyses. Similarly, risk is higher for male drivers and rises with the proportion of time ATVs are used in recreational activities.

There are, however, some differences worth noting. First, while the injury risk increased with engine size for at least one class of drivers, children under age 16, the analysis did not demonstrate a significant statistical relationship between engine size and risk for all drivers generally. This lack of significance may be related to the increasing market share of utility-oriented ATVs with large engines. In contrast to 1989, when few ATVs were four-wheel drive vehicles, the 1997 exposure survey found that about one-fifth of all ATVs in use were four-wheel drive vehicles, most with 300cc or larger engines. These utility-oriented vehicles tend to have low gearing to accommodate heavy loads, and may be used somewhat differently or on different terrains than sports or recreational ATVs with large engines. The lack of statistical significance may also be related to the relatively small sample of observations used in the 1997 analysis (133 injury observations and 457 exposure observations). The 1989 risk analysis, on the other hand, was based on over 1,800 observations (314 injury and 1530 exposure observations), more than three times the number in the 1997 analysis.

Second, while the 1997 analysis indicates that risk is inversely correlated with driving experience, the relationship is not statistically significant in all the regression models. That is, in *some* of the regression models we could not reject, with a high degree of certainty, the hypothesis of no relationship between risk and experience. The explanation for this lack of statistical significance may be related to some intercorrelations between driver age and experience, in combination with the relatively small sample of observations used in the 1997 analysis.

Additionally, the relationship between experience and risk may have been confounded by a larger percentage of new inexperienced drivers who have participated in organized training programs in recent years, programs which intend to reduce risks for new beginning drivers. Based on industry reports, during the last 10 years about 25% of first-time ATV buyers without experience have participated in the Specialty Vehicle Institute of America (SVIA) training program.[4] Polaris Inc., which negotiated a separate consent decree, requires buyers of the Polaris ATVs to take point-of-sale training before the vehicle warranty can go into effect. This contrasts with the very small percentage of drivers who had participated in organized training programs (2% or less) prior to the 1989 risk analysis.

These findings have several implications. First, the finding of higher risks on three-wheel ATVs supports the stop-sale of three-wheel models that was instituted under the 1988 Consent Decrees. Second, the substantially higher risks for children, in combination with the finding that risk rises with engine size for children, supports efforts to keep young children off adult-sized ATVs. Finally, the inverse relationship between risk and driving experience, in combination with the stronger risk-experience findings from the earlier risk analyses, suggests the need for training programs for beginning drivers.

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[4]Specialty Vehicle Institute of America. *ATV Rider Training Summary*. Irvine, CA: Author, (quarterly reports) 1988-1998.

REFERENCES

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

David, Jo-Annette. (January 14, 1998). *Update of ATV Deaths and Injuries*. Washington, DC: U.S. Consumer Product Safety Commission.

Kyle, Susan B. (April 1998). *Preliminary Results 1997 ATV Injury Survey*. Washington, DC: U.S. Consumer Product Safety Commission.

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

Pindyck, Robert. S., and Daniel L. Rubinfeld. (1991). *Econometric Models and Economic Forecasts*. New York: McGraw-Hill.

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.

Rodgers, Gregory B. (1993). All-Terrain Vehicle Injury Risks and the Effects of Regulation. *Accident Analysis and Prevention, 25*(3), 335-346.

Rodgers, Gregory B. (April 1998). *Results of the 1997 ATV Exposure Survey*. Washington, DC: U.S. Consumer Product Safety Commission.

Scheers, N.J., Rae Newman, Curtis Polen, and Debra Fulcher. (February 1991). *The Risk of Riding ATVs: A Comparison from 1985 to 1989*. Washington, DC: U.S. Consumer Product Safety Commission.

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.

Stoner, Diane, and K.P. Srinath. (1998). *All-Terrain Vehicle Exposure Survey*. Contract CPSC-C-94-1115, Task 004. Cambridge, MA: Abt Associates, Inc.

Table 1: Explanatory Variable Definitions

Variable	Definition
Age	The age of the driver in years
Age(X-Y)	1 if the driver is aged x to y, 0 otherwise
Female	1 if the driver is a female, 0 otherwise
Hours	the number of hours driven in an average month
ln(Exp)	the natural logarithm of years of driving experience
Non-Rec	the number of hours out of 10 that the driver uses ATVs in non recreational activities
Engine Size	engine size in cubic centimeters of displacement
3-Wheel	1 if the ATV driven has three wheels, 0 if the ATV has four wheels
Mod	if the ATV was substantially modified (with different tires or wheels, a special exhaust system, suspension modifications, or an engine high performance kit) , 0 otherwise

Table 2: Logistic Regression Results - Risk of Injury

	Model 1			Model 2			Model 3		
Variable	Coeff	Std Err	OR(95% CI)	Coeff	Std Err.	OR(95% CI)	Coeff	Std Err	OR(95% CI)
Intercept	-4.753**	.686	.01(0-.03)	-4.189**	.650	.02(0-.05)	-2.408**	.809	.09(.02-.44)
Age	-.037**	.016	.96(.93-.99)	-.045**	.016	.96(.93-.99)	-.036**	.015	.96(.94-.99)
Female	-1.074**	.538	.34(.12-.99)	-1.021**	.506	.36(.13-.98)	-1.297**	.553	.27(.09-.81)
ln(Exp)	-.501**	.241	.61(.38-.97)	-.463**	.230	.63(.40-.99)	-.438*	.232	.65(.41-1.02)
Non Rec	-.214**	.089	.81(.68-.96)	-.227**	.091	.80(.67-.95)	-.244**	.091	.78(.65-.94)
3-Wheel	1.054**	.492	2.87(1.1-7.6)	1.052**	.470	2.86(1.1-7.2)	1.510**	.510	4.53(1.7-12.3)
Engine Size	.002	.002	1.00(1.0-1.01)	.001	.002	1.00(1.0-1.0)	.002	.002	1.00(1.0-1.01)
Hours	.004	.005	1.00(1.0-1.01)	-	-	-	.005	.004	1.01(1.0-1.01)
Mod	-	-	-	-	-	-	-2.154**	.452	.11(.05-.28)
N(Injury)	96			117			96		
N(Exposure)	421			434			421		
Adj Wald F	4.15			5.52			5.42		

** Significant at 5%
* Significant at 10%

Table 3: Logistic Regression Results - Risk of Injury

	Model 4			Model 5			Model 6		
Variable	Coeff	Std Err	OR(95% CI)	Coeff	Std Err	OR(95% CI)	Coeff	Std Err	OR(95% CI)
Intercept	-7.133**	1.225	0(0-.01)	-6.412**	1.127	0(0-.02)	-4.947*	1.130	.01(0-.07)
Age(<16)	2.083**	1.005	8.02(1.11-58)	1.819**	.924	6.16(1.0-38)	2.016**	.952	7.51(1.2-49)
Age(16-24)	.992	1.011	2.70(.37-20)	.825	.866	2.28(.4-12.6)	1.338	1.016	3.81(.52-28)
Age(25-34)	1.330	.969	3.78(.56-25)	.853	.865	2.35(.4-12.9)	1.261	.993	3.53(.50-25)
Age(35-44)	.666	1.008	1.95(.26-14)	-.005	.902	.99(.17-5.9)	1.109	1.010	3.03(.42-22)
Age(45-54)	.469	.871	1.60(.29-8.9)	-.036	.882	.96(.17-5.5)	.050	.899	1.05(.18-6.2)
Female	-1.210**	.574	.30(.10-.92)	-1.112**	.537	.33(.11-.95)	-1.321**	.579	.27(.09-.83)
ln(Exp)	-.403	.276	.67(.39-1.2)	-.367	.265	.69(.41-1.2)	-.377	.265	.69(.41-1.2)
Non-Rec	-.240**	.090	.79(.66-.94)	-.252**	.092	.78(.65-.93)	-.260**	.093	.77(.64-.93)
3-Wheel	.926*	.511	2.52(.92-6.9)	.971**	.476	2.64(1.03-6.7)	1.548**	.541	4.70(1.6-13.6)
Engine Size	.002	.002	1.00(1.0-1.01)	.002	.002	1.00(1.0-1.01)	.003	.002	1.00(1.0-1.01)
Hours	.005	.005	1.00(1.0-1.01)	-	-	-	.005	.005	1.01(1.0-1.01)
Mod	-	-	-	-	-	-	-2.194**	.504	.11(.04-.30)
N(Injury)	96			117			96		
N(Exposure)	421			434			421		
Adj Wald F	2.96			3.80			3.80		

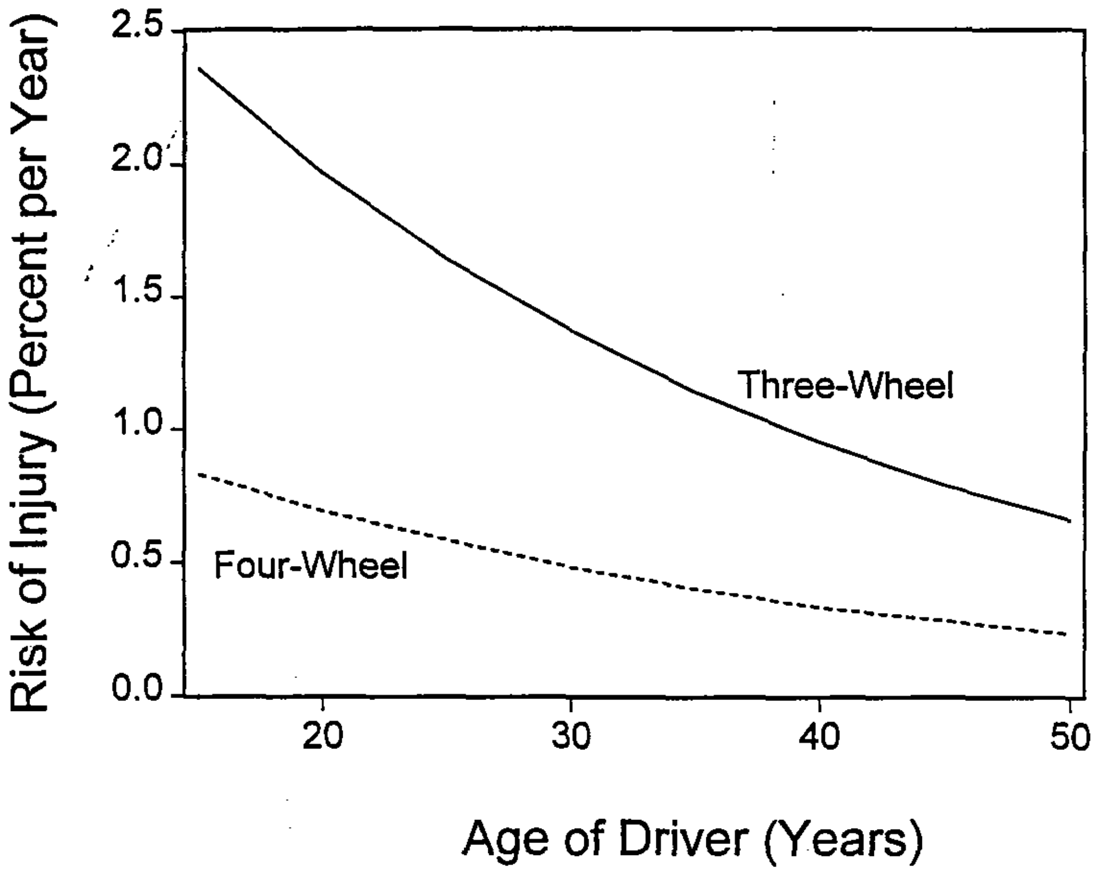
** Significant at 5%
* Significant at 10%

Table 4: Logistic Regression Results - Risk of Injury

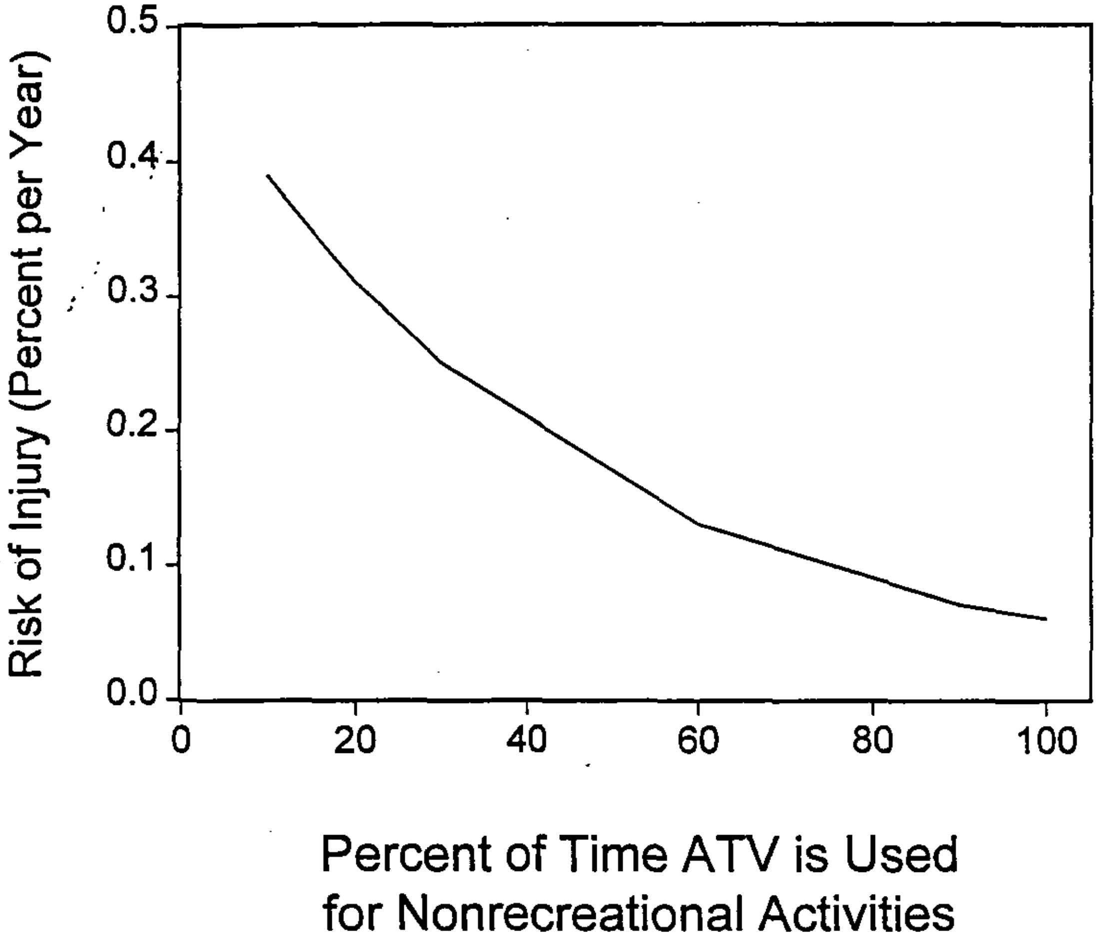
Variable	Coeff	Std Err	Odds Ratio (95% CI)
Intercept	-6.0681**	.7796	.002(0.001-0.011)
Age(<16) * Engine Size	.0060**	.0025	1.006(1.001-1.011)
Age(16-24)*Engine Size	.0010	.0022	1.001(0.997-1.005)
Age(25-34)*Engine Size	.0018	.0019	1.002(0.998-1.006)
Age(35-44)*Engine Size	.0007	.0024	1.001(0.996-1.005)
Age(45-54)*Engine Size	-.0007	.0024	.999(0.995-1.004)
Age(>54) * Engine Size	-.0034	.0040	.997(0.989-1.005)
Female	-1.2011**	.5972	.301(0.093-0.975)
ln(Exp)	-.3200	.2738	.726(0.424-1.245)
Non-Rec	-.2448**	.0878	.783(0.659-0.931)
3-Wheel	.9862**	.4960	2.681(1.010-7.118)
Hours	.0056	.0042	1.006(0.997-1.014)
N(Injury)	96		
N(Exposure)	421		
Adj Wald F	2.97		

** Significant at 5%
* Significant at 10%

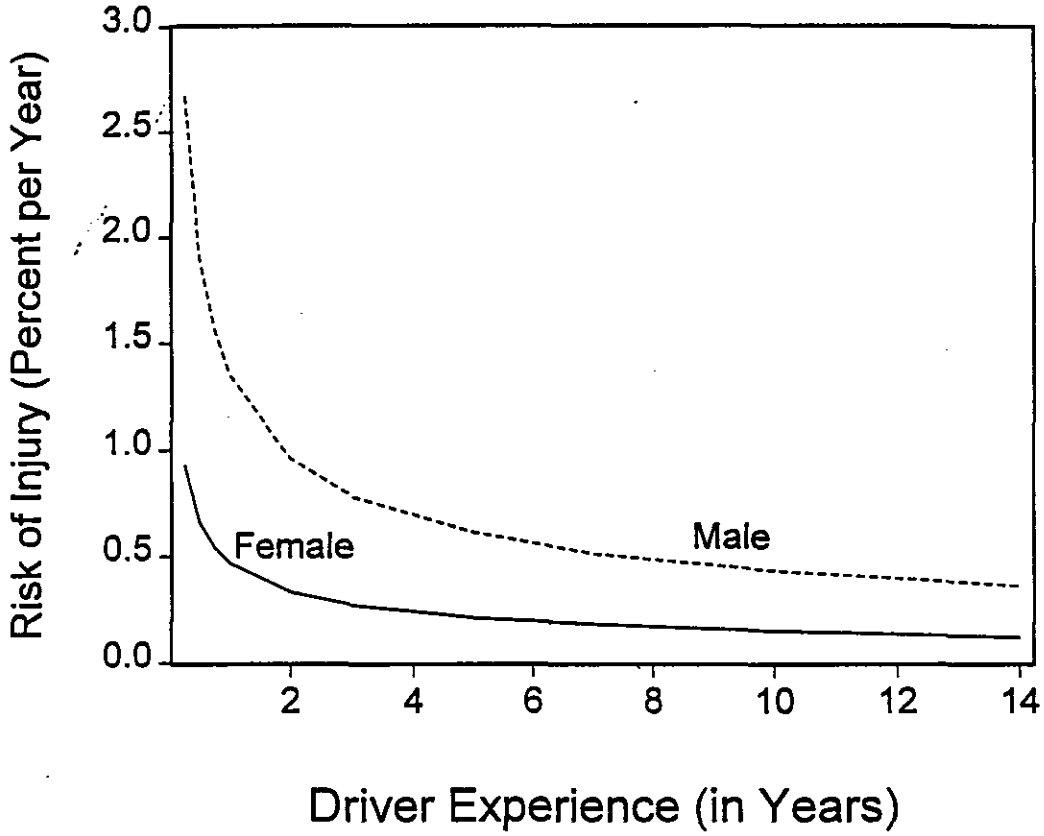
Graph 1: Risk of Injury by Age of Driver (For Both Three- and Four-Wheel ATVs)



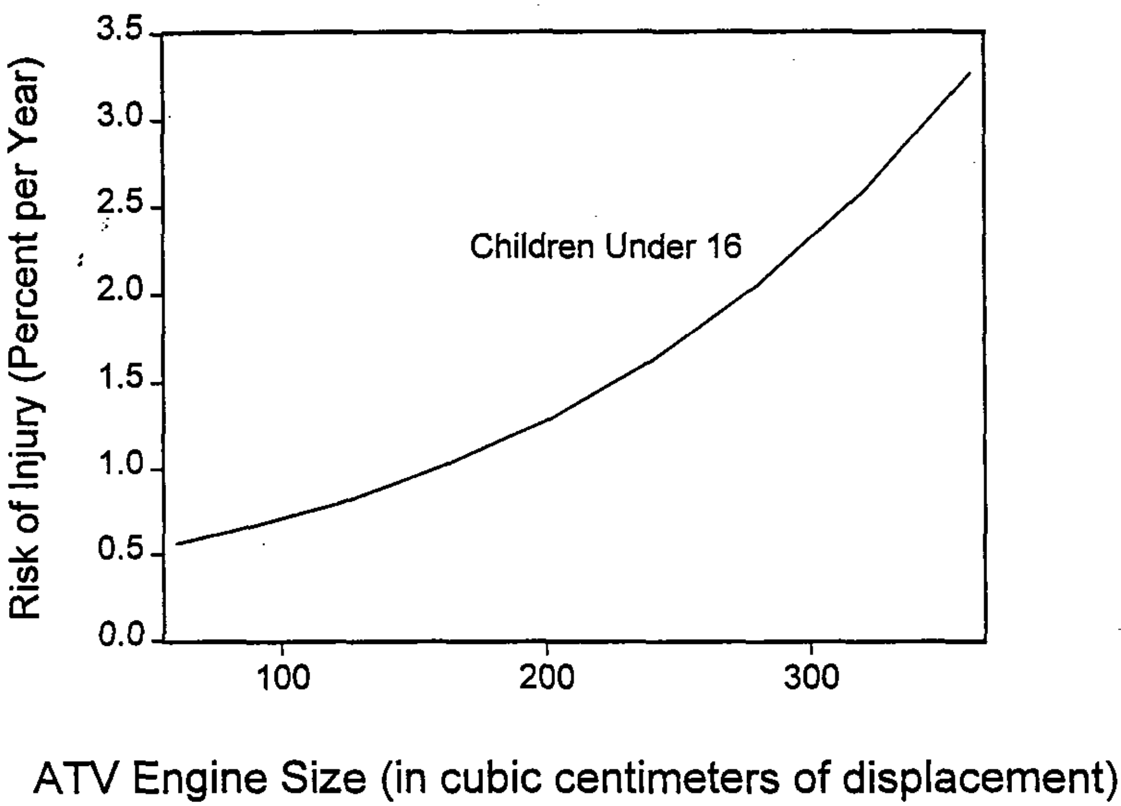
Graph 2: Risk of Injury by Type of Use (Recreational vs. Nonrecreational)



Graph 3: Risk of Injury by Driver Experience (for females and males)



Graph 4: Risk of Injury for Children Under Age 16 by ATV Engine Size



Graph 5: ATV Risks by Driver Age Group (Relative to Risks for Drivers Age 35-54)