Crash Related Fire Occurrence in Selected Vehicle Subfleets

An Investigation Conducted for
the FHWA/NHTSA Crash Analysis Center
at George Washington University, Virginia

July 7, 1994
DeBlois Associates
Washington, D.C.

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Introduction

This investigation addresses and evaluates the incidence of crash related fires in selected subfleets of cars and sport utility vehicles, model years post-84, in highway crashes from the mid 1980's to the early 1990's.

The incidence of crash related fires is addressed by an evaluation of fire occurrence rates, both proportional and absolute rates, in comparative analyses of the selected classes of vehicles.

The investigation is based on the crash experience of the cited vehicles on U.S. roads, in the 1980's and early 1990's. Both crashes of all outcome severities, and fatal accidents are addressed.

Issues

The following issues are addressed and evaluated:

1. Fire and fuel leak occurrence rates for the selected vehicle populations in the perspective of fire occurrence in all cars or all vehicles on the road.
2. Whether or not fire or fuel leak rate differences are evident among the individual classes of cars and sport utility vehicles under consideration.
3. If differences exist, are they statistically significant?
4. Whether or not a ranking pattern of cited differences is evident in the accident experience.
5. Does the existence, or non existence, of a ranking pattern hold all across the board irrespective of impact mode (front, side, rear, rollover) or of accident outcome severity (all police reported accidents or fatal accidents)?
6. Are there any extra-vehicular factors, with strong influence on fuel leak, or fire rates, confounding the comparative evaluations and ranking patterns of this investigation?

This draft of the investigation addresses and evaluates primarily issues #1 to #5. Issue #6 will be addressed in a subsequent draft.

Vehicle Subfleets under Evaluation

A total of seven subfleets of vehicles, all of model years post-84 are stipulated in this investigation, as follows:

A. All Ford Made Cars
B. All GM Made Cars
C. All Cars Other than Ford or GM
D. Ford Sport Utility Vehicles: Bronco II and Explorer
E. GM Sport Utility Vehicles: S10 Blazer and S1500 Jimmy
F. Other Sport Utility Vehicles, such as: Toyota 4Runner; Nissan Pathfinder; Isuzu Trooper, Trooper II, and Rodeo; and Mitsubishi Montero; and
G. Jeep Cherokee and Grand Cherokee.

Two additional subfleets have been stipulated for evaluation: the GM sport utility vehicles, according to fuel system, i.e. Carburator or Fuel Injection.

Sources of Data

Three primary data sources, of national coverage, are used in the investigation: the FARS, the R.L.Polk Database, and the NASS/GES. In addition the Michigan State accident records are used. A brief description follows.

(a) The FARS (Fatal Accident Reporting System) is the national census of the fatal accident experience on U.S. roads, as compiled annually since 1975 by the National Highway Traffic Safety Administration, (FARS 1975-1993).

(b) The R.L.Polk database is the National Vehicle Population Profile, i.e. the counts of vehicle registrations, as issued annually since 1975 by R.L.Polk, as a function of make, model, and model year.

(c) The NASS/GES is a nationally representative sample of all police reported accidents in the U.S., compiled annually by the NHTSA as the National Accident Sampling System for general estimate purposes (NASS/GES 1988-1992); and

(d) The Michigan State accident records, a census of all police reported accidents in the State of Michigan, 1986 to 1990. These records are virtually the only source of data concerning crash related fuel leaks, in conjunction with fire occurrence.

Descriptors of Fire or Fuel Leak Incidence in Crashes

Several descriptors may be formulated and are necessary for evaluating the incidence of fires or fuel leaks in highway crashes. Both proportional and absolute rates are formulated as follows:

A proportional rate, Rp, is defined as:

$$Rp = 100 * Ne / N \qquad (1)$$

where: Ne is the number of events at issue (e.g. fire occurrence or fuel leak, or both); and
N is the corresponding number of crash involed vehicles, irrespective of particular events

Relation (1) essentially measures:

Vehicles with Event Occurrence per 100 Crash Involved Vehicles, under Identical Vehicular Attributes, in Identical Accident Records.

Expressing proportional rates on a per 100 basis, as is done in (1), is a simple numerical convenience. Elsewhere in this investigation, rates may be expressed on a per 1,000 or on a per 10,000 basis.

An absolute rate, Ra, is defined as:

$$Ra = 1{,}000{,}000 * Ne / VY \qquad (2)$$

In this application a count of events, Ne, is used in conjunction with the corresponding count of vehicle years in service, VY.

Relation (2) essentially measures: Vehicles with Event Occurrence per 1,000,000 Vehicle-Years in Service, under Identical Vehicular Attributes, and Year Span.

Absolute rates are considered absolute in the sense that they focus on event occurrence per vehicle on the road and ignore crash involvement in general.

Estimation of Reported Standard Errors

All results in this investigation are reported with a standard error. A straightforward procedure is followed in the analysis of data originating from census files like the FARS data, the

Michigan State Data, or the FARS data in conjunction with the R.L.Polk data.

As discussed earlier, a commonly used descriptor of fire or fuel leak occurrence is the proportional rate, Rp, given by (1). Standard practice prescribes the statistical variability error for the proportional rate given by (1) as follows:

$$SEp = 100 * SQRT[P*Q/N] \quad (3)$$

where: SQRT is a square root; and

$$P = (Ne/N); \quad \text{and} \quad Q = (1 - P)$$

Beyond the proportional rate, Rp, discussed above, this investigation addresses an absolute rate, Ra, given by (2). A relation similar to (3):

$$SEa = [SQRT(Nr)/Nr] * Ra \quad (4)$$

is applicable for the standard error of the absolute rate, Ra, given by relation (2).

When dealing with analyses of data from the NASS, all standard errors are estimated with the help of statistical procedures prescribed in "Survey Data Analysis" (SUDAAN) software, Research Triangle Institute, Research Triangle Park, North Carolina, 1992. Such procedures are applicable in the analysis of data from multi-stage sample designs, like that of the NASS.

Results of the Evaluation

The findings of the comparative evaluation are summarized in Tables 1-a, 1-b and 2 to 6; and illustrated in Figures 1 to 9. Detailed results from the Michigan records are given in Tables A-1 to A-6 of the Appendix.

Statistical Significance of Observed Rate Differences

Given that certain differences exist in the results of the comparative evaluation above, the next issue to be addressed and evaluated is whether or not the observed differences are statistically significant. The framework for making these evaluations is discussed next.

When two fuel leak, or fire, or other casualty rates, each accompanied by its error, are compared, any observed rate

difference may or may not be statistically significant. The answer depends on how large the rate difference is, in comparison with an error compounded from the errors of the individual rates.

Specifically consider two rates: Ra and Rb, and their corresponding errors: Ea and Eb. For the purpose of the comparative rate evaluations of interest in this investigation, the rate difference (Ra - Rb) is considered statistically significant, with a 90% confidence, when the following criterion is satisfied:

$$|(Ra - Rb)| > 1.65 * SQRT[SQR(Ea) + SQR(Eb)] \quad (5)$$

where:

| |	denotes an absolute value;
SQRT	denotes a square root;
SQR	denotes a square power; and
1.65	is a multiplier dictated by the desired 90% confidence level

The treatment described above is standard practice. Variations may be considered, if for example the desired confidence level is 95% or 80%. In these variations the corresponding multiplier is: 1.96 or 1.28 respectively.

Table 1-a. Concerning All Impact Modes;
Rates of Occurrence of Shown Events
in Michigan Crashes, MY Post-84, CY 1986-1990

Cars	Leak No Fire		Fire No Leak		Leak and Fire	
	Rates (Shown Events per 1,000 Crashes) +/- Std. Error					
Ford	3.07	0.11	1.03	0.06	0.26	0.03
GM	2.62	0.08	1.19	0.05	0.32	0.03
All Other	3.21	0.11	1.14	0.06	0.26	0.03
Sport Util.						
Ford	4.06	0.27	0.98	0.13	0.30	0.07
GM	3.20	0.22	1.20	0.14	0.37	0.08
Jeep	4.64	0.91	0.89	0.40	0.71	0.36
All Other	3.36	0.65	0.87	0.33	0.25	0.18

Rates for Any Leak, or Fire, or Both

Cars	Rate	+/-
Ford	4.36	0.13
GM	4.13	0.10
All Other	4.61	0.13
Sport Util.		
Ford	5.33	0.30
GM	4.77	0.27
Jeep	6.24	1.05
All Other	4.48	0.74

Table 1-b. Concerning GM Sport Util. Fuel System;
Rates of Occurrence of Shown Events
in Michigan Crashes, CY 1986-1990

Fuel System	Rates (Shown Events per 1,000 Crashes) +/- Std. Error					
	Leak No Fire		Fire No Leak		Leak and Fire	
Carburator	2.95	0.37	1.32	0.24	0.55	0.16
Fuel Injct	3.32	0.30	1.12	0.18	0.33	0.10

Rates for Any Leak, or Fire, or Both

Fuel System	Rate	+/-
Carburator	4.82	0.47
Fuel Injct	4.77	0.36

Table 2. Nationally Representative Fire Occurrence Rates in the NASS/GES Records, 1988-1992

Cars	Car Fire Rate per 1,000 Crashes
Ford	1.36 +/- 0.21
GM	1.37 +/- 0.20
All Other	1.62 +/- 0.19

The NASS/GES samples of these subfleets with fire occurrence are:

Ford	54
GM	84
All Other	109

Table 3. Counts of Vehicles and Proportional Fire Rates in Fatal Accidents, by Impact Type; the FARS 1985-1993

Subfleet	Counts of Vehicles with Fire, by Impact Mode					
	All	Front	Side	Rear	Rollover	Other
Ford Cars	497	243	108	34	94	18
GM Cars	1005	522	182	74	190	37
Other Cars	946	471	172	68	199	36
Ford Util.	25	10	5	2	7	1
GM Utility	34	22	4	1	5	2
Other Util.	9	3	1	.	4	1
Jeep	8	5	1	1	1	.

Subfleet	Counts of All Vehicle Crashes, by Impact Mode					
	All	Front	Side	Rear	Rollover	Other
Ford Cars	23224	12624	5234	991	3753	622
GM Cars	42426	23604	9928	1816	5913	1165
Other Cars	41848	22138	9812	1936	6715	1247
Ford Util.	763	287	62	20	382	12
GM Utility	1049	566	119	38	299	27
Other Util.	410	213	59	19	107	12
Jeep	404	173	27	12	182	10

Subfleet	Fire Rate per 100 Crashes, by Impact Mode									
	All		Front		Side		Rear		Rollover	
Ford Cars	2.1	0.1	1.9	0.1	2.1	0.2	3.4	0.6	2.5	0.3
GM Cars	2.4	0.1	2.2	0.1	1.8	0.1	4.1	0.5	3.2	0.2
Other Cars	2.3	0.1	2.1	0.1	1.8	0.1	3.5	0.4	3.0	0.2
Ford Util.	3.3	0.6	3.5	1.1	8.1	3.5	10.0	6.7	1.8	0.7
GM Utility	3.2	0.5	3.9	0.8	3.4	1.7	2.6	2.6	1.7	0.7
Other Util.	2.2	0.7	1.4	0.8	1.7	1.7	.	.	3.7	1.8
Jeep	2.0	0.7	2.9	1.3	3.7	3.6	8.3	8.0	0.5	0.5

Table 4. When Fire is the Most Harmful Event; Counts of Vehicles and Proportional Fire Rates in Fatal Accidents, by Impact Type; the FARS 1985-1993

Subfleet	Counts of Vehicles with Fire, by Impact Mode					
	All	Front	Side	Rear	Rollover	Other
Ford Cars	130	56	27	12	25	10
GM Cars	260	116	47	31	52	14
Other Cars	256	110	41	27	60	18
Ford Util.	6	2	1	1	2	.
GM Utility	7	7	.	.	.	.
Other Util.	.	.	.	.	.	.
Jeep	2	1	.	.	1	.

Subfleet	Counts of All Vehicle Crashes, by Impact Mode					
	All	Front	Side	Rear	Rollover	Other
Ford Cars	23224	12624	5234	991	3753	622
GM Cars	42426	23604	9928	1816	5913	1165
Other Cars	41848	22138	9812	1936	6715	1247
Ford Util.	763	287	62	20	382	12
GM Utility	1049	566	119	38	299	27
Other Util.	410	213	59	19	107	12
Jeep	404	173	27	12	182	10

Subfleet	Fire Rate per 100 Crashes, by Impact Mode									
	All		Front		Side		Rear		Rollover	
Ford Cars	0.6	0.1	0.4	0.1	0.5	0.1	1.2	0.3	0.7	0.1
GM Cars	0.6	0.1	0.5	0.1	0.5	0.1	1.7	0.3	0.9	0.1
Other Cars	0.6	0.1	0.5	0.1	0.4	0.1	1.4	0.3	0.9	0.1
Ford Util.	0.8	0.3	0.7	0.5	1.6	1.6	5.0	4.9	0.5	0.4
GM Utility	0.7	0.3	1.2	0.5	.	.	.	.	.	.
Other Util.	.	.	.	.	.	.	.	.	.	.
Jeep	0.5	0.4	0.6	0.6	.	.	.	.	0.5	0.5

Table 5. Counts of Vehicles and Absolute Fire Rates in Fatal Accidents, by Impact Type; the FARS & R.L.Polk 1985-1988

Subfleet	Counts of Vehicles with Fire, by Impact Mode					
	All	Front	Side	Rear	Rollover	Other
Ford Cars	136	50	31	15	32	8
GM Cars	278	140	50	27	45	16
Other Cars	261	119	51	17	63	11

Subfleet	Vehicle-Years in Service
Ford Cars	17,068,858
GM Cars	36,392,122
Other Cars	37,028,502

Subfleet	Fire Rate per 1,000,000 Veh-Yrs, by Impact Mode									
	All		Front		Side		Rear		Rollover	
Ford Cars	8.0	0.7	2.9	0.4	1.8	0.3	0.9	0.2	1.9	0.3
GM Cars	7.6	0.5	3.8	0.3	1.4	0.2	0.7	0.1	1.2	0.2
Other Cars	7.0	0.4	3.2	0.3	1.4	0.2	0.5	0.1	1.7	0.2

Table 6. When Fire is the Most Harmful Event; Counts of Vehicles and Absolute Fire Rates in Fatal Accidents, by Impact Type; the FARS & R.L.Polk 1985-1988

Subfleet	Counts of Vehicles with Fire, by Impact Mode					
	All	Front	Side	Rear	Rollover	Other
Ford Cars	40	13	9	5	8	5
GM Cars	75	38	10	8	16	3
Other Cars	74	29	14	4	21	6

Subfleet	Vehicle-Years in Service
Ford Cars	17,068,858
GM Cars	36,392,122
Other Cars	37,028,502

Subfleet	Fire Rate per 1,000,000 Veh-Yrs, by Impact Mode				
	All	Front	Side	Rear	Rollover
Ford Cars	2.3 0.4	0.8 0.2	0.5 0.2	0.3 0.1	0.5 0.2
GM Cars	2.1 0.2	1.0 0.2	0.3 0.1	0.2 0.1	0.4 0.1
Other Cars	2.0 0.2	0.8 0.1	0.4 0.1	0.1 0.1	0.6 0.1

Appendix: Detailed Tables (A-1 to A-6)

Table A-1. Concerning All Impact Modes;
Counts and Rates of Occurrence of Shown Events
in Michigan Crashes, MY Post-84, CY 1986-1990

Vehicle Counts

Cars	Leak No Fire	Fire No Leak	Leak and Fire	No Leak No Fire
Ford	750	252	63	243261
GM	1119	508	136	425037
All Other	902	320	73	279820
Sport Util.				
Ford	233	56	17	57100
GM	205	77	24	63846
Jeep	26	5	4	5573
All Other	27	7	2	8000

Rates (Shown Events per 1,000 Crashes) +/- Std. Error

Cars	Leak No Fire		Fire No Leak		Leak and Fire	
Ford	3.07	0.11	1.03	0.06	0.26	0.03
GM	2.62	0.08	1.19	0.05	0.32	0.03
All Other	3.21	0.11	1.14	0.06	0.26	0.03
Sport Util.						
Ford	4.06	0.27	0.98	0.13	0.30	0.07
GM	3.20	0.22	1.20	0.14	0.37	0.08
Jeep	4.64	0.91	0.89	0.40	0.71	0.36
All Other	3.36	0.65	0.87	0.33	0.25	0.18

Rates for Any Leak, or Fire, or Both

Cars		
Ford	4.36	0.13
GM	4.13	0.10
All Other	4.61	0.13
Sport Util.		
Ford	5.33	0.30
GM	4.77	0.27
Jeep	6.24	1.05
All Other	4.48	0.74

Table A-2. Concerning Specific Impact Modes;
Vehicle Counts for Shown Events
in Michigan Crashes, MY Post-84, CY 1986-1990

Vehicles	Vehicle Counts: Leak No Fire	Fire No Leak	Leak and Fire	No Leak No Fire
Cars		Frontal Impacts		
Ford	404	134	43	133091
GM	598	279	73	239800
All Other	441	165	37	152858
Sport Util.				
Ford	97	30	10	29770
GM	101	44	13	35395
Jeep	11	3	2	3006
All Other	13	1	1	4257
		Side Impacts		
Cars				
Ford	89	22	8	34956
GM	149	49	14	63124
All Other	116	30	10	39832
Sport Util.				
Ford	38	4	3	8065
GM	28	9	2	8664
Jeep	1	1	0	700
All Other	2	0	1	912

Table A-2. Cont'd

Vehicles	Vehicle Counts: Leak No Fire	Fire No Leak	Leak and Fire	No Leak No Fire
	Rear Impacts			
Cars				
Ford	148	38	5	66320
GM	196	81	30	108745
All Other	175	52	20	76666
Sport Util.				
Ford	26	7	3	14654
GM	28	11	5	16440
Jeep	8	0	1	1529
All Other	3	3	0	2122
	All Other Impacts			
Cars				
Ford	109	58	7	8894
GM	176	99	19	13368
All Other	170	73	6	10464
Sport Util.				
Ford	72	15	1	4611
GM	48	13	4	3347
Jeep	6	1	1	338
All Other	9	3	0	709

Table A-3. Concerning Specific Impact Modes;
Rates of Occurrence of Shown Events
in Michigan Crashes, MY Post-84; CY 1986-1990

Vehicles	Rates (Shown Events per 1,000 Crashes) +/- Std. Error					
	Leak No Fire		Fire No Leak		Leak and Fire	
Frontal Impacts						
Cars						
Ford	3.02	0.15	1.00	0.09	0.32	0.05
GM	2.48	0.10	1.16	0.07	0.30	0.04
All Other	2.87	0.14	1.07	0.08	0.24	0.04
Sport Util.						
Ford	3.24	0.33	1.00	0.18	0.33	0.11
GM	2.84	0.28	1.24	0.19	0.37	0.10
Jeep	3.64	1.10	0.99	0.57	0.66	0.47
All Other	3.04	0.84	0.23	0.23	0.23	0.23
Side Impacts						
Cars						
Ford	2.54	0.27	0.63	0.13	0.23	0.08
GM	2.35	0.19	0.77	0.11	0.22	0.06
All Other	2.90	0.27	0.75	0.14	0.25	0.08
Sport Util.						
Ford	4.69	0.76	0.49	0.25	0.37	0.21
GM	3.22	0.61	1.03	0.34	0.23	0.16
Jeep	1.42	1.42	1.42	1.42	0.00	0.00
All Other	2.19	1.55	0.00	0.00	1.09	1.09

Table A-3. Cont'd

Vehicles	Rates (Shown Events per 1,000 Crashes) +/- Std. Error					
	Leak No Fire		Fire No Leak		Leak and Fire	
	Rear Impacts					
Cars						
Ford	2.23	0.18	0.57	0.09	0.08	0.03
GM	1.80	0.13	0.74	0.08	0.28	0.05
All Other	2.28	0.17	0.68	0.09	0.26	0.06
Sport Util.						
Ford	1.77	0.35	0.48	0.18	0.20	0.12
GM	1.70	0.32	0.67	0.20	0.30	0.13
Jeep	5.20	1.83	0.00	0.00	0.65	0.65
All Other	1.41	0.81	1.41	0.81	0.00	0.00
	All Other Impacts					
Cars						
Ford	12.02	1.14	6.40	0.84	0.77	0.29
GM	12.88	0.96	7.25	0.73	1.39	0.32
All Other	15.87	1.21	6.81	0.79	0.56	0.23
Sport Util.						
Ford	15.32	1.79	3.19	0.82	0.21	0.21
GM	14.07	2.02	3.81	1.05	1.17	0.59
Jeep	17.34	7.02	2.89	2.89	2.89	2.89
All Other	12.48	4.13	4.16	2.40	0.00	0.00

Table A-4. Concerning Specific Impact Modes;
Rates of Occurrence of Shown Events
in Michigan Crashes, MY Post-84, CY 1986-1990

Rates for Any Leak, or Fire, or Both

Frontal Impacts

Cars	Rate	+/-
Ford	4.35	0.18
GM	3.95	0.13
All Other	4.19	0.16
Sport Util.		
Ford	4.58	0.39
GM	4.44	0.35
Jeep	5.29	1.32
All Other	3.51	0.90

Side Impacts

Cars	Rate	+/-
Ford	3.39	0.31
GM	3.35	0.23
All Other	3.90	0.31
Sport Util.		
Ford	5.55	0.82
GM	4.48	0.72
Jeep	2.85	2.01
All Other	3.28	1.89

Table A-4. Cont'd
Rates of Occurrence of Shown Events
in Michigan Crashes, MY Post-84, CY 1986-1990

Rates for Any Leak, or Fire, or Both

Rear Impacts

Cars	Rate	+/-
Ford	2.87	0.21
GM	2.82	0.16
All Other	3.21	0.20
Sport Util.		
Ford	2.45	0.41
GM	2.67	0.40
Jeep	5.85	1.94
All Other	2.82	1.15

All Other Impacts

Cars	Rate	+/-
Ford	19.19	1.44
GM	21.52	1.24
All Other	23.24	1.46
Sport Util.		
Ford	18.73	1.98
GM	19.05	2.34
Jeep	23.12	8.08
All Other	16.64	4.76

Table A-5. Concerning GM Sport Util. Fuel System
Counts and Rates of Occurrence of Shown Events
in Michigan Crashes, CY 1986-1990

Fuel System	Vehicle Counts: Leak No Fire	Fire No Leak	Leak and Fire	No Leak No Fire
Carburator	65	29	12	21908
Fuel Injct	121	41	12	36281

Fuel System	Rates (Shown Events per 1,000 Crashes) +/- Std. Error: Leak No Fire		Fire No Leak		Leak and Fire	
Carburator	2.95	0.37	1.32	0.24	0.55	0.16
Fuel Injct	3.32	0.30	1.12	0.18	0.33	0.10

Rates for Any Leak, or Fire, or Both

Fuel System	Rate	+/-
Carburator	4.82	0.47
Fuel Injct	4.77	0.36

Table A-6. Concerning GM Sport Util. Fuel System, as a Function of Impact Mode; Counts and Rates of Occurrence of Shown Events in Michigan Crashes, CY 1986-1990

Impact Mode	Fuel System	Vehicle Counts: Leak No Fire	Fire No Leak	Leak and Fire	No Leak No Fire
Frontal	Carburator	26	15	5	12319
	Fuel Injct	63	24	7	20050
Side	Carburator	16	1	1	2899
	Fuel Injct	18	3	1	4760
Rear	Carburator	5	3	3	5508
	Fuel Injct	16	7	3	9479
Other	Carburator	18	10	3	1182
	Fuel Injct	24	7	1	1992

Impact Mode	Fuel System	Rates (per 1,000 Crashes) +/- Std. Error: Leak No Fire		Fire No Leak		Leak and Fire	
Frontal	Carburator	2.10	0.41	1.21	0.31	0.40	0.18
	Fuel Injct	3.13	0.39	1.19	0.24	0.35	0.13
Side	Carburator	5.49	1.37	0.34	0.34	0.34	0.34
	Fuel Injct	3.76	0.89	0.63	0.36	0.21	0.21
Rear	Carburator	0.91	0.41	0.54	0.31	0.54	0.31
	Fuel Injct	1.68	0.42	0.74	0.28	0.32	0.18
Other	Carburator	14.84	3.47	8.24	2.60	2.47	1.43
	Fuel Injct	11.86	2.41	3.46	1.31	0.49	0.49

Impact Mode	Fuel System	Any Leak, or Fire, or Both: Rate	+/-
Frontal	Carburator	3.72	0.55
	Fuel Injct	4.67	0.48
Side	Carburator	6.17	1.45
	Fuel Injct	4.60	0.98
Rear	Carburator	1.99	0.60
	Fuel Injct	2.74	0.54
Other	Carburator	25.56	4.53
	Fuel Injct	15.81	2.77

Fig. 1. Cars with Crash Related Fuel Leaks per 1,000 Crash Involved in Michigan Accidents, 1986-1990

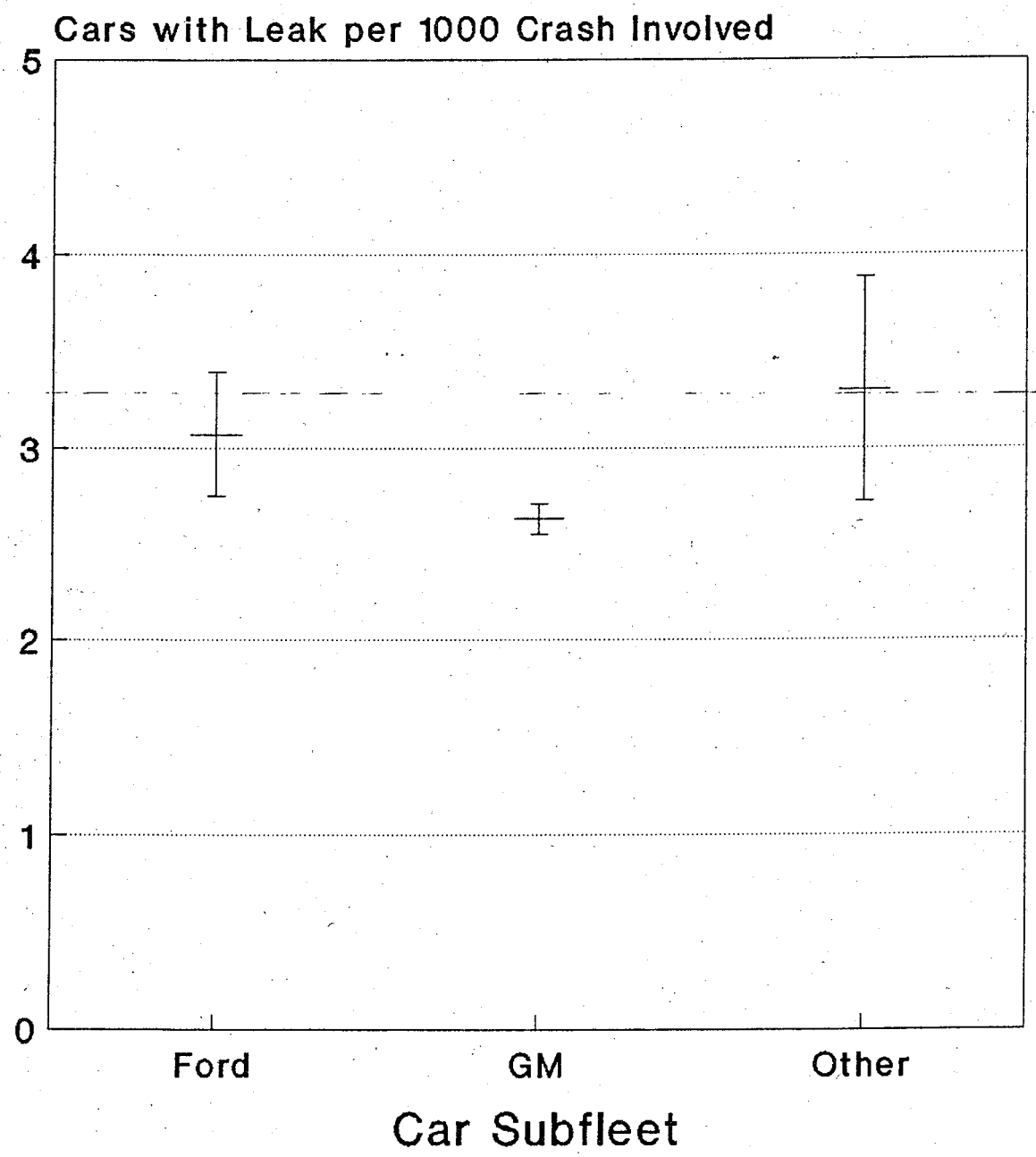


Fig. 2. Cars with Crash Related Fuel Leak, Fire, or Both per 1,000 Crash Involv. Cars in Michigan Accidents 86-90

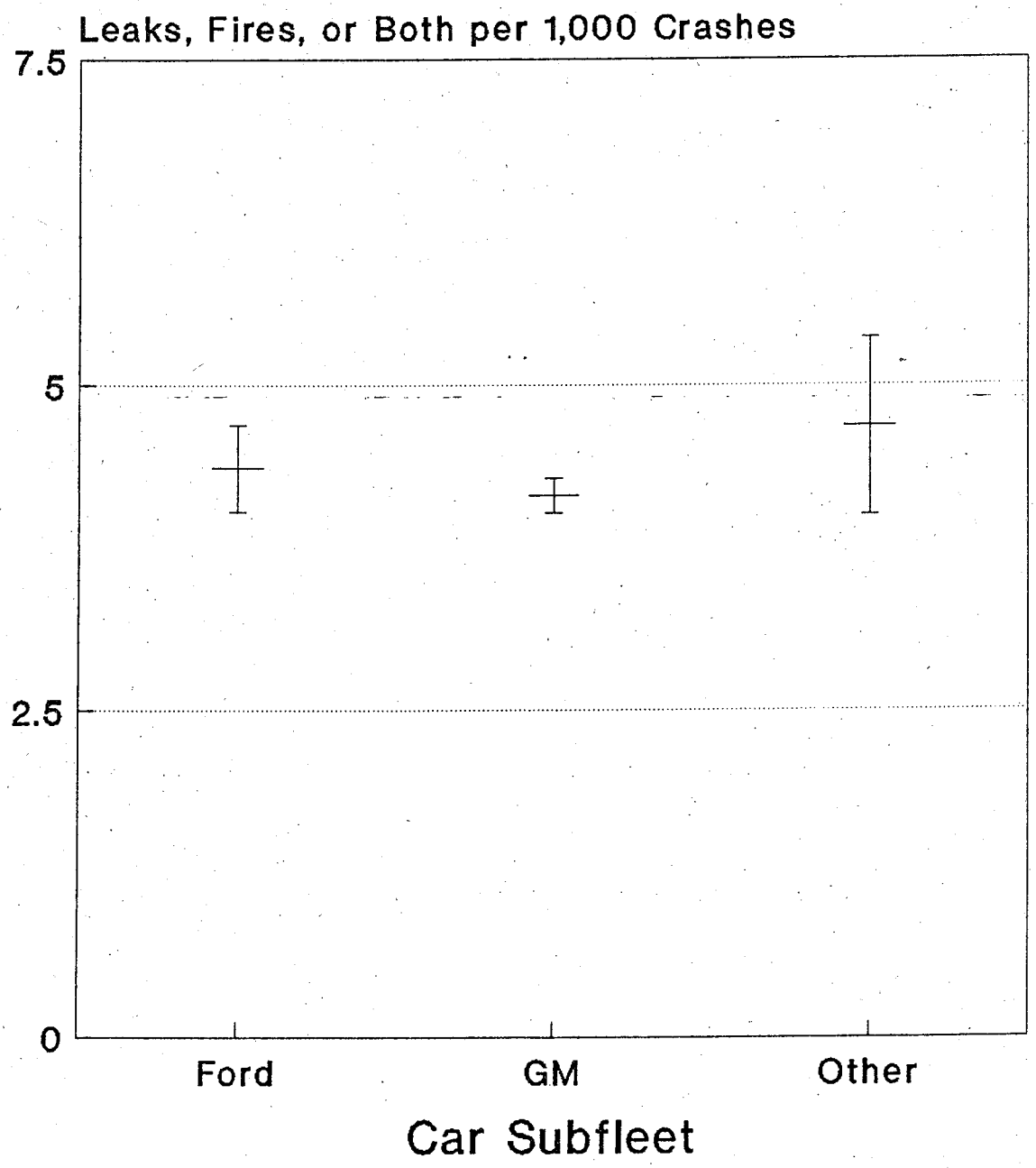


Fig. 3. Nationally Representative Proportional Rates of Car Fires in All Crash Severities; the NASS/GES 1988-1992

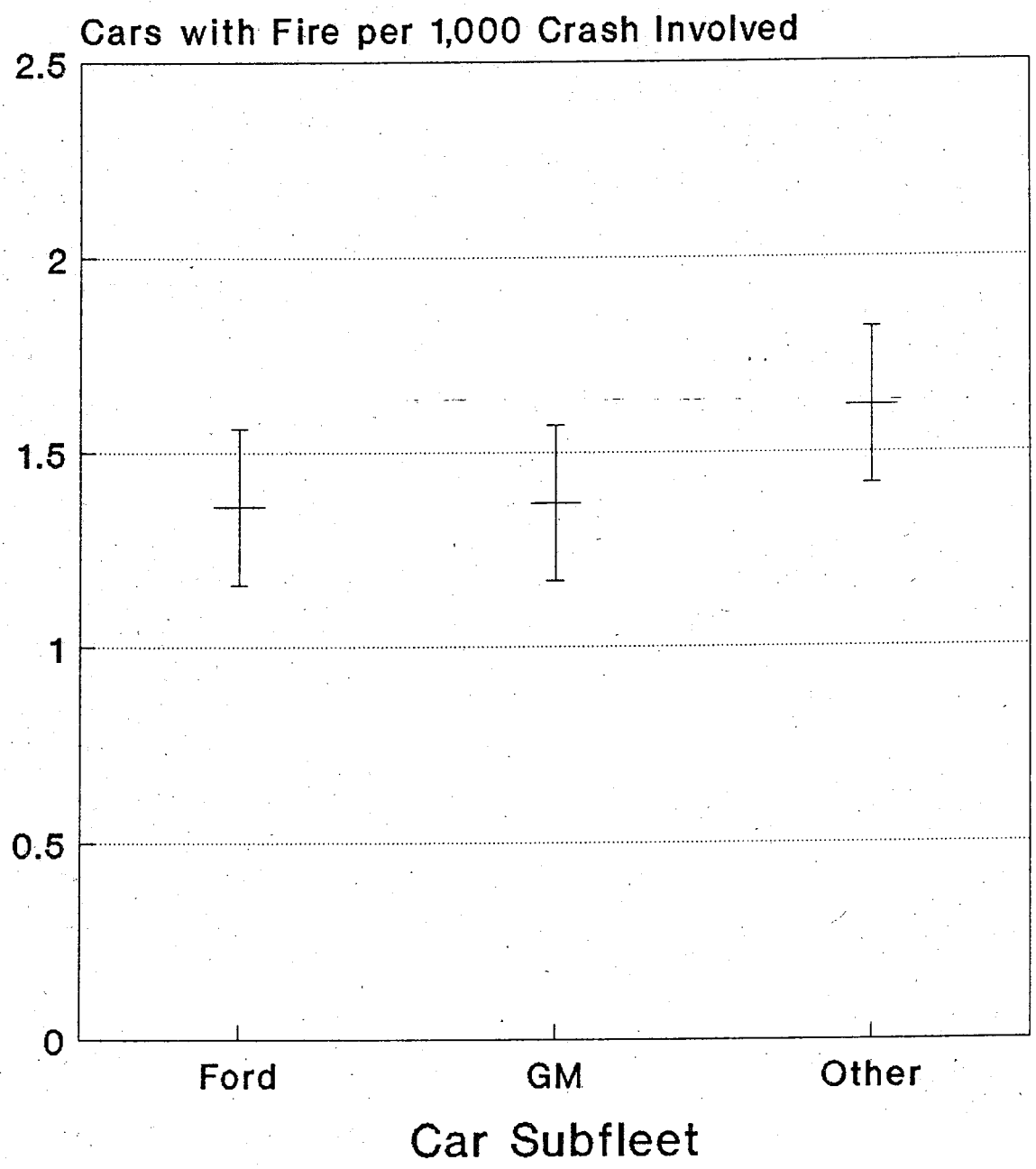


Fig. 4. Vehicles with Crash Related Fires per 100 Crash Involved in Fatal Accidents; All Impacts

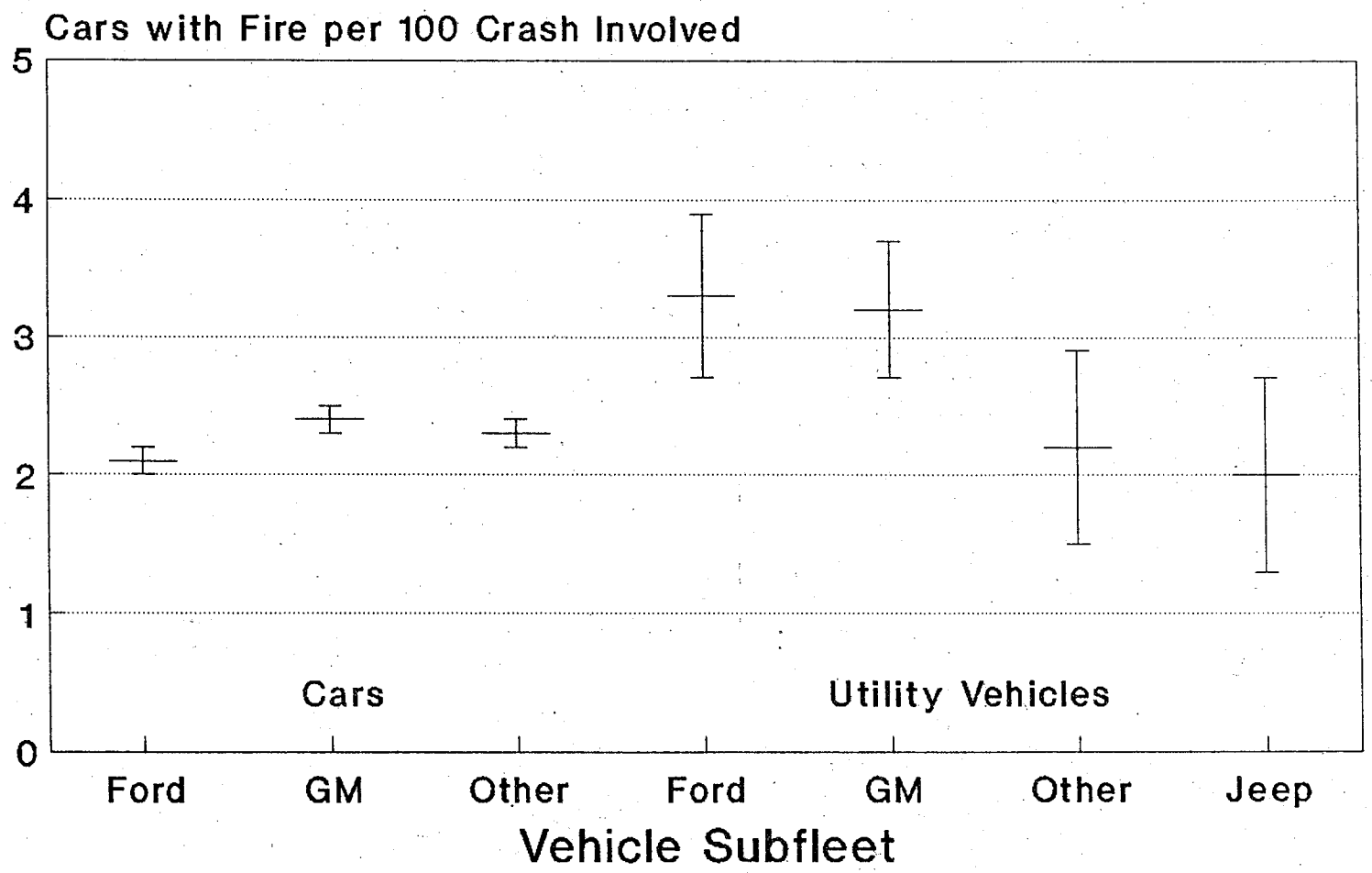


Fig. 5. Vehicles with Crash Related Fires per 100 Crash Involved in Fatal Accidents; Frontal Impacts

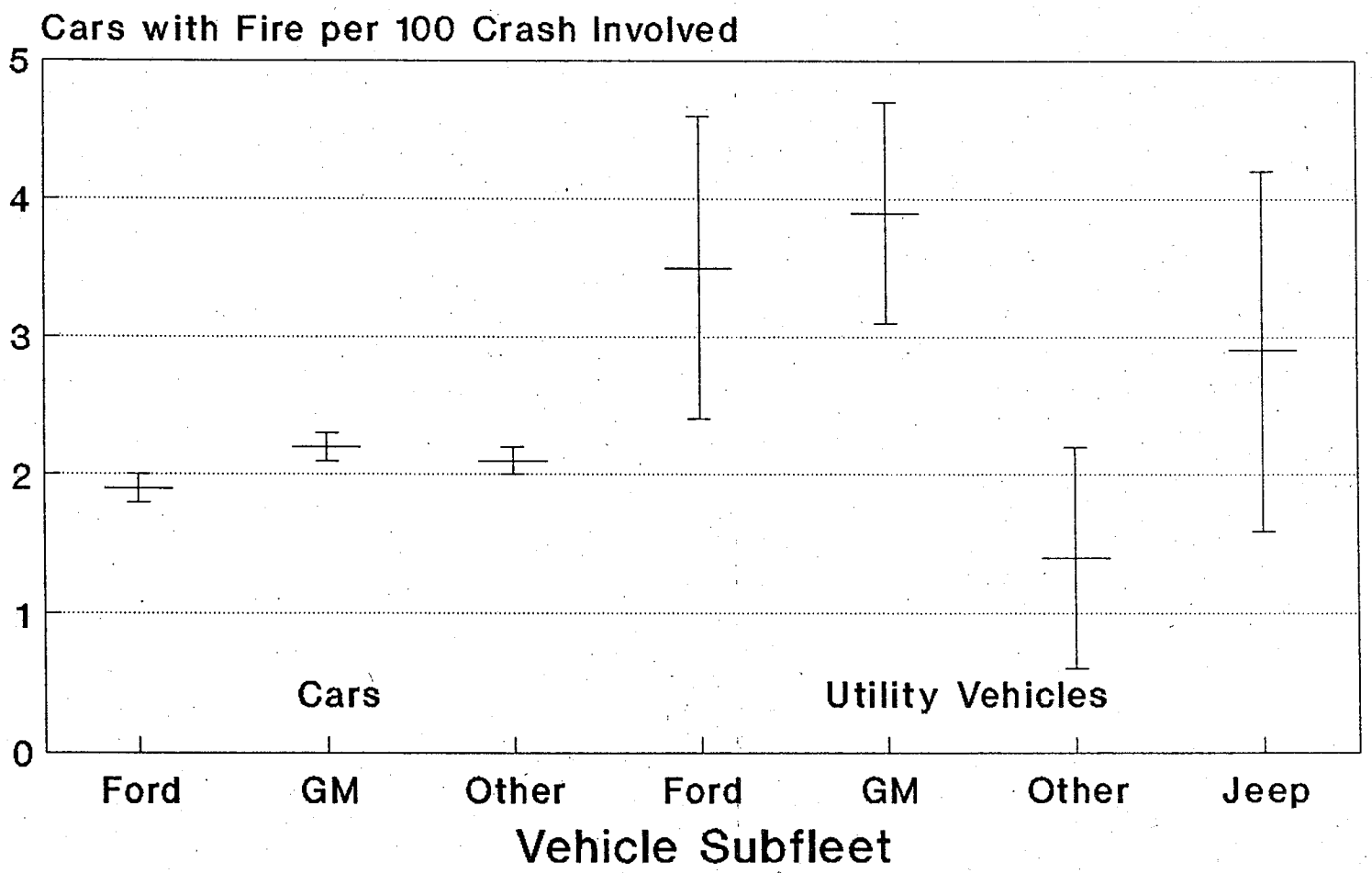


Fig. 6. Vehicles with Crash Related Fires per 100 Crash Involved in Fatal Accidents; Side Impacts

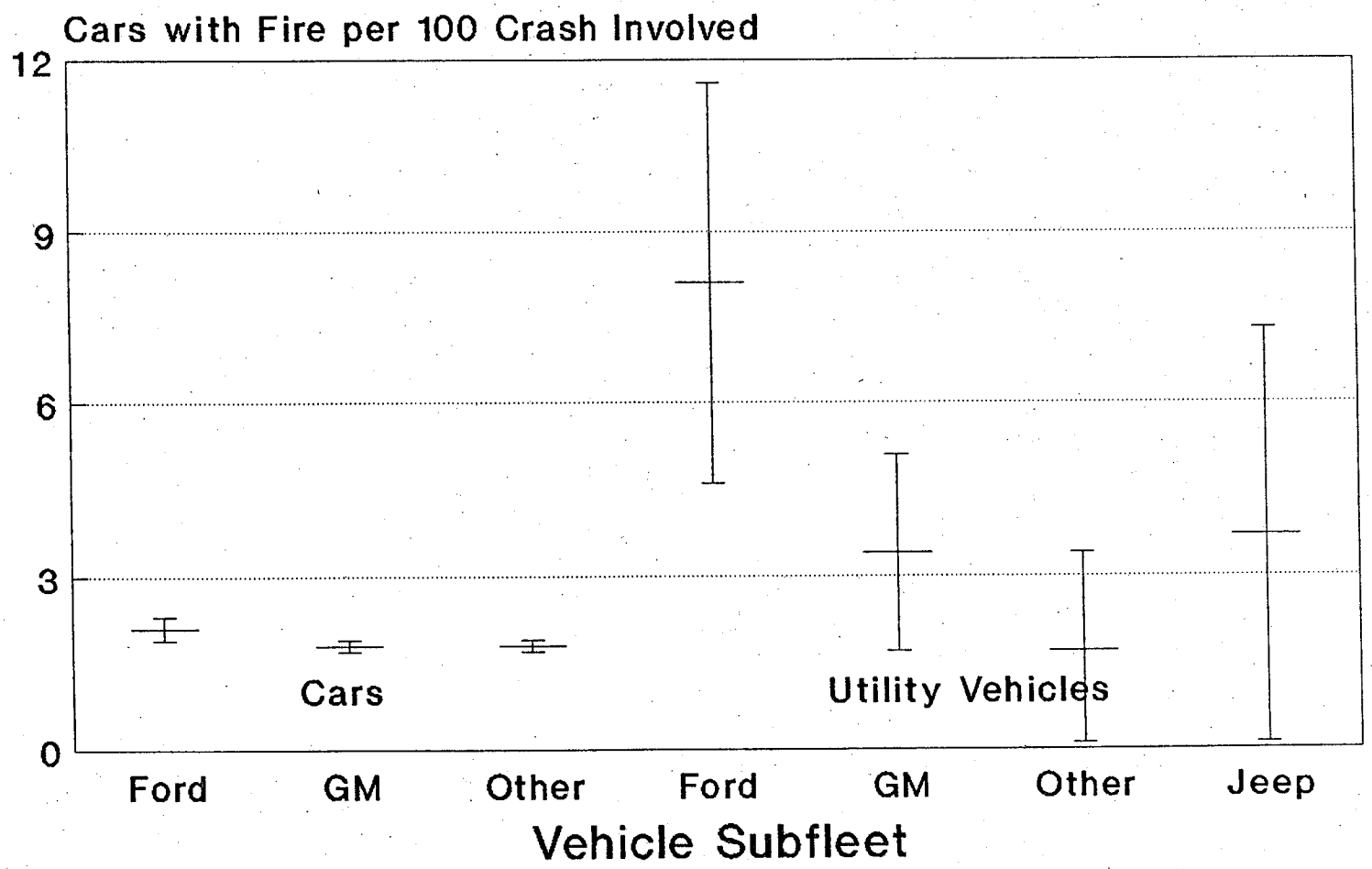
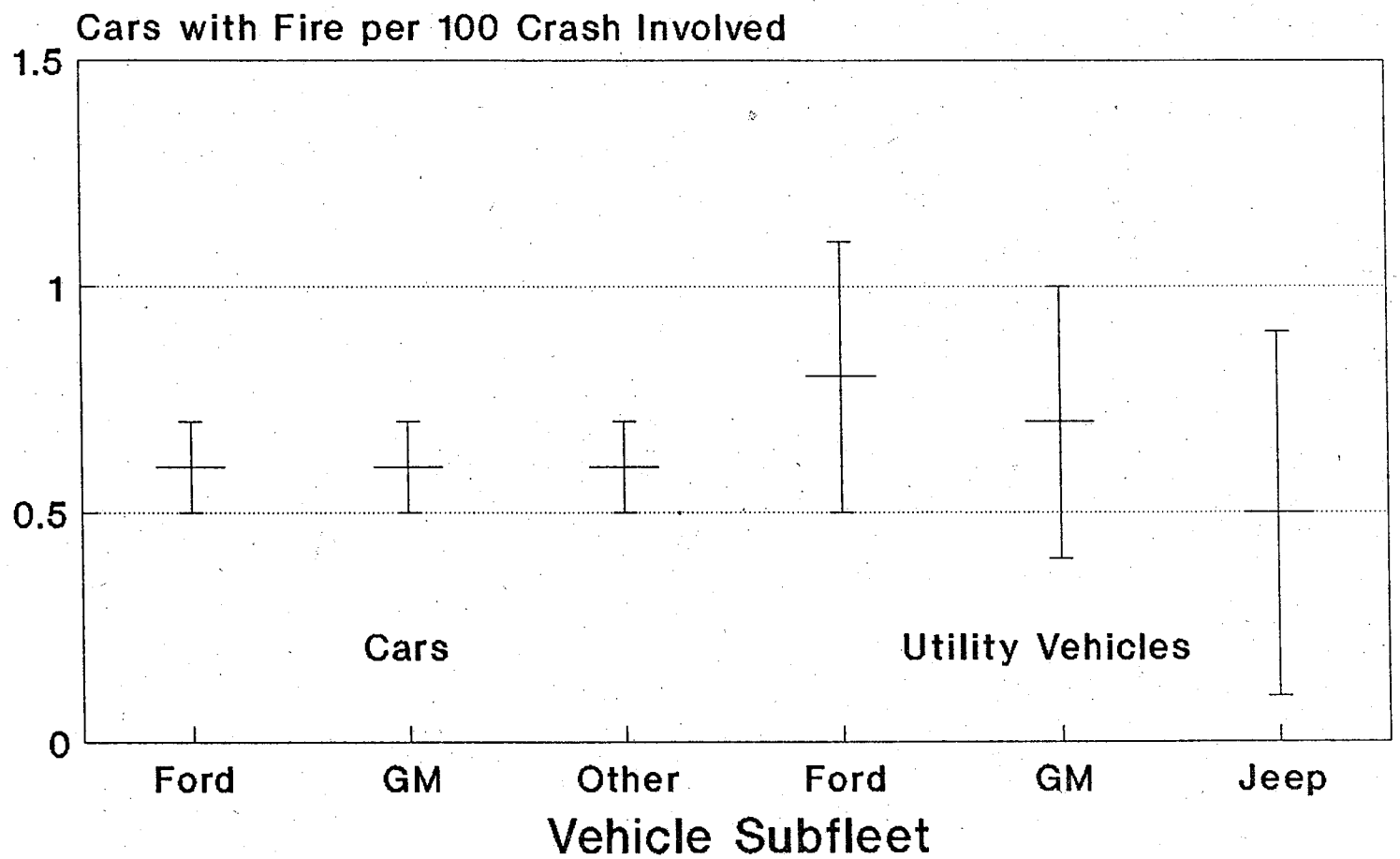


Fig. 7. Vehicles with Crash Related Fires per 100 Crash Involved in Fatal Accidents; All Impacts



Fire is Most Harmful Event

Fig. 8. Absolute Rates of Fire in Fatal Accidents, per 1,000,000 Car-Yrs in Service; the FARS & R.L.Polk 1985-88

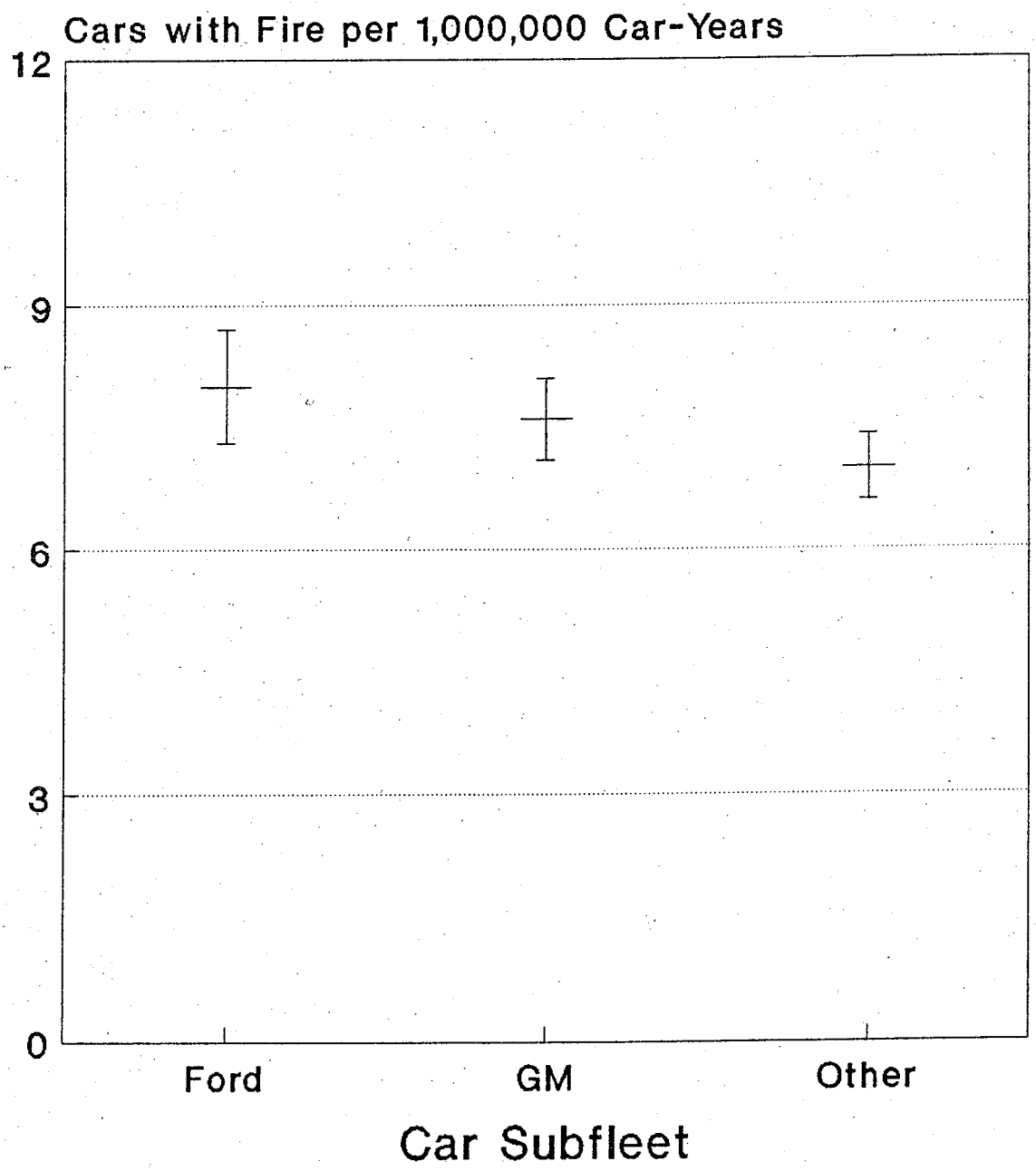
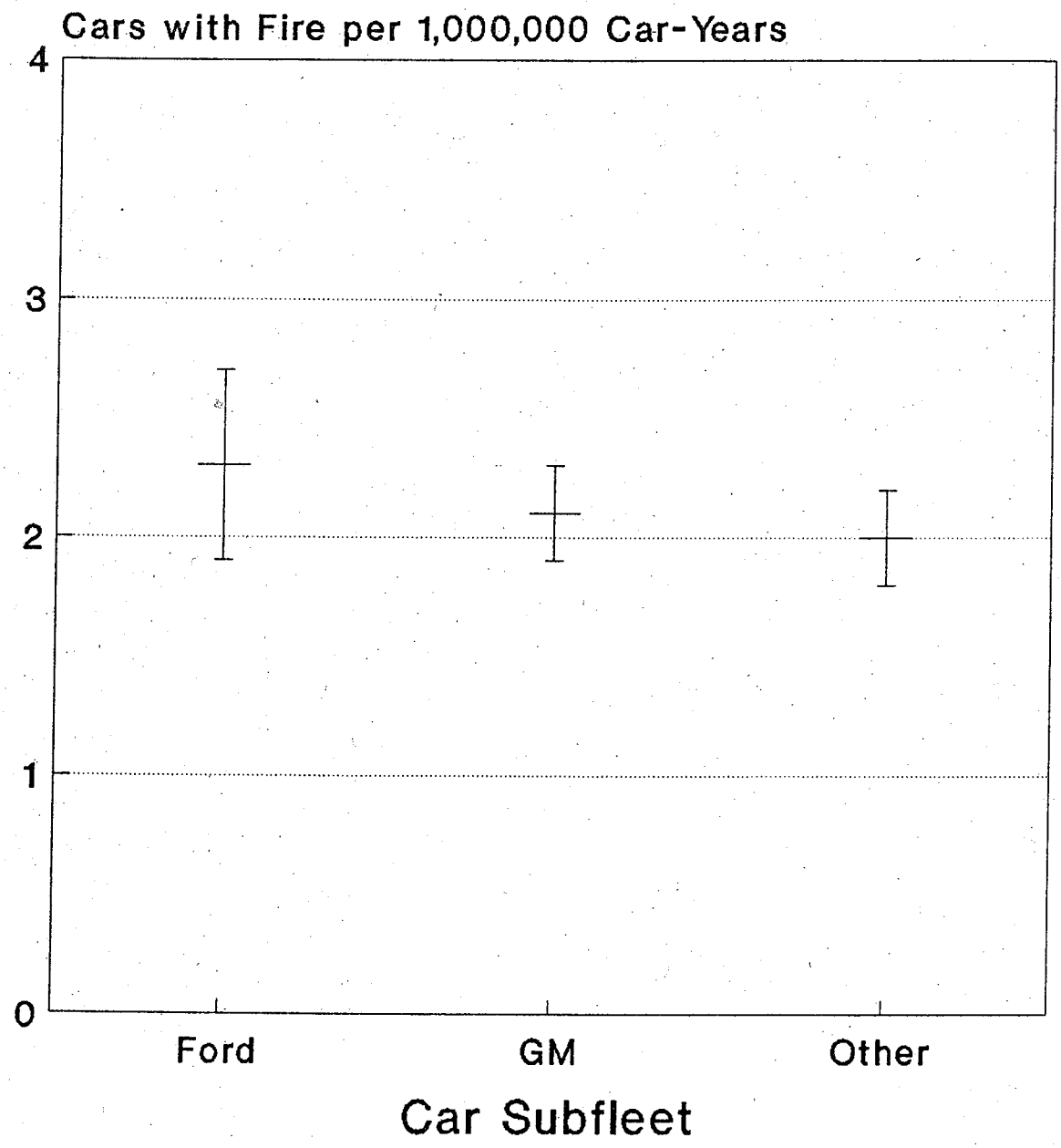


Fig. 9. Absolute Rates of Fire in Fatal Accidents, per 1,000,000 Car-Yrs in Service; the FARS & R.L.Polk 1985-88



Fire is Most Harmful Event