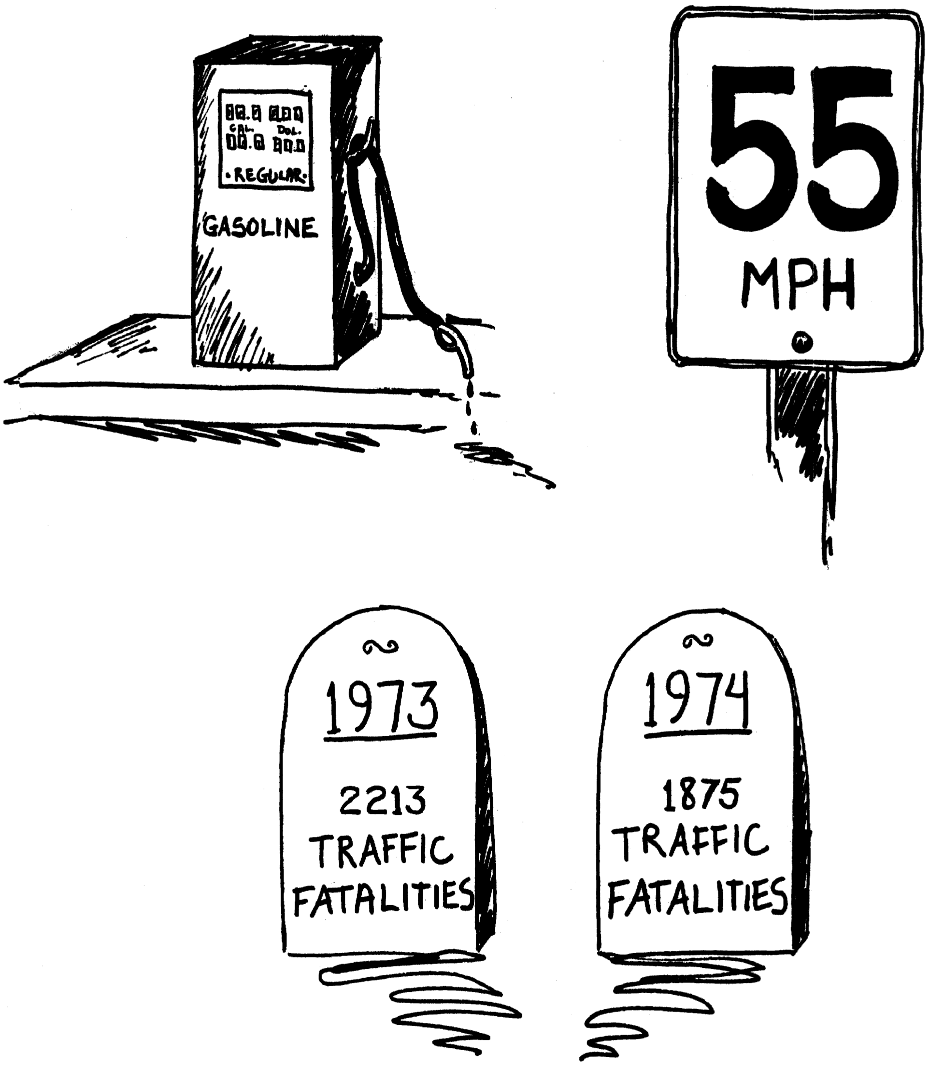
EFFECTS OF THE ENERGY CRISIS AND 55 M.P.H. SPEED LIMIT IN MICHIGAN



THE UNIVERSITY OF MICHIGAN
HIGHWAY SAFETY RESEARCH INSTITUTE

Prepared by HIGHWAY SAFETY RESEARCH INSTITUTE

In cooperation with:

Michigan Office of Highway Safety Planning
and
U.S. Department of Transportation
National Highway Traffic Safety Administration

UM-HSRI-SA-75-9

The Effects of the Energy Crisis and 55 MPH Speed Limit in Michigan

by

James O'Day

Daniel J. Minahan

Dan H. Golomb

April 1975

Prepared for Office of Highway Safety Planning in response to a request from the Michigan State Safety Commission.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UM-HSRI-SA-75-9		

4. Title and Subtitle	5. Report Date
Study on the Effects of the Energy Crisis and 55 MPH Speed Limit in Michigan	April 1975
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
James O'Day, Daniel J. Minahan, Dan Golomb	UM-HSRI-SA-75-9
9. Performing Organization Name and Address	10. Work Unit No.
Highway Safety Research Institute University of Michigan Huron Parkway & Baxter Road Ann Arbor, Michigan 48105	11. Contract or Grant No. 013454
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address Office of Highway Safety Planning 1020 Long Boulevard, Suite 14 Lansing, Michigan 48910	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report is a presentation of the findings and conclusions derived from an analysis of Michigan traffic accident data and related data for the periods before, during, and after the peak energy crisis months of 1974. A major objective of this study was to identify the effect of the speed limits imposed as a result of the energy shortage. Some other causative factors relating to traffic crashes also were investigated.

This report differs from others in that it seeks to define the cause-effect relationships specifically within Michigan, rather than nationally. Also by concentrating the study to a single state, it has been possible to get more consistent data across several measures--exposure, accident data, speed data--resulting in a more detailed analysis.

17. Key Words	18. Distribution Statement
Energy Crisis, Speed Limits, Accident Reduction	unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	54	---

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INTRODUCTION

This report is a presentation of the findings and conclusions derived from an analysis of Michigan traffic accident and related data for the periods before, during, and after the peak energy crisis months of 1974. A major objective of this study was to identify the effects of the speed limits imposed as a result of the energy shortage. Some other causative factors relating to traffic crashes also were investigated.

Over the past six months a number of reports on the same topic have been published. These include a National Safety Council publication, an AASHTO analysis, a General Motors study, a State of California study, etc. All of these studies have concluded that there was a significant relationship between speed reduction and the reduction in fatal accidents, and some of these studies have identified other factors (such as reduced exposure, a narrower spread of speeds) as contributors to accident reduction. In general this report does not conflict with those findings. Some of those reports are summarized briefly in appendices to this report.

This report differs from the others in that it seeks to define the cause-effect relationships specifically within Michigan rather than nationally. Also, by concentrating the study to a single state, it has been possible to get more consistent data across several measures--exposure, accident data, speed data--resulting in a more detailed analysis.

METHODOLOGY AND SOURCES OF DATA

The principal method employed in this study is the multivariate analysis of the differences in the accident, fatality, and travel patterns in the three time periods--before, during, and after the peak of the energy crisis. Using traffic fatality records as a starting point, the Automatic Interaction Detector (AID), which is a computer algorithm, was used to seek out those factors that best explain the differences in fatal accidents within the compared periods. Then, following an AID diagram as a guide, similar comparisons were made for the same time period of records of all reported traffic accidents (i.e., the non-fatal accidents), along with records of highway travel and driver exposure.

Data for the present study were made available by several State of Michigan agencies. A sample file of traffic accident data for the years 1973 and 1974 was furnished by the Michigan Department of State Police, and transformed into a fixed-format, fixed-record-length form for the analyses done here. Traffic volume data were furnished by the Michigan Department of State Highways and Transportation as taken from their permanent traffic recorder stations. A sample of hourly traffic counts taken on three different classes of roads (Interstate, other U.S. and state trunk line, and county) was used to estimate changes in traffic volumes within the state.

A sample of driver records was furnished by the Office of the Secretary of State. These records provided information concerning traffic violations during the study period according to age and sex of drivers.

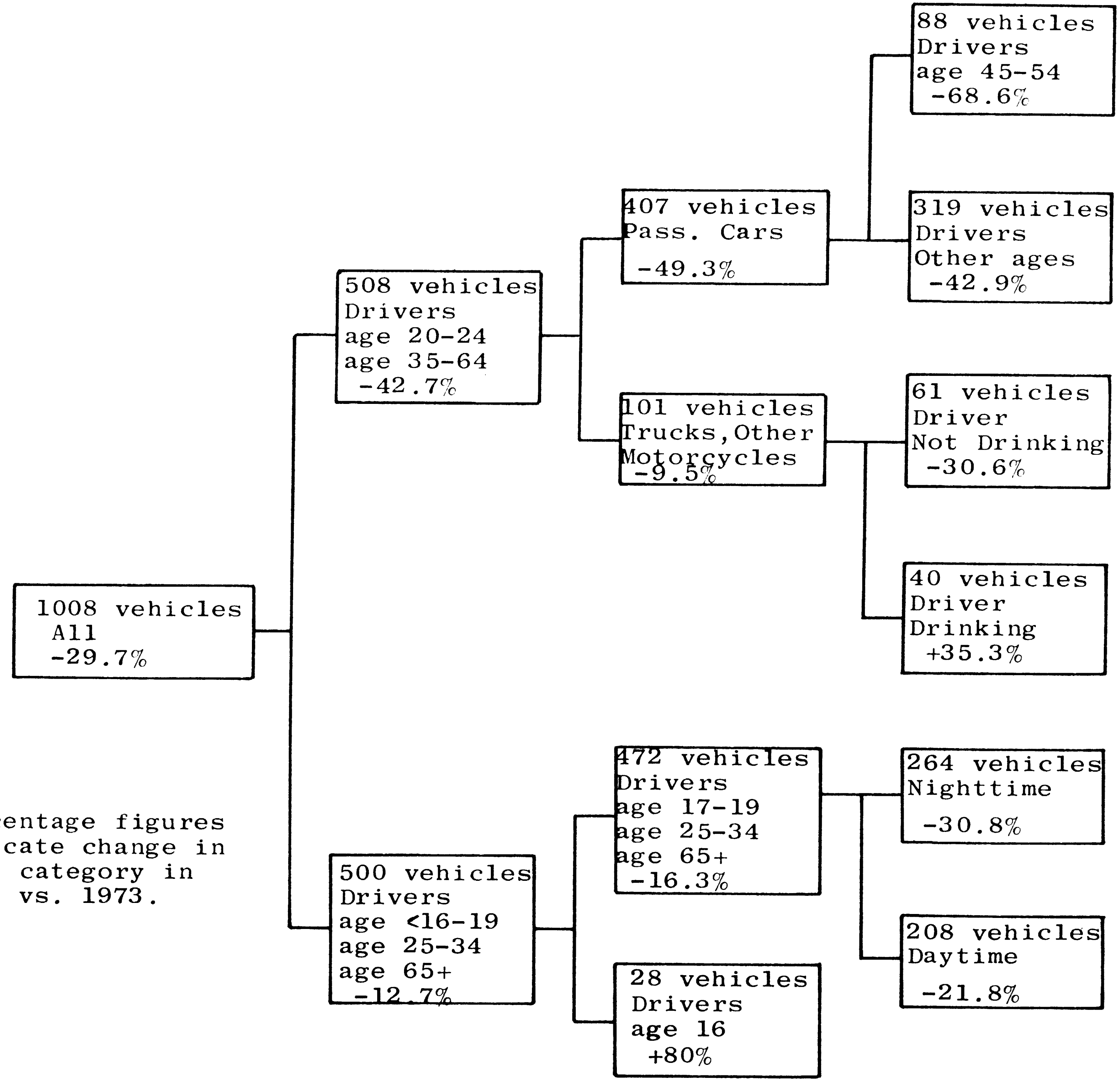
A set of exposure information gathered separately by HSRI under a U.S. Department of Transportation program was used to augment the highway department data on traffic volumes. By chance this mail survey had been going on for the same two-year period over which the other comparisons were made, and provided additional information about the travel characteristics of Michigan drivers, classified according to age, sex, and type of vehicle driven--factors not available from traffic counter data. Where possible such data were used as a secondary exposure measure in the analysis.

COMPARISON OF THE PERIODS JANUARY-MAY 1974 with JANUARY-MAY 1973.

Although the 55 mph speed limit did not become law until the first of March, 1974, changes in traffic pattern (i.e., reduced travel) and in speed of travel began during the fall of 1973. However, the January to May period is considered as the time of peak effect, wherein, in varying degree, the factors of increased fuel prices, evening and Sunday gas station closings, and the enforcement of speed limits had their impact. In order to study the maximum differences in the accident record, a comparative analysis was made of these same months for 1973 and 1974.

The Automatic Interaction Detector (AID) computer program provides an excellent means for identifying those elements in the accident data which best explain the differences between the two periods. In technical terms, the AID program seeks to answer the question, "What two-way split of all the factors considered best explains the variability of fatal accident involvement between the two periods?" Given an answer to that question, the data subsequently are divided into the two identified categories and the question now is asked about the data in each of the two categories. The process is continued until ultimately a tree structure is defined. For the 1974 data one branch of the tree successively identified sub-groups exhibiting a much lower fatality rate than in 1973, and another branch identified sub-groups in which the reduction was less (or in which there actually may have been an increase).

For the January-to-May periods two AID comparisons were made. The first comparison considered only fatal vehicles--i.e., vehicles in which some person was killed. The second comparison considered vehicles involved in any way in a fatal crash in which someone (including pedestrians) was killed, but with the analysis limited to the involved vehicles and their drivers.



Note: Percentage figures indicate change in each category in 1974 vs. 1973.

Figure 1: AID Diagram Analysis: "Fatal Vehicle" Accidents, Jan.-May '74 vs. Jan.-May '73

Figure 1 is the AID diagram resulting from the fatal vehicle analysis. Note that the factor which best explains the difference between the two years is the age of the driver, with ages being split into five groups. Drivers aged 20-24 and 35-64 performed markedly better in 1974 (their involvement was down by 35% and 47%, respectively). Drivers in age groups 19 or less, 25-34, and 65 or older performed better in 1974, but relatively not as well (involvement down 6%, 17%, and 17%, respectively).

Subsequent splits in the upper arm of the diagram show that the greatest reduction was among passenger cars (as opposed to trucks and motorcycles), and that the 45-54 age group had the peak reduction of 68.6%.

Table 1 lists the five driver age groups identified in the AID analysis, together with their percentage reduction both in fatal vehicle accidents and involvement in all accidents for the two periods. The latter data were derived from a sampling of all reported accidents as compiled by the Michigan State Police. This involvement in all accidents is taken as a rough measure of exposure (by age), although as will be seen later the total accident count apparently was down more than total travel. With regard to driver age, however, there was not a great deal of difference in total involvements--the range being approximately -11% to -17%.

Table 1: Involvements by Driver Age, Jan.-May 1974 vs. Jan.-May 1973

Driver Age	Fatal Vehicle Accidents	All Accidents	Difference
<16-19	-6%	-11%	+5%
20-24	-35%	-16%	-19%
25-34	-17%	-14%	- 3%
35-64	-47%	-17%	-30%
65+	-17%	-17%	0%

Perhaps the most interesting aspect of the age comparison is in the Difference column, which indicates that in age groups 20-24 and 35-64 there was a much greater reduction in fatal vehicle accidents than in all accidents. This is an indication that among these age groups collisions occurred at lower speeds, which in turn means that travelling speeds were lower than previously. The differences for the other age groups (between fatal accidents and all accidents) is quite small; actually for age group <16-19 it is reversed.

Tables 2 through 6 display the difference between fatal vehicle accidents and all accident involvements for several alternate breakdowns of the data.

Table 2: Involvements by Sex of Driver, Jan.-May 1974 vs. Jan.-May 1973

Sex	Fatal Vehicle Accidents	All Accidents	Difference	Exposure Rate*
Males	-25%	-18%	- 7%	-21%
Females	-47%	- 9%	-38%	+ 2%

*Exposure rate derived from survey by mail.

Table 2 indicates that female drivers were down less in total involvements (suggesting that the reduction in their driving was proportionately less than for males during the peak of the energy crisis), but females were down much more than males in fatal vehicle accidents--suggesting that driving at lower speeds was a likely cause. This table also includes an estimate of exposure rate as taken from data acquired in a mail survey of Michigan drivers during the 1973-74 period. This mail survey also supports the inference that female drivers did more than their normal proportionate share of driving during the energy crisis period.[1]

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[1] UM-HSRI-SA-75-3, Driver Exposure Survey, A Field Test of Trip Log Method, Philip S. Carroll, February 1975.

One tool that has been universally lacking in highway safety research is a means of determining driver exposure, i.e., a way to measure selectively such factors as daily and annual mileage driven, purpose (business vs. pleasure), age and sex of driver, type of vehicle, weather and highway conditions under which driving is done etc. Such data need be collected only on a random sample basis, but it must be done continuously if researchers are to realistically determine the effect on drivers and driving patterns of changes in traffic laws, safety regulations, or economic and social conditions.

HSRI implemented its own mail survey of Michigan drivers in order to obtain such data. Unfortunately only about 30% replied, but that was enough to confirm the big increase in female driving, the drop in male driving, and the change in weekend driving patterns.

An official personal interview survey conducted by a state agency would be much more successful. One of several possible ways is to randomly interview drivers at license renewal time. Presently no state has a system for determining driver exposure. It is strongly suggested that Michigan lead the way by initiating a driver exposure survey and thereby be in a position to better measure the effects of future changes in the driving environment.

Table 3 indicates that a greater reduction in fatal accidents occurred during nighttime vs. daytime, and that exposure to risk (as indicated by all involvements) was down about equally, day and night. An estimate of driver exposure derived from traffic recorder data indicates that total travel was down a bit more at night than during daytime, but not nearly as much as were nighttime fatal involvements.

Table 3: Accidents by Light Conditions, Jan.-May 1974 vs. Jan.-May 1973

Time	Fatal Vehicle Accidents	All Accidents	Difference	Exposure Rate*
Day	-20%	-14%	- 6%	- 7.7%
Night	-35%	-16%	-19%	-12%

*Estimated from Traffic Records Data

Table 4 shows the reduction in fatal vehicle accidents and all accidents by class of road--grouped into three categories. Exposure data were estimated from traffic recorder data. The speed difference is that reported in the Michigan Department of Highways Quarterly Speed Reports. Although the accident data include "County Roads and Local Streets" as one group, the exposure and speed information does not include data for city streets. The greatest difference between fatal vehicle and all accidents is in the category, "Other U.S. and State Trunk Lines."

Table 4: Accident by Road Class, Jan.-May, 1974 vs. Jan.-May 1973

Roadway	Fatal Vehicle Accidents	All Accidents	Difference	Exposure Rate	Speed Differential*
Interstate/ Limited Access	-20%	-24%	+ 4%	-10.4%	-10 mph
Other US/ State Trunk-lines	-41%	-20%	-21%	- 7.6%	- 5 mph
County Rds/ Local Sts.	-22%	-14%	- 8%	- 1.1%	- 3 mph

*From Michigan Dept. Highways Quarterly Speed Reports

Table 5 indicates a larger decrease in passenger car accidents, both in the total and fatal accident figures, and again a substantial differential between the two.

Table 5: Accidents by Type of Vehicle, Jan.-May 1974 vs. Jan.-May 1973

Vehicle	Fatal Vehicle Accidents	All Accidents	Difference
Car	-35%	-19%	-15%
Truck	-14%	- 4%	-10%
Motorcycle	- 3%	-10%	+ 7%

Table 6 shows that there was not much difference between weekend and weekday involvements. For this table, weekends were defined as the period from 6:00 p.m. Friday through 7:00 a.m. Monday.

Table 6: Accidents by Weekend/Weekday, Jan.-May 1974 vs. Jan.-May 1973

Time	Fatal Vehicle Accidents	All Accidents	Difference	Exposure Rate*
Weekend	-32%	-17%	-15%	-13.2%
Weekday	-27%	-14%	-13%	- 6.9%

*Estimated from Traffic Recorder Data

Remember that the AID analysis resulted in a division of drivers by age into two principal groups--those whose fatal involvements dropped greatly, and those whose fatal involvements were reduced only by about as much as their involvements in all crashes.

The sample of all accidents for the Jan.-May 1974 and 1973 periods was searched for evidence of significant shifts in accident characteristics according to the driver age groups previously identified. Table 7 lists those accident characteristics which did indeed show significant shifts within each age group together with the accident involvements presented in Table 1.

Table 7: Shifts in Accident Characteristics vs. Driver Involvements by Age Group, Jan.-May 1974 vs. Jan.-May 1973

	Driver Age Group				
	1	2	3	4	5
	<16-19	20-24	25-34	35-64	65+
Involvement:					
Fatal Vehicle	- 6%	-35%	-17%	-47%	-17%
All Accidents	-11%	-16%	-14%	-17%	-17%
Accident Characteristics:					
On Interstate	-28%	-13%	-27%	-10%	-26%
Weekends	--	--	--	--	--
Nighttime	--	--	--	- 3%	--
Male Drivers	--	--	--	- 3%	--
Drinking Driver	+10%	- 4%	+ 8%	-15%	-29%

Note: Blank spaces indicate no significant change

In Table 7, note particularly that those groups more involved in fatal vehicle accidents (Columns 1, 3, and 5) were under-represented in accidents on Interstate highways (i.e., apparently they drove proportionally more of the time on other type roads and streets). Also these same groups, except for age group 65+, actually increased in their proportion of accidents where drinking was involved. Within the group showing the greatest reduction in fatal vehicle accidents (age 35-64), there was a substantial proportional decrease in male driver involvements (and by inference, a decrease in the proportion of driving done by males). Also this same age group had a substantially lower proportion of accidents in which drinking was involved. By inference, then, the females in this age group proportionally did more of the driving than normally and characteristically were driving slower while less often under the influence of liquor.

Up to this point of the analysis it appears that the change in all accidents generally paralleled a change in exposure. However, the reduction in accident frequency was even greater than the observed change in the exposure rate. The reduction in fatal accidents (as compared to all accidents) was greater among drivers in age groups 20-24, and 35-64, notably among female drivers, indicating that among these age groups peak travel speeds had been reduced, resulting in a lower average severity of collisions, especially on other U.S. and State highways at night.

It is unfortunate that the Michigan accident reporting system does not include a measure of crash severity independent of the injury and fatality information. Several other states have begun to report vehicle damage on an ordinal scale, the most common being the TAD (Traffic Accident Data) scale recommended several years ago by the National Safety Council's Traffic Accident Data Committee. The TAD rating number is entered on the accident report form by the investigating police officer who has a small handbook of photos or sketches of damaged vehicles and their respective TAD ratings for quick comparison with the on-scene vehicle(s). While the data are not directly comparable, Table 8 shows the distribution of crash severity on this TAD scale within the State of Texas for the period 1974 vs. 1973.

Table 8: Texas TAD Scale Damage Severity Change, 1974 vs. 1973.

TAD Damage Severity	Change (1974 vs. 1973)
1 (Minor)	-12%
2	-16%
3	-13%
4	-19%
5	-19%
6	-18%
7 (Most Severe)	-24%

Note that involvements producing crash damage at TAD Level 1 were reduced by 12%; involvements at TAD level 6 and 7 were reduced by -18% and -24% respectively. This is taken as a clear indication that the average crash speed was lower during the crisis period. By inference,a proper response to the lower speed limit occurred.

COMPARISON OF FATAL INVOLVEMENTS IN THE 1973-74 JANUARY-MAY PERIODS

For the same two time periods an AID analysis also was run on all vehicles in any way involved in a fatal accident. This run differs from the preceding one in that here each vehicle (and driver) involved in a fatal collision is considered, whereas, previously, only those vehicles which contained a fatality were considered. Pedestrian fatalities also are included in the second analysis, together with the characteristics of the vehicle involved (e.g., the type of vehicle and the age of driver).

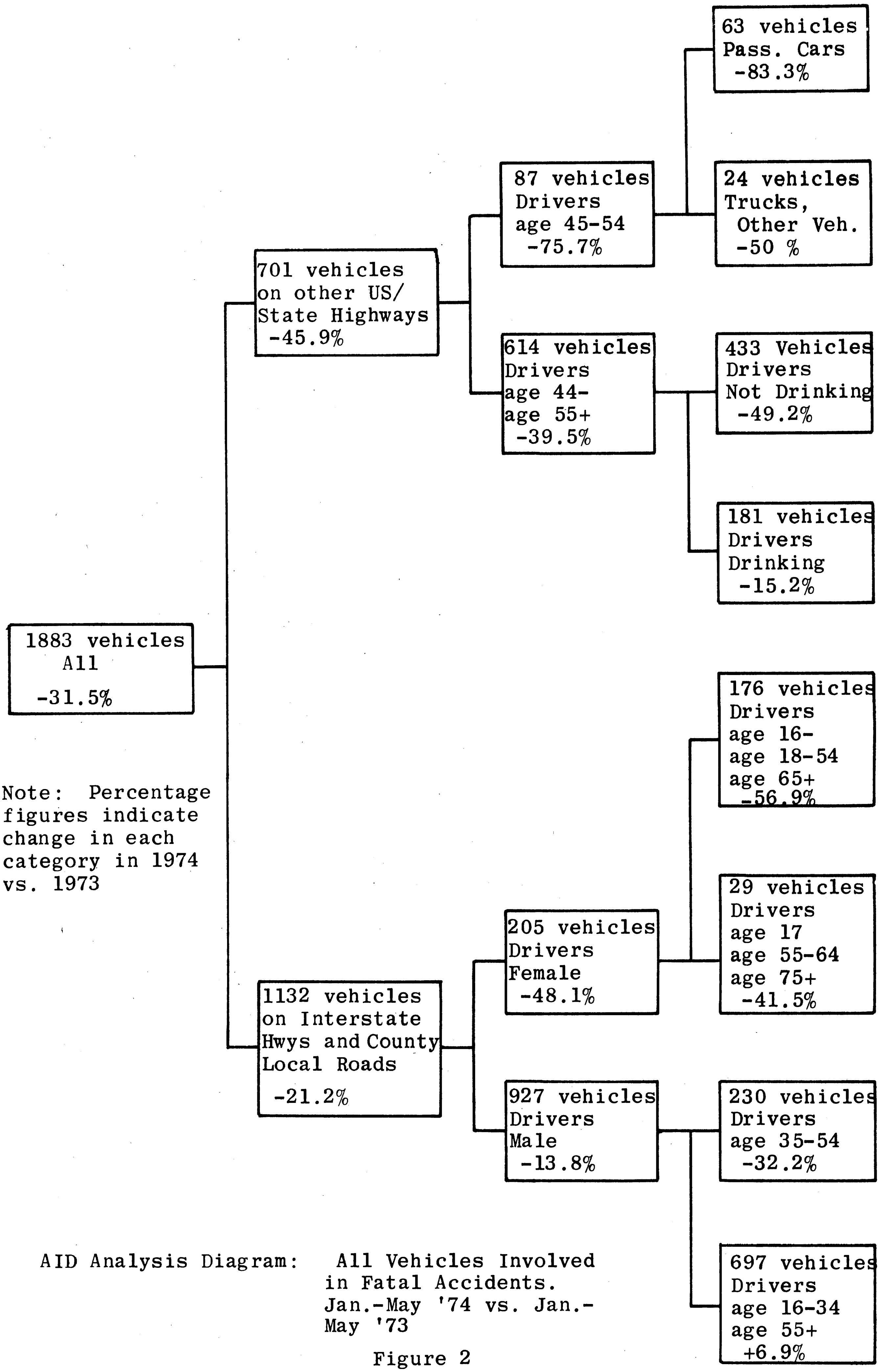
The AID algorithm again inquired, "What two-way split of which factor (variable) best explains the difference in vehicle involvements in fatal accidents during the two time periods." The derived diagram is shown in Figure 2.

The overall decrease in involvements averaged 31.5%, but the factor which now differs most is type of highway. Interstates and County and Local Roads, when combined, show a decline of only 21.2%, as compared to a 45.9% reduction on Other U.S. and State Trunklines. The upper branch of the diagram (Other U.S. and State Trunklines) indicates that the greatest reduction occurred in passenger cars whose drivers were age 45-54 (down 83.3%). Within the other age groups (ages <16-44 and 55+) there was a greater decrease in "not-drinking" accidents--suggesting that those who did not drink paid more attention to the speed limit than did the drinkers.

The lower branch of the AID diagram indicates that on Interstates and County and Local Roads female drivers had a substantially better record than males, and that male drivers under 35 and over 55 performed worse in 1974 than in 1973.

Distributions of the several variables studied for all vehicles involved in fatal accidents during the two periods are shown in Table 9.

Again a sample of all accidents for the two periods, January-May 1973/74, was searched to detect what major differences existed according to type of highway. Table 10 contains the



Note: Percentage figures indicate change in each category in 1974 vs. 1973

AID Analysis Diagram: All Vehicles Involved in Fatal Accidents. Jan.-May '74 vs. Jan.-May '73

Figure 2

Table 9: Distributions for several variables pertaining to vehicles involved in any way in fatal accidents, Jan.-May 1974 vs. Jan.-May 1973

Variable	Number of Drivers Involved	Change ('74 vs. '73)
Weekdays	1019	-28.2%
Weekends	814	-35.6%
Interstates	178	-18.5%
Other U.S./State Trunklines	701	-45.9%
County/Local Road	954	-21.7%
Daytime	814	-25.7%
Nighttime	1018	-36.1%
Multi-vehicle	1056	-34.5%
Single vehicle	777	-27.6%
Female drivers	330	-48.6%
Male drivers	1503	-27.2%
Passenger Cars	1394	-35.2%
Trucks	357	-21.5%
Motorcycles	82	- 4.8%
Drinking drivers	554	-19.6%
Not-drinking drivers	1279	-36.2%
Under age 20	316	-17.3%
Age 20-24	345	-34.1%
Age 25-34	415	-24.2%
Age 35-64	601	-42.3%
Age 65 & older	125	-16.2%

principal findings together with speed differentials as determined by the Michigan Dept. of Highways.

Table 10: Principal characteristic changes in all accidents by road type, Jan.-May 1974 vs. Jan.-May 1973

Interstate/Limited Access	Other U.S./ State Trunklines	County/Local Roads
Weekend accidents down (33%)—slightly more than weekday	Little difference in weekend/weekday accidents	Little difference in weekend/weekday accidents
Sunday and Thursday accidents down 43% and 48%, Friday, down 20%	Sunday accidents down 22%; weekdays except Friday, down 17%; Friday, up 5%	Sunday accidents down 24%; Friday, up 3%; other weekdays, down 18%
Single-vehicle accidents down 23%; 2-vehicle, down 30%	Single-vehicle accidents down 14%, 2-vehicle, down 10%	Single-vehicle accidents down 7%; 2-vehicle, down 16%
Little difference in night and day reductions	Nighttime accidents down more (16%) than daytime (8%)	Little difference in night and day reductions
All Accidents: -29.4%	All Accidents: -11.3%	All Accidents: -14.5%
Fatal Accidents: -18.4%	Fatal Accidents: -45.9%	Fatal Accidents: -21.7%
Speed: -10 mph	Speed: -5 mph	Speed: -3 mph

Sunday accidents were less frequent on all road types, certainly consistent with the closing of gas stations and reduced vacation travel. Multiple-vehicle accidents decreased somewhat more than single-vehicle accidents for all road categories. But on Other U.S. and State trunkline roads, accidents were down substantially more at night than in the daytime.

Perhaps the most anomalous finding on this chart is the large differential between fatal accidents and all accidents on Other U.S. and State Trunklines, where the average speed reduction was 5 miles per hour, and the inverse (i.e., a smaller reduction in fatal accidents than all accidents) on Interstate and Limited Access Highways, where the average speed reduction was 10 mph. Some discussion of this point is in order.

The fatal accident rate on Interstates was relatively low, even in 1973. However it should be remembered that these roads were built to be reasonably safe at speeds up to eighty miles per hour, so that a reduction in speed--while of some obvious benefit in reducing both total accidents and fatalities--is less beneficial than a comparable reduction on roads designed for much slower speeds.

Figure 3 shows a hypothetical relationship between the probability of a fatal accident and the speed of travel. For a two-lane non-limited-access road (solid line), the curve suggests that the probability of a fatal accident rises rather slowly in the range below 50 mph, but rises quite rapidly above that speed. On the other hand, for the four-lane limited-access road the slope is less acute, and although there is a knee in the curve at the 70-mph limit, the curve rises less steeply even above 70 mph. We may argue, then, that a 5-mph reduction in speed on a two-lane road with non-limited access will have greater effect than a 10-mph reduction in speed on an Interstate Highway, for two reasons: The fatality rate (fatalities per vehicle mile) was higher on the conventional road to begin with; and the speed change occurred on a steeper part of the curve for the non-Interstate-quality road.

A formal proof of this hypothesis would require an experiment which is difficult to conduct. We probably are not able to control speeds by type of road precisely enough to collect exactly the data needed. But the present data, with the natural speed changes which came about during the energy crisis, certainly are compatible with this hypothesis. Incidentally, a very similar result was observed in the Texas data for the same time period comparison.*

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*AID Analysis of Texas Fatal Accidents During the Energy Crisis, by Golomb and O'Day, prepared for the National Highway Traffic Safety Administration under contract DOT-HS-4-00937, (See HSRI HIT-Lab Reports - March 1975).

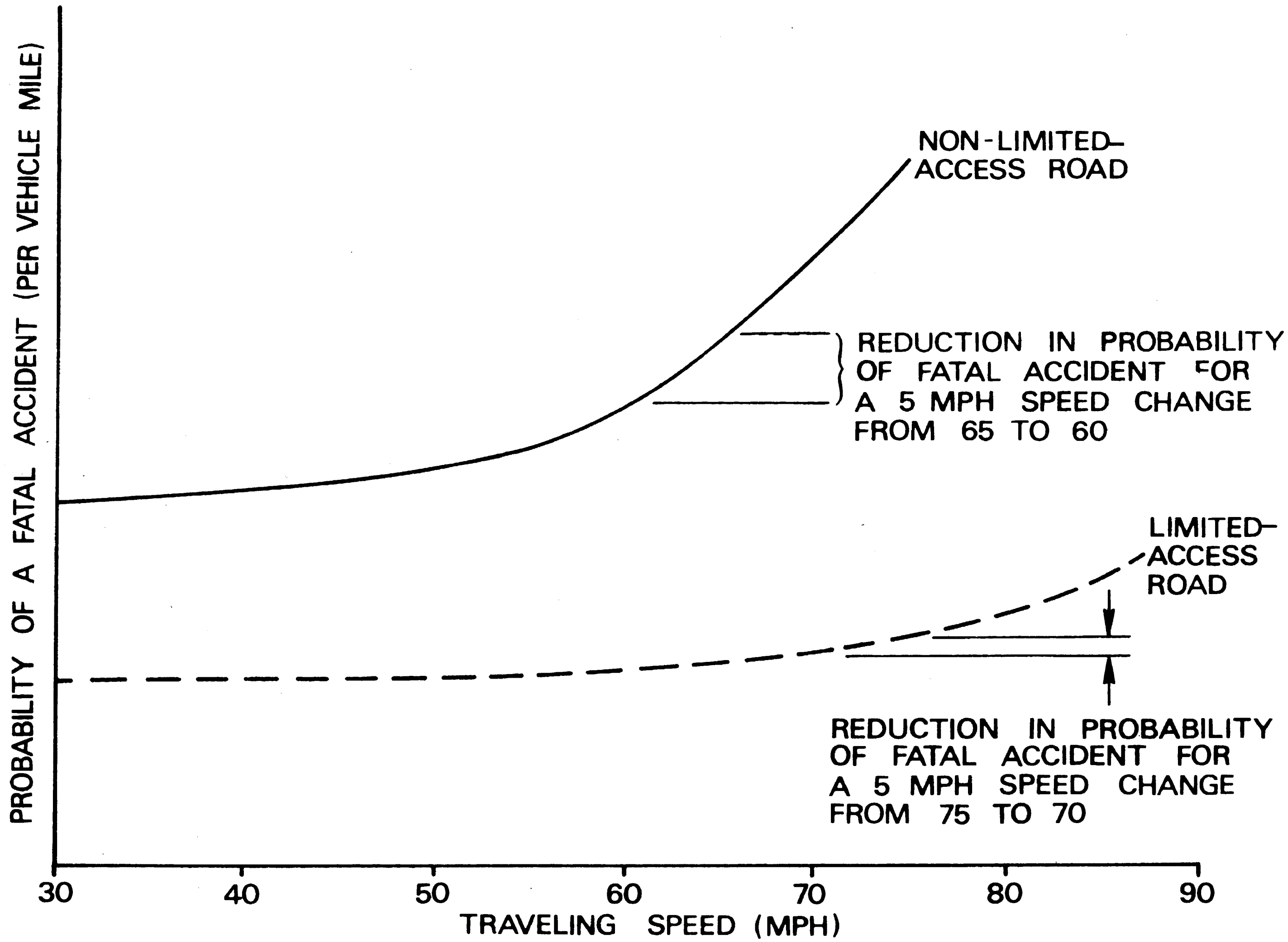


Figure 3 - Hypothetical Relationship Between Speed and Probability of a Fatal Crash

The data suggest, at least, that additional fatality reduction could be gained by even further reductions in speed limits, or by more rigid enforcement of the existing speed limits,on roads of non-Interstate quality.

Universal enforcement,of course, is limited by economics as well as public reaction. But an alternative solution for netting additional fatality reduction is the trade-off. For example, as both the data and the hypothesis suggest, raising the speed limit to 65 mph on Interstate quality roads would result in a small increase in the fatality rate, but lowering the speed limit to 45 or 50 mph or even maintaining it at 55 mph (but strictly enforced at whatever speed limit) on less than Interstate-quality roads would result in a larger decrease in the fatality rate,for a net gain in lives saved. Such a trade-off probably would meet with public acceptance and require little or no additional police effort. It is a solution that should be considered when the national 55 mph speed limit is lifted.

The analyses also suggest the desirability of concentrating future highway programs on upgrading other U.S. and State trunk-line roads to as close to Interstate quality as is economically possible or at least to AASHTO standards.

ANALYSIS OF THE CRISIS PERIOD VS. THE POST-CRISIS PERIOD

During the last six months of 1974 the energy crisis lessened and gasoline became more available. However, the 55-mph speed limit which had been legislated earlier in the year was continued in order to conserve fuel and also in order to retain the substantial safety benefits that had occurred as a by-product. The pattern of travel shifted, however.. Traffic volume and weekend and nighttime travel returned closer to the levels of the previous year. Table 11 shows the change in traffic count by class of road, by weekend/weekday, and by daytime/nighttime, both for a half-year comparison (Jan. to June 1974 vs. 1973) and a full-year comparison (January through December 1974 vs. 1973).

TABLE 11. Percentage Change in Traffic Volumes by Road Type. Jan. - Jun., 1974, vs. 1973 and Jan.-Dec.,1974 vs. 1973.

	Road Type	Time of Week	Half Year	Full-Year
Daytime	IS-Limited	Weekdays	-7.1%	-5.6%
"	Other US/M Trklns	"	-6.3%	-3.2%
"	Co.Rds/Local	"	+0.3%	+0.3%
"	IS-Limited	Weekends	-13.8%	-11.3%
"	Other US/M Trklns	"	- 7.5%	- 4.4%
"	Co.Rds/Local	"	-4.1%	- 3.3%
Night-time	IS-Limited	Weekdays	-11.0%	- 9.4%
"	Other US/M Trklns	"	-10.6%	- 5.8%
"	Co.Rds/Local	"	- 1.5%	- 2.5%
"	IS-Limited	Weekends	-20.1%	-14.5%
"	Other US/M Trklns	"	-11.0%	- 4.5%
"	Co.Rds/Local	"	- 3.9%	- 3.6%

The Michigan fatal accident count rose during the second half of 1974—substantially, as compared with the first half. Historically, however, in the second half of any given year there have been somewhat more fatal accidents than in the first half, as Table 12 illustrates.

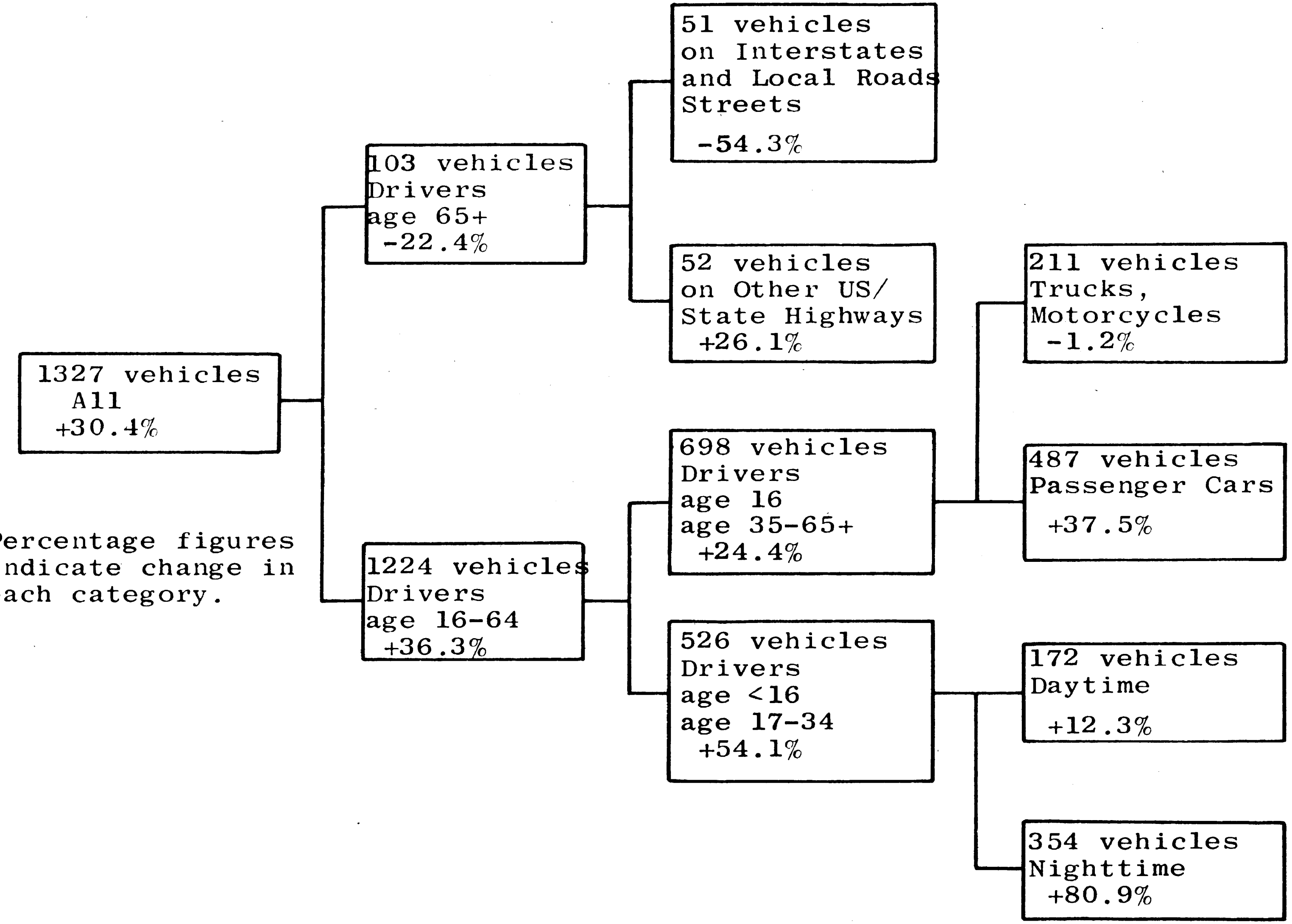
TABLE 12. Michigan Fatal Involvement by Highway Type,1971-74.

	1971		1972		1973		1974	
Highway Type	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half
Interstate	153	185	126	151	133	161	101	139
Other US/M Hwys	446	565	539	599	559	550	334	469
Co.Rds/Local	647	795	707	855	718	788	586	792
Total	1246	1545	1372	1605	1410	1499	1021	1400

Again the AID technique was used to study the differences in accidents between these two six-month periods.

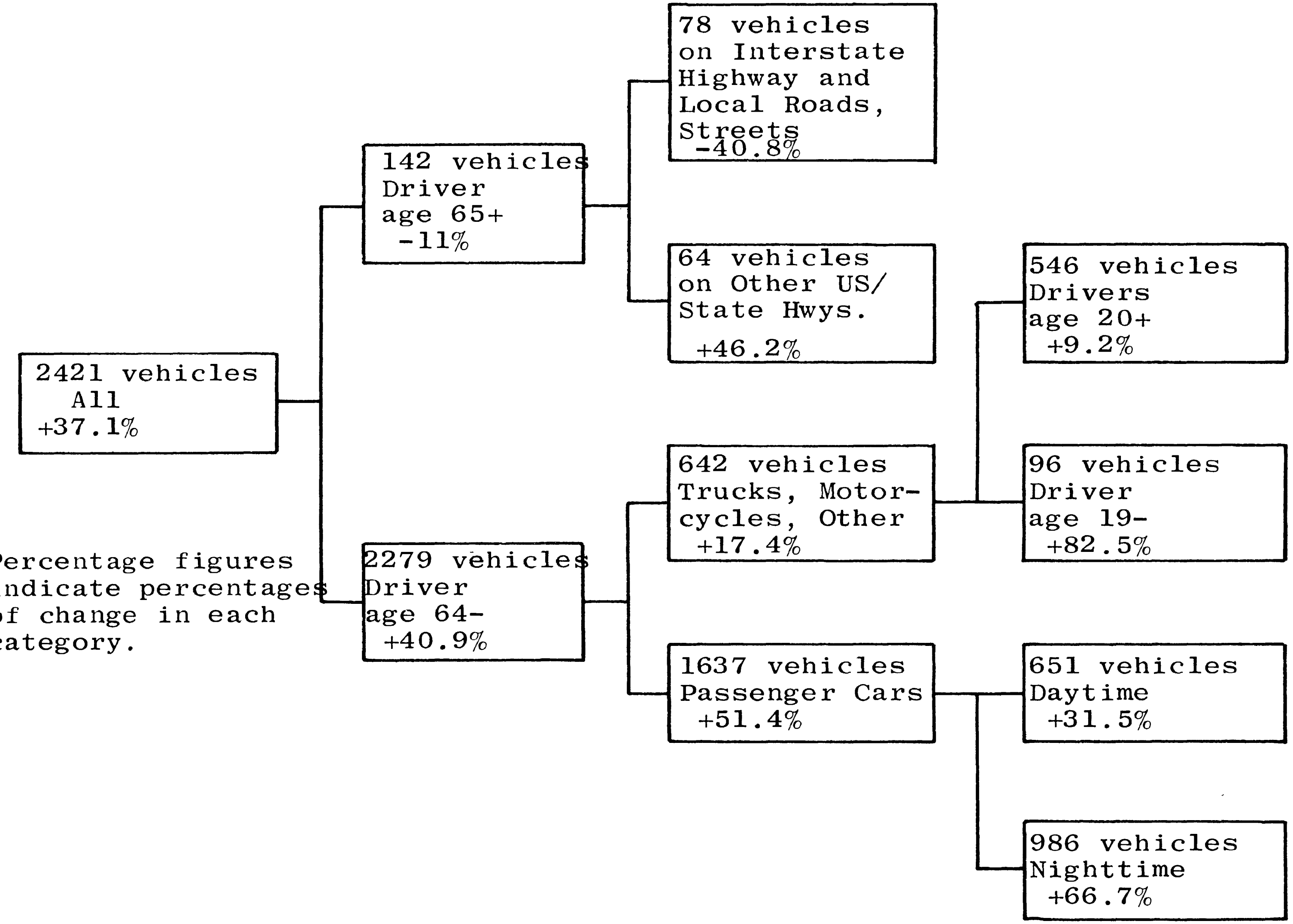
The resulting AID Diagrams, Figure 4 (based on all vehicles in which fatalities occurred), and Figure 5 (based on all vehicles involved in any way in a fatal crash) indicate, in general, large increases—reversals of the decreases which occurred during the first half of the year. The diagrams also highlight the rise in passenger car, nighttime, and weekend involvements. A small group of drivers (age 65 and over) experienced an overall reduction(-22.4% in fatal vehicle accidents and -11% in fatal involvements), although in both categories they went up on Other US and State Highways. Drivers under age 35 disproportionately increased their share of fatal vehicle accidents, particularly at night in passenger cars, as the Fatal-Vehicle AID diagram indicates.

The increase in fatal accidents during the second half of 1974, while, striking, at first glance must be examined carefully with respect to the starting point--i.e. there had been such a pronounced low in the first, "crisis" half of the year that a return to "normal" conditions was bound to appear as a substantial increase. In fact, as Table 12 indicates, the second half of 1974 was the best second half re fatal involvements in four years.



Note: Percentage figures indicate change in each category.

Figure 4: AID Diagram Analysis:"Fatal Vehicle" Accidents, July-Dec. 1974 vs. Jan.-June 1974



Note: Percentage figures indicate percentages of change in each category.

Figure 5: AID Diagram Analysis: All Vehicles Involved in Fatal Accidents, July - Dec. 1974 vs. Jan. - June 1974

A more useful comparison can be made by looking at the last half of 1974 vs. the last half of 1973. The period, July-December of 1973, marked the beginning of the energy crisis with a slight tapering in travel and a noticeable reduction in speed.

Table 13 shows what happened in the second half of 1974, compared with the same period in 1973, regarding fatal involvements and such other factors as highway type, exposure (as measured by traffic counts) and speed change.

TABLE 13. Changes in Fatal Involvements, Exposure, and Speed, Second-half 1974 vs Second-half 1973

Highway Type	a. Fatal Involvements % Change	b. Exposure % Change*	c. Difference (a vs b)	d. Speed Change
Interstate	-14%	-7%	7%	-8 mph
Other US/M Hwys	-15%	-1%	14%	~~-14~~ -5 mph
Co.Rds/Local Sts	0%	-1%	-1%	- 3 mph
Total Change	- 7%	-3%	4%	- 5 mph

*Derived from Michigan Dept/Hwys volume and speed data.

Note that the reduction in fatal involvements was almost entirely on Interstates and Other US and State Highways. The Interstate reduction is related at least partly to exposure--i.e., there is a 7% drop in travel and a 14% drop in fatal involvements. But the change on Other U.S. and State Highways is not related to travel, and must be assigned to other factors such as speed change.

Table 14 lists the change in the second half of 1974 as compared with the first half for each variable considered. Also tabulated for comparison is the average change (second half-year vs. first half-year) for the years 1971 and 1972. Note particularly that for the reference years (1971 and 1972), with no significant changes in travel patterns, there have been about 20% more fatal accidents and fatal involvements in the second half of the year, so that the 30% increase for the second-half of 1974 is not as significant as it appears at first glance but largely reflects a return to normal driving patterns. However, examination of each factor in Table 14 reveals,

TABLE 14: Half-Year Changes (Second Half vs First Half) for all Variables Considered

	FATAL VEHICLES			VEHICLES INVOLVED IN FATALS		
	Cases	%Change '74	%Change 71-72	Cases	%Changes '74	%Changes 71-72
Weekday	727	+27.2	+26.8	1362	+34.2	+26.8
Weekend	600	+34.4	+13.7	1059	+40.4	+12.8
Interstate	139	+13.7	+10.5	240	+37.5	+20.3
US/M Routes	430	+31	+22.7	803	+40.4	+18.3
Local	758	+31	+21.7	1378	+35.3	+21.7
Day	568	+15.1	+17.9	1104	+23.2	+14.1
Night	759	+43.3	+22.7	1317	50.0	25.7
2 Vehicle	699	37.0	+21.2	1398	39.2	19.3
Fixed Obj.	485	20.3	+13.2	875	33.1	17.9
ROR/O-T	143	34.2	+45.7	148	42.7	48.8
<16	17	42.7	+43.9	17	42.7	+18.8
16	53	20.8	+63.1	69	15.5	44.5
17	76	61.8	+40.4	124	53.2	8.3
18-19	161	59.7	+12.3	280	66.7	8.3
20-24	270	47.5	+17.9	452	46.9	22.2
25-34	294	21.0	+11.4	564	30.4	18.8
35-44	143	30.4	+16.5	302	34.2	20.8
45-54	111	31.2	+16.5	246	51.3	20.8
55-64	97	20.3	+23.2	191	27.3	18.8
65-74	59	-21.2	+43.3	89	- 6.6	+43.9
>74	44	-24.0	+31.5	53	-17.2	+24.7
Male	1127	25.2	+17.4	2016	31.5	18.3
Female	200	63.2	+35.8	405	68.1	29.9
Cars	967	37	+23.2	1766	45.7	20.3
Trucks	173	3.7	+11.4	454	14.1	+27.3
Motorcycle	187	25.2	+ 7.9	201	20.8	+ 4.5
Drinking	581	34.2	+16.5	1817	35.3	17.9
Not Drinking	746	27.3	+22.7	1604	37.5	21.2
Overall	1327	+30.4	+20.3	2421	+37.1	20.3

among ages 17-19 (and to some extent among ages 20-24), a startling disproportionate increase in fatal vehicle accidents and fatal involvements for the second half of 1974. Other factors showing significant change include female drivers, motorcycle accidents, and drinking involvement.

Table 15 puts the 1974 year in perspective with respect to driver age. The numbers of licensed drivers in the same five age groups previously identified have been adjusted proportionately to reflect that group's rate of fatal involvements--i.e., in the first half of 1971, one "under-20-year-old" driver out of 3227 was involved in a fatal crash. Except for the "under 20" age group, each group indicates for 1974 the best second half-year record in the past four years. The youngest group, however, displays its worst second half-year record in four years.

Table 15: Number of Licensed Drivers per Fatal Involvement, by Half Year and by Age Group Shown. Michigan Fatal Accidents, 1971-1974.

	1971 1st half	1971 2nd half	1972 1st half	1972 2nd half	1973 1st half	1973 2nd half	1974 1st half	1974 2nd half	Mean
Under 20	3227	2467	2132	2087	2607	2211	3093	2010	2479
20-24	3251	2752	3409	2699	3029	2845	4601	3130	3214
25-34	5451	4387	4945	4347	4627	4296	5873	4511	4804
35-64	5781	5393	5874	4807	5427	5427	8254	5861	5853
65 and older	6920	4436	5350	4361	5831	5039	6920	7746	5823

The performance of younger drivers during 1974 relative to all other drivers suggests the need for special remedial treatment of this group. Most of them, it appears, are beyond high school age; hence it may be too late to approach them through driver education courses. However, warning letters, driver improvement sessions, traffic court action, driver record reviews and examinations at license renewal time, and public information programs which cite the findings of this study regarding the fatality record of this age group druing 1974, could be effective in modifying their driving habits.

DAYLIGHT SAVINGS EFFECTS

An added feature of the energy crisis period was the implementation of nationwide Daylight Savings Time on February 23, 1974. In 1973 Daylight Savings Time did not go into effect in Michigan until April 26, and was not in effect at the beginning of 1974. Thus there were comparable periods of about 2 months (February 23 to April 26 in 1973 and 1974) when Michigan was on different times. There had been much controversy regarding the effect of Daylight Savings on accidents, particularly those involving school age pedestrians. Late in 1974 NHTSA compiled national pedestrian fatality statistics and concluded that there had been no significant change in the rate of pedestrian fatalities during daylight savings periods.

It could be expected that accident statistics might show an increase in dawn accidents as compared with dusk accidents--because of increased travel during morning hours of darkness during 1974 winter and spring mornings. Tables 16 and 17 were derived from a file of Michigan fatal accidents and a 5% sample of all Michigan accidents, comparing the periods of 1973 and 1974.

TABLE 16. Fatal Accident Distribution 23 Feb. - 25 Apr. 1973 (EST) and 23 Feb. - 25 Apr. 1974 (DST)

	FATAL ACCIDENTS					
	Motor Vehicle		Pedestrian		Bicycle	
Time	'73	'74	'73	'74	'73	'74
Daylight	117	82	23	9	3	1
Dawn	8	9	3	3	0	0
Dusk	43	32	11	4	2	0
Darkness	130	75	17	17	3	1

TABLE 17. Distribution of 5% Sample of All Accidents, 23 Feb-25 Apr. 1973(EST) and 23 Feb.-25 Apr., 1974 (DST)

ALL ACCIDENTS

	Motor Vehicle		Pedestrian		Bicycle	
Time	'73	'74	'73	'74	'73	'74
Daylight	1847	1434	36	30	25	11
Dawn	97	82	0	1	1	1
Dusk	389	274	10	5	2	0
Darkness	499	401	6	7	0	0

In both the fatal and sample sets of data there is a slight increase in the proportion of dawn (vs.dusk) accidents, which is consistent with the daylight savings argument. However, in the second year there is a substantial reduction in all accidents (and in fatal accidents), most of which is associated with speed and volume reduction, so that it does not seem possible to isolate the total effect of Daylight Savings Time. That is, within the limits of the data, it seems an equally good explanation that the reductions were due to changes in the traffic pattern resulting from other than the daylight savings factor.

Again much that is left unanswered probably could have been resolved had an adequate random sample driver exposure survey been in existence.

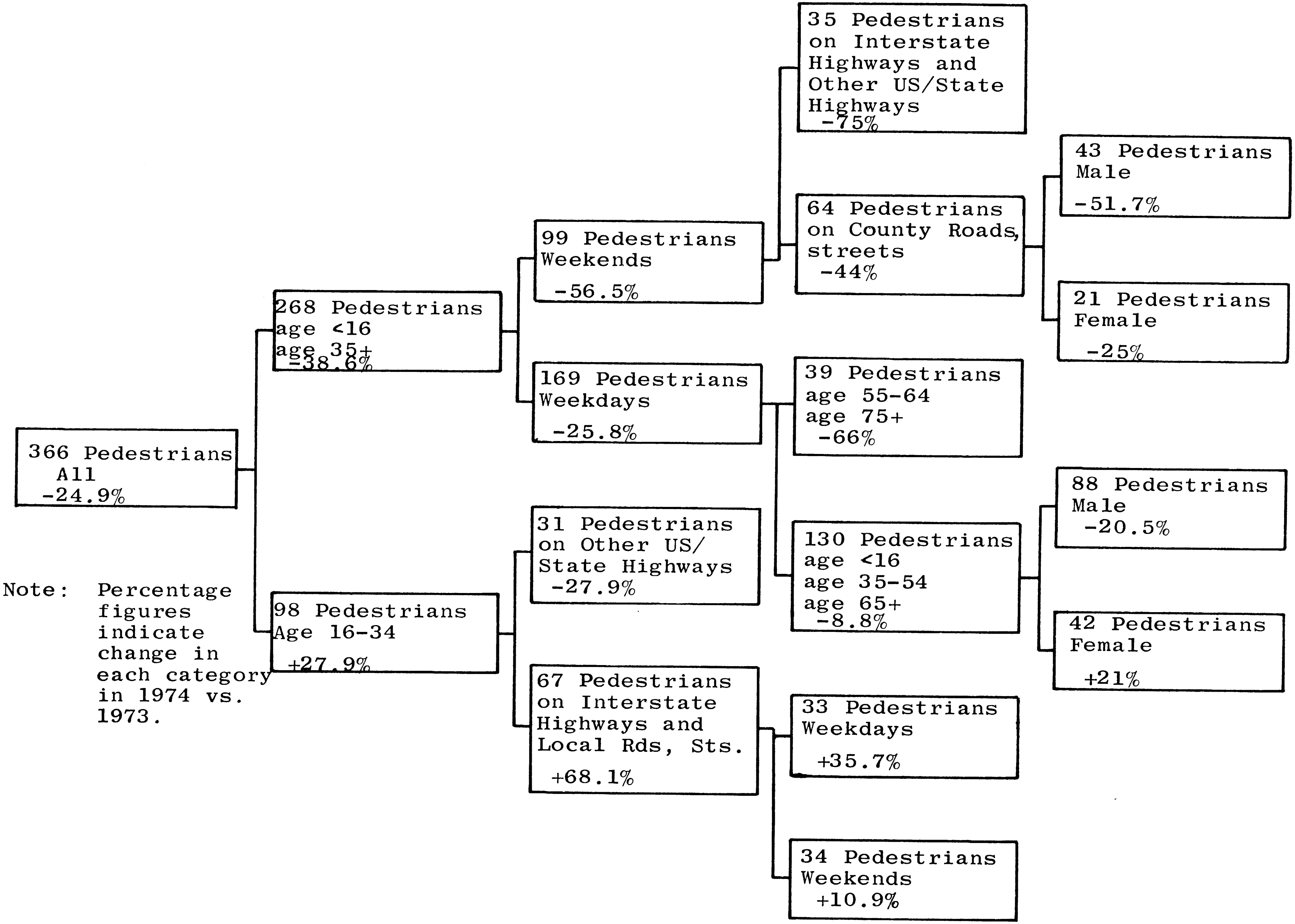
PEDESTRIAN FATALITIES

Pedestrian fatalities were compared over two six-month periods in a manner similar to the other fatal accident analysis. One comparison was made between the first halves of the years 1973 and 1974, and another comparison was made between the two halves of 1974.

According to the AID analysis (Figure 6), the most different thing about pedestrian fatal accidents in the first half of the two years was in the age of the pedestrian--a reduction of 38.6% among pedestrians under age 16 and over age 34, and an increase of 27.9 among those between age 16 - 34. The upper branch of the diagram indicates the reduction was greatest on weekends, and particularly in rural areas (on Interstate, Other US and State trunklines) where a 75% reduction occurred. Among those age 16-34 (all in lower branch) there was an increase during the 1974 period on both Interstate Highways and County Roads and Streets (mostly in the latter category).

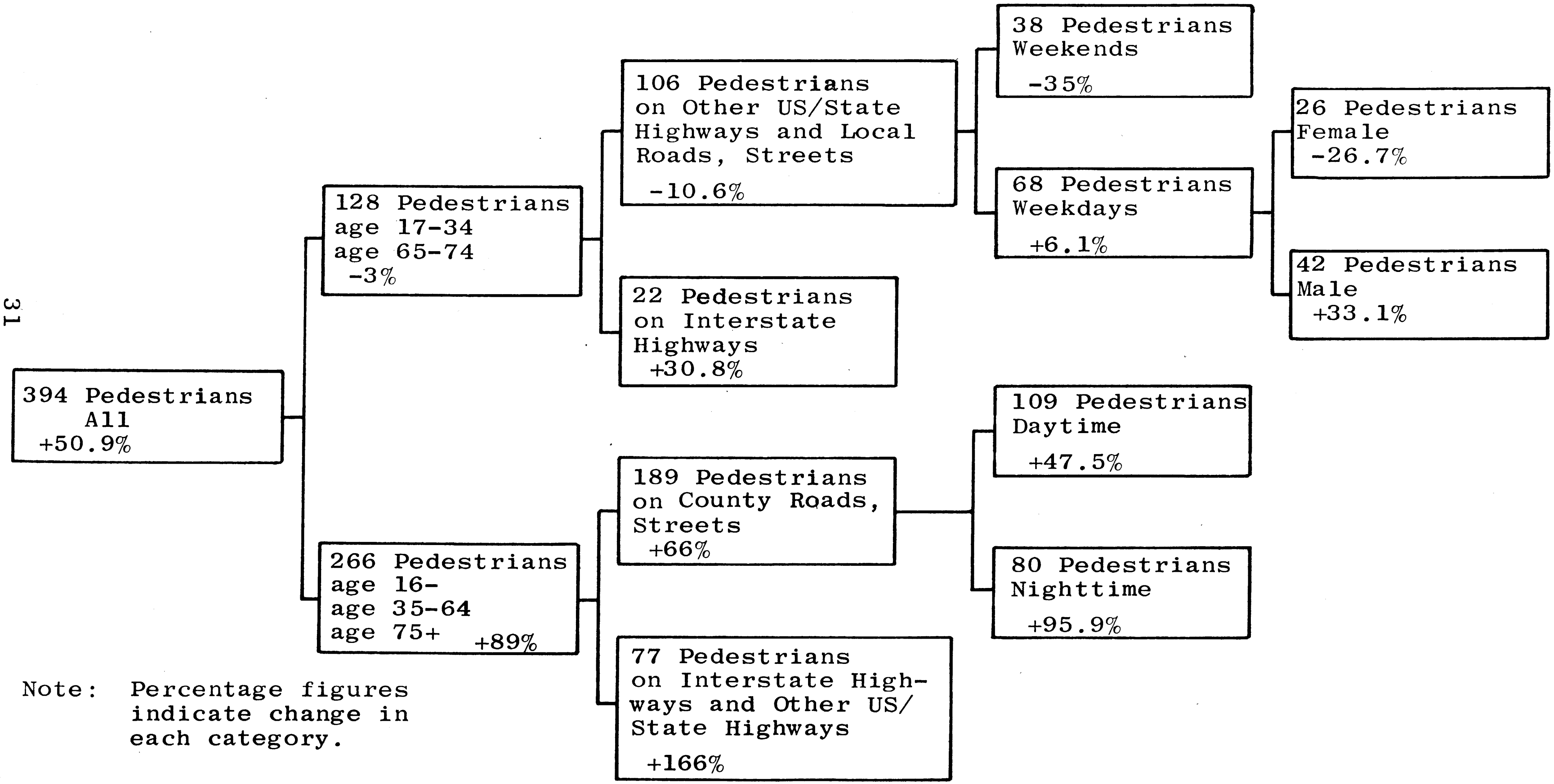
In comparing the second half of 1974 with the first half, we see that the pattern is essentially inverted (Figure 7). There is an increase in the rate for both young and old, but a slight decrease for age group 16-34.

Pedestrian fatalities, like all other fatal accidents, historically are more frequent in the second six months of each year. One-way distributions for each of the comparisons shown in the AID diagrams are listed in Table 18, which also includes similar data for a reference period of 1971-72.



Note: Percentage figures indicate change in each category in 1974 vs. 1973.

Figure 6: AID Diagram Analysis: Pedestrian Fatalities, Jan.-June '74 vs. Jan.-June '73



Note: Percentage figures indicate change in each category.

Figure 7: AID Diagram Analysis: Pedestrian Fatalities, July - Dec. '74 vs. Jan.-June '74

Table 18. Comparison of Pedestrian Fatalities

VARIABLE	Jan. - Jun 1974 vs. 1973 N	Jan. - Jun 1974 vs. 1973 % Change	Jul.-Dec 1974 vs. Jan.-Jun.1974 N	Jul.-Dec 1974 vs. Jan.-Jun.1974 % Change	Jul.-Dec. 71 and 72 vs. Jan.-Jun. 71 and 72 N	Jul.-Dec. 71 and 72 vs. Jan.-Jun. 71 and 72 % Change
Weekend	148	-37.4	145	+49	411	+33.6
Weekday	218	-15.3	249	+54.4	552	+15.5
Interstate	24	0	34	+83.4	48	+66.7
US/State	104	-42.5	103	+71.1	312	+26.2
Local	238	-18.3	257	+40.2	603	+18.3
Daytime	157	-25.6	172	+56.7	408	- 4.7
Nighttime	209	-24.4	222	+46.7	555	+48.8
<15	132	-32.9	146	+75.5	376	+17.4
16	5	+50	10	+133.3	31	+81.7
17	12	0	13	+16.5	26	+89.0
18-19	17	+42.8	18	-20	46	+55.8
20-24	36	+40	39	-14.3	51	+32
25-34	28	+16	30	0	55	-22.7
35-44	16	-32.9	20	+133.3	44	+240
45-54	30	-40	30	+72.7	88	+31.5
55-64	22	-30.8	23	+55.6	76	+23.7
65-74	29	-18.7	28	+15.4	81	-15.8
75+	34	-58	36	+160	81	+ 7.9
Male	259	-28.5	278	+57.4	679	+26.2
Female	107	-15.5	116	+36.7	284	+15.1
Drinking	62	+21.4	81	+38.2	131	-23.0
Not Drinking	304	-32	313	+54.5	832	+32.6
Overall	366	-24.9	394	+50.9	963	+22.7

EFFECTS OF THE 55 MPH SPEED LIMIT

"Speed Kills" is an old safety slogan. Another one is "Slow Down and Live"--which is what Michigan drivers did in 1974, as both the data and the analyses herein so plainly indicate. All drivers slowed down, some more than others, particularly on certain highways. Also many drivers drove less--some hardly at all. The result—279 lives were saved during the first half of 1974.

What made drivers slow down and drive less during 1974?

Obviously during the first half of 1974 it was lack of gas. They could not get gas, or, if they could, they conserved it by driving less and by driving slowly. It did not require a speed law to make them slow down--just economics. And the slow-down began much sooner than the new speed limit went into effect in March 1974. In fact, it had begun in late 1973.

Generally speaking, then, it is unlikely that for the first half of 1974 the 55 mph speed limit, per se, had significant effect on driving habits or the accident rate. At least for this time period there is no discernible evidence of the speed law's effect in the available Michigan data.

However, for the second half of 1974 the situation is different. The data have shown that, as fuel again became easily available, traffic volumes and traffic patterns generally returned to 1973 levels. Also along with the rise in these levels (increased exposure), fatal accidents and fatal involvements rose too--not to 1973 levels, however. Nor did driving speeds return to anywhere near 1973 levels. This is clearly indicated back in Table 13 which shows the changes in both fatal involvements and speeds for the latter half of 1974 vs. 1973. Speeds still were down and so were fatal involvements.

That drivers had recovered from the energy crisis shock and were "straining at the leash" is evident, however. The Michigan Dept. of Highways Quarterly Speed Report for October

1974 indicates that the passenger car overall rural speed was 56.5 mph,compared to the 1974 low of 55.3 mph attained in April.

Obviously that overall average of 56.5 mph is in violation of the 55 mph speed limit. However,all speed law enforcement in Michigan is compromised by historic precedent whereby 5-10 mph above the legal limit generally was ignored in the past, especially on Interstates and limited-access highways. Some other states are much more ruthless in enforcing legal speed limits. Nevertheless, Michigan speeds for the latter part of 1974 were down relatively and undoubtedly due to more enforcement.

Figure 8, a plot of several categories of speeding violations according to driver age, reveals that drivers of all ages tend to comply with any speed law according to a fixed pattern. Older, more conservative drivers usually are under-represented in speed violations in proportion to their population, whereas younger drivers are heavily over-represented in proportion to their population. As the "Energy Speed"[1] violation curve indicates,drivers obeyed the 55 mph speed limit about the same way they obeyed the other speed laws.

During 1974 the 55 mph speed limit was enforced largely on Interstate highways--which explains the abnormal rise in the curve among the age 36-55 group. These are mostly business men, travelling salesmen, truck drivers, etc. Where were they stopped? On the Interstate as usual--in the same proportion; now, however, for a different speed violation.

On the other hand the 16-20 year olds, as the curves show, were still disregarding all speed limits, but in proportion to all their violations were receiving less "Energy Speed" tickets. They were speeding elsewhere--on roads where, as the data and analyses previously indicated, speed does kill. This is the age group, it will be recalled, that showed the worst second-half-year record in the past four years.

The data indicate, then, that the 55 mph Speed Limit is effective in reducing fatal accidents and fatal involvements to the extent that it is enforced.

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[1]Violation of Michigan's "Energy Speed" law incurs a mandatory fine but no point assessment on the driving record for driving above 55 mph but below the original higher legal speed limit.

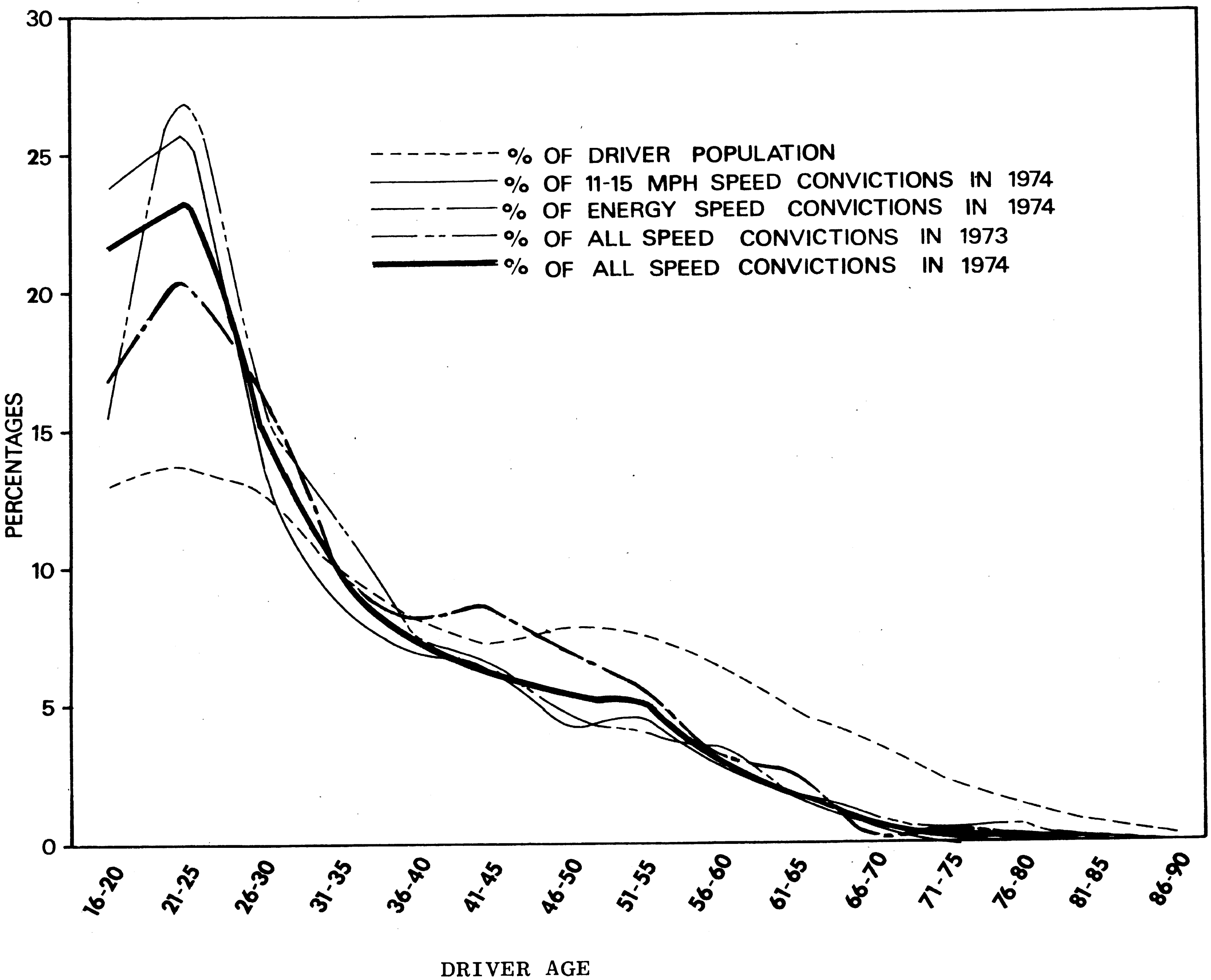


Figure 5: Speeding Convictions vs. Driver Age

SUMMARY

From data furnished by Michigan Departments of State, State Police,and Highways and Transportation, supplemented by an HSRI Driver Exposure Survey, an Automatic Interaction Detector (AID) computer Analysis Program was conducted in order to identify those factors which best explained how the Michigan 1974 Traffic Accident record differed from prior years.

The analysis revealed that during the first half of 1973 Michigan experienced the smallest number of fatal vehicle accidents in many years. In comparing the early months of 1974 with a similar period of 1973,total travel (as estimated from traffic recorder data) declined about 7%, all accident involvements declined 15%, and fatal accidents declined 29%.

Vehicle speeds within the state were down on all categories of roads, most (10 mph) on limited access routes, less (5 mph) on other U.S. and state trunklines, and least (about 3 mph) on county roads. The concurrent differential between total accident reduction and fatal accident reduction suggests that these speed reductions resulted in reduced severity of most crashes. This observation is reinforced by analysis of Texas TAD scale crash data,which unfortunately Michigan does not collect.

The AID analyses diagrams described in this report reveal that the most significant changes in accident pattern were related to driver age and to highway type. Drivers age 20-24 and 35-64 exhibited a reduction of 42.8% in fatal vehicle involvement; by contrast, drivers under 20, 25-34,and older than 64 showed only 12.7% reduction. The major reduction occurred on Other U.S. and State Trunklines, where the decline was 45.9%, whereas the combined reduction on Interstate Highways and County Roads and Local Streets was 21.2%. The two driver groups which experienced the most reduction in accidents also are associated

with fewer drinking drivers, a larger proportion of female drivers, and a large difference in reduction in fatal accidents versus reduction in all accidents. On the other hand, the driver age groups which experienced the least reduction in accidents are not associated with these factors.

In addition to the greater presence of female drivers (who apparently had different trip purposes than the males they replaced, drove at different times of the day, and drove more slowly), there also was less nighttime driving (as shown both by traffic recorder data and the large reduction in all nighttime accidents), and less overall driving--(again shown by traffic recorder data, as well as a HSRI statewide driver exposure survey).

On the highways where accident reduction was greatest there was less speed reduction than on those of Interstate quality, but as analysis indicated,even a small reduction on two-lane, non-limited-access roads made travel on them much safer, suggesting that even lower speeds on such roads or continuing improvements toward AASHTO standards would result in even lower fatality rates.

On all types of roads, multiple-vehicle accidents declined more than single-vehicle accidents. A reasonable explanation for this occurrence lies in the observed narrower distribution of speeds and the consequent reduction of driver conflicts.

Several changes are rather directly associated with the energy shortage. During the peak of the energy crisis, Sunday (and weekend) accidents declined more than weekday accidents. Friday accidents actually increased relative to the previous year, apparently as the result of more local area recreation trips in lieu of weekend vacations, or more shopping trips in anticipation of Saturday night and Sunday gas station closings.

During the second half of 1974 as gasoline became readily available traffic volume and traffic patterns approached previous levels. Also fatal accidents rose, as did accident involvement of all drivers under age 65. Passenger car, nighttime, and weekend accidents increased. Accidents on Interstate Highways and Other U.S. and State Highways increased, and on County Roads and Local Streets returned to a four-year average. However, as analysis revealed, the second half of any given year historically has a greater proportion of accidents and fatalities of all types compared to the first half (about +20%). After the unusual low in the first half, the overall increase of about +30% in the second half appears "normal" for 1974. Nevertheless, in nearly all categories the second half of 1974, highway safety-wise, was the best second half in four years. Compared to the second half of 1973, fatal involvements were down about 7% and overall speeds were down 5 mph.

The glaring exception during the 1974 second half was the record of driver age group 17-19, which in fatal involvements and all accidents was their worst second-half year record in four years. The record suggests the need for remedial action in regard to this group, i.e., warning letters, driver improvement courses, special examining at license renewal, counselling, etc.

A separate analysis of pedestrian fatalities indicates they declined roughly in proportion to other fatal accidents during the first half of 1974. The principal reduction was among pedestrians under age 16 (the largest group) and those over age 34. Pedestrian fatalities among ages 16-34 actually increased in the first half. The largest percentage reduction in pedestrian accidents occurred on Other U.S. and State Trunklines (down 42.5%), as compared with an 18.5% reduction on County Roads and Local Streets and no change on Interstates. During the second half, pedestrian fatalities increased by 50% over the first half of the year, especially where there had been reductions before (among those under age 16 and on Other U.S. and State Trunklines).

Another factor considered was the early shift to Daylight Savings on February 23, 1974. A comparison of accident data during the parallel periods of February 23 - April 25, 1973 and 1974, supports the hypothesis of a small increase in the relative frequency of dawn (vs. dusk) accidents, but the general reduction in all accidents, including dawn and dusk accidents, in 1974 swamped this analysis, making it difficult to draw any firm conclusions. In determining the effects of Daylight Savings, the existence of a driver exposure survey would have been of inestimable value.

It appears that the slowdown in driving and consequent reduction in fatal accidents during the first half of 1974 was due mainly to lack of gasoline or conservation of gasoline when obtainable rather than the 55 mph speed limit. During the second half, however, when gasoline again became plentiful and traffic volumes and traffic patterns returned to 1973 levels, speeds and fatal accidents still were down relatively, indicating that the 55 mph speed limit was effective where it was enforced. An analysis of speed violations indicates that drivers tend to obey all speed laws (including the 55 mph speed limit) according to a consistent pattern by age group. Proportionally, the greatest violations of the 55 mph law (and all speed laws) were drivers age 17-19 (those with the worst half-year record in 1974), and apparently mostly on other than Interstate highways, which suggests that selective enforcement might be applied to these other highways with this age group in mind.

Analysis indicated that a 10 mph reduction in speeds on Interstate highways resulted in a 20% reduction in fatalities, whereas a 5 mph reduction in speed in other U.S. and State Trunklines resulted in a 41% reduction in fatalities. These findings suggest the feasibility of a trade-off in selective enforcement (especially if police budgets are reduced) whereby speeds on Interstates are allowed to rise somewhat (they still averaged about 61 mph in October) and the 55 mph speed limit (or even a lower limit) is vigorously enforced on Other U.S. and State Trunklines. It appears that the slight increase in fatalities that might occur on Interstates would be more than offset by larger reductions in fatalities on Other U.S. and State Trunklines.

Histograms of fatal accident involvements by age group on the three highway systems over the past four years (Figures 9, 10, and 11) succinctly summarize what happened during each half of the year 1974.

Figure 9

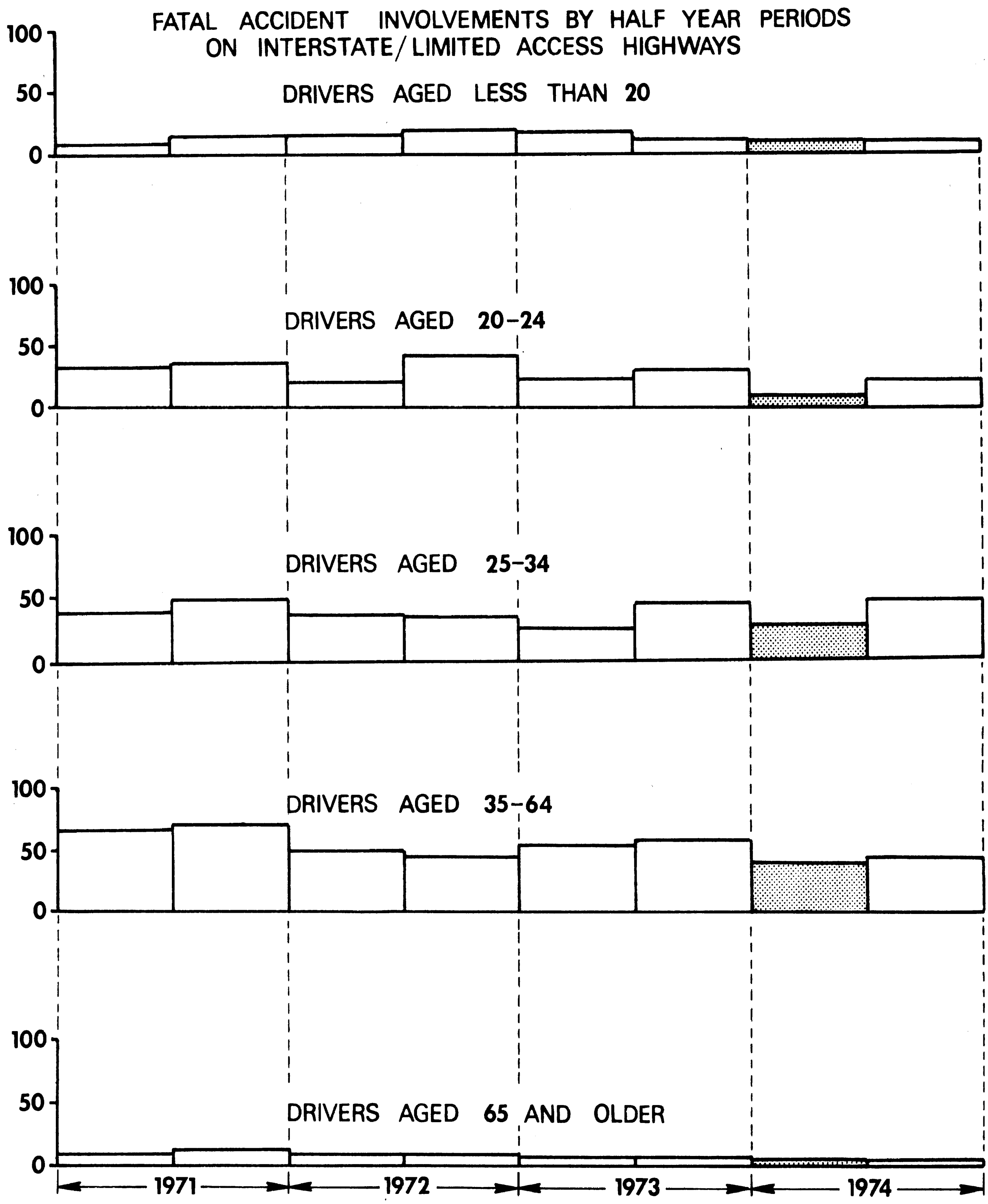
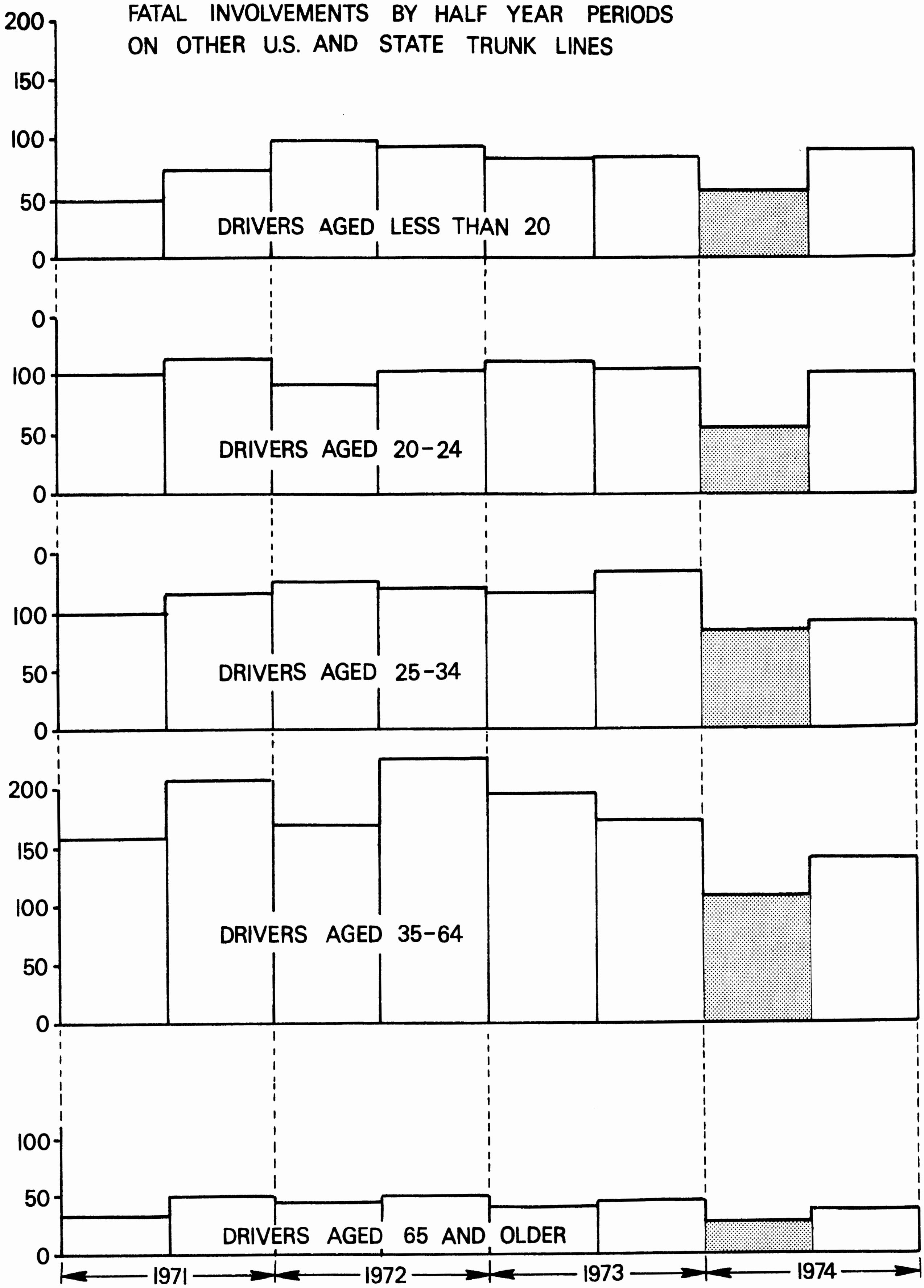

FATAL ACCIDENT INVOLVEMENTS BY HALF YEAR PERIODS
ON INTERSTATE/LIMITED ACCESS HIGHWAYS
DRIVERS AGED LESS THAN 20
DRIVERS AGED 20-24
DRIVERS AGED 25-34
DRIVERS AGED 35-64
DRIVERS AGED 65 AND OLDER
100
50
0
1971
1972
1973
1974

Figure 10


FATAL INVOLVEMENTS BY HALF YEAR PERIODS
ON OTHER U.S. AND STATE TRUNK LINES
200
150
100
50
0
DRIVERS AGED LESS THAN 20
0
100
50
0
DRIVERS AGED 20-24
0
100
50
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DRIVERS AGED 25-34
200
150
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DRIVERS AGED 35-64
100
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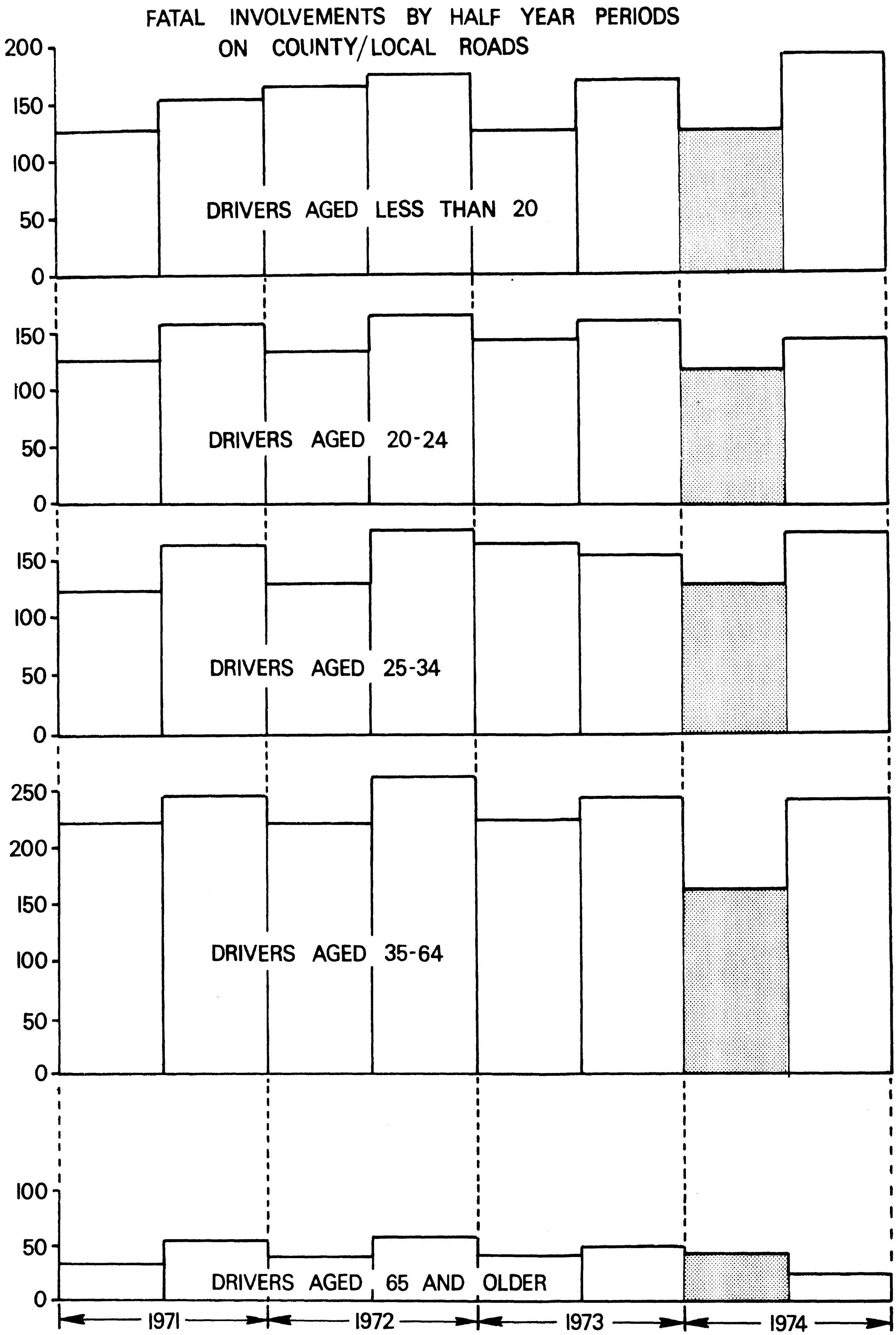
DRIVERS AGED 65 AND OLDER
1971
1972
1973
1974

Figure 11


FATAL INVOLVEMENTS BY HALF YEAR PERIODS
ON COUNTY/LOCAL ROADS
200
150
100
50
0
DRIVERS AGED LESS THAN 20
DRIVERS AGED 20-24
DRIVERS AGED 25-34
250
DRIVERS AGED 35-64
DRIVERS AGED 65 AND OLDER
1971
1972
1973
1974

CONCLUSIONS

In Michigan the most significant feature of the energy crisis and the resulting 55 mph speed limit law was the response by drivers according to their age group and the resulting reduction in traffic fatalities for each age group.

Next in order of significance was the drop in fatalities on non-limited access U.S. and other State Highways.

The reduction in driver exposure (-7%) due to the energy crisis does not alone account for 29% reduction in fatal vehicle involvements—which resulted in 279 lives being saved—during the first half of 1974.

The 1974 reduction in speeds on all categories of roads (-10 mph on Interstates, -5 mph on Other U.S. and State Trunklines, -3 mph on County and Local Roads) reduced crash severity, which in turn resulted in less traffic fatalities.

The continuation of reduced speeds and reduced fatalities during the second half of 1974, despite a return to normal traffic volumes and patterns, shows that the 55 mph speed limit is effective in reducing fatalities when enforced.

The large reduction in fatal involvements (-41%) on non-interstate quality highways, even with a relatively small decrease in average speeds (-5 mph), leads to the conclusion that speed limits even lower than 55 mph on these type roads, if strictly enforced, would pay off in even lower fatalities.

The relatively small reduction in fatal involvements (-20%) on Interstate-quality highways, even with a relatively large decrease in average speeds (- 10 mph) and with average apeeds still 60 mph, points out the possibility of a net gain in lives saved in allowing speeds to rise slightly on these type highways, while allocating available police resources to strict enforcement of the 55 mph speed limit on non-Interstate-quality highways.

The large reduction in fatal accident involvement, even with a relatively small decrease in average vehicle speeds, on non-Interstate quality roads leads to the conclusion that an acceleration of the long term program of upgrading all of Michigan's primary highway system toward Interstate standards would be of value.

The sudden jump of drivers aged 17-19 to a new high fatality rate (up almost 50% in the last half of 1974) together with their continuing disproportionate share of speeding violations during the energy crisis (See Figure 8) signals a need for improving driver behavior within this age group by such direct active measures as warning letters, driver improvement sessions, court admonitions, or special reviews and examinations at license renewal time.

Two types of traffic accident data, currently not officially gathered in Michigan, would have been of value in this study, and would be important in future analyses. These are (1) damage scale data, such as the TAD (Traffic Accident Data) severity scale used by Texas and North Carolina, (2) a continuing driver exposure survey to provide information about driving patterns within the state for comparison with accident data. The UD-10 police accident report form could be modified to provide space for entering "Damage scale rating number." Although the Highway Department permanent traffic recorders do supply much exposure information through vehicle counts and peak times, additional information on driver exposure characteristics (e.g., age, sex, type of vehicle driven, average yearly and daily mileage, etc.) would help to explain those variations in the accident data which remain uncertain in the present analysis and would help determine the effects of new safety programs in another energy crisis. Such a survey could be done randomly by personal interview at the time of license renewal or by mail on a periodic schedule.

RECOMMENDATIONS

1. In order to attain lower fatality rates, concentrate enforcement of the 55 mph speed limit (or lower limits where warranted) on those U.S. and State routes of non-Interstate quality, even at the expense of a slight rise in speeds on the Interstate Highways.

2. Accelerate Michigan's long-range highway construction program for upgrading all primary and secondary road systems to AASHTO standards.

3. In order to reduce their disproportionately high fatality rate, take positive measures (warning letters, driver improvement courses, court admonitions, special reviews and examinations at license renewal time), based on pertinent findings of this report, to develop more responsible driver attitudes among drivers in age group 17-19.

4. Modify the Michigan UD-10 police accident report form to include provision for entering vehicle damage scale data.

5. Implement a Michigan Driver Exposure Survey in order to have a solid basis for measuring the effects of safety rules and programs and changes in economic conditions on traffic patterns and driver performance.

Appendix I

Summaries of Other Studies Relative to the 55 MPH Speed Limit

A. "Impact Considerations of the 55 mph Speed Limit" Braddock, Dunn, and McDonald, Inc. Sept. 27, 1974.

This interim study first summarizes the governmental rationale and actions which led to the adoption of a national 55 mph speed limit and then examines the resulting impacts in the area of economics, safety, and social behavior. Because a complete and reliable data base was lacking,many findings and conclusions are tentative.

The study concludes that the original purpose of the 55 mph speed limit, energy conservation, was not achieved. The impact on the trucking industry was negligible. The busing industry was forced into revising schedules, but there were no serious distortions within the industry even though ridership was up. The rail system experienced no significant up trend in either freight or passenger service. However, there was one significant by-product, a 30% to 50% reduction in traffic fatalities and accident severity relative to 1973, substantiated in part by insurance data, which seems to have been due to the reduced speed.

B. "Accident Changes Under Energy Crisis," California Highway Patrol, July 1974.

This study attempts to explain quantitatively the unprecedented traffic accident declines experienced during the first three months of 1974 in California. In order to reach meaningful conclusions it was found necessary to utilize a number of assumptions, some of which are dependent upon relationships which have not been explored completely and therefore are not universally accepted. The study, which was updated through June of 1974, concluded that the decrease in fatal accidents could be attributed to the following factors: Reduced traffic volume (31.1%), 55 mph speed limit (25.6%), speed distribution (9.1%), permanent daylight savings time (1.1%). A remaining 32.5% reduction could not be explained. By the end of the second quarter it was observed that the impact of the four identified factors was wearing off.

C. "Traffic Fatalities and the Energy Crisis," J.F. Carpenter, GM Environmental Activities Staff, Nov. 20, 1974.

This study made a time series analysis of traffic accident fatality trends, comparing the first three months of 1974 with the prior three year periods and concluded that the drop in early 1974 was not due to random variation nor in consonance with the historic trend.

Based on actual data and assumptions it was concluded that each of the following factors, if acting independently, produced the indicated reductions in fatalities.

Reduced traffic volume	-6.2%
Shift from night to day travel	-6.0%
Historic trend drop	-3.6%
Shift from weekend to weekday travel	-1.3%
Shift from rural to urban travel	-0.2%
Shift to motorcycle and pedacycle travel	+1.2%
Total	-16.1%

However it was estimated that the above factors when acting simultaneously produced a net -15.6% drop.

The actual reduction was -24.4%.

Therefore it was concluded that reduced speeds in early 1974 produced (24.4 - 15.6) or -8.8% reduction in fatalities.

Separate analysis led to the conclusion that most of this reduction in fatalities (-7.3%) occurred in rural areas. It also was noted that states which most vigorously enforced the 55 mph limit also had the most severe gas shortages, and, hence, also had the most reduced travel and most conservation minded drivers.

D. "Effects of the 55 MPH Speed Limit," American Association of State Highway and Transportation Officials, Nov. 1974.

This study, conducted by an AASHTO ad hoc committee, utilized data on speeds, accidents, and vehicle miles of travel collected from 48 states and the District of Columbia, as well as a variety of other information and research findings, in order to determine the effects of the national 55 mph speed limit and to recommend an AASHTO position on future speed limits.

The study noted that for over 80 years, as car design and road design has improved, there has been a continuous increase in driving speeds except during the WW II period of fuel and tire shortages. As people drove faster, speed limits were set at the 85^{th} percentile, that speed limit which most drivers considered reasonable and safe, and which in practice was found to be enforceable. During the same years, despite the increase in speeds, there has been a small but steady drop in U.S. motor vehicle fatalities per 100 million vehicle miles driven as the vehicle population and vehicle miles driven have increased.

From January 1 to June 30, 1974, both as a result of governmental urging to save fuel and the national 55 mph speed limit, the driving public generally reduced speeds by about 10 mph. Observed reductions were about eight to ten mph on rural freeways, five to seven mph on conventional rural roads, and five to seven mph on urban freeways. Even though many drivers exceeded the 55 mph limit, more drivers than previously drove closer to the average speed, resulting in speeds being more uniform on any highway.

During the same period there was a 23% drop nationwide in traffic fatalities as compared to the same period in 1973. This drop was far in excess of what could be expected from the historic trend. Most of the drop was on rural roads,where historically speed has been associated with high fatality rates,as compared to urban areas,where congestion at slower speeds has been associated with high accident rates.

Also during the same six-month period vehicle miles driven were off 5% as compared to the year before, whereas under normal conditions they should have been up 5%. This drop in vehicle miles driven, caused by fuel shortages, Sunday gas station closings, and fuel price increases is credited with 5% of that 23% drop in traffic fatalities as compared to the same period in the year before.

Other factors which appear to have contributed to the reduction in fatalities were more conservative driver attitudes, daylight savings time (minimal), a small shift from nighttime to daytime driving, a shift from weekend to weekday driving, more use of seat belts in newer model cars, better car design, traffic safety programs, and traffic law enforcement. By mid year,as fuel became more available, however, vehicle miles driven increased, tending to negate the drop in fatalities.

However, the major conclusion of the study is that over half the reduction in fatalities was due to reduced speeds and more uniform speeds and that the general public now is driving at speeds which are acceptable and highly desirable from a safety standpoint.

The study also concludes without documentation that reduced speeds saved approximately 3% or 3 billion gallons of fuel annually.

The study recommends that the authority and responsibility for setting speed limits be returned to the states with the strong recommendation that the state maximum speed limit be 55 mph except when engineering and traffic studies plus strong and compelling reasons indicate those situations where it should be higher.

Appendix II
Development of Traffic Volume Data

A most complex question raised by the study was whether traffic volume and traffic patterns had changed significantly during the two year period. Had such factors as fuel shortages, gas station closings, escalating fuel prices, the lower speed limit, and new driver attitudes caused drivers to take shorter, more direct routes, join car pools, eliminate vacation trips to northern recreation areas, cut down on shopping trips and Sunday drives, stay close to home, or just not drive at all? Was there an answer in the available Michigan data?

Analysis of the state highway network and traffic volume data furnished by the Michigan Department of State Highways and the City of Detroit indicated the possibility of obtaining some answers.

This analysis also pointed out the feasibility of confining the study to lower Michigan south of an East-West line running just below Grand Haven, Alma, and Bay City. This area contains the broadest cross-section of Michigan's economic and sociological stratas, industry, agriculture, transportation systems, and urban and rural environments. Also the non-measurable changes in 1974 northern traffic patterns caused by the completion of the I-75 section between West Branch and US-27 could be disregarded.

After a detailed review of data collected by the Highway Department's permanent traffic recorders and their locations it was decided to select for study a judgment sample of 12 stations that had existed in the same place during all of 1973 and 1974 and where there had been no significant changes in the surrounding highway environment. Within this grouping it also was found possible to select four station locations in each of the following highway categories: Interstate or limited-access highways, other US and Michigan state highways, and county roads.

The twelve locations chosen were:

Station #	Route Designation	Type Roadway	Locality
5029	US-27	US;limited access*	St. John
5229	I-96	IS;limited access	Grand Rapids
6129	I-75	IS;limited access	Birch Run
7169	I-94	IS;limited access	Jackson
5169	M-57	State highway	Perrinton
6049	US-25	Other US highway	Port Sanilac
6089	M-21	State highway	Capac
8129	US-12	Other US highway	Jonesville
5109	Washington Road	County Road	Ithaca
5189	Jordan Lake Road	County Road	Lake Odessa
7129	Niles-Buchanan Road	County Road	Buchanan
8049	Old US-23	County Road	Brighton

*This small section of US-27, while not classified as limited access by the Dept. of Highways, connects the two major sections of N-S US-27, both of which are limited access; for the purposes of this study US-27 was considered limited access in its entirety.

For each of the above stations the Michigan Department of State Highways furnished the magnetic tapes which contained the actual vehicle counts by day of month, day of week, and hour of day for the period January 1, 1973 through December 31, 1974. This data was translated into a HSRI computer program after augmentation of the hourly times with illumination levels in terms of daylight or darkness. The hours of daylight and darkness were determined from the Nautical Almanac by hourly review of the two-year period for 42° N. Latitude and 85° W. Longitude, the mean geographic center of the study area. Corrections were made for those days during each year when Daylight Savings Time was in effect.

The traffic volume data now could be correlated with traffic accident and driver exposure data in other computer programs.

Appendix III

Adjusted traffic counts for estimating volume change in Michigan 1973/74

Table A shows traffic count data summed over four stations for each road type. In order to estimate the total volume change on Michigan highways over several periods these data were weighted by factors of 1 (for interstate), 3 (for other U.S. and state trunklines), and 10 (for County Roads and Local Streets). Weighting factors were best estimates of the author.

Table B displays the weighted counts and presents the percentage change in traffic estimated from this. For the January-June 1974 period, the total traffic is estimated as being down 7% relative to the same period of 1973. For the July to December 1974 period, it is down about 3% with respect to 1973. And for the whole year 1974, it is down 4.9% relative to 1973.

These estimates are fairly consistent with national estimates as given in the AASHTO report.

Table A: Unweighted Traffic Counts, 12 Stations

	1973 1st Half	1973 2nd Half	1974 1st Half	1974 2nd Half
Interstate/Limited Access	33820	40202	30303	37428
Other US/State Trunklines	6561	7615	6062	7533
County Roads/ Local Streets	5500	5809	5434	5751

Table B: Weighted Traffic Count

	1973 1st Half	1973 2nd Half	1974 1st Half	1974 2nd Half
Interstate/Limited Access	33820	40202	30303	37428
Other US/State Trunklines	19683	17427	16302	17253
County Roads/ Local Streets	55000	58090	54340	57510
Total (WTD)	108503	115719	100945	112191

Estimated Total Change in Travel as Derived from above:

1st half of 1974 vs. 1st half of 1973	-7%
2nd half of 1974 vs. 2nd half of 1973	-3%
All of 1974 vs. all of 1973	-4.9%