

REPORT BY THE U.S.

General Accounting Office

Small Car Safety: An Issue That Needs Further Evaluation

The rising number of smaller cars and their ability to adequately protect their occupants are continuing concerns of vehicle and highway safety experts. The physics of smaller cars prevent them from offering as much passenger protection in every situation as larger cars. However, safety problems cannot adequately be defined or corrected until the smaller cars' performance on today's roads is determined.

The Department of Transportation has done some studies, but it has never made a complete analysis using accident data. The Department should determine which smaller car safety issues need the greatest attention and what countermeasures can be used to reduce accidents, injuries, and fatalities.



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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

COMMUNITY AND ECONOMIC
DEVELOPMENT DIVISION

B-206762

The Honorable Drew L. Lewis
The Secretary of Transportation

Dear Mr. Secretary:

This report examines the issue of small car safety, which needs further evaluation using accident data. This report contains recommendations to you on page 42. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report, and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of this report.

We are also sending copies of this report to the Director, Office of Management and Budget; appropriate Senate and House committees; transportation officials from Michigan and New York States; and other interested parties. In addition, we are sending copies of this report to the Administrators of the Federal Highway Administration and the National Highway Traffic Safety Administration.

Sincerely yours,

A handwritten signature in cursive script that reads "Henry Eschwege".

Henry Eschwege
Director

D I G E S T

Much of the increase in highway fatalities is being attributed to smaller cars, which are rapidly replacing the 4,000-pound and heavier cars of the 1960's and 1970's. Smaller cars comprised about 39 percent of the fleet in 1979 compared with about 4 percent in 1960.

The physical characteristics of smaller size, lesser weight, and shorter length have caused safety experts to question the smaller car's ability to adequately protect its occupants in an accident. Some vehicle and highway safety experts have predicted that the shift to smaller cars will result in an increase in passenger car fatalities while others claim that the safety picture for the smaller car is not known. Many vehicle and highway safety experts agree that until more is known about the record of smaller car experiences, safety problems will not be adequately defined and corrected.

GAO conducted this review because vehicle and highway safety experts and the general public have expressed concern over smaller car safety and because of disagreement over alleged safety problems. GAO reviewed numerous research studies as well as analyzed accident data gathered from New York, Michigan, and the Department of Transportation's National Highway Traffic Safety Administration. (See pp. 1 to 9.)

IS THE SMALLER CAR A SAFETY PROBLEM?

Few conclusions about current or future smaller car safety problems have been unanimously agreed upon by the vehicle and highway safety experts and the automobile industry. Major issues concern whether smaller cars are in more accidents, how well they protect occupants during accidents, and the adequacy of roads to safely contain smaller cars. GAO found that:

--Many studies concurred with New York and Michigan data indicating that smaller cars were not overrepresented in total vehicle accidents when compared with the numbers of smaller vehicles registered in those States. However,

smaller cars were generally overrepresented in single-vehicle accidents with guardrails and, to a lesser degree, median barriers. (See pp. 10 to 12 and 17 to 26.)

- When smaller cars collided with larger cars, smaller car occupants received from 2 to 4 times more severe and fatal injuries than the larger car occupants, according to Safety Administration and New York data. (See pp. 12 to 14.)
- Safety Administration and New York data did not agree on the performance of smaller cars in collision with each other as compared with larger cars in collisions with each other. New York data indicated that smaller car occupants experienced twice as many severe and fatal injuries, whereas Safety Administration data showed no difference in the amount of injuries. (See p. 14.)
- New York data indicated that in single-vehicle accidents, the smaller the car, the more severe the injuries. Michigan and some Safety Administration data showed no consistent trend between occupant injury and all classes of car weight, though both data generally showed fewer injuries and fatalities in the heaviest cars. However, other Safety Administration data showed a slight increase in severe injuries and fatalities for the larger car occupant. (See pp. 14 and 15.)
- New York data indicated that severe and fatal injuries were more prevalent with smaller cars than with larger cars in single-vehicle collisions with utility and light poles. However, no definite relationship could be established between car weights and occupant injuries in median barrier and guardrail accidents. Safety Administration and Michigan data showed no trends in any of these collisions. (See pp. 16 to 26.)

In addition, a highly publicized insurance industry report recently noted that the rate of deaths in small subcompact cars was more than twice that of full-size cars. In light of these varying conclusions on smaller car safety, GAO believes that this issue requires further examination, especially since the physics of smaller cars prohibit them from offering as much occupant protection in every situation as large, heavier cars. (See p. 12.)

INFORMATION IS AVAILABLE TO DETERMINE
SAFETY PROBLEMS OF SMALLER CARS

The Department of Transportation's Safety Administration and Federal Highway Administration include smaller cars in research and testing; however, neither agency has determined the highway safety experience of smaller cars. Statistical analysis using accident data can provide this information, but the Department has conducted research with only limited use of this data. The research does not provide enough information on specific types of accidents, such as collisions with roadside barriers. Much of it is not current and may not represent the present day safety concerns with smaller cars. Without such information, the Department is unable to determine which smaller car issues are most important to public safety.

The Federal Government, States, and private groups have performed many studies and tests on smaller cars, providing a wealth of information. Much of this information is engineering analysis which uses automotive crash tests under controlled or laboratory conditions to understand the physical structure of the vehicle and roadway. This information could be tapped to help define and appraise the physical elements of safety and smaller cars.

However, a fuller examination of real-world accident data should be conducted to show how smaller cars are actually performing and what problems peculiar to smaller cars are actually occurring on the roadways. To date, such analysis has not been used to establish smaller car safety research priorities.

RECOMMENDATIONS

GAO recommends that the Secretary of Transportation determine which smaller car safety issues need the Nation's greatest attention and what countermeasures can be used to reduce accidents, injuries, and fatalities. To accomplish this task, GAO recommends that the Secretary analyze all relevant sources of available accident and test information but that emphasis be given to using accident data.

GAO also recommends that the Secretary use the results of the above analysis to rank research priorities in deciding on future programs which can affect the safety of smaller cars on the

highway. These rankings will also assist the Congress with its oversight responsibilities in the vehicle safety area. (See p. 41 for further recommendations.)

AGENCY COMMENTS

In commenting on the report, the Department of Transportation did not concur with the majority of GAO's findings and conclusions. It said that GAO had not added to the general level of knowledge in the area and had produced a misleading research product. It also claimed that the report provided simplistic and unsupported recommendations for the Department's management of highway safety research.

GAO's primary purpose was not one of furthering the general level of research knowledge. GAO's objectives were to assess smaller car safety concerns in light of present research and to determine what is being done and what remains to be done by the Federal Government. To accomplish its task, GAO reviewed over 200 research and study documents, conducted extensive interviews with industry, private research groups, and State and Federal officials.

GAO determined that vehicle and highway safety experts do not agree on the existing smaller car safety problems and that the Department has not conducted a thorough study of the subject. Furthermore, GAO established, through examination of accident data and interviews with safety experts, that accident data is a useful method to determine injury and accident experiences and is available to study smaller car safety.

As stated below, both the States of New York and Michigan indicated agreement with the report and believed the statements contained therein were supported.

The Department's summary comments, along with GAO's evaluation, are located in appendix II. The Department's comments about GAO's recommendations are at the end of chapter 3 along with GAO's evaluation. (See pp. 41 and 42.)

STATE COMMENTS

GAO asked New York and Michigan officials who provided accident data for the review to comment on the report. Michigan "found it acceptable as

is" and stated "that more research is needed as relates to small cars." New York found the report to be "thorough and comprehensive" and believed that statements made in the report were fully supported by the data presented.

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ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
DOT	Department of Transportation
EPA	Environmental Protection Agency
FARS	Fatal Accident Reporting System
FHWA	Federal Highway Administration
GAO	General Accounting Office
NASS	National Accident Sampling System
NCHRP	National Cooperative Highway Research Program
NCSS	National Crash Severity Study
NHTSA	National Highway Traffic Safety Administration

CHAPTER 1

INTRODUCTION

The Nation's passenger car fleet has witnessed a slow, steady increase of smaller cars during the last decade. Oil embargoes, increasing fuel costs, and Federal fuel economy requirements were major events of the 1970's that influenced automobile manufacturing and customer purchasing decisions. These events explain much of the Nation's subsequent shift to smaller cars.

Concerns about smaller car safety are not a present day phenomena. Vehicle and highway safety experts have questioned the safety of small cars for more than a decade. The physical characteristics of smaller size, lesser weight, and shorter length have caused safety experts to question the smaller car's ability to adequately protect its occupants in an accident. Some vehicle and highway safety experts have predicted that the shift to smaller cars will result in an increase in passenger car fatalities while others claim that the safety picture for the smaller car is not known. Many vehicle and highway safety experts agree that until more is known about the record of smaller car experiences, safety problems will not be adequately defined and corrected.

FEDERAL SAFETY ACTIONS

In 1966 the Congress passed two acts aimed at improving safety on our Nation's highways--the National Traffic and Motor Vehicle Safety Act (15 U.S.C. 1381 et seq.) and the Highway Safety Act (23 U.S.C. 401 et seq.).

The Motor Vehicle Safety Act constituted the first significant Federal entry into motor vehicle safety. Under this act, the Secretary of Transportation, through the National Highway Traffic Safety Administration (NHTSA), issues (1) minimum performance safety standards for motor vehicles, including cars, trucks, and buses and (2) standards for vehicle equipment. The standards are designed to protect the public against unreasonable risks of traffic accidents and against injury when an accident does occur.

Previous legislation had allowed States to voluntarily implement highway safety programs. The Highway Safety Act of 1966 required the Secretary of Transportation, through the Federal Highway Administration (FHWA), to take a more forceful role in State highway safety operations. The act called for a cooperative effort where the Secretary would provide financial aid to States to accelerate highway safety programs. The Highway Safety Act of 1973 authorized additional categorical funds for special safety-related roadway construction programs involving rail-highway crossings, pavement marking, high-hazard locations, elimination of roadside obstacles, and safety improvement projects on non-Federal-aid roads. Subsequent acts and amendments have

continued funding and refined these categorical programs but have not substantially changed them.

MORE SMALLER CARS AND THEIR EFFECT ON FATALITIES

Approximately 50,000 highway fatalities occur every year with more than half of these deaths happening to passenger car occupants. Government statistics of passenger car fatalities indicate that more fatalities occur in smaller than in larger cars. A 1981 NHTSA report predicts that:

"* * * annual fatalities in the United States are expected to increase by 10,000 by 1990 due solely to changes in the size and weight of vehicles on the road * * *. * * * fatalities in smaller cars will increase at a rapid rate while large car fatalities will decline."

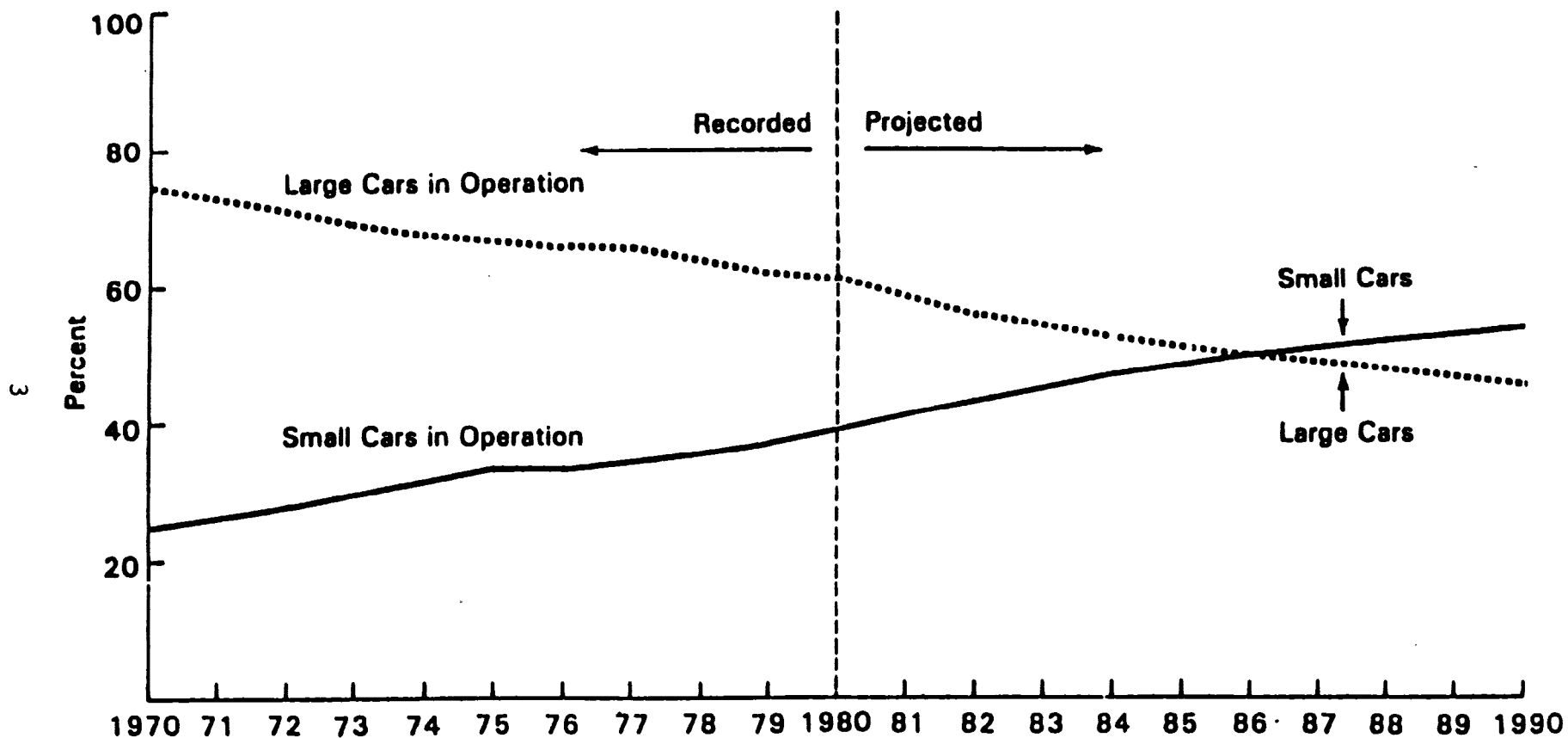
In addition, a January 1982 report by the Insurance Institute for Highway Safety reported that:

"* * * comparison of car sizes shows 1.6 passenger car occupant deaths per 10,000 registered full-size cars one to five years old in 1978-1980. For small subcompact cars, the number of deaths is more than twice as high--3.5 per 10,000 cars."

Some auto industry officials do not agree that rising fatalities are due to the increasing number of smaller cars. They indicate that, in 1974 and 1975, fatalities decreased as the smaller car population increased. It should be noted that these years coincide with reduced vehicle miles of travel due to the oil embargo and to the imposition of the 55 mph speed limit. However, one official from General Motors did state that the small car safety problem may be a significant problem particularly as careful analysis of recent data reveals that smaller cars fare worse in many accident situations.

As cars of lesser size, weight, and dimension grow in numbers on the roadway, the larger, heavier full-size car has begun to decrease as a percentage of the fleet. A recent study by Pot- ters Industries Inc., showed that the smaller car fleet has in- creased from 4 percent in 1960 to 21 percent in 1970 to 39 percent in 1979. The chart on page 3 shows the recorded and projected increase in smaller cars and decrease in larger cars. NHTSA sta- tistics show that in 1970 only about 25 percent of cars were small but by 1980 this percentage had increased to about 40 percent. During this period, larger cars decreased from about 75 to 60 per- cent. By 1986 the balance of smaller to larger cars is projected to be equal, with the smaller cars dominating thereafter.

Historical and Projected Small and Large Cars in Operation, 1970-1990



Large Cars = Mid-Size and Large

Small Cars = 2-Seater, Minicompact, Subcompact, and Compact

Size Categories Are Based on Environmental Protection Agency's Interior Roominess Classification.

Source: R.L. Polk and Co. and the National Highway Traffic Safety Administration

The new cars of the 1980's will be characterized by (1) downsizing--reducing the vehicle's external dimensions without changing the interior volume, (2) front-wheel drive, and (3) light-weight materials. All of these elements will contribute to significant weight reductions. In 1979, cars weighing less than 3,500 pounds represented only 37 percent of the passenger cars in operation, but by 1990, they are estimated to represent 64 percent of the passenger car fleet.

Estimated percent of fleet

<u>Car weight</u> (pounds)	<u>1979</u>	<u>1990</u>	<u>Percent of change</u>
2,000 or less	4	8	+100
2,000 - 3,000	18	44	+144
3,000 - 3,500	15	12	-20
3,500 - 4,000	24	25	+4
4,000 - 4,500	26	2	-92
4,500 or more	<u>13</u>	<u>10</u>	-23
	<u>100</u>	<u>101</u>	

Source: Texas Transportation Institute

SMALL CAR DEFINITIONS VARY

Although the term "small car" seems readily understandable, it has varied definitions. Automobile manufacturers, the Federal Government, States, and private researchers do not use the same classifications to define small cars. Cars can be classified by weight, length, wheelbase, interior space, car configuration, or any combination of these. Names given to these categories include minicompact, subcompact, compact, midsize, intermediate, large, and luxury. Some cars maintain these names because of tradition, that is, last year's intermediate may be next year's intermediate even though its weight or size may be reduced.

The Environmental Protection Agency (EPA) classifies passenger cars by interior space to provide information to consumers to help them compare fuel economy of similarly sized cars. Other groups use criteria such as those on page 5 for their own reporting purposes.

Organizations

	Environmental Protection Agency (<u>note a</u>)	"Automotive News" (<u>note b</u>)	National Association of Fleet Administrators (<u>note c</u>)	Highway Loss Data Institute (<u>note d</u>)
Categories	Minicompact Subcompact Compact Midsize Large	Subcompact Compact Intermediate Standard Luxury	Subcompact Compact or small Midsize Large	Small subcompact Subcompact Small compact Compact Intermediate Full size
Criteria for cat- egories	Interior volume	Tradition Many other classifiers except weight are used.	Wheelbase and weight	Wheelbase

a/NHTSA and FHWA generally use EPA criteria.

b/The automotive industry's weekly newspaper.

c/A professional association of people who manage large corporate car fleets and those who provide services to these managers.

d/Gathers, processes, and publishes insurance data relating to human injury and other losses associated with motor vehicles.

States also classify automobiles for records management purposes. Some classify by weight but have different weight groupings, while others use wheelbase or other criteria mentioned above. Michigan and Illinois State officials told us that since no common categories or criteria existed, they arbitrarily established their own--Michigan using weight to establish four categories and Illinois using weight and wheelbase to establish two categories.

Most vehicle and highway safety experts agree that weight is a good standard by which to measure the safety differential between small and large cars. Weight, along with size, is a primary factor affecting the force exerted against the car during an accident. The force affects, in turn, the collision damage and injury severity.

OBJECTIVES, SCOPE, AND METHODOLOGY

This review was conducted because of concern about smaller car safety and because of disagreement over alleged safety problems. The objectives of the review were to assess the smaller car safety concerns in light of present research and to determine

what is being done and what needs to be done by the Federal Government to correct these problems.

To obtain information concerning smaller car safety, we reviewed over 200 reports, studies, and opinion papers from numerous vehicle and highway safety experts. We talked with officials from General Motors Corporation, Ford Motor Company, and Chrysler Corporation as well as with NHTSA and FHWA headquarters and regional officials. In addition, we talked with representatives from 14 other organizations, agencies, and private concerns interested in smaller car safety. (See app. I.) We visited Department of Motor Vehicle and other State officials in New York, Texas, Michigan, Illinois, and North Carolina and visited researchers in Michigan, North Carolina, New York, and Texas.

We collected data from several sources to study smaller car safety. We chose weight as a way of classifying vehicles, but we did not attempt to define a specific weight for a small or large car; instead, we referred to cars by various weight classes. We requested data by certain weights from New York, Michigan, Illinois, and NHTSA. For multivehicle accidents, information was provided by New York, Michigan, and NHTSA for three weight classes--less than 2,500 pounds, 2,500 to 3,499 pounds, and 3,500 pounds or more. Michigan also used these general weight classes for single-vehicle accidents, whereas New York and NHTSA single-vehicle information was classified in five categories--less than 2,000 pounds, 2,000 to 2,499 pounds, 2,500 to 2,999 pounds, 3,000 to 3,999 pounds, and 4,000 pounds and above. Illinois could only provide information for two classes based on weight and wheelbase.

We asked New York, Michigan, and Illinois officials to provide us with accident and injury data because (1) they are known within the vehicle and highway safety communities for their ability to retrieve data by vehicle weight and (2) because they were willing to participate.

The States generously compiled this data by vehicle weight categories to enable us to analyze the accident, injury, and fatality performance of various-sized cars. These States provided a breakdown of accident and injury data by (1) driver age and sex, (2) numbers of single-vehicle accidents with light poles, guardrails, and median barriers, (3) urban and rural accidents, (4) single-vehicle accidents, and (5) multivehicle accidents. New York included data on vehicles with model years from 1965-80.

The amount of data available from the three States differed substantially. New York and Michigan supplied 3 years of police-reported data from which we drew many of our conclusions. Both States have established practices for verifying their data to ensure its accuracy. Illinois could supply only 3 months of data, which eliminated meaningful analysis and conclusions based on that data.

Vehicle registration data was also provided by Michigan and New York by vehicle weight categories. Registration data from Michigan was based on a representative year sample and not on fiscal or licensing year since the State's licensing procedures changed during the 1978-80 study period. New York registration data was from the actual 1978-80 registrations.

We asked NHTSA for similar accident data from its Fatal Accident Reporting System (FARS), National Crash Severity Study (NCSS), and National Accident Sampling System (NASS). It provided data from all three sources. Five years of FARS data included the same type of information as the New York and Michigan data except no nationwide registration data was available. NCSS data only included information on all single-vehicle accidents and pole accidents. NASS data included information similar to FARS; however, it was based on a small sample size which eliminated meaningful analysis and conclusions based on that data.

Injury data that NHTSA and the States provided was based on National Safety Council definitions. In analyzing the data, we used only the two most severe categories, fatal and incapacitating injuries, 1/ which we combined to make analysis and presentation less complicated and more statistically relevant. Fatality information alone could not provide adequate data to analyze specific types of accidents such as guardrail collisions, whereas combining the two most severe categories could provide that data in many cases. We explained this approach to several Federal, State, and private research officials who agreed that the approach was reasonable.

Figures presented in chapter 2 were, for the most part, taken from analyses of data described above. We calculated percentages and ratios directly from these data sources by automobile weight groupings to determine whether there were major differences in numbers of accidents, severe injuries, or fatalities of different weight cars. We presented our methodology and calculations to State and Federal officials who provided the data. In analyzing this accident, injury, and registration data and presenting it in this report, we recognize that in many cases it must be qualified due to the multiplicity of factors which contribute to accidents. We make these qualifications within the report as the data is used.

We performed this review in accordance with GAO's "Standards for Audit of Governmental Organizations, Programs, Activities, and Functions."

1/An incapacitating injury is one other than a fatal injury which prevents the injured person from walking, driving, or continuing normal activities performed before the injury occurred.

HANDLING AGENCY COMMENTS

The Department of Transportation commented on a draft of this report in a February 8, 1982, letter. (See app. II.) The Department did not concur in the majority of the findings, conclusions, and recommendations in our draft report. The Department provided comments that, in our opinion, did not warrant changing our conclusions or recommendations.

In commenting on our draft report, the Department found it to be an unacceptable and misleading research product which did not advance the general level of highway safety knowledge. However, the Department mistakenly interpreted the objectives of our review. As stated in our draft report, we conducted this review on smaller car safety to assess safety concerns in light of present research and to determine what is being done and what remains to be done by the Federal Government. To this end, we believe the report is accurate and informative. Both the States from which comments were requested indicated agreement with the report's contents and believed that statements made in the report were fully supported by the data presented.

In its response, the Department stated that the small car is part of a larger highway safety problem and that our draft report suggested that the small car is a separate and distinct problem from other vehicles in the traffic stream. We recognize that there are safety problems associated with vehicles other than smaller cars; however, smaller cars, unlike larger vehicles, are a new and growing phenomenon and passengers of these vehicles account for over half the passenger car deaths in the Nation. For these reasons, we believe the Department has a responsibility to specifically study and identify smaller car safety problems.

We have responded to the Department's comments by evaluating

--its comments to our recommendations at the end of chapter 3 and

--its entire summary comments in appendix II.

The Department also provided 40 pages of attachments which are not included in this final report. However, any changes to the draft report that resulted from the Department's comments are incorporated. Other minor changes were made to the draft report during our own internal review process.

HANDLING STATE COMMENTS

We asked the Michigan and New York officials who provided accident data for our review to comment on the draft report. In keeping with our Office policy, we did not include the conclusions and recommendations sections of the draft report.

In commenting on the draft report, Michigan "found it acceptable as is" and stated "that more research is needed as relates to small cars." New York found the draft report to be "thorough and comprehensive" and believed that statements made in the report were fully supported by the data presented. The States' comments are located in appendixes III and IV.

CHAPTER 2

IS THE SMALLER CAR A SAFETY PROBLEM?

Uncertainty about smaller car safety has existed for many years, and opinions on the subject continue to vary. One common presumption is that smaller cars are less safe than larger ones. However, that general opinion neither addresses nor assesses the complexity of issues surrounding smaller car safety. More about the experiences of smaller cars needs to be known, such as:

- Are smaller cars in more accidents?
- Do smaller car occupants receive more injuries than larger car occupants in smaller car/larger car collisions?
- Do smaller car occupants receive more injuries than larger car occupants in collisions of two vehicles of similar weight?
- Do smaller car occupants receive more injuries than larger car occupants in single-vehicle accidents?
- Are roadways more hazardous for smaller cars?
- Do designs of smaller cars present safety hazards?

If answers to these questions indicate smaller car safety problems, then reasons for these occurrences must be determined along with feasible solutions.

To date, vehicle and highway safety experts have few definitive responses to these questions. Most concur that in a crash between a smaller and a larger car, occupants of the smaller car fare worse than occupants of the larger car, if all things other than vehicle size are equal. Beyond that, no consensus exists, and available research does not provide the necessary answers even though NHTSA reported in 1979 that occupants of minicompact, subcompact, and compact cars accounted for 55 percent of deaths in multivehicle collisions and 51 percent in single-vehicle collisions while the cars comprised only 38 percent of the fleet.

The following discussion examines each of the above smaller car safety issues and presents what is known about the safety record of smaller cars in various accident situations. It presents both the existing literature and an original analysis of accident data.

ARE SMALLER CARS IN MORE ACCIDENTS?

The probability of smaller cars having more accidents has been a subject of disagreement for many years. One 1975 Texas study reported that larger cars are in more accidents, while a series of North Carolina studies conducted during the 1970's

indicated that smaller cars have a higher accident rate. The California official responsible for the statewide traffic record system told us in May 1981 that he had not noticed smaller cars being in more accidents even though his State had a high percentage of smaller cars. A 1976 study by the Center for Environment and Man in Connecticut reviewed the existing literature and concluded that no evidence existed relating car size--positively or negatively--to accident frequency.

Our analysis of New York data shows that, based on the number of registered cars in each weight class, smaller cars are not overrepresented in total accidents 1/ and are not significantly overrepresented in single-vehicle or multivehicle accidents. The schedule below shows that the percent of accident involvement and fleet composition within each weight class are comparable for total accidents. This suggests that the rate of accidents in each weight class of vehicles is approximately the same as the rate that vehicles are represented in the passenger car fleet.

Comparison of Total Police-Reported Accidents to
Size of Fleet - New York

<u>Vehicle weight</u> (pounds)	<u>1978</u>		<u>1979</u>		<u>1980</u>	
	<u>Percent of fleet</u>	<u>Percent involved in accidents</u>	<u>Percent of fleet</u>	<u>Percent involved in accidents</u>	<u>Percent of fleet</u>	<u>Percent involved in accidents</u>
Less than 2,000	5.8	5.7	6.1	5.8	6.3	5.9
2,000-2,499	8.9	8.4	10.1	9.5	11.5	10.6
2,500-2,999	13.2	13.6	13.9	13.8	14.5	14.4
3,000-3,999	45.5	45.5	45.5	46.0	45.3	45.7
4,000 and above	26.5	26.8	24.4	25.0	22.4	23.4

However, our analysis of Michigan data indicated inconsistencies between accidents and registration. Generally, for total accidents and multivehicle accidents in 1978 and 1979, the percent of registered cars and percent of accidents were about the same for all weight classes. For 1980 the smallest weight group was underrepresented and the largest group was overrepresented in accidents. For single-vehicle accidents 2/ in 1978 and 1979, the two smallest weight groups were overrepresented in accidents and the largest group was underrepresented. For 1980 single-vehicle accidents, this pattern was reversed.

1/In New York, the number of total accidents in 1978 was 244,902; in 1979, 229,933; in 1980, 228,395.

2/In Michigan, the number of single-vehicle accidents in 1978 was 29,449; in 1979, 27,850; in 1980, 27,688.

Comparison of Single-Vehicle Accidents to
Size of Fleet - Michigan

Vehicle weight (pounds)	1978		1979		1980	
	Percent of fleet	Percent involved in accidents	Percent of fleet	Percent involved in accidents	Percent of fleet	Percent involved in accidents
Less than 2,500	10.6	12.5	10.9	11.8	16.2	12.9
2,500-3,499	30.5	35.4	32.7	36.6	35.1	37.5
3,500 and above	58.9	52.2	56.4	51.6	48.7	49.6

Other factors such as driver error, driver age, age of car, speed, and time of day can influence accident rate. No study has yet examined all these factors, partially because much of this information is not readily available.

Registration data is only one method of determining whether cars of the lighter weight classes have more accidents than those of the heavier weight classes. Vehicle miles traveled is another measure of comparison for accident frequency; however, this data is not generally available by weight class. Different measures could result in findings different than ours. However, New York Department of Motor Vehicle officials and officials from NHTSA's National Center for Statistics and Analysis agree that using registration data is an acceptable measure for studying smaller car safety.

DO SMALLER CAR OCCUPANTS RECEIVE MORE
INJURIES THAN LARGER CAR OCCUPANTS
IN SMALLER CAR/LARGER CAR COLLISIONS?

One fact undisputed by the vehicle and highway safety experts and the auto industry is that occupants in smaller cars receive more injuries in collisions with larger cars than do larger car occupants. This assumes that safety conditions, such as wearing seat belts, between the two colliding cars are equal.

The larger car has the inherent advantage of sheer size and weight over the smaller car. For example, a larger car normally has a longer front end which helps slow down the vehicle in collisions. A smaller car will come to a more abrupt halt during a collision. This puts its occupants in more danger by placing greater demands on the car's interior characteristics, such as the steering column, seat belts, and interior padding. Further, a General Motors report states that it simply is not possible to engineer a small, light car that provides as much occupant protection in every instance as a large, heavy one. NHTSA officials agree that, all things other than size being equal, larger cars provide more occupant protection.

Several studies have confirmed that the occupants of smaller cars that collide with larger cars have a higher injury risk. The North Carolina Highway Safety Research Center reported in 1978 that drivers of the lighter (smaller) cars in crashes are more than twice as likely to be killed or seriously injured as drivers of the heavier (larger) cars. Using the five EPA vehicle interior size categories (minicompact, subcompact, compact, mid-size, and large), NHTSA studied 1979 data from FARS. NHTSA determined that occupants of the smallest cars (mini and subcompact) had 8.2 times more fatalities than occupants of the largest cars (full size) when the cars from these two categories collided. We analyzed the same 1979 FARS data using weight categories instead of EPA categories. (The smallest cars were 2,500 pounds and below; the largest cars were over 3,500 pounds.) Based on these weight categories, the smaller car occupants had 6.2 times more fatalities.

Similar results were found in New York data and 5 years of FARS data when fatalities and severe injuries were examined. In all 1978-80 New York police-reported accidents, the data indicated that when a car weighing less than 2,500 pounds collides with one weighing over 3,500 pounds, the smaller car occupants had about 4 times more severe and fatal injuries. The FARS data showed almost twice as many severe and fatal injuries to smaller car occupants. See the table below for a comparison. We were not able to compare Michigan multivehicle data because the data did not allow comparison of particular types of collisions--for example, a collision of a 2,500-pound car with one weighing more. The data only provided a total of injuries in the three weight classes.

Ratio of Occupants Severely and Fatally
Injured in 2,500-Pound Car to
3,500-Pound Car Collisions

Year	FARS		New York	
	More than 3,500- lb. car	Less than 2,500- lb. car	More than 3,500- lb. car	Less than 2,500- lb. car
1980	N/A	N/A	1.0	3.94
1979	1.0	2.14	1.0	4.21
1978	1.0	2.07	1.0	4.0
1977	1.0	1.98	N/A	N/A
1976	1.0	2.03	N/A	N/A
1975	1.0	1.70	N/A	N/A

Vehicle and highway safety experts question whether this safety differential between larger and smaller cars will only be temporary since fewer larger cars will be on the road as the auto manufacturers downsize the passenger car fleet. By the mid-1980's, less than half of the cars on the road are projected to be full-sized. This could mean that the probability of smaller car/larger car accidents will be much less. On the other

hand, the Acting Associate Administrator for Research and Development, NHTSA, noted that all car models, whether large, medium, or small, would be downsized. Therefore, there will continue to be different sizes of cars on the road, and smaller car/larger car accidents will continue even though the 4,000-pound car may disappear from the fleet.

The safety differential also appears to exist between small- and medium-size cars. New York data shows that collisions between smaller cars weighing less than 2,500 pounds and medium size cars weighing between 2,500 to 3,500 pounds resulted in about 2 times as many severe injuries and fatalities to smaller car occupants. FARS data showed about 1-1/2 times as many injuries.

DO SMALLER CAR OCCUPANTS RECEIVE MORE INJURIES THAN LARGER CAR OCCUPANTS IN COLLISIONS BETWEEN TWO VEHICLES OF SIMILAR WEIGHT?

Studies and our analysis of accident data have conflicting results on the incidence of injury in two-vehicle crashes of cars with similar weights. Some studies have shown that the smaller car occupants tend to be injured more frequently than the larger car occupants; others have demonstrated no difference in injury rate.

A 1978 North Carolina Highway Safety Research Center report stated that the risk of severe injuries or death to drivers was more than 1-1/2 times as great when two cars weighing between 1,000 to 2,000 pounds collide than when two cars weighing 3,950 pounds or more collide. A 1973 Michigan Highway Safety Research Institute report cited that in head-on collisions, the percent of cars in which there was a minimum of one injury was approximately 30 percent higher between two cars weighing 3,100 pounds or less than for two cars weighing 3,300 pounds or more. However, the report also stated that when all types of collisions between two vehicles of similar weights were combined, the percent did not differ substantially for collisions of smaller or larger cars.

Our analysis of 1975-79 FARS data indicates that in fatal accidents when two cars of similar weight collide, injuries and fatalities to occupants are about the same regardless of car size. The New York data suggests that when two cars of the same weight class collide, the occupants of cars weighing less than 2,500 pounds have twice as many injuries and fatalities as those in cars weighing over 3,500 pounds. Occupants of cars weighing from 2,500 pounds to 3,500 pounds have nearly 1-1/2 times as many injuries and fatalities as occupants of cars weighing over 3,500 pounds.

DO SMALLER CAR OCCUPANTS RECEIVE MORE INJURIES THAN LARGER CAR OCCUPANTS IN SINGLE-VEHICLE ACCIDENTS?

About one-third of all fatalities to passenger car occupants occur in single-vehicle accidents. However, vehicle and

highway safety experts disagree on whether smaller car occupants are injured more frequently than larger car occupants in single-vehicle accidents. Some research suggests that injuries might be greater to smaller car occupants, but other research indicates that no consistent trend by car weight can be found.

Based on FARS data, NHTSA reports that 51 percent of fatalities in single-vehicle crashes in 1979 were in minicompact, subcompact, and compact cars. The Insurance Institute for Highway Safety in a 1982 report stated that the occupants of small subcompact cars are more than twice as likely as occupants in full-size cars to die in single-vehicle crashes. On the other hand, the North Carolina Highway Safety Research Center issued a 1978 report based on data from North Carolina and which noted that there appeared to be no distinct patterns linking fatalities or severe injuries to car size.

Our analysis of 1975-79 FARS data and 1978-80 Michigan data generally showed fewer injuries and fatalities in the heaviest cars. However, the percent of injuries does not consistently decrease with an increase in vehicle weight, as shown in the following schedule of FARS data.

Percent of Occupants Suffering Fatal and Severe Injuries in Fatal Single-Vehicle Accidents

<u>Year</u>	<u>Less than 2,000- lb. car</u>	<u>2,001-2,500 lb. car</u>	<u>2,501-3,000 lb. car</u>	<u>3,001-4,000 lb. car</u>	<u>More than 4,000- lb. car</u>
1975	61.1	65.5	62.2	59.5	58.9
1976	65.7	64.5	65.9	60.9	60.1
1977	64.6	66.9	63.3	62.1	59.9
1978	67.2	67.9	66.7	61.7	59.9
1979	68.4	67.7	65.0	62.2	59.6

New York accident data indicated that occupants of lighter cars consistently suffer more injuries/fatalities in single-vehicle accidents, as follows.

Percent of Occupants Suffering Fatal and Severe Injuries in Single-Vehicle Accidents - New York

<u>Year</u>	<u>Less than 2,000- lb. car</u>	<u>2,000-2,500 lb. car</u>	<u>2,501-3,000 lb. car</u>	<u>3,001-4000 lb. car</u>	<u>More than 4,000- lb. car</u>
1978	13.0	13.5	12.2	11.1	8.6
1979	13.6	13.0	12.3	11.5	9.6
1980	12.9	12.5	12.5	11.5	10.0

On the other hand, our analysis of NCSS data which includes only tow-away accidents indicated that as the weight of the car

increases, occupants of larger cars, to a small degree, suffer more injuries/fatalities in single-vehicle accidents.

ARE ROADWAYS MORE HAZARDOUS FOR SMALLER CARS?

Much of recent highway literature suggests that today's roadways are unsafe for smaller cars. In fact, many experts state that injuries and fatalities from hitting roadside features could increase due to the smaller car. It has not been determined how many of these accidents involve smaller cars; however, FARS data indicates that in 1979 about 31 percent of all fatal accidents involved hitting a roadside feature as the first harmful event of the accident.

The Nation's roadways were designed and built when smaller cars were not a dominant part of the vehicle fleet. Roadside hardware (guardrails and median barriers) and roadway signs and markings were designed for heavier, larger cars. Though roadway design guidelines have changed to keep pace with changes in fleet composition, the recent surge of smaller car sales may have outpaced the present guidelines. In September 1980, FHWA stated that downsizing effects on roadside hardware performance is an immediate concern and that FHWA and the American Association of State Highway and Transportation Officials (AASHTO) are reviewing certain highway design criteria.

Vehicle and highway safety experts disagree over whether smaller cars are incompatible with roadways.

- Federal and State highway safety officials and industry representatives told us that roadway features, such as roadway surfaces, roadside slopes, or roadside hardware, have not been proven to be more hazardous to smaller car occupants than to larger car occupants.
- Some vehicle and highway safety experts indicated that smaller car safety problems are related more to the vehicles, not the roadways, and that more occupant protection with structural improvements to the vehicles can help solve incompatibilities.
- Other experts indicated that smaller car problems are related more to roadways, not to the vehicles. For example, they stated that much existing roadside hardware was designed for larger cars and is hazardous to smaller cars.
- The National Transportation Safety Board as early as 1969 identified incompatibilities between vehicles and highways, such as the ability of vehicles to withstand crashes with highway barriers.

--The National Highway Safety Advisory Committee in a June 1980 report to the Secretary of Transportation warned that the road system might not be compatible with the future downsized fleet.

--The Insurance Institute for Highway Safety in a January 1982 report stated:

"The incompatibility of lower, lighter cars with roadside structures designed to keep larger, heavier vehicles on the road may account in part for the high number of deaths among small car occupants in single-vehicle crashes."

Though these disputes are unresolved, especially for the smaller car, FHWA is beginning to examine problems the smaller car has on the roadway. For example, crash testing has been conducted with smaller cars against roadside hardware. The tests have demonstrated that the lighter (1,800 pound) car does not perform adequately against some roadside hardware. The guidelines for some highway design elements, such as passing distance, have been reconsidered in light of the smaller car, but no thorough examination of their impact on smaller car safety performance has been made.

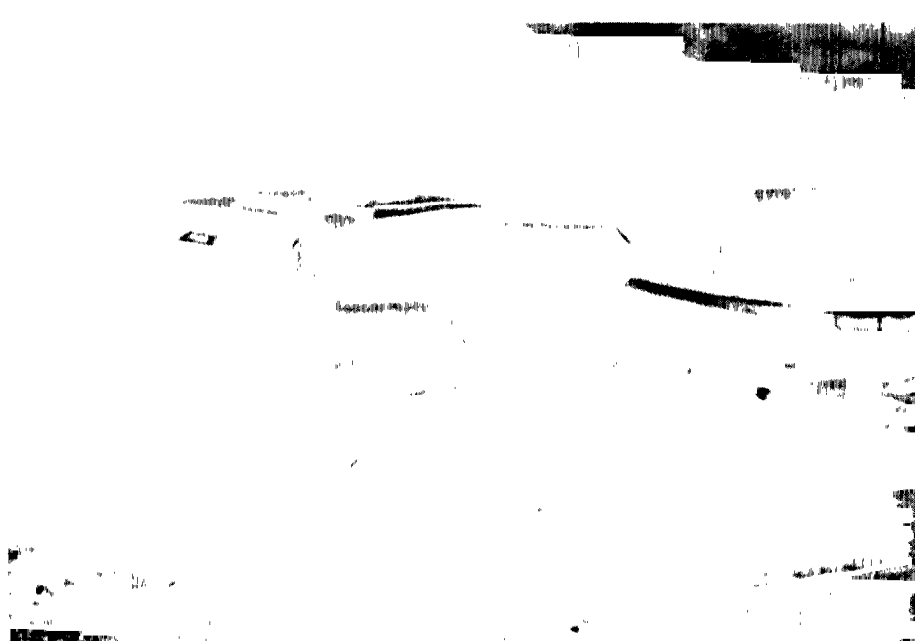
Many Federal and State highway safety officials question whether crash test results and limited analysis can fully evaluate the smaller car's roadway performance. They state that real-world accident data is necessary to support any decision to adjust highway hardware and roadway design for the smaller car.

To determine what real-world accident data is available for making such decisions on whether roadways are more hazardous to smaller cars, we collected data on guardrails, median barriers, and utility poles. We also attempted to collect data on the effect of smaller cars being lower to the road surface, therefore affecting eye height. The results of these analyses follow.

Guardrails

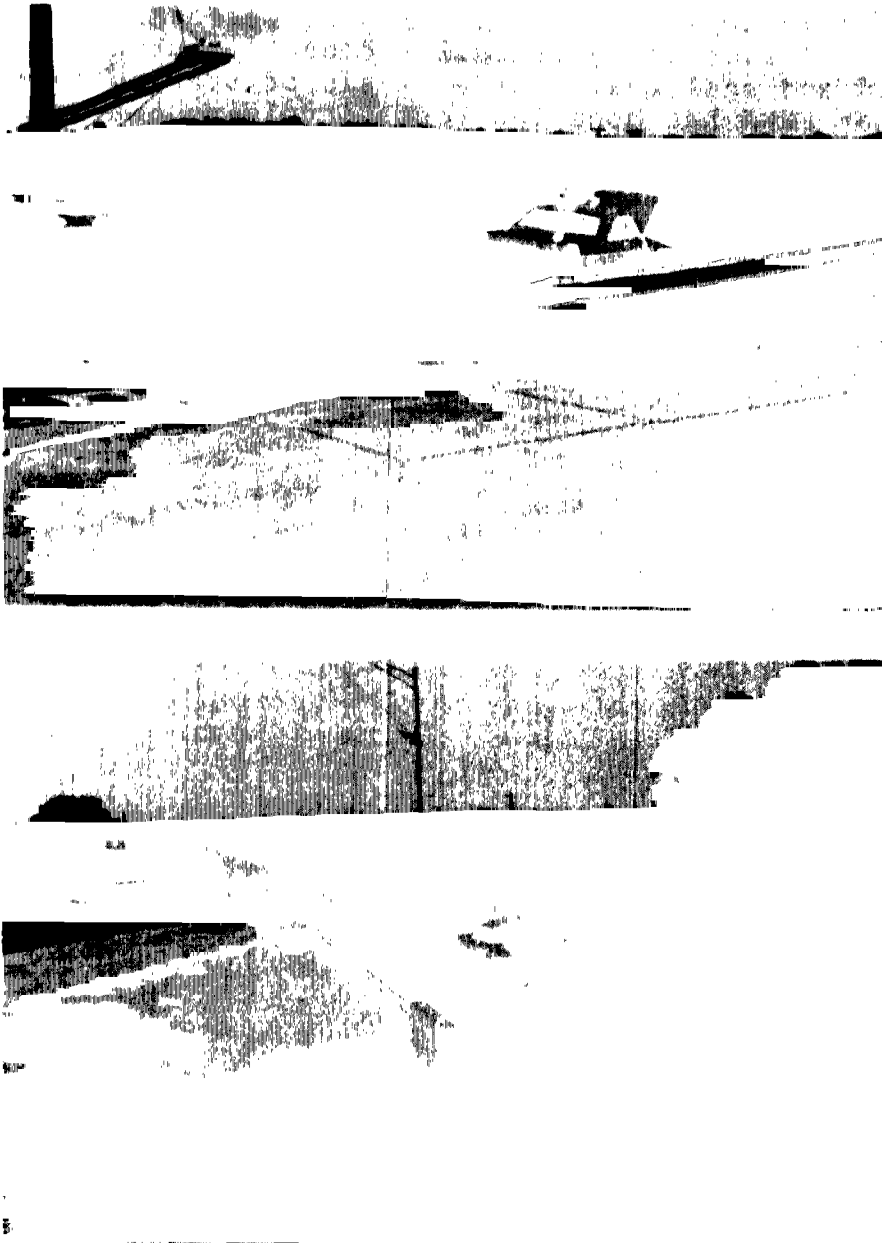
Guardrails are intended to protect cars from running off the road into trees, embankments, and ravines. However, accidents involving guardrails accounted for about 1,400 deaths in 1979. FHWA and State highway safety officials believe guardrails to be most dangerous to smaller car occupants.

As most guardrails were designed for larger cars, guardrail accidents can significantly damage smaller cars. Crash tests show that smaller cars can snag the support post of guardrails, be speared when hitting the rail, or roll over after hitting the rail. This was demonstrated in FHWA crash tests with an 1,800-pound car which did not perform well against many existing guardrail and bridge terminals. (See photographs on pp. 18 and 19 for performance of 1,800- and 4,000-pound cars.)



(SOUTHWEST RESEARCH INSTITUTE AND FHWA .)

A 1,800-POUND CAR TRAVELING AT 60 MILES PER HOUR IS ROLLED OVER BY A BREAK-AWAY CABLE TERMINAL BARRIER IN ONE TEST AND IS SPEARED IN ANOTHER . TESTS CONDUCTED FOR FHWA BY THE SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO, TEXAS , IN 1980.



(SOUTHWEST RESEARCH INSTITUTE AND NCHRP.)

A 4,000-POUND CAR TRAVELING AT 60 MILES PER HOUR IS STOPPED BY A BREAKAWAY CABLE TERMINAL BARRIER , WITH DAMAGE TO VEHICLE BUT WITH MINOR INJURY POSSIBILITY. THE TEST WAS CONDUCTED FOR THE NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM (NCHRP) BY SOUTHWEST RESEARCH INSTITUTE, SAN ANTONIO , TEXAS, IN 1971.

Accident data is available for real-world performance of smaller car versus larger car guardrail accidents, but it has not been compiled and analyzed. Our analysis of available studies indicates that FHWA has done few tests involving guardrails where accident data has been analyzed. Our analyses of New York accident data 1/ show that when compared with the percent of smaller cars in the fleet, smaller cars in guardrail accidents tend to be overrepresented.

Comparison of Guardrail Accidents to
Size of Fleet - New York

Vehicle weight (pounds)	1978		1979		1980	
	Percent of fleet	Percent involved in accidents	Percent of fleet	Percent involved in accidents	Percent of fleet	Percent involved in accidents
Less than 2,000	5.8	7.2	6.1	8.2	6.3	8.3
2,000-2,499	8.9	10.9	10.1	11.8	11.5	13.6
2,500-2,999	13.2	17.9	13.9	16.9	14.5	18.5
3,000-3,999	45.5	44.7	45.5	46.1	45.3	43.3
4,000 and more	26.5	19.3	24.4	17.0	22.4	16.3

Michigan accident data also showed an overrepresentation of smaller cars in guardrail accidents 2/ except in the smallest weight category for 1980.

Comparison of Guardrail Accidents to
Size of Fleet - Michigan

Vehicle weight (pounds)	1978		1979		1980	
	Percent of fleet	Percent involved in accidents	Percent of fleet	Percent involved in accidents	Percent of fleet	Percent involved in accidents
Less than 2,500	10.6	13.0	10.9	12.1	16.2	13.7
2,500-3,499	30.5	37.3	32.7	40.3	35.1	39.1
3,500 and more	58.9	49.7	56.4	47.6	48.7	47.2

1/In New York, the number of guardrail accidents in 1978 was 3,743; in 1979, 4,074; in 1980, 4,357.

2/In Michigan, the number of guardrail accidents in 1978 was 1,533; in 1979, 1,338; in 1980, 1,423.

The New York data, the 1975-79 FARS data, and the 1978-80 Michigan data showed no definite relationship between injuries and smaller car accidents with guardrails. The percent of severe and fatal injuries did not consistently decrease as the weight of the car increased. However, NHTSA officials said that FARS data did not provide sufficient numbers of guardrail accidents to show such trends.

Median barriers

Median barriers redirect vehicles from oncoming traffic. However, this does not always happen with smaller cars, particularly the less-than-2,000-pound cars. Research and Government officials said that the New Jersey barrier, when hit by a larger, heavier car, effectively redirects the car back into traffic. However, the smaller car with front-wheel drive has been known to climb the barrier wall and roll over.

FHWA has performed median barrier testing which showed that some 2,250-pound cars overturned when striking both General Motors and New Jersey barriers. Caltrans, the California Department of Transportation, has stated recently that smaller cars appear to be overrepresented in median barrier rollover accidents on California freeways.

Data on median barrier accidents in New York and Michigan from 1978-80 indicate no definite relationship between car weight and occupant injury, nor did the 5 years of FARS data. However, the FARS, New York, and Michigan data was limited because of the low number of accidents with median barriers in any one year--in 1979 only 139 accidents for FARS, 424 for New York, and 428 for Michigan.

Nevertheless, the New York data does indicate that cars weighing less than 3,000 pounds, when compared with the number of registered cars in each weight class, are generally overrepresented in single-vehicle collisions with median barriers. ^{1/} It is interesting to note that the greatest overrepresentation is not in the smallest car category but in the 2,500- to 2,999-pound category. The following schedule of New York data demonstrates this relationship between percent of accident involvement and fleet composition within each weight class.

^{1/}In New York, the number of median barrier accidents in 1978 was 477; in 1979, 424; and in 1980, 526.

Comparison of Median Barrier Accidents to
Size of Fleet - New York

<u>Weight of vehicles</u> (pounds)	<u>1978</u>		<u>1979</u>		<u>1980</u>	
	<u>Percent in fleet</u>	<u>Percent involved in accidents</u>	<u>Percent in fleet</u>	<u>Percent involved in accidents</u>	<u>Percent in fleet</u>	<u>Percent involved in accidents</u>
Less than 2,000	5.8	6.5	6.1	6.8	6.3	6.1
2,000-2,499	8.9	11.9	10.1	12.5	11.5	12.0
2,500-2,999	13.2	17.6	13.9	21.0	14.5	19.5
3,000-3,999	45.5	45.5	45.5	44.6	45.3	45.8
4,000 and more	26.5	18.4	24.4	15.1	22.4	16.8

The Michigan data also demonstrates an overrepresentation in collisions in the 2,500- to 3,500-pound category while cars weighing less than 2,500 pounds were underrepresented.


Utility and light poles

Poles are second only to trees in the number of fixed objects struck each year in single-vehicle accidents. Poles were involved in over 1,200 fatal accidents in 1979.

Poles can be of two structural designs, breakaway or non-breakaway. Breakaway poles are designed to break on impact in accidents to prevent serious injury to vehicle occupants. Many breakaway light poles were designed for heavier vehicles, not the smaller, lighter cars of today. FHWA conducted some crash testing with utility and light poles which demonstrated that poles do not break away as effectively when hit by smaller cars as they do with larger cars.

Although no thorough examination of smaller car pole accidents has been made, FHWA and NHTSA are attempting to analyze these single-vehicle accidents with accident data. FHWA tried to isolate smaller car to pole accidents from its data base of 5,000 breakaway and nonbreakaway pole accidents. However, FHWA could not find sufficient data on accidents involving smaller cars and poles to draw conclusions. An official from FHWA's Office of Research could not explain why there was so little data.

The preliminary findings of FHWA's study, based on information collected, did not consistently associate decreased vehicle weight with increased injury in pole accidents. It did find that occupants in cars weighing less than 3,000 pounds receive more severe or fatal injuries than those in cars weighing more than 3,000 pounds. The highest percentage of severe and fatal injuries was found in vehicles weighing between 2,500 and 3,000 pounds, not in the vehicles weighing less than 2,500 pounds.



(SOUTHWEST RESEARCH INSTITUTE AND FHWA.)

AN 1,800-POUND CAR TRAVELING AT 40 MILES PER HOUR IS SUCCESSFULLY REDIRECTED BY A NEW JERSEY SHAPED CURVED BARRIER. TEST PERFORMED FOR FHWA BY SOUTH-WEST RESEARCH INSTITUTE, SAN ANTONIO, TEXAS IN 1980.



(SOUTHWEST RESEARCH INSTITUTE AND FHWA.)

A 2,250-POUND CAR ROLLS OVER AFTER COLLIDING WITH GENERAL MOTORS MEDIAN BARRIER. THESE BARRIERS ARE NO LONGER BEING INSTALLED. TEST PERFORMED FOR FHWA BY THE SOUTHWEST RESEARCH INSTITUTE IN 1974.

Our analysis of New York accident data showed that the smallest cars weighing less than 2,500 pounds were not consistently overrepresented in accidents with utility and light poles. However, cars weighing between 2,500 and 2,999 pounds were continuously overrepresented. The Michigan data also demonstrates an overrepresentation in pole accidents for the cars weighing 2,500 to 3,500 pounds. No trend existed for cars of the other weight classes.

As for occupant injury, the New York data, as shown in the following table, indicates that severe and fatal injuries increased as vehicle size decreased. This relationship was evident in 3 years of data involving about 7,000 to 8,000 accidents. A recent analysis by the Texas Transportation Institute found a relationship between driver injury and passenger car weight, with the drivers of lighter cars more likely to receive serious injury than drivers of heavier cars.

Percent of Occupants Suffering Fatal and Severe Injuries in Single-Vehicle Accidents with Utility Poles - New York

<u>Weight of vehicles</u> (pounds)	<u>1978</u>	<u>1979</u>	<u>1980</u>
Less than 2,000	23.8	24.3	22.7
2,000-2,499	21.5	22.3	21.1
2,500-2,999	18.8	18.8	17.7
3,000-3,999	16.8	16.0	16.4
4,000 and more	15.0	13.5	14.6

Our analysis of the FARS data, Michigan data, and NCCSS data on tow-away accidents involving poles indicated no trend regarding vehicle weight and occupant injury.

Eye height

Eye height is that level measured from the road surface to the eyes of the seated driver. It is a major factor in determining how far down the road a driver can see. No Federal eye-height standard exists for designing vehicles, but FHWA has an eye-height standard for designing roadways. Eye height has been an increasing concern in the safety community, particularly with the growing smaller car fleet.

Eye height and its use in standard setting is important because of its impact on driver visibility. For example, FHWA's eye-height standard is used to determine roadway stopping and

passing distances for vehicles. If these distances are inadequate, the driver may not be able to stop or pass safely.

Many vehicle and highway safety experts state that the present FHWA eye-height standard is too high for the smaller car and, as such, creates many of the aforementioned problems. They further state that the driver's vision in a smaller, lower car may be impaired by guardrails, walls, and parked vehicles. Signs and signals may not be as visible to the smaller car driver, and rear vision could be reduced. Also, other drivers may not be able to see the smaller car in the traffic stream.

Recently, there has been a move to change the eye-height standard for roadway design and some discussion that a Federal standard on eye height should exist for vehicle design as well. Presently, FHWA is considering changing the eye-height standard from 3.75 feet to 3.5 feet. Even this proposed standard has been criticized by some vehicle and highway safety experts as too high for the fleet of new, smaller cars. According to a May 1980 FHWA study, 63 percent of all passenger cars sold in 1979 had an eye height of less than 3.5 feet (based on the 95th percentile smallest driver).

Other vehicle and highway safety experts state that the existing FHWA standard is adequate and see no need for a vehicle standard for eye height. They state that:

- Brakes on today's cars are better and can compensate for the car's lower eye height and the driver's inability to see as far down the road.
- Standards proposed currently by FHWA for stopping sight distances are adequate for smaller cars. Lowering of the eye-height criteria would unnecessarily increase those distances.
- Any injuries/fatalities caused by the effects of a lower eye height in cars would be much less than those caused by other factors such as drunk drivers, so lowering the eye-height standard should not be a priority.
- It seems easier to lengthen no-passing lanes on existing roads than to redesign all automobiles or roadways to meet new eye-height standards.

Critics of a change in eye-height standards further state that no evidence exists to prove that the lower eye height in smaller cars is dangerous. One Michigan study examined accidents and violations occurring in and around no-passing zones to determine if eye height had been a cause of the accident or violation. The study analyzed the problem when a standard of 4 feet existed and compared results after a new eye-height standard of 3.5 feet was instituted for passing zones. The study reported that its sample size of accidents was too small and that the analysis of

violations could not determine if improper eye height had been the sole cause of improper passing. Therefore, the study could not provide any conclusion on the adequacy of the new eye height standard.

Outside of the Michigan study, experts have done little analysis of accident data on this issue of eye height. In fact, some argue that it may not be possible to study eye height from accident data. We asked officials from NHTSA, FHWA, New York, Michigan, Texas, and several private researchers for accident data related to eye height and were told that the information is not available and may not be possible to collect.

The proponents of a lower FHWA eye-height standard and eye-height standards for vehicles stress that the emergence of a small car fleet and the design logic of eye height are evidence enough to warrant a change in smaller car design. However, NHTSA said that no rulemaking will be done to have industry raise passenger car height to match present roadway designs. The industry says that no changes will be made in cars until eye height is proven to be a problem. AASHTO, FHWA, and others are still in the process of studying the eye-height question as it relates to highway design.

DO DESIGNS OF SMALLER CARS PRESENT SAFETY HAZARDS?

Vehicle and highway safety experts consider some design characteristics of smaller cars to be hazardous to the safety of the occupants and they consider other characteristics to be advantageous. However, most experts agree that using seatbelts or other restraints can offset many safety disadvantages of smaller cars.

Disadvantages of smaller cars

Smaller car design elements such as lack of acceleration, reduced stability, and lower ground clearance are sometimes considered to increase the risk of accidents and injuries. However, no consensus exists on whether these design characteristics increase smaller car dangers or result in smaller cars being better able to avoid accidents. Little research has been done in this area, so, even though smaller cars may do poorly when they do crash, the overall effect of smaller car design features on safety is unknown.

Some vehicle and highway safety experts state that smaller cars' lower acceleration capability makes them less able to avoid certain crashes. However, a General Motors official said that its research showed no direct relationship between low acceleration performance and safety and that drivers often compensate for low acceleration performance by driving more cautiously. We found no other studies on the relationship between accidents and acceleration.

Vehicle stability is often linked with car width and tire size. The smaller car is narrower with smaller tires and is thus considered by many highway safety officials to be less stable. Therefore, it is more susceptible to rolling over or going out of control. Tests performed in Texas of single-vehicle accidents have shown that smaller car accidents with poles, sign-support posts, and median barriers result in roll-overs more frequently than larger car accidents. A recent analysis of 39,580 single-vehicle accidents by the Texas Transportation Institute showed that the lighter weight vehicle had a much greater probability of overturning.

Our analysis of 1978-80 Michigan data shows that when compared with the percent of the smaller cars in the fleet, smaller cars rolled over more often during an accident than larger cars. ^{1/} (See the following chart.) However, when a rollover occurs, occupants in cars weighing less than 2,500 pounds sustained fewer severe or fatal injuries than occupants of larger cars.

Comparison of Rollovers to Size of
Fleet - Michigan

Car weight (pounds)	1978		1979		1980	
	Percent of fleet	Percent involved in rollover	Percent of fleet	Percent involved in rollover	Percent of fleet	Percent involved in rollover
Less than 2,500	10.6	25.1	10.9	24.5	16.2	25.7
2,500-3,500	30.5	44.7	32.7	44.8	35.1	44.5
More than 3,500	58.9	30.2	56.4	30.6	48.7	29.8

Inadequate ground clearance is another design criticism of smaller cars because many have a ground clearance of less than 6 inches. Many highway safety officials state that the new smaller cars are not able to clear 6-inch objects in the roadway without damaging the car's underbody. Cars may not be able to clear rocks and other items and may also have difficulty with roadside features, such as breakaway poles, some of which leave a 6-inch stump after breaking away. Michigan highway safety officials

^{1/}In Michigan, the number of rollover accidents in 1978 was 3,218; in 1979, 3,301; in 1980, 2,869.

were not too concerned about this perceived problem. They said, for instance, that if a breakaway pole saved a life they would not care about the damage to the car's underbody; but other highway safety experts are concerned about smaller cars coming to abrupt stops or rolling over in these circumstances.

Advantages of smaller cars

One generally accepted advantage of smaller cars is better fuel mileage. A 1981 Department of Energy study indicated that consumers may be making conscious safety tradeoffs for improved fuel economy by rejecting the larger, heavier car. New car buyers were asked to indicate which factor was most important in their decision to purchase a particular model. Fuel economy was the leading choice and safety was one of the least specified factors.

Some vehicle and highway safety experts indicate that the smaller car may be more maneuverable than the larger car, which may be a safety advantage. General Motors Corporation officials state that a smaller car does have an advantage when maneuvering through tight turns, simply because its size gives it more road-maneuvering space. They note, however, that it is questionable whether advantages in handling and maneuverability can be related directly to vehicle safety because these advantages depend on the driver's ability. Some NHTSA officials and vehicle and highway safety experts state that a smaller car may be safer for the pedestrian since it may injure the pedestrian less than a large car in a collision. Neither of these claims for smaller car safety, however, has been substantiated by real-world data.

Other vehicle and highway safety experts suggest that smaller cars are getting progressively safer each model year. A 1977 Highway Safety Research Center study of North Carolina accident data examined car age and noted that newer cars did better than older cars across all weight categories in accident and driver injury involvement. NHTSA officials stated that recent crash tests have demonstrated that newer, smaller cars are faring better than older ones.

Our examination of the New York data had varying results. It showed that newer cars in specific types of single-vehicle accidents have lower injury rates; however, the New York data did not demonstrate a consistent trend for the smaller car. For example, in accidents with poles and guardrails, the data showed that newer cars (model years 1975-80) weighing 2,500 pounds or more had a lower rate of severe and fatal injuries than the older cars of the same weight class (model years 1965-74). However, the data did not show a similar trend for the new cars versus older cars weighing less than 2,500 pounds. For total single-vehicle accidents, the New York data established no relationship between car age and severity of occupant injury.

Seatbelts and other restraints are important features for smaller cars

Though not related to vehicle size, seatbelts and other occupant restraint devices are factors often discussed with regard to vehicle safety. The value of occupant restraints lies not in preventing traffic crashes but in minimizing the effects when crashes occur. In 1980 NHTSA's Associate Administrator for Traffic Safety Programs estimated that 15,000 lives could be saved each year if motorists used their safety belts. Other research indicates that nonfatal injuries could be reduced substantially through universal seatbelt use.

Many experts state that seatbelts and other restraints are more important than vehicle size and weight as safety factors. Studies have demonstrated that the smaller car occupant can sustain less injury in a crash when restrained. This is true for all cars, but is particularly important for smaller cars which may not provide as much protection as larger cars. General Motors has stated that using available restraints and driving defensively can offset the effect of a smaller car's reduced size by more than 2 to 1.

The Highway Safety Research Center reported in 1974 that the overall injury severity for belted drivers of subcompacts was about the same as for unbelted drivers of full-size cars. In 1978 the Center reported that the percent of belted drivers killed or seriously injured in two-car crashes was less than half that for unbelted drivers in all weight categories. The same is true among drivers in Michigan; those occupants protected by seatbelts suffered half as many fatalities and injuries as those unrestrained.

Seat Belt Usage in Michigan, 1978-80

Car weight (pounds)	Percent of severe and fatal injury accidents					
	1978		1979		1980	
	<u>Re-</u> <u>strained</u>	<u>Unre-</u> <u>strained</u>	<u>Re-</u> <u>strained</u>	<u>Unre-</u> <u>strained</u>	<u>Re-</u> <u>strained</u>	<u>Unre-</u> <u>strained</u>
Less than 2,500	6.5	12.8	5.5	12.3	5.6	11.7
2,500-3,500	5.2	11.1	4.7	9.7	4.8	9.2
More than 3,500	5.0	10.9	4.5	9.4	4.2	8.6

Though seatbelts have a proven safety record, they have a low usage rate. NHTSA estimates that only 11 percent of all drivers and even fewer passengers make regular use of the manual safety belts. This figure represented a decline from previous

years from 25 percent in 1974, to 19 percent in 1976, and 14 percent in 1978. 1/

CONCLUSIONS

Experts in vehicle and highway safety disagree on many of the issues surrounding smaller car safety. They question whether smaller cars are in more accidents, whether smaller car occupants sustain more injuries in accidents than larger car occupants, and whether smaller cars are compatible with today's roadways. In addressing some of these issues, our analysis of accident data from FARS, NCSS, New York, and Michigan indicated that:

- Smaller cars in New York and Michigan were not overrepresented in the total vehicle accidents when compared with the numbers of smaller vehicles registered; however, smaller cars tended to be overrepresented in single-vehicle accidents with guardrails and, to a lesser degree, median barriers.
- Smaller car occupants suffered more severe and fatal injuries than larger car occupants when smaller cars collided with larger cars.
- The data did not agree on whether occupant injury was greater when two smaller cars collided as compared to when two larger cars collided.
- The data did not agree on whether occupant injury was greater in smaller cars than in larger cars in single-vehicle accidents.
- The data did not agree on whether occupant injury was greater in smaller cars than larger cars in collisions with roadside barriers, utility and light poles, and median barriers.

Available research has not resolved many of these issues involving smaller car safety. However, we believe the discussion in this chapter demonstrates sufficient evidence to warrant concern about smaller car safety especially when it appears that the physics of smaller cars will prohibit them from offering as

1/Recently, requirements mandating automatic seatbelts were rescinded. The 1977 amendment to the Federal Motor Vehicle Safety Standard #208, Occupant Crash Protection, required manufacturers to install automatic (passive) occupant restraints in all passenger car front seats by September 1983. On October 23, 1981, NHTSA rescinded the passive restraint portion of the standard because of their belief of the uncertainty about the public acceptability and probable usage rate of the restraints given the ease of disconnecting passive belts.

much occupant protection in every situation as a large, heavy vehicle.

Smaller cars have begun and will probably continue to dominate the Nation's fleet. This shift to smaller cars adds urgency to the smaller car safety question. We recognize the magnitude of identifying and solving any safety problems associated with smaller cars because (1) collecting and analyzing the necessary information is a tremendous undertaking, (2) any solutions must involve the cooperation of the industry, public, and government at all levels, and (3) safety solutions will probably be expensive. On the other hand, if the projections of thousands of more injuries and fatalities due to smaller cars are correct, can we afford not to take actions to identify the most significant problems and to implement feasible solutions?

Automobile industry and NHTSA officials state that further safety changes should not be made to the automobile until problems have been identified. FHWA officials recognize safety hazards on the roadways but are not certain how to prioritize them. One way to determine what actions can be taken is for a comprehensive study of the issues affecting smaller car safety to be performed as was the congressionally mandated study on truck size and weights issued in August 1981. Many vehicle and highway safety experts have begun to study these issues. The availability of information including crash test results, accident data analysis, research reports, and the limitations of this information is discussed in the next chapter.

CHAPTER 3

MORE ANALYSIS OF ACCIDENT DATA

COULD HELP IDENTIFY AND APPRAISE SMALLER

CAR SAFETY ISSUES

No comprehensive Federal study has been conducted to fully determine the safety of smaller cars on today's roads. Available research and testing reveal many reasons to be concerned about smaller car safety, but no complete analysis of real-world performance has been done. Therefore, the safety issues concerning smaller cars which require national attention have not been identified. To identify these issues, a full examination of the smaller cars' performance is necessary. Federal and State accident data is available and should be tapped to help define and appraise smaller car safety issues.

FEDERAL RESEARCH HAS PROVIDED USEFUL INFORMATION BUT MORE IS NEEDED

NHTSA and FHWA have included smaller car safety in various studies. Though both agencies have become more concerned with smaller car safety, their studies have been limited in the type of accidents studied and the type and amount of accident data used. Generally, these studies have centered on safety problems, such as guardrail collisions, rollovers, and seat belt protection, which include other issues as well as smaller car safety. To date, neither agency has assumed responsibility for a comprehensive study of smaller car safety.

Smaller car research and its limitations

Federal research for identifying smaller car safety issues has generally been of two types: (1) engineering analysis, which uses automotive crash tests conducted under controlled conditions and (2) statistical analysis, which uses real-world accident data. These types of research have been used in varying degrees by both NHTSA and FHWA to study smaller cars.

Engineering analysis has been used by both agencies to test smaller car performance in various types of controlled accidents. NHTSA has used smaller cars in its crash tests for research and rulemaking. FHWA, under its guidelines for developing roadside hardware, tests 2,250-pound cars and recently began testing 1,800-pound cars as a part of most studies, as suggested by a proposed guideline. FHWA and NHTSA engineering analyses involving smaller cars include the following:

- In its Research Safety Vehicle Program, NHTSA developed its own 2,600-pound safety vehicle to demonstrate the state of the art in automotive safety and fuel economy.

--As part of the New Car Assessment Program, NHTSA crash tested smaller and larger cars to determine their crash-worthiness and provide a means for consumers to compare safety and other aspects of new cars before purchasing them.

--FHWA conducted several studies and determined that smaller cars did not always perform well when colliding with small signs. Both 1,800- and 2,250-pound cars were used in the studies. (See photographs on p. 35.)

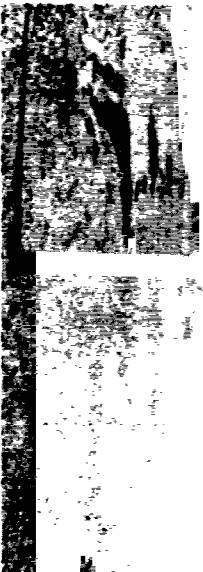
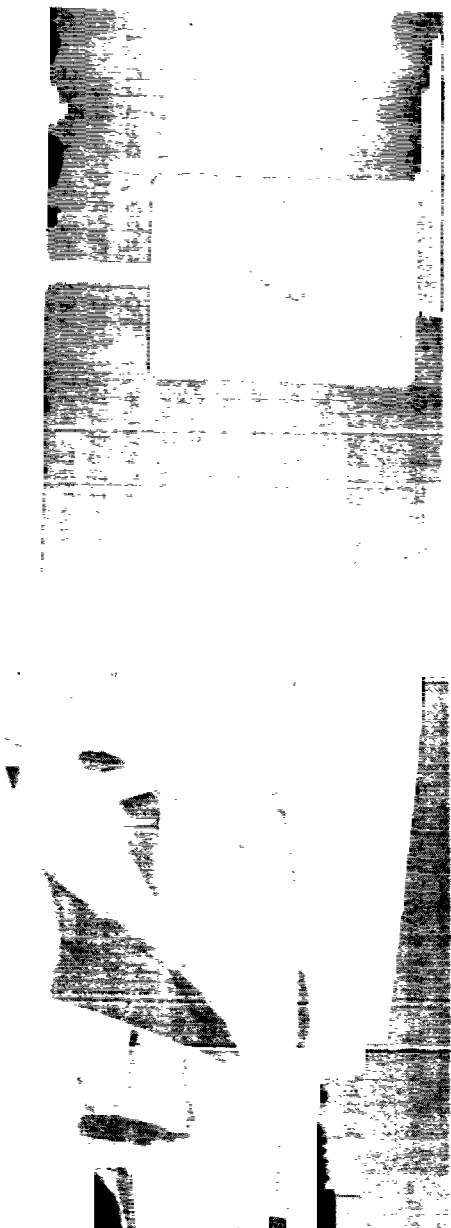
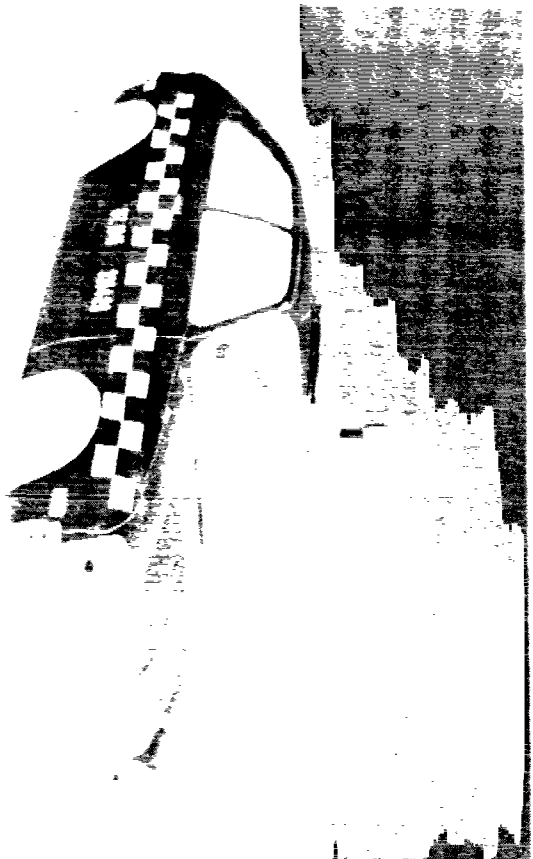
--FHWA conducted a study to test three bridge rail retrofit designs. These were crash tested with minicompacts, compacts, and school buses.

NHTSA and FHWA have both conducted statistical analyses with limited use of accident data to study the safety issues involving smaller cars. In these studies both agencies generally examined accident data on all passenger cars. The cars were categorized by weight or interior size with accident and injury information determined for these categories. Principal studies using accident analysis and involving smaller cars include the following:

--NHTSA funded several studies by the North Carolina Highway Safety Research Center which used 1973-75 accident data from that State to assess (1) safety differences between larger and smaller cars by vehicle weight in multivehicle versus single-vehicle accidents, (2) the relationship between vehicle weight and driver injury, and (3) accident involvement by vehicle weight.

--FHWA started collecting data on breakaway/nonbreakaway pole accidents in 1975 and 1976. When the agency found that smaller cars were not hitting many poles in the States where the study was being conducted, it began looking for sites which would have a larger number of smaller cars in accidents with poles. Agency officials are still in the process of locating these types of accidents to complete this research.

Although the engineering analyses by NHTSA and FHWA have identified many potential smaller car safety problems, these tests do not suggest which of these problems are the most hazardous to smaller cars. The engineering analysis of head-on collisions, side collisions, roadside-barrier collisions, or rollover accidents may all be important, but until a comprehensive study is conducted it will not be possible to determine if these or other accident situations should be of primary concern.



(TEXAS TRANSPORTATION INSTITUTE)

A 1,900-POUND CAR IS CRUSHED BY A SMALL SIGN POST. FHWA IS CONTINUING STUDIES ON THESE TYPE SIGNS . TEST PERFORMED BY THE TEXAS TRANSPORTATION INSTITUTE IN 1978.

NHTSA and FHWA have done statistical analyses with accident data, but the data does not provide a basis to determine which smaller car safety issues are most important to address. Their data bases are limited to either fatal accidents or to a small sample of the total accidents which provides only enough data to draw general conclusions. This national data does not provide enough information on specific types of accidents, such as collisions with roadside barriers, to make an analysis of the smaller car experience in specific types of single-vehicle accidents. State information is available but has not been used for a detailed study of such smaller car safety issues as those presented in chapter 2 since the North Carolina Highway Safety Research Center used 1975 data to conduct such a study. Accident information from one State was used in that study. Because the smaller car fleet has changed considerably since 1975 in both design and number, it is not possible to know if issues addressed in that study are still relevant.

Accident data is necessary to define issues

The research discussed above demonstrates that there is reason to be concerned with smaller car safety issues; however, the research limitations do not allow defining or assessing these issues. Accident data is necessary to determine what smaller car safety problems actually exist on the road.

With limited Federal, State, and other funds, it seems prudent to concentrate resources on smaller car safety issues systematically identified to be most cost-beneficial in terms of saving lives and preventing injuries. Systematic identification can be enhanced through statistical analysis of accident data by (1) concentrating on smaller cars in all types of accidents and (2) using available State and national data to provide thorough nationwide analysis of smaller car accidents. To date, neither FHWA nor NHTSA has assumed the responsibility for conducting this analysis, though both are continuing with research which involves smaller cars.

Analysis of real-world accident data can provide information on injuries, accidents, and the type and size of cars involved and can highlight specific areas of concern. Data can be gathered to provide a representation of the national highway situation and can be used to analyze the present status for highway safety as well as be compared with data of previous years to study any measured improvement over time.

Many vehicle and highway safety experts indicate that more and better use of accident data could help identify and appraise smaller car safety issues. NHTSA research officials indicated that further study of smaller cars with accident data would be useful in clarifying many perceived safety problems. A 1979 FHWA study entitled "Safety-Related Information Needs" stated that collecting real-world accident information by vehicle size and weight and by type of roadside hardware hit was a high

priority for FHWA. FHWA, NHTSA, State, and industry representatives held a meeting in June 1981 to determine how to better use existing data. They concurred that, along with computer simulation and crash testing, accident data was central to evaluating the severity of collisions with roadside features.

ACCIDENT DATA IS AVAILABLE TO ADDRESS
THE SMALLER CAR SAFETY ISSUES

A wealth of information is available to study smaller car safety issues. NHTSA has at least two data systems which are useful for identifying and assessing the issues--FARS and NASS. FHWA has several data files from which accident locations, type of accidents, and other information about roadways can be retrieved. Many States have data not included in NHTSA's or FHWA's systems, and private organizations, such as the Highway Safety Research Institute, have their own data to study smaller car safety. The following discussion briefly describes some of the available data systems.

FARS is currently the most comprehensive accident record system NHTSA manages. It consists of data collected on all fatal accidents since 1975 from the 50 States, the District of Columbia, and Puerto Rico. NHTSA and others use FARS data to measure trends in nationwide fatal accidents by type of vehicle, miles traveled, time of day, type of weather, and type of crash. The FARS annual report includes fatalities by passenger car size based on EPA's interior volume classification, but, as can be seen in chapter 2, FARS data can also be classified by vehicle weight.

NASS is a data system sponsored by NHTSA and supported by FHWA. It consists of a sample of motor vehicle traffic accidents representative of the Nation's highway accident experience. Data is collected by 30 accident investigation teams located nationwide, and NHTSA plans to have 75 sites operating by 1984. Each team collects a specified set of data on a sample of accidents in its area. Both the location of the teams and accidents investigated are chosen using probability sampling techniques. As of July 1981, the NASS data file consisted of only 3,367 accidents from the first 10 NASS sites set up in 1979. The file is designed to eventually record approximately 15,000 accidents per year.

Some NASS data is collected continuously and other data is collected using special studies to address specific questions. Five special studies were initiated in 1979, but none emphasized smaller cars. Three more studies will be started in 1982 for FHWA. Two of these will consider car size; one focusing on accidents with poles and the other on longitudinal barriers; neither one, however, will consider smaller cars in all accident situations. A special study of smaller cars in all accident situations may be an effective way to use NASS data because

it will enable more sample accidents to be studied and more detailed information to be gathered on the specific issue.

In addition to FARS and NASS, NHTSA has gathered data through the National Crash Severity Study which links crash severity with injury severity. In this study more than 15,000 towaway accidents were investigated by seven teams over a 4-year period that began in 1976. This data, though not nationally representative, can be analyzed by vehicle weight.

NHTSA also has access to several State files through its own and various contractor systems. NHTSA maintains limited accident data files on Washington State and is attempting to include other States. It has also contracted with various organizations which have access to several States' accident records.

In addition, FHWA has systems which could also be used to help determine problems. Historically, FHWA has relied heavily on State highway and transportation agencies for data which would satisfy most of the safety-related information needs for Federal-aid programs.

Each State highway department submits an annual summary of accident and travel data to FHWA. Information provided includes number of (1) fatalities and injuries, (2) fatal and injury accidents, (3) pedestrian fatal and injury accidents, and (4) the amount of total travel for each highway classification. Other reports include data which in some cases can be used to help identify accident locations, assess countermeasures, and determine vehicle exposure.

FHWA also maintains special data bases, such as one containing 5,000 breakaway and nonbreakaway pole accidents in seven geographical areas and about 8,000 single-vehicle run-off-the-road accidents. Information can be drawn from these special data bases concerning smaller car accident causes, locations, and severity as well as data to determine the various levels of exposure for smaller cars.

Most highway and accident data available today was collected by States. Therefore, information is available from States that cannot be obtained elsewhere. Some of the information is readily accessible in various computer data bases, other information is buried in stacks of nonautomated records. However, in whatever form, accident data exists which can help define smaller car safety problems and may be the best or only way to obtain the type of information necessary to identify and appraise specific problems. Some experts state that a select few States with federally supported data bases could provide detailed information on a continuing basis to answer such questions as those posed by this report.

STANDARD UNIT OF MEASURE IS NECESSARY
TO EVALUATE SMALLER CAR SAFETY ISSUES

As discussed in chapter 1, the classifications used for passenger cars can lead to confusion. These classifications make meaningful data collection and analysis extremely difficult, and without meaningful data smaller car issues cannot be evaluated.

Cars can be classified in numerous ways, including weight, wheelbase, and interior space. (See chart on p. 5.) Though based on different classifications, the vehicle and highway safety experts commonly use such categories as minicompact, subcompact, compact, intermediate, and large. To illustrate the confusion that can arise, the "Automotive News," which publishes much of the industry's statistics, considers a Pontiac Firebird to be a compact car but EPA classifies it as a subcompact. The General Motors' Phoenix and Citation X-body models are classified as compact by the "Automotive News" and as midsize by EPA. Some researchers and safety officials would say "small" is a subcompact or smaller; others would include compact as "small."

Furthermore, manufacturers' changes in models may alter the concept of car sizes over time. The General Motors Corporation estimates that the average weight of its 1985 models will be less than 3,000 pounds, which is approximately 1,500 pounds less than its 1974 models. The following data obtained from NHTSA shows an estimated drop in weight of all passenger cars during this same time period. It is interesting to note that the average weight of a compact car in 1975 was greater than the average projected weight of a large car in 1985.

	<u>Average Curb Weight</u>			
	<u>Large</u>	<u>Midsize</u>	<u>Compact</u>	<u>Subcompact</u>
	----- (pounds) -----			
1975	4,885	4,260	3,660	2,690
1980	3,900	3,400	2,800	2,500
1985	3,400	3,000	2,500	2,200

- Notes:
1. Station wagons are included with related sedans.
 2. Subcompact includes minicompact and two seater.
 3. "Urban" cars are not included in 1985 estimates.
 4. No electric cars are included.
 5. 1975 weights actual; 1980 and 1985 weights estimated by NHTSA.
 6. Entries represent the total new car fleet, domestic and imported.

In the early 1970's, researchers considered small cars to weigh around 3,100 pounds or less. Today, small cars are considered by many to weigh 2,250 pounds or less.

Without a common unit of measure such as wheelbase, weight, or interior volume, this confusion will continue and collection and analysis of meaningful accident data will be difficult to impossible.

CONCLUSIONS

Little research has been done involving all smaller car issues. Both FHWA and NHTSA have recognized a concern for smaller car safety; however, neither has proposed a thorough study on the problem. NHTSA has done considerable testing and accident analysis concerning the safety of the smaller car in multivehicle collisions and has determined that smaller cars in general are not as safe as larger cars. FHWA is evaluating performance of roadway hardware when hit by smaller cars and has identified some hardware which can be especially hazardous to smaller car occupants. However, to date, there is little consensus on smaller car safety problems.

What has not been done is to analyze real-world accident data, especially as it relates to accidents involving only one vehicle, to determine what smaller car safety problems exist. If, as predicted, smaller cars are to be the dominant vehicle on our roads, emerging safety problems need to be identified and assessed so they can be addressed before they become alarming.

Testing of vehicles and roadways, whether by crash testing or by computer simulation, is necessary to help define the issues of smaller car safety. However, we believe that it is important to more fully understand actual smaller car performance before testing is undertaken, especially in single-vehicle accidents where less accident data analysis has been done. Questions such as "what smaller car accidents are occurring and why?" should be answered to determine priorities for testing. Data is available now to pursue these questions. NHTSA and FHWA both have systems which can provide specific information on what accidents smaller cars are involved in and why. Private sources also have access to data; however, States have the most detailed information available. Detailed analyses using these sources could provide answers to questions and direction to research for pinpointing major problem areas. Such analyses would require collection of data based on a common definition of a smaller car which does not yet exist.

Which smaller car safety issues need the Nation's greatest attention must be determined. When these issues are identified, it will be possible to determine how to approach and perhaps solve many of the emerging safety problems with the economical, political, and social limitations which may be present.

RECOMMENDATIONS

We recommend that the Secretary of Transportation determine which smaller car safety issues need the Nation's greatest attention and which countermeasures can be used to reduce accidents, injuries, and fatalities involving smaller cars. To accomplish this task, we recommend that the Secretary examine all relevant sources of available accident and test information but that emphasis be given to using accident data. We recommend that for this purpose, the Secretary (1) establish standard units of measure to define all sizes of passenger cars and (2) include an examination of the contributing effects of both the driver and roadway on smaller car performance.

To determine which smaller car safety issues are most important, we recommend the Secretary use one or more of the following techniques.

- Organize a task force composed of FHWA and NHTSA personnel; advisors from Federal agencies, States, and industry; and vehicle and highway safety experts.
- Develop a special studies program on smaller cars to be carried out with NASS teams and to be reviewed by both NHTSA and FHWA.
- Develop a program to use accident data from several selected States on a continuing basis to supplement test data which is available.

We recommend that the Secretary use the results of this examination to rank research priorities. No new long-term research directed at smaller cars should be started until these priorities are determined. Any new plans for short-term research involving smaller cars should be reviewed to ensure that they will be consistent with the type of examination described above. Ranking research priorities by expected benefits and costs will assist the Department in charting future courses of action and also assist the Congress with its oversight responsibilities in the vehicle safety area.

AGENCY COMMENTS AND OUR EVALUATION

The Department does not concur with our recommendation to conduct an examination of the smaller car safety problem. However, in its response to our draft report, the Department recognized the need to collect data on the issue.

Responding to specific segments of our recommendations, the Department indicated that it

- has conducted and is conducting numerous analyses of the small car and has identified its most significant safety problems,

--has a current approach to problem identification and research which is adequate and will lead to long-term research priorities,

--does not concur with the need to create additional study groups on smaller car safety since groups already exist, and

--does not want to disrupt ongoing research programs nor does it believe that long-term research in this area should be withheld until the actual highway safety performance of small cars is determined.

Our report points out that, although the Department has conducted some research on smaller cars, its research with accident data is too limited and general to assess the many types of smaller car accidents and, thus, to determine the most significant problems relating to small cars.

The Department erroneously assumed that we recommended creating a study group to assess the smaller car safety issues. In fact, we suggested three techniques or a combination of them to be used to examine smaller car safety. We are aware of the existing organizational structures within the Department; however, these groups have not assumed any responsibility for a coordinated examination of smaller cars.

The Department mistakenly assumed that our recommendations would require a halt to ongoing research--not true. We recommended that any research be reviewed to ensure that it will be consistent with the type of examination that we proposed and that long-term research be delayed until a better understanding of the actual small car performance is established. We believe that long-term research should be consistent with actual fatality and injury experience which the Department has yet to determine.

We believe that the Department should examine smaller car safety with emphasis on the analysis of accident data. We believe that the increasing size of the smaller car fleet and the rising number of smaller car fatalities add urgency to obtaining this type of information. Without such information, the Department cannot be assured that its resources are concentrated on those issues systematically identified to be most cost-beneficial in terms of saving lives and preventing injuries.

SOME ORGANIZATIONS CONTACTED DURING THE REVIEW

American Association of Motor Vehicle Administrators
American Association of State Highway and Transportation
Officials
Center for Auto Safety
Highway Users Federation
Insurance Institute for Highway Safety
Minnesota Mining and Manufacturing
Motor Vehicle Manufacturers' Association
National Advisory Committee on Uniform Traffic Control
Devices
National Association of Governors' Highway Safety
Representatives
National Committee on Uniform Traffic Laws and Ordinances
National Governors' Association
National Safety Council
National Transportation Safety Board
Transportation Research Board

GAO COMMENTS ON THE DEPARTMENT OF
TRANSPORTATION'S REPLY TO THE DECEMBER 23, 1981,
GAO DRAFT REPORT ENTITLED
"SMALL CAR SAFETY: AN ISSUE THAT NEEDS TO BE CLARIFIED"

SUMMARY OF GAO FINDINGS AND RECOMMENDATIONS

GAO reviewed the relationship between highways and small cars and concluded the following:

"The rising numbers of small cars on the Nation's roadways have concerned vehicle and highway safety experts for many years. The physics of smaller cars prohibit them from offering as much passenger protection in every situation as larger cars. However, it will not be possible to adequately define or correct smaller car safety problems until it is determined how they are performing on today's roadways.

Studies have been done on various aspects of smaller car safety; however, a complete analysis has not been conducted to understand how smaller cars perform in the real world or which smaller car issues need the Nation's greatest attention. Data is available to make such an analysis. Such a study should be conducted by the Department of Transportation to determine the issues and identify countermeasures which can be used to reduce accidents, injuries, and fatalities involving smaller cars."

GAO recommends that the Secretary of Transportation:

1. --determine which safety issues concerning smaller cars on our roadways need the Nation's greatest attention and which countermeasures can be used to reduce accidents, injuries, and fatalities involving smaller cars. To accomplish this task, GAO recommends that the Secretary (1) establish, for the purpose of this study, standard units of measure to define all sizes of passenger cars, (2) use all relevant sources of available accident and test information, and (3) include an examination of the contributing effects of both the driver and roadway on smaller car performance.
2. --use the results of this study to establish research priorities. Because this study would be the basis for research involving smaller cars, no long-term research directed at smaller cars should be started until such study is completed. Any plans for short-term research involving smaller cars should be coordinated with this study.
3. --examine the following alternatives or combinations of alternatives in deciding how to collect and analyze information necessary to determine safety issues and answers.

--Organize a task force composed of FHWA and NHTSA personnel with advisors from other Federal agencies, States, industry, and other vehicle and highway safety experts.

--Develop a special studies program on smaller cars to be carried out with NASS teams and to be reviewed by both NHTSA and FHWA.

--Develop a program to use accident data from several selected States on a continuing basis to supplement test data which is available.

4. --define the issues as soon as possible and list them in rank order by expected benefits to society. GAO also recommends that available solutions be listed in rank order on a cost/benefit basis so that the Congress can use this information in deciding on future programs which can affect smaller cars safety.

[GAO COMMENT: Except for minor language changes made to the text in the final report, this is an accurate restatement of our recommendations.]

We have reviewed the GAO draft report and find it to be unacceptable because (1) the research product represented by the report does not add to the general level of knowledge in the area and could be misleading,

[GAO COMMENT: DOT mistakenly interpreted the objectives of our review. As stated in our draft report, we conducted this review on smaller car safety to ascertain safety concerns in light of present research and to determine what is being done and what remains to be done by the Federal Government. To this end, we believe the report is accurate and informative. Both the States from which comments were requested indicated agreement with the report's contents.]

and (2) in seeking to couch the research within the framework of operational auditing, the report makes recommendations for management of highway safety research in the Department that cannot be supported by the text, or are otherwise too simplistic.

[GAO COMMENT: We reviewed over 200 research and study documents and conducted extensive interviews with industry, private research groups, and State and Federal officials. We believe our recommendations are not simplistic and are supported by the comprehensive audit work mentioned above. For further comment, see pp. 42 and 43 which include DOT's specific comments on our recommendations and our evaluation.]

Detailed comments are provided in Attachment 1. A list of the current and recently completed NHTSA and FHWA research studies is provided in Attachment 2, Parts A and B, respectively. Also attached is a summary of presentations made at the summer meeting of the Transportation Research Board (TRB) Committee A2A04.

[GAO COMMENT: We believe that the information provided in the attachments did not warrant any change to the report's findings, conclusions, or recommendations. DOT should note that the information presented in Attachment 2 and the TRB summary were requested by us on numerous occasions during our review. In May and June 1981, FHWA representatives provided us with several different listings of FHWA research studies involving smaller cars. NHTSA representatives also provided a bibliography of its smaller car research in June 1981. We attempted to attend the TRB Committee meeting when it was held, but our request was denied by a FHWA chairperson. Further requests to obtain tapes or a summary of the proceedings were not granted by the same FHWA official.]

The General Accounting Office (GAO) report suggests that the small car poses a problem that is distinct and separate from the problems associated with other vehicles in the traffic stream. However, from our perspective, the small car is part of the larger problem of providing a safe highway environment for a wide range of vehicles, including large trucks. For example, recent crash tests indicate that some current longitudinal barrier designs may be ineffective in safely redirecting the small car. But the study of only the effects on small cars, without knowledge of the effects on larger and heavier vehicles, does not suggest design solutions that are responsive to as much of the vehicle population as possible.

[GAO COMMENT: We recognize that there are safety problems associated with vehicles other than smaller cars and that these problems cannot be ignored. However, the larger and heavier trucks with their related safety issues have been around for a number of years while the number of smaller cars on the road is a new and growing phenomenon. By NHTSA's own estimates, small cars will dominate the fleet as early as 1987 and fatalities in smaller cars will increase rapidly while larger car fatalities will decline. Therefore, it is essential to consider the subject of smaller cars for the future of our Nation's highway safety. However, solutions to problems identified in our suggested small car examination would certainly consider any effect on other vehicles. Our draft report stated that:

"Smaller cars have begun and will probably continue to dominate the Nation's fleet regardless of safety problems. This shift to smaller cars

adds urgency to the smaller car safety question. We recognize the magnitude of identifying and solving any safety problems associated with smaller cars because (1) collecting and analyzing the necessary information is a tremendous undertaking, (2) any solutions must involve the cooperation of the industry, public, and government at all levels, and (3) safety solutions will probably be expensive. On the other hand, if projections of thousands more injuries and fatalities due to smaller cars are correct, can we afford not to take actions to identify the most significant problems and to implement feasible solutions?"]

It is not clear what GAO means by a "complete analysis...to understand how smaller cars perform in the real world or which smaller car issues need the Nation's greatest attention." The problem is that in a changing situation one can never have "complete" analyses.

[GAO COMMENT: In the paragraph following the one from which the above sentence was extracted, we specify what a complete analysis would entail, including sources available as follows:

"The Federal Government, the States, and private groups have performed many studies and tests, providing a wealth of information. This information needs to be tapped to help define and quantify all elements of safety and smaller cars. A fuller examination of real-world accident data should be conducted to show how smaller cars are performing and what problems peculiar to smaller cars are emerging. Data sources available include:

- The Safety Administration's Fatal Accident Reporting System,
- The Safety Administration's National Accident Sampling System, and
- State accident files.

Detailed analyses using these and other sources could provide answers to questions and direction to research to pinpoint major problem areas."

Chapter 3 of the draft report (in particular pp. 38 and 39) further elaborated on what analysis of real-world accident data should include and could provide. We agree that the vehicle and highway environment is continually changing; however, that has never precluded research being done in the past nor should it preclude future research in light of the projected injuries and deaths in motor vehicle accidents.]

The agency is aware of the basic small car problems, and has analyzed the data and drawn conclusions to the extent that can be justified. Analysis is far from complete, but it is clear that the most significant problems are occupant injury from contact with steering columns, instrument panels, windshields, side door surfaces and A-pillars, as well as occupant ejection from doors, windows, and windshields. Current work in FHWA is directed at problems that already have been clearly identified, e.g., single vehicle accidents involving roadside devices such as signs, utility poles, and barriers. The recent Insurance Institute for Highway Safety study of small car safety (Status Report, January 5, 1982) tends to support this position since it identifies single vehicle frontal crashes as a significant cause of fatalities.

[GAO COMMENT: FHWA and NHTSA officials repeatedly told us that no studies with accident data had been conducted to determine the most significant problems of smaller cars. We recognized in our draft report that both agencies have conducted some engineering and statistical analyses with smaller cars but these analyses had serious limitations. The draft report stated:

"* * * Although the engineering analyses by both agencies have identified many potential smaller car safety problems, these tests do not suggest which of these many problems have the potential of being most hazardous to smaller cars in the real world. The engineering analysis of head-on collisions, side collisions, roadside-barrier collisions, or rollover accidents may all be important, but until a comprehensive study is conducted it will not be possible to determine if these or other accident situations should be of primary concern.

"NHTSA and FHWA have done statistical analyses with accident data but the data do not provide a basis to determine which smaller car safety issues are most important to address. Their data bases are limited to either fatal accidents or to a small sample of the total accidents which provides only enough data to draw general conclusions. These national data do not provide enough information on specific types of accidents such as collisions with roadside barriers to make an analysis of the smaller car experience in specific types of single-vehicle accidents."]

We disagree with the statement that "Data is (sic) available to make such a (complete) analysis." Unfortunately, the GAO has a naive faith in the quality of the data they used for their cursory analysis of small car safety that we believe is not justified.

Generally, there are serious problems with State accident data and with all exposure data. State accident data are necessarily taken from police reports, and cannot contain the detailed information on impact forces, vehicle and roadside hardware damage, occupant contact points, and specific occupant injuries which are necessary to explore the effects of vehicle size and structure, much less to consider how these injuries can be alleviated. The National Accident Sampling System (NASS) was developed precisely to address these deficiencies. Accidents in the NASS sample are investigated by personnel trained to observe and record important features relating to vehicle crash performance and occupant injury information. The accident scene is visited, documented, and photographed; vehicles are inspected and damage measured; occupants are interviewed; medical records are obtained and digested. From all of these sources a comprehensive picture of the accident emerges, one which has immediate use in exploring possible countermeasures. Since NASS is also a true probability sample of the nation's traffic accidents, NASS can provide accurate national estimates of accidents in many important areas. At the present, NASS is only partially operational, with 30 teams in the field. When fully operational, with 75 teams, it will provide precisely the detailed, accurate accident data which we presently lack.

[GAO COMMENT: We recognize that there are problems with the quality of some States' data; however, both New York and Michigan have established practices for verifying their data to ensure its accuracy which has provided accurate, acceptable data for this report.

We should also note that even though DOT refers to the "serious problems" with State accident data, it relies continuously on State data for its research. For example, NHTSA has contracted for research with private institutes to conduct studies using State accident data. Further, our draft report stated that:

"NHTSA also has access to several State files through its own and various contractor systems. NHTSA maintains limited accident data files on Washington State and is attempting to include other States. It has also contracted with various organizations which have access to several States' accident records."

In its comments, DOT fails to note the serious limitations of the NASS data base. At the time of our review, NASS data was based on a small sample size of only 3,367 accidents which, NHTSA officials stated, eliminated meaningful analysis and conclusions based on that data.

Recognizing the present limitation of NASS, we recommended a couple alternative approaches by which DOT could determine which smaller car accidents present the greatest harm to the American public. We stated in the draft report:

"A special study of smaller cars in all accident situations may be an effective way to obtain NASS data on the subject because it will enable more sample accidents to be studied and more detailed information to be gathered on the specific issue."

* * * * *

"Develop a program to use accident data from several selected States on a continuing basis to supplement test data which is available."

Regarding the latter alternative, State accident data may not provide as detailed a study of each accident as NASS. However, analysis of this data could begin immediately to answer some questions (such as those proposed by the draft report) which have not been studied by DOT. With this method, States also could be regionally represented and accidents could be studied in large numbers.]

In addition, we lack satisfactory exposure data. Such data are necessary to understand the differences between small and large cars in the type and quantity of mileage driven, the age and sex of their drivers, their occupancy rate, and so on. The results of accident data analysis are highly sensitive to these factors. The joint NHTSA-FHWA Exposure Data Subcommittee was formed to address the issue of a coordinated exposure data collection effort. This need becomes even more crucial given the climate of budget reductions. Indeed over the 1982-84 period as the need for a comprehensive exposure data collection program increases, all indications point to further reductions in the budget for implementing such a program.

[GAO COMMENT: We acknowledged in our draft report that other factors can influence accident data analysis as follows:

"In analyzing this accident, injury, and registration data and presenting it in this report, we recognize it, in many cases, must be qualified due to the multiplicity of factors which contribute to accidents.

"Accident rate can be influenced by factors other than car weight. Driver error, driver age, age of car, speed, and time of day are but a few factors which can influence accident rate. No study has yet examined all these factors, partially because much of this information is not readily available.

"In determining whether cars of the lighter weight classes have more accidents than those of the heavier weight classes, registration data which we use, is only one measure which could be used for comparison. Vehicle miles traveled could be another measure of comparison for accident frequency. However, data on vehicle miles traveled is not generally available by weight class, and registration data is. Different measures could result in findings other than the ones our data has shown. However, New York Department of Motor Vehicle officials and officials from NHTSA's National Center for Statistics and Analysis agree that the use of registration data is an acceptable measure for studying safety of smaller cars."

We recognize that budgetary reductions may limit a program for exposure data collection. Since DOT recognizes the obvious need for more and better exposure data, we believe it should make every effort to improve its data collection effort within the present budgetary climate. Our recommendations are aimed at obtaining satisfactory exposure data within DOT's present budget limitations.]

While the detailed comments of Attachment 1 provide many specific instances in the report where statistical validity has been badly stretched, it is noted that the report exhibits a general disregard of the inherent difficulties in reaching reliable conclusions on specific questions from accident data. In addition to the problem of limited sample size when existing data sets are sliced thin by stratification against specific questions or parameters, accidents are part of a time series which is not stable as history moves on. Failure to recognize the transient nature of these data obscures the fact that both the highway community and the automotive industry have made progress in developing greater safety for smaller automobiles. Some aspects of this improvement have moved rapidly in the past 3 to 5 years so that the merging of data sets over such a period obviously leads to the elimination of insights which might otherwise be apparent.

[GAO COMMENT: We believe that we have not stretched statistical validity in our report as DOT stated in its detailed comments.

Only a few of DOT's detailed comments criticized the "statistical validity" of our report. They suggested our results to be less valid because we use limited data bases and limited exposure data.

For example, one detailed comment stated:

"The use of percent of occupants suffering injury is questionable since there must be the same number of occupants per vehicle to make this comparison, (e.g., two and four seater cars could have fewer occupants than a six seater)."

It should be noted that statisticians from New York and Michigan believe our methodology to be acceptable and that other researchers have used the same method of analysis. We also presented our methodology to officials from NHTSA's National Center for Statistics and Analysis before issuing the draft report, and at that time they agreed with our methodology.

We note throughout the report the limitations of the data we use. The report's conclusions were based on data from two States, NCSS, and FARS, which we do not claim to be representative of the Nation as a whole. We present the data simply to point out that there is disagreement on what the smaller car safety issues are and to note available sources for studying smaller car safety. We believe our recommendations present techniques by which DOT could aggregate more and better data.

We acknowledged that research with accident data, as with all data, can have some inherent difficulties. In fact, we recognized in the draft report that sample size could be a problem and did not use NASS or Illinois data for that reason. There were areas in chapter 2 where we noted the condition of limited sample sizes, such as with median barriers and guardrails.

We agree that automobile safety progress may have been made during the past few years. We considered the difference in safety performance between older and newer vehicles, as stated in the draft report as follows:

"Other vehicle and highway safety experts suggest that smaller cars are getting progressively safer each model year. A 1977 Highway Safety Research Center study of North Carolina accident data examined age of car and noted that newer cars did better than older cars across all weight categories in accident and driver injury involvement. NHTSA officials stated that recent crash tests have demonstrated that newer, smaller cars are faring better than older ones.

"Our examination of the New York data had varying results. It showed that newer cars in specific types of single-vehicle accidents have lower injury rates; however, the New York data did not demonstrate a consistent trend for the smaller car. For example, the data showed that newer cars (model years 1975-80) weighing 2,500 pounds or more had a lower rate of severe and fatal injuries than the older cars of the same weight class (model years 1965-74) in accidents with poles and guardrails. However, the data did not show a similar trend for the new cars versus older cars weighing less than 2,500 pounds. For total single-vehicle accidents, the New York data established no relationship between car age and severity of occupant injury."]

The GAO draft report does present one major finding which is worthy of attention, namely, that increased efforts be made to collect data related to the safety of small automobiles in a more systematic and comprehensive manner. However, the approach suggested by GAO shows a shallow appreciation of the problems involved in working with existing data files or the magnitude of the effort required to create new data files with adequate sample size to provide statistically valid conclusions.

Therefore, we do not concur with the recommendation that a special study be conducted by the Office of the Secretary through statistical interpretation of existing data files and by the establishment of a special task force for this purpose. The GAO should be advised that organizational structures already exist which are adequate for this task and are indeed engaged in its pursuit; namely, the joint NHTSA-FHWA Executive Coordination Group and the various subcommittees of the National Highway Safety Advisory Committee established by the Secretary. It would be better to support and expand these existing efforts than create new structures. Also, a joint NHTSA-FHWA study of compatibility issues has begun to look at the same safety questions raised by GAO but with a broader perspective than simply "smaller cars."

[GAO COMMENT: It is encouraging that DOT agrees that increased efforts need to be made to collect data on smaller car safety in a more systematic and comprehensive manner. We still believe that our report, along with the concern of others, including the Insurance Institute's January 1982 report showed that smaller cars can present a significant safety problem which deserves special attention. Our draft report stated:

"We believe it is imperative to determine which smaller car safety issues need the Nation's greatest attention. When that is accomplished, it will be possible to determine how to approach and perhaps solve many of the emerging safety problems with the economical, political, and social limitations which may be present."

In our draft report we did not recommend a task force as the only technique to interpret existing data files. Our recommendations suggest that the Secretary examine several alternatives to accomplish this task. The draft report stated:

"We recommend that the Secretary examine the following alternatives or combinations of alternatives in deciding how to collect and analyze information necessary to determine safety issues and answers.

- Organize a task force composed of FHWA and NHTSA personnel with advisors from other Federal agencies, States, industry, and other vehicle and highway safety experts.
- Develop a special studies program on smaller cars to be carried out with NASS teams and to be reviewed by both NHTSA and FHWA.
- Develop a program to use accident data from selected States on a continuing basis to supplement test data which is available."

Others agree that these alternatives could be used in determining safety issues and answers. For example, our draft report stated:

"Some experts state that a select few States with federally supported data bases could provide detailed information on a continuing basis to answer such questions as those posed by this report.

"NHTSA research officials indicated that further study of smaller cars with accident data would be useful in clarifying many perceived safety problems."

In addition, the Acting Associate Administrator for Research and Development told us during our review, that it would be useful to study smaller car safety with a NASS special study.]

We also do not concur that "no long-term research directed at smaller cars should be started until such study is completed." This position places the public at unnecessary risk, leading to large numbers of fatalities and injuries that can be prevented. Current research, at least in FHWA, is directed at problems in the reduction of the severity of single vehicle accidents involving roadside hazards where specific problems with respect to smaller vehicles have been positively identified from the physics of the problem. This work should proceed concurrently with efforts to improve our statistical knowledge of small vehicle involvement and performance for two reasons. First, we should ensure that any highway hardware now being installed will provide adequate performance for the smaller vehicles as well as other vehicles to be protected. Secondly, the development of technical solutions for countermeasures is essential prior to decisions with respect to a massive retrofit program in order that costs may be accurately assessed.

[GAO COMMENT: We do not believe that DOT has demonstrated successfully the smaller car safety problems which need study. We stated in the report:

"Although the engineering analyses by both agencies have identified many potential smaller car safety problems, these tests do not suggest which of these many problems have the potential of being most hazardous to smaller cars in the real world. The engineering analysis of head-on collisions, side collisions, roadside-barrier collisions, or rollover accidents may all be important, but until a comprehensive study is conducted it will not be possible to determine if these or other accident situations should be of primary concern."

We believe that any long-term research should be delayed until a better understanding of the actual smaller car performance is established. We agree with DOT that the public should not be placed at unnecessary risk. That concern is reflected in our recommendations as we believe better examination of smaller car problems will enable DOT to plan its long-term research with the actual fatality and injury experience of smaller car occupants.

Though FHWA may understand the physics of a particular safety problem through current engineering research, FHWA and DOT will never know the magnitude of the public problem until it is studied with accident data.

We believe that it is necessary to first identify a problem occurring on the roadways before developing technical solutions. It would be impossible to develop solutions to all possible problems in hopes that the primary problems would be addressed. As our draft report stated:

"With limited Federal, State, and other funds it seems prudent to concentrate resources on smaller car safety issues systematically identified to be most cost-beneficial in terms of saving lives and preventing injuries."]

POSITION STATEMENT

We have reviewed the GAO draft report and find it to be unacceptable because (1) the research product represented by the report does not add to the general level of knowledge in the area and could be misleading, and (2) in seeking to couch the research within the framework of operational auditing, the report makes recommendations for management of highway safety research in the Department that cannot be supported by the text, or are otherwise too simplistic.

PART I. THE RESEARCH PRODUCT

We find the basic research product does not advance general knowledge of the area and may be misleading.

[GAO COMMENT: Our review was not undertaken as a research project. As stated in the draft report:

"GAO conducted this review because of concerns about safety of smaller cars expressed by members of the vehicle and highway safety communities and the public in general and because of disagreement on alleged safety problems. The objectives of the review were to determine what safety issues and problems exist for smaller cars on today's roadways, what is being done to correct these, what needs to be done, and the extent of Federal involvement in this area."

We believe we have added to the general knowledge of what research efforts have been undertaken and what remains to be done. For example, the draft report stated:

"Little research has been done which centers on the totality of the smaller car issues. Though both FHWA and NHTSA have recognized a concern for the emerging smaller car fleet, neither has proposed a thorough study on the safety of smaller cars. NHTSA has done considerable testing and accident analysis concerning the safety of the vehicle itself in multivehicle collisions and has determined that smaller cars in general are not as safe as larger cars. FHWA is evaluating performance of roadway hardware when hit by smaller cars and has identified some roadway hardware which can be especially hazardous to smaller car occupants. To date, there is little consensus on smaller car safety problems.

"What has not been done is to analyze real-world accident data, especially as it relates to accidents involving only one vehicle, to determine what smaller car safety problems exist. If, as predicted, smaller cars are to be the dominant vehicle on our roads, emerging safety problems need to be identified and quantified so they can be addressed before they become alarming."]

By example on page 111 it states,

"...the physics of smaller cars will (emphasis supplied) prohibit them from offering as much occupant protection in every situation as a large heavy one. (See pp 30 and 31)"

Nothing in the text of the pages referenced supports this statement. Rather, pp. 30 and 31 deal with seat belt usage. Only on page 32, does it appear and there, again, only as a conclusive statement unsupported in text.

[GAO COMMENT: The page references which support the statement about the physics of small cars should be pages 11 and 12 instead of pages 30 and 31. The statement on page 32 is based on a General Motors report and concurrence by NHTSA officials as cited on pages 11 and 12. The draft report stated:

"* * * a General Motors report states that it simply is not possible to engineer a small, light car that provides as much occupant protection in every instance as a large, heavy one. NHTSA officials agree that, all things other than size being equal, large cars provide more occupant protection."]

The GAO review of existing analyses as well as the analyses performed by the GAO ignores many parameters that contribute significantly to the frequency of crashes for all vehicle sizes, as well as the injury levels given a crash. These parameters include driver age and its influence on high risk taking and subsequent crash frequency, driver age distribution by vehicle class, occupant age and its influence on tolerance to injury, seat belt use and its influence on injury reduction, vehicle damage or crash severity and its influence on exposure to injury, and specific types of roadside hardware struck and their influence on the interaction with the vehicle itself.

[GAO COMMENT: Our draft report acknowledges that other factors can influence accident data analysis, as follows:

"In analyzing this accident, injury, and registration data and presenting it in this report, we recognize it, in many cases, must be qualified due to the multiplicity of factors which contribute to accidents."

"Accident rate can be influenced by factors other than car weight. Driver error, driver age, age of car, speed, and time of day are but a few factors which can influence accident rate. No study has yet examined all these factors, partially because much of this information is not readily available.

"In determining whether cars of the lighter weight classes have more accidents than those of the heavier weight classes, registration data which we use, is only one measure which could be used for comparison. Vehicle miles traveled could be another measure of comparison for accident frequency. However, data on vehicle miles traveled is not generally available by weight class, and registration data is. Different measures could result in findings other than the ones our data has shown. However, New York Department of Motor Vehicle officials and officials from NHTSA's National Center for Statistics and Analysis agree that the use of registration data is an acceptable measure for studying safety of smaller cars."

In addition, we have a section in chapter 2 which considers seat belt use, and two sections which address specific types of roadside hardware, roadside barriers, and poles.]

GAO implies that many data bases are available to study these phenomena and particularly stresses State data bases as well as FARS and NASS. We believe State data bases are inadequate to study these key issues, and indeed, this inadequacy is the genesis of need for FARS and NASS. For example, on page 39, it is stated that annual accident summaries provided to FHWA by the States would be helpful in identifying accident locations and evaluating countermeasures. This is not accurate. These summary data do not identify measures of car size, nor do they identify measures relating to any of the key issues rated above. Indeed, these data do not report on non-injured persons and consequently cannot be used to determine the injury rate for crash-exposed occupants, which is the most accepted measure of performance for comparing small vs. large vehicles in crashes.

[GAO COMMENT: We are very concerned about DOT's negative attitude in these comments about the adequacy of State data. It infers that only the Federal Government, particularly NHTSA, can acquire adequate data. We were told repeatedly by NHTSA and FHWA officials that many States have reliable data bases. States mentioned included New York, Washington, Michigan, North Carolina, Texas, and California. Further, DOT has relied on State data for its research. Our draft report stated that:

"NHTSA also has access to several State files through its own and various contractor systems. NHTSA maintains limited accident data files on Washington State and is attempting to include other States. It has also contracted with various organizations which have access to several States' accident records."

FARS and NASS, which DOT prefers, have some serious limitations. FARS is limited to reporting on fatal accidents, and at the time of our review, NASS had a limited data base which, NHTSA officials stated, eliminated meaningful analysis and conclusions in certain types of accidents. Therefore, in order to study smaller car safety, accident data appears to be available primarily through the States. The draft report stated that:

"Most highway and accident data available today was collected by States. Therefore, information is available from States that cannot be obtained elsewhere. Some of the information is readily accessible in various computer data bases, other information is buried in stacks of nonautomated records. However, in whatever form, accident data exists which can help define smaller car safety problems and may be the best or only way to obtain the types of information necessary to identify and quantify specific problems. Some experts state that a select few States with federally supported data bases could provide detailed information on a continuing basis to answer such questions as those posed by this report."

DOT fails to note that we recognized other methods of obtaining information on smaller cars in the draft report. In fact, one alternative would utilize NASS, as stated in the draft report:

"Develop a special studies program on smaller cars to be carried out with NASS teams and to be reviewed by both NHTSA and FHWA."

Concerning the annual accident summaries provided by States to FHWA, we have deleted the sentence which states the data can be broken out by vehicle size. However, we believe that State data summaries which report on numbers of fatalities and injuries, fatal and injury accidents, and other such information must have detailed information as backup. We believe that any examination of smaller cars

could benefit by studying the backup for these summaries, especially in light of information received from the States of New York and Michigan. DOT should note, however, that though one can determine injury rate by including all crash-exposed occupants, many experts also measure the performance of large versus small vehicles in crashes by only driver injury.]

Are smaller cars in more accidents: The data shown for Michigan and New York compare percent of fleet to percent of accidents and find no overrepresentation for smaller cars. The report only briefly mentions the North Carolina study. The report should have noted that the North Carolina study gives accident rates per million vehicle miles and, by that more satisfactory measure, small cars are overrepresented. The Michigan and New York data are misleading because they do not take into account that smaller cars are driven fewer miles per year.

[GAO COMMENT: NHTSA and FHWA were unable to provide us with the exposure data (accident rates per million vehicle miles traveled) for New York and Michigan. It is not acceptable to assume that, because one study states that smaller cars are driven fewer miles per year in North Carolina that they are also driven fewer miles in New York and Michigan. Further, when we found the exposure data mentioned above was not available, we decided to use registration data and conferred with NHTSA officials. Our draft report stated that:

"In determining whether cars of the lighter weight classes have more accidents than those of the heavier weight classes, registration data which we use, is only one measure which could be used for comparison. Vehicle miles traveled could be another measure of comparison for accident frequency. However, this data on vehicle miles traveled is not generally available by weight class, and registration data is. Different measures could result in findings other than the ones our data has shown. However, New York Department of Motor Vehicle officials and officials from NHTSA's National Center for Statistics and Analysis agree that the use of registration data is an acceptable measure for studying safety of smaller cars."]

Collisions between cars of similar weight: The report states that FARS data do not follow the usual trend of greater severity for smaller cars. But this is a misuse of FARS. Since a collision cannot get into FARS unless it kills at least one person and since collisions with multiple fatalities are relatively uncommon, it is hardly surprising that a FARS collision of 2 small cars kills about the same number of people as a collision of 2 large cars - i.e., slightly more than 1. Injury rates based on FARS occupants alone are similarly misleading.

[GAO COMMENT: We do not use injury rates based on FARS occupants alone to discuss collisions between cars of similar weight. We also use two studies and New York data. We qualify the FARS data by stating that this data represents only fatal accidents. The draft report stated:

"Our analysis of 1975-79 FARS data indicates that in fatal accidents when two cars of similar weight collide, injuries and fatalities to occupants are about the same regardless of car size. The New York data suggests that when two cars of the same weight class collide, the occupants of cars smaller than 2,500 pounds consistently have twice as many injuries and fatalities as those in cars weighing over 3,500 pounds. Occupants of cars from 2,500 pounds to 3,500 pounds have nearly 1-1/2 times as many injuries and fatalities as cars over 3,500 pounds."]

Single vehicle accidents: For the same reasons as discussed above, FARS injury rates are not useful for determining the effect of car size on single vehicle crash fatalities. The report also uses NCSS data to address single vehicle accidents. This is a misuse of NCSS. A single vehicle accident gets on NCSS only if it is a towaway. Smaller cars are more vulnerable to disabling damage - i.e., it takes a more severe accident to produce a large car towaway. Since the small-car single-vehicle accidents on NCSS are a less severe class of accidents than the large car accidents, the injury rate comparison is not meaningful.

[GAO COMMENT: In conducting this review, we discussed with NHTSA, FHWA, State, private research, and industry officials the sources of data available. We were told to explore NCSS, FARS, NASS, and State data. However, now DOT tells us that State data is not acceptable, FARS and NCSS cannot be used, and NASS has a limited base. Therefore, DOT in effect is saying that single-vehicle accidents cannot be studied for small cars, yet NHTSA has sponsored a series of studies using North Carolina data which included an analysis of single-vehicle accidents in smaller cars.

Concerning the limitations of NCSS data, wherever that data is used we have explained that this represents only tow-away accidents. Since that data is always one of many sources used in each section, we believe that the NCSS data can help give a better understanding of single-vehicle accidents.]

PART II. RECOMMENDATIONS

1. The report recommends that the Secretary determine which safety issues concerning smaller cars on our roadway need the Nation's greatest attention and which countermeasures can be used to reduce accidents, injuries and fatalities involving smaller cars.

This recommendation does no more than restate the primary mission of the Department within the field. To the extent that the GAO is recommending that we continue to seek solutions to these issues, we naturally concur and accept the recommendation.

[GAO COMMENT: The NHTSA and FHWA studies which we reviewed did not specify which issues need the Nation's greatest attention. If this is not known, then specific countermeasures to reduce smaller car injuries, accidents, and fatalities cannot be established. If this is the primary mission of DOT within the field, we believe it is not being accomplished.]

To accomplish the recommendation (our mission) the report recommends further that the Secretary:

- (1) establish for the purpose of this study, standard units of measure to define all sizes of passenger cars.

As the report points out (p.5), NHTSA and FHWA generally use the EPA definition. This would appear to negate the need for the recommendation. That "Automotive News", and others may use a less rigorous, or different definition, is not shown by the report to have caused any "confusion" in the NHTSA research program.

[GAO COMMENT: NHTSA and FHWA may generally use EPA definitions though NHTSA did not use the EPA definition in the 1981 Car Book which received extensive consumer distribution. NHTSA stated in the publication:

"The Environmental Protection Agency (EPA) puts automobiles into size categories by measuring their interior space. In this book we use weight to classify automobiles because currently their relative safety is dependent on weight." (Emphasis added.)

Also, NHTSA has not used a consistent definition in other research. For example, the North Carolina Highway Safety Research Center has conducted NHTSA-sponsored studies using weight categories. It would be logical to use standard units so that all elements in the analysis would have the same measure and thus be comparable.]

- (2) use all relevant sources of available accident and test information.

We find this recommendation gratuitous. While we may disagree with the GAO as to the reliability of specific data, we do not believe it necessary to recommend that we use all relevant sources which are available, within our resource limitations.

[GAO COMMENT: DOT has acknowledged throughout this response that Federal accident information such as FARS and NCSS have certain limitations in studying smaller car safety. We therefore believe that other relevant sources of information should be included such as State accident data. The recommendation is made to encourage the use of these other sources particularly at the State level. DOT's comments add evidence to the need for this recommendation by their negative position toward State data.]

- (3) include an examination of the contributing effects of both the driver and roadway on smaller car performance.

The GAO may be assured that the Department will continue to examine these effects within the framework of its overall research programs.

[GAO COMMENT: These factors are not always considered in FHWA and NHTSA research and testing. For example, the roadway is not considered in NHTSA's New Car Assessment Program, nor is the driver considered in FHWA's crash tests conducted without dummies. The recommendation is made relative to the small car examination which we advocate and should be taken in this framework only.]

2. GAO further recommends that the Secretary use the results of this study to establish research priorities. Because this study would be the basis for research involving smaller cars, no long-term research directed at smaller cars should be started until such study is completed. Any plans for short-term research involving smaller cars should be coordinated with this study.

The Agency has conducted, and is conducting, numerous analyses of the small car safety problem. Sufficient data are available to identify the major vehicle related safety problems. Analysis is far from complete, but it is clear that the most significant problems are occupant injury from contact with steering columns, instrument panels, windshields, side door surfaces and A-pillars, as well as occupant ejection from doors, windows, and windshields. Current work in FHWA is directed at problems

that already have been clearly identified, e.g., single vehicle accidents involving roadside devices such as signs, utility poles, and barriers. The recent Insurance Institute for Highway Safety study of small car safety (Status Report, January 5, 1982) tends to support this position since it identifies single vehicle frontal crashes as a significant cause of fatalities.

[GAO COMMENT: FHWA and NHTSA officials repeatedly told us that no studies with accident data had been conducted to determine the most significant problems of smaller cars nor did they provide us with any information to document that the "most significant problems * * * have been clearly identified." We recognize in our draft report that both agencies have conducted some statistical and engineering analyses with small cars.

* * * Although the engineering analyses by both agencies have identified many potential smaller car safety problems, these tests do not suggest which of these many problems have the potential of being most hazardous to smaller cars in the real world. The engineering analysis of head-on collisions, side collisions, roadside-barrier collisions, or rollover accidents may all be important, but until a comprehensive study is conducted it will not be possible to determine if these or other accident situations should be of primary concern.

"NHTSA and FHWA have done statistical analyses with accident data but the data do not provide a basis to determine which smaller car safety issues are most important to address. Their data bases are limited to either fatal accidents or to a small sample of the total accidents which provides only enough data to draw general conclusions. This national data does not provide enough information on specific types of accidents such as collisions with roadside barriers to make an analysis of the smaller car experience in specific types of single-vehicle accidents."]

We believe that these problems should be addressed without waiting for data on these problems which are more difficult to identify. Therefore, we do not agree with the GAO position that no long-term research should be undertaken until all safety problems in small cars are identified. In recommending that a study be performed before longer term research on small cars be performed, GAO is implying that safety component or subsystem research in small cars be stopped. We agree that accident analysis leads to setting research priorities, and serves to identify long-term research. We will, however, never have all the details on accidents involving small cars,

or for that matter, involving any vehicle size. This situation has been recognized by the Agency for many years; and, therefore, we have complemented our accident analysis with engineering judgment based on laboratory crash testing. While this latter approach must necessarily make some assumptions, it nevertheless results in solutions which can be transferred to production vehicles.

[GAO COMMENT: As stated previously, DOT did not demonstrate which problems should be addressed without further delay. Again, we noted in the report that:

"NHTSA and FHWA have included smaller car safety in various studies. Though both agencies have become more concerned with the subject of smaller car safety, their studies have been limited in the types of accidents studied and in the type and amount of accident data used. Generally, these studies have centered on safety problems such as guardrail collisions, rollovers, and seat belt protection which include other issues as well as smaller car safety. To date, neither agency has assumed responsibility for a comprehensive study of smaller car safety."

We believe that any long-term research should be delayed until a better understanding of the actual smaller car performance is established. Long-term research should be consistent with actual fatality and injury experience, which DOT has yet to determine. Our position, as stated in the draft report, is that:

"We believe it is imperative to determine which smaller car safety issues need the Nation's greatest attention. When that is accomplished, it will be possible to determine how to approach and perhaps solve many of the emerging safety problems with the economical, political, and social limitations which may be present."

Furthermore, we do not recommend that ongoing research involving smaller cars be stopped; however, we do recommend that any plans for short-term research should be reviewed to assure that it will be consistent with the type of examination we proposed. The information from this examination would help establish research priorities providing a basis for determining the Nation's greatest needs.

We agree that DOT will never have all the details on accidents; however, we believe it is necessary to develop a better statistical base than presently exists. We have seen no substantial effort by DOT to assess the accident environment of small cars from statistical data in establishing its research priorities.]

A most impressive example has been the testing conducted in our New Car Assessment Program. A production vehicle tested in a laboratory crash exhibited extremely poor occupant crash protection. This result was discussed with the manufacturer, leading to improvements in the safety systems of their vehicle. Upon retest of a new production vehicle of the identical make and model, outstanding occupant crash protection was demonstrated in a laboratory test. This technology has now reached the marketplace.

[GAO COMMENT: As stated previously, we are not recommending that DOT disrupt its ongoing research programs but that ongoing research be consistent with the recommended examination and that no new research directed primarily at smaller cars be started until well-founded research priorities are established.]

We believe that NHTSA's current approach to problem identification and research is adequate and will lead to setting long-term research priorities, as well as transferring safety technology to the marketplace. We do not concur with the need to create additional DOT study groups for small car safety.

In effect the report is recommending that the Secretary disrupt the Department's on-going research programs, processes and initiate no new long-range research until a "study" of issues, as defined by the GAO, is completed.

We reject this recommendation.

[GAO COMMENT: We believe that the present approach to problem identification and research should be joint (not just NHTSA's) and that currently it is inadequate, as stated in the draft report:

"Little research has been done which centers on the totality of smaller car issues. * * * There is little consensus on smaller car safety problems."

We recommended three alternatives or combinations of alternatives to collect and analyze information necessary to determine safety issues and answers. These are:

"--Organize a task force composed of FHWA and NHTSA personnel with advisors from other Federal agencies, States, industry, and other vehicle and highway safety experts.

"--Develop a special studies program on smaller cars to be carried out with NASS teams and to be reviewed by both NHTSA and FHWA.

"--Develop a program to use accident data from several selected States on a continuing basis to supplement test data which is available."

We cannot understand why DOT insists that we recommended only one approach, that of a special study group. We believe there may be more alternatives than three but recommended that at least these three be examined before a method is selected. As stated previously, we are not recommending that ongoing research involving smaller cars be stopped; however, we do recommend that no new research directed primarily at smaller cars be initiated until after research priorities, based on our proposed examination, are established.]

3. GAO recommends that the Secretary define smaller car safety issues and countermeasures as soon as possible and list these in rank order by expected benefits and costs so that Congress can use this information in deciding on future programs which can affect safety of smaller cars on the highway.

The National Highway Traffic Safety Administration (NHTSA) began a program in 1974 which was directed at: (1) defining small car safety issues anticipated in the 1980's; (2) designing countermeasures which could mitigate various aspects of the safety problem, i.e. motor vehicle occupant fatalities and injuries in all crash modes and pedestrian injuries; and (3) developing, fabricating, and testing vehicles which incorporated improved levels of safety performance. This program, the Research Safety Vehicle (RSV) program, was a multi-phase activity which ended in 1980.

The intent of this program was identical to the GAO recommendation. Once the safety issues were defined, various levels of safety improvement were specified. These improvements--reduced injuries and fatalities--were translated to an economic benefit. Countermeasures were developed through an iterative process of design, testing, evaluation, and redesign. The final design provided the hardware from which a mass production cost could be specified. Together, the benefits and costs provided the information necessary to determine the appropriate priority of a specific safety improvement.

[GAO COMMENT: During our review, DOT both failed to mention and failed to document that it had established a program in 1974 to define small car safety issues. Further, we do not believe the RSV program, mentioned in DOT's response, had this intent. In fact, NHTSA does not describe the program as one for small cars in its Motor Vehicle Safety report (1979):

"The major objective (emphasis added) of the RSV program is to evaluate the performance of experimental vehicles in the areas of crash protection, fuel economy and emissions, crash avoidance, reducing pedestrian injuries, vehicle damageability and consumer acceptance."

To our knowledge, this program not only did not center on small car safety but it did not evaluate cars less than 2,000 pounds. Moreover, the program is a NHTSA program. Traditionally, NHTSA's responsibilities are limited to concerns for the driver and the vehicle in multivehicle collisions. The RSV program did not include an analysis of the compatibility of roadway hardware and the small car nor did it advance any highway countermeasures. In our draft report, we recommended that all accident situations, not just multivehicle ones, be analyzed. For these safety concerns, FHWA expertise and resources should be part of any analysis since its Federal responsibilities include concern for single-vehicle accidents and roadway interaction.]

The accident data utilized to define small car safety issues in the RSV Program were inadequate to perform this task well and served to focus the need for improved data systems such as NASS. Currently, the NHTSA is performing benefit and cost analyses and utilizing the results in the development of our policy towards future research on all safety issues, including small car safety.

Again, as this recommendation does no more than restate the current procedure and ultimate goal of our program evaluation and budgeting processes, we naturally concur with and accept the recommendation.

[GAO COMMENT: NHTSA indicates that its use of accident data was inadequate for this RSV program and that other systems such as NASS can be used. We encourage this use of NASS as we stated in our recommendation.]

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January 22, 1982

Mr. Henry Eschwege, Director
 Community and Economic
 Development Division
 United States General Accounting Office
 Washington, D.C. 20548

Dear Mr. Eschwege:

Per your December 23, 1981 letter, we have reviewed your draft report entitled, "Smaller Car Safety: An Issue That Needs to Be Clarified." Our state was most happy to cooperate with your agency in the preparation of the report and find it acceptable as is. We agree that more research is needed as relates to small cars and are naturally concerned with the relationship of small cars and highway hardware in crashes. In fact, the January 5, 1982 issue of Insurance Institute for Highway Safety just crossed my desk and is totally devoted to the small car issue. In case you haven't seen it, I'm enclosing a copy for your information.

If we can be of any assistance in future highway safety reports of this nature, please feel free to contact us. We would be most interested in seeing the conclusions and recommendations portion of the report once it is drafted.

Thank you for the opportunity to review the body portion of the report.

Sincerely,

PHILIP W. HASELTINE
 Executive Director

cc: Jim Hay
 John Abbruzzese
 Bill Lebel





STATE OF NEW YORK
DEPARTMENT OF MOTOR VEHICLES
EMPIRE STATE PLAZA
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ROBERT J. HOGAN
DEPUTY COMMISSIONER
FOR ADMINISTRATION

January 25, 1982

Mr. Henry Eschwege
Director
Community and Economic Development Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

I received your letter and copies of your draft report on "Small Car Safety" and appreciate the opportunity for comment.

Together with my technical staff in the Division of Research and Development, we carefully reviewed the document, and found it to be thorough and comprehensive. In general, we agree with the statements made in the report, and find that they are supported by the data presented. In addition, we conducted a series of spot check calculations of confidence intervals around the percents shown for New York State data. These checks confirm the findings from a statistical viewpoint.

By way of constructive criticism, to accommodate those persons questioning the report from a technical nature, I would like to suggest the following:

- . Specify the model years of vehicles included in the data (1965-80 for New York State data); and
- . Indicate the sample size of vehicle counts used in the various tables. (e.g., the table on Page 10 - 228,000 vehicles in 1980; Page 20 - 4,400 vehicles in 1980 guardrail accidents.)

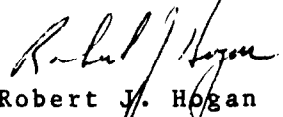
A minor typographical error noticed was: On Page 20; the first weight category should be "less than 2,000" in place of "less than 2,500".

In light of the great publicity given to the automobile industry's resistance to the automatic (passive) restraint requirement, the Administration's philosophy on deregulation, and the arguments that the cost of these restraints would further depress already ailing new car sales, the rationale you give on Page 31 for NHTSA rescinding the passive restraint standard seems inappropriate and would better be omitted.

We particularly agree with your call for more small car research. The need exists and will not go away by ignoring it. As before, New York State is interested in participating in such a study, in its design as well as in its implementation.

It was a pleasure working with your staff. Please feel free to contact us if you require any additional assistance.

Very truly yours,



Robert J. Hogan

RJH/aj

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