EFFECT OF DAYTIME MOTORCYCLE HEADLIGHT LAWS ON MOTORCYCLE ACCIDENTS

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This paper describes the results of an analysis of the motorcycle accident records of four states with daytime motorcycle headlight laws—Indiana, Montana, Oregon, and Wisconsin—and of four control states. This analysis was conducted by the Franklin Institute Research Laboratories as part of a study for the National Highway Safety Bureau to determine the effect of daytime motorcycle headlight laws on motorcycle accidents. Motorcycle accidents (a) involving another motor vehicle, (b) at intersections, and (c) in urban areas are more frequent and are reduced more by daytime motorcycle headlight laws than single-vehicle, nonintersectional, or rural motorcycle accidents. Angle and opposite direction motorcycle accidents are the most frequent types involving two motor vehicles and are reduced the greatest amount by daytime motorcycle headlight operation. Motorcycle accidents in which the motorcycle headlight is in the field of view of the driver of an opposing vehicle are reduced more than motorcycle accidents in which the taillight is in the field of view of the driver of a following vehicle. Total daylight motorcycle accidents in the four states with daytime headlight laws were reduced 41.3 percent; nighttime accidents were reduced 37.5 percent. This difference of 3.8 percent, which indicates the effect of daylight head-lamp operation, is significant at the 0.1 level. If the 3.8 percent figure is applied to the total daytime motorcycle accident involvements in the United States, a reduction of 7,140 can be achieved. If daytime motorcycle headlight laws were adopted on a nationwide basis, the total yearly savings in reduced motorcycle accident involvements would be approximately $15.7 million to $22.8 million, or approximately $7.50 to $10.90 per motorcycle per year.

•THE Franklin Institute Research Laboratories has recently completed a study for the National Highway Safety Bureau to determine the efficacy of using motorcyle headlights and taillights during daylight hours as a crash avoidance technique (1). In conducting this study an extensive review was made of the literature relating to motorcycle accidents and accident costs.

Analysis of motorcycle accident data found in the literature has shown the following:

1. The majority of motorcycle accidents occur in urban areas;
2. Most motorcycle accidents take place at intersections;
3. About 65 to 75 percent of the motorcycle accidents take place in daylight hours;
4. Collision with other motor vehicles is the predominant type of motorcycle accident;
5. The most common types of motorcycle accidents involving another vehicle are angle and turning collisions at an intersection; and
6. Other important types of motorcycle accidents involving another vehicle are those with vehicles traveling in the opposite direction with both moving, in the same direction with both moving, with one vehicle parked or stopped, and with one vehicle entering or leaving an alley or driveway (2 through 10).

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In order to verify these findings and gain insight into the effects of daytime motorcycle headlight and taillight operation on accidents and accident costs, an analysis was made of motorcycle accident data in four states with daytime motorcycle headlight laws and four control states with no daytime headlight laws. Because motorcycle electrical systems are designed so that the taillight goes on whenever the headlight is turned on, the daytime headlight laws cover operation of both motorcycle headlights and taillights.

This paper describes the design of the state accident survey, the analysis of motorcycle accident data in the four states with daytime headlight laws and in four control states, and the effect of the daytime headlight laws in reducing accidents and accident costs.

STATE ACCIDENT DATA: SOURCES, FORMATS, AND AVAILABILITY

At the time of this study, five states had daytime motorcycle headlight laws: Arkansas, Indiana, Montana, Oregon, and Wisconsin. However, Arkansas made changes in their methods of reporting motor-vehicle accidents immediately after passage of their headlight law, thus invalidating comparisons of statistics obtained before and after passage of the law.

Contacts were made in each of the remaining four states to determine the availability and formats of their state accident data. It was determined that motorcycle accident data, either summarized or in raw form (punch card or magnetic tape), were available from each of these states. The accident classification used by the four states closely followed the National Safety Council (NSC) format. In addition, overall motor-vehicle accident data were obtained from the NSC, and motorcycle and motor-vehicle registration data were obtained from Highway Statistics, published annually by the U. S. Bureau of Public Roads.

Accident and registration data also were obtained from four control states (that is, states with no daytime headlight laws) for statistical comparison with data in states having a daytime headlight law. Each of the control states was selected and matched with a state requiring daytime operation of motorcycle headlights on the basis of criteria such as geographical nearness, similarities in climate and terrain, demographic factors, size, and motorcycle registration. These pairings are as follows:

State With Headlight Law	Paired Control State
Indiana	Ohio
Montana	Idaho
Oregon	Washington
Wisconsin	Minnesota

Selected data for the states are given in Table 1.

TABLE 1

STATE COMPARISONS

Characteristics	Indiana	Ohio	Montana	Idaho	Oregon	Washington	Wisconsin	Minnesota
1968 population	5,061,000	10,588,000	693,000	703,000	2,008,000	3,276,000	4,221,000	3,647,000
Land area (square miles)	36,189	41,018	145,603	82,677	96,209	66,663	54,464	79,289
Population per square mile	139.8	258.1	4.8	8.5	20.9	49.1	77.5	46.0
Percent urban population (1960 data)	62.4	73.4	50.2	47.5	62.2	68.1	63.8	62.1
1968 motorcycle registrations	64,851	123,393	17,032	22,627	37,070	47,127	60,091	60,832
Registrations per 100,000 population	1,281	1,165	2,457	3,219	1,846	1,439	1,424	1,668

Sources: (11, 12).

For each of these states, extracts were obtained of the state motorcycle laws and the effective dates of these laws. In each of the states, the headlight law was the only motorcycle law that would affect motorcycle accidents only in daylight hours. All other laws (for example, helmet and face shield requirements, licensing, etc.) should be effective throughout the day and night. Therefore, any significant difference between day and night accident rates would be a measure of the effectiveness of the headlight law.

STATE ACCIDENT DATA: ANALYSIS

This section summarizes the results of the analyses made on the motorcycle accident data for the four states with daytime headlight laws and the four control states. Two of the four states (Indiana and Montana) with headlight laws supplied data in detailed summary form; little analysis was required of their data. The other two states, Wisconsin and Oregon, supplied data in raw form (punch cards and magnetic tape respectively), which necessitated development of computer programs for data analysis.

All of the control states supplied only summary data except Minnesota, which provided a complete NSC classification of motorcycle accidents there for the appropriate time periods. These data allowed us to make excellent comparisons between Wisconsin's and Minnesota's motorcycle accident history.

Indiana and Ohio

Indiana Motorcycle Accident Data—Comparison of data for the last 6 months of 1966 with comparable 1967 data indicates that Indiana's motorcycle laws effected a 43 percent reduction in motorcycle accidents. The difference between the daytime reduction (44 percent) and the nighttime reduction (41 percent) is not significant using the "t" test (13) (Table 2). Daytime motorcycle accidents were the most frequent.

Motorcycle accidents involving another motor vehicle were reduced 48 percent; accidents involving only a motorcycle were reduced 16 percent; and other accidents were reduced 27 percent. These differences are significant at the 0.01 level. Motorcycle accidents involving other motor vehicles in traffic were the most frequent types of accidents. The most frequent types of motorcycle accidents involving two motor vehicles were entering at an angle (intersection), opposite direction—one left turn and one straight (intersection), one entering alley or driveway, and same direction—both moving. The laws reduced accidents for the first three types more than the last one (Table 3).

Intersectional accidents were most frequent and were reduced more than noninterscctional accidents (49 percent versus 45 percent), as given in Table 3; however, the difference is not significant. Most of the accidents occurred in urban areas, and these accidents were reduced much more than were rural accidents (47 percent versus 31 percent), with the difference significant at the 0.01 level.

Indiana Versus Ohio—Ohio realized a 5 percent increase in motorcycle accidents between 1966 and 1967 compared with Indiana's 43 percent reduction. Motorcycle registrations increased by 17 percent in Ohio and 4 percent in Indiana during this period. Normalized by total motorcycle registrations, Ohio had a 10 percent reduction, whereas Indiana had a 45 percent reduction in the accident rate.

TABLE 2

ACCIDENT REDUCTION BY LIGHT CONDITION, INDIANA

Light Condition	Number of Motorcycle Accidents		Reduction[a]	
	1966	1967	Number	Percent
Daylight	1,450	809	641	44
Dawn and dusk	85	58	27	32
Darkness	487	289	198	41
Not stated	6	9	(3)	(50)
Total	2,028	1,165	863	43

[a]Figures represent reductions unless parenthesized; parenthesized figures are increases.

Table 4 compares Indiana's and Ohio's motorcycle accident, registration, and accident rate data in 1966 and 1967. The Indiana accident and accident rate data are based on 6 months, whereas the Ohio data are based on the full year. Therefore, although the percentage of change in accidents and accident rates can be compared between the two states in the two time periods, no direct comparison can be made in total number of accidents and total accident rates.

TABLE 3

ACCIDENT REDUCTION BY DIRECTIONAL ANALYSIS, INDIANA

Location and Vehicle Movement	Number of Motorcycle Accidents		Reduction	
	1966	1967	Number	Percent
Intersection—total	898	459	439	49
Angle	497	254	243	49
Same direction—both straight	18	7	11	61
Same direction—both turning	97	67	30	31
Same direction—one stopped	81	37	44	54
Opposite direction—one turning left and one straight	190	85	105	55
Other	15	9	6	40
Nonintersection—total	689	381	307	45
Opposite direction—both moving	65	42	23	35
Same direction—both moving	127	73	54	43
One parked	80	58	22	28
One stopped in traffic	107	58	49	46
One leaving parked position	24	9	15	63
One entering alley or driveway	165	82	83	50
One leaving alley or driveway	101	50	51	50
Other	20	9	11	55

Montana and Idaho

Montana Motorcycle Accident Data—Montana had a 10 percent decrease in total motorcycle accidents between 1967 and 1968. The daytime reduction was 15 percent, whereas the nighttime reduction was 19 percent (Table 5). This difference is not significant; however, night accidents on unlighted roadways increased 15 percent.

TABLE 4

INDIANA AND OHIO MOTORCYCLE ACCIDENT DATA

State	Number of Motorcycle Accidents		Reduction[a]	
	1966	1967	Number	Percent
Indiana (last 6 months)	2,028	1,165	863	43
Ohio (full year)	3,020	3,170	(150)	(5)
State	**Motorcycle Registrations**		**Change**	
	1966	1967	Number	Percent
Indiana	63,552	66,378	+2,826	+4
Ohio	93,826	109,790	+15,964	+17
State	**Motorcycle Accident Rate per 10,000 Motorcycles**		**Reduction**	
	1966	1967	Number	Percent
Indiana (last 6 months)	319	176	143	45
Ohio (full year)	322	289	33	10

[a]Figures represent reductions unless parenthesized; parenthesized figures are increase

Though dawn and dusk accidents increased, no percentages were calculated because of the possibly misleading magnitude of the change. The majority of the accidents occurred during the daytime.

Motorcycle accidents involving collision with another motor vehicle were reduced 16 percent; accidents in which only the motorcycle was involved increased 8 percent; and other types of motorcycle accidents (pedestrian, fixed object, etc.) increased 9 percent.

Motorcycle accidents involving other motor vehicles were the most frequent type. Of these, the most frequent types were angle (intersection), opposite direction—one left turn and one straight (intersection), and same direction—both moving. The greatest reduction in accidents was for opposite direction—one left turn and one straight (26 percent), opposite direction–both moving (27 percent), and one entering alley or driveway (50 percent), as Table 6 indicates.

TABLE 5

ACCIDENT REDUCTION BY LIGHT CONDITION, MONTANA

Light Condition	Number of Motorcycle Accidents		Reduction[a]	
	1967	1968	Number	Percent
Daylight	189	160	29	15
Dawn and dusk	2	17	(15)	—
Darkness	43	35	8	19
Street lights	30	20	10	33
No lights	13	15	(2)	(15)
Not stated	1	0	1	—
Total	235	212	23	10

[a]Figures represent reductions unless parenthesized; parenthesized figures are increases.

Intersectional accidents were more frequent than nonintersectional accidents. Intersectional accidents were reduced by 15 percent and nonintersectional accidents by 13 percent (Table 6). The largest number of accidents took place in urban areas; these accidents were reduced 8 percent and rural accidents 13 percent.

Due to the small number of motorcycle accidents in Montana (235 in 1967 and 212 in 1968), tests for significant differences in accident reduction were impractical.

Montana Versus Idaho—Idaho realized an 11 percent reduction in motorcyle accidents between 1967 and 1968, compared with Montana's 10 percent reduction for the same period. If the figures are normalized by total registrations (motorcycle registrations remained almost constant in Idaho and increased by 10 percent in Montana during this time period), Montana had a 17 percent decrease in the motorcycle accident rate per

TABLE 6

ACCIDENT REDUCTION BY DIRECTIONAL ANALYSIS, MONTANA

Location and Vehicle Movement	Number of Motorcycle Accidents		Reduction[a]	
	1967	1968	Number	Percent
Intersection—total	128	109	19	15
Angle	79	75	4	5
Opposite direction—one left turn and one straight	38	28	10	26
Other	11	6	5	45
Nonintersection—total	52	45	7	13
Opposite direction—both moving	11	8	3	27
Same direction—both moving	20	22	(2)	(10)
One entering alley or driveway	8	4	4	50
Other	13	11	2	15

[a]Figures represent reductions unless parenthesized; parenthesized figures are increases.

TABLE 7

MONTANA AND IDAHO MOTORCYCLE ACCIDENT DATA

State	Number of Motorcycle Accidents		Reduction	
	1967	1968	Number	Percent
Montana	235	212	23	10
Idaho	508	452	56	11

State	Motorcycle Registrations		Change	
	1967	1968	Number	Percent
Montana	15,529	17,032	+1,503	+10
Idaho	22,673	22,627	-46	0

State	Motorcycle Accident Rate per 10,000 Motorcycles		Reduction	
	1967	1968	Number	Percent
Montana	151	125	26	17
Idaho	224	200	24	11

TABLE 8

ACCIDENT REDUCTION BY LIGHT CONDITION, OREGON

Light Condition	Number of Motorcycle Accidents		Reduction[a]	
	1967	1968	Number	Percent
Daylight	452	349	103	23
Darkness	93	81	12	13
Street lights	76	61	15	20
No lights	17	20	(3)	(17)
Total	545	430	115	21

[a]Figures represent reductions unless parenthesized; parenthesized figures are increases.

10,000 registered motorcycles, whereas the Idaho motorcycle accident rate was decreased by 11 percent. Table 7 compares the total motorcycle accident, motorcycle registration, and accident rate data of Montana and Idaho for the years 1967 and 1968.

Oregon Motorcycle Accident Data—Oregon had a 21 percent reduction in motorcycle accidents during the analysis period (first 7 months of 1967 and of 1968). As given in Table 8, the daytime reduction was 23 percent, whereas the nighttime reduction was 13 percent (significant at the 0.05 level). The majority of the accidents took place in the daytime.

Motorcycle accidents with motor vehicles in traffic were reduced 25 percent, whereas other accidents were reduced 8 percent (significant at the 0.01 level). Turning and angle collisions were the most frequent types of motorcycle accidents, followed by rear-end collisions. Reductions were greatest for rear-end, angle, turning, and parking collisions.

The directional analysis of motorcycle accidents involving another motor vehicle (Table 9) showed that the most frequent types were angle, opposite direction—one left turn and one straight, same direction—one turn and one straight, same direction—one stopped, and same direction—both straight. The numbers of these five types of motorcycle accidents were reduced, whereas the other five types all increased.

TABLE 9

ACCIDENT REDUCTION BY DIRECTIONAL ANALYSIS, OREGON

Vehicle Movement	Number of Motorcycle Accidents		Reduction[a]	
	1967	1968	Number	Percent
Entering at angle—one stopped	6	9	(3)	(50)
Entering at angle—all others	153	116	39	25
Same direction—both straight	31	25	6	19
Same direction—one turn and one straight	60	40	20	33
Same direction—one stopped	61	35	26	43
Same direction—all others	6	7	(1)	(17)
Opposite direction—both stopped	16	24	(8)	(50)
Opposite direction—one left turn and one straight	84	52	32	38
Opposite direction—one stopped	4	8	(4)	(100)

[a]Figures represent reductions unless parenthesized; parenthesized figures are increases.

Intersectional accidents were more frequent than nonintersectional accidents (Table 10). Intersectional accidents were reduced by 11 percent and nonintersectional accidents by 15 percent. Urban accidents, which were more frequent than rural accidents, were reduced by 27 percent, and rural accidents increased by 9 percent (significant at the 0.01 level).

TABLE 10

ACCIDENT REDUCTION BY ACCIDENT LOCATION, OREGON

Location of Accident	Number of Motorcycle Accidents		Reduction	
	1967	1968	Number	Percent
Intersection	235	210	25	11
Alley or driveway entrance	92	64	68	30
Nonintersection	218	156	62	28

Oregon Versus Washington—Oregon realized a 21 percent decrease in motorcycle accidents during the analysis period (first 7 months of 1967 and of 1968), while Washington had a 22 percent decrease between 1967 and 1968 (12 months). Motorcycle registrations increased by 13 percent in Oregon and decreased by 12 percent in Washington during this period. If the figures are normalized by the number of registered motorcycles, Oregon had a 30 percent reduction, whereas Washington had an 11 percent reduction in the motorcycle accident rate.

Table 11 compares the total motorcycle accident, registration, and accident rate history for Oregon and Washington for 1967 and 1968. Because the Oregon accident and accident rate data cover a 7-month period and the Washington data cover a 12-month period in both years, the totals are not directly comparable. However, the percentage change in accidents and accident rates can be compared between the two states even though different lengths of time are involved.

Wisconsin and Minnesota

Wisconsin Motorcycle Accident Data—Wisconsin realized a 46 percent reduction in motorcycle accidents between the last 6 months of 1967 and of 1968. The daytime reduction was 48 percent, whereas the nighttime reduction was 41 percent (Table 12). The difference, 7 percent, is significant at the 0.01 level. For both time periods, the major portion of the accidents occurred in the daytime.

Motorcycle accidents involving two motor vehicles were reduced 49 percent, whereas accidents involving one motor vehicle were reduced 41 percent. This difference is significant at the 0.01 level. Collisions with other motor vehicles in traffic were the most frequent type of accident; of these, the most frequent accident

TABLE 11

OREGON AND WASHINGTON MOTORCYCLE ACCIDENT DATA

State	Number of Motorcycle Accidents		Reduction	
	1967	1968	Number	Percent
Oregon (first 7 months)	545	430	115	21
Washington (full year)	1,454	1,137	317	22

State	Motorcycle Registrations		Change	
	1967	1968	Number	Percent
Oregon	32,905	37,070	+4,165	+13
Washington	53,562	47,127	-6,435	-12

State	Motorcycle Accident Rate per 10,000 Motorcycles		Reduction	
	1967	1968	Number	Percent
Oregon (first 7 months)	166	116	50	30
Washington (full year)	271	241	30	11

TABLE 12

ACCIDENT REDUCTION BY LIGHT CONDITION, WISCONSIN

Light Condition	Number of Motorcycle Accidents		Reduction	
	1967	1968	Number	Percent
Daylight	1,262	650	612	48
Dusk	78	41	37	47
Darkness	525	312	213	41
Street lights	369	196	173	47
No lights	156	116	40	26
Not stated	32	13	19	59
Total	1,897	1,016	881	46

types were entering at an angle (intersection), opposite direction—one left turn and one straight (intersection), one entering alley or driveway, and same direction—both moving (Table 13). However, the first three of these types were reduced more than twice as much as the last type.

Accidents occurred most frequently at intersections. Total intersectional accidents were reduced more than total nonintersectional accidents (Table 13). This difference is significant at the 0.01 level.

Motorcycle accident data were also analyzed separately for daylight and dusk hours (Table 13). In most cases, the data followed a pattern similar to the total accident pattern, although there were some differences.

The majority of the motorcycle accidents occurred in urban areas; these accidents were reduced more than rural accidents (significant at the 0.01 level).

Wisconsin Versus Minnesota—Minnesota realized an overall 9 percent increase and a daytime increase of 16 percent in motorcycle accidents between the last 6 months of 1967 and 1968 as compared to Wisconsin's 48 percent reduction during daylight and 46 percent overall decrease. The number of motorcycle registrations decreased by about 1 percent in Wisconsin and increased by about 9 percent in Minnesota. If the figures are normalized by total motorcycle registrations, Wisconsin had a 46 percent decrease in the motorcycle accident rate per 10,000 registered motorcycles, whereas Minnesota had no change. These drastic differences in accident reduction cannot be attributed solely to the headlight law. Two other important factors caused these differences: (a) Wisconsin's extensive safety campaign and (b) Minnesota's much lower overall motorcycle accident rate.

Table 14 gives a comparison of Wisconsin's and Minnesota's motorcycle accident, registration, and accident rate data. Both the accident and accident rate data cover only the last 6 months of 1967 and 1968. On a yearly basis, the total number of motorcycle accidents and accident rates would be considerably higher in both states.

In Minnesota, as in Wisconsin, motorcycle accidents with other moving vehicles occurred most frequently. The most common types of collisions involving a motorcycle and another vehicle were angle (intersection), opposite direction—one left turn and one straight (intersection), entering alley or driveway, same direction—both moving, and one parked. These results agree very closely with Wisconsin's motorcycle accident data.

TABLE 13

ACCIDENT REDUCTION BY DIRECTIONAL ANALYSIS, WISCONSIN

Location and Vehicle Movement	Number of Motorcycle Accidents				Reduction[a]			
	1967		1968		Number		Percent	
	Total	Day + Dusk	Total	Day + Dusk	Total	Day + Dusk	Total	Day + Dusk
Intersection—total	785	602	354	269	431	333	55	55
Entering at angle	421	336	188	148	233	188	55	56
Same direction—one turn and one straight	88	58	47	38	41	20	47	34
Same direction—one stopped	39	31	19	14	20	17	51	55
Opposite direction—one left turn and one straight	180	136	82	55	98	81	54	60
All others	57	41	18	14	39	27	68	66
Nonintersection—total	509	369	300	213	209	156	41	42
Opposite direction—both moving	43	26	29	22	14	4	33	15
Same direction—both moving	106	64	79	47	27	17	25	27
One parked	75	47	45	28	30	19	40	40
One stopped in traffic	62	50	27	20	35	31	56	60
One entering alley or driveway	142	112	60	50	82	62	58	55
One leaving alley or driveway	47	40	42	36	5	4	11	10
All others	34	30	18	10	16	20	47	67
Other	0	0	5	4	(5)	(4)	—	—

[a]Figures represent reductions unless parenthesized; parenthesized figures are increases.

EFFECT OF DAYTIME HEADLIGHT LAWS ON MOTORCYCLE ACCIDENTS

Motorcycle accidents involving another motor vehicle are more frequent and are reduced more by daytime headlights than accidents that involve the motorcycle only. In addition, intersectional accidents are more frequent than nonintersectional accidents and are reduced more by headlights. Similarly, urban accidents are more frequent and are reduced more than rural accidents by the headlight law.

The most frequent types of motorcycle accidents with another motor vehicle are angle (at intersection), opposite direction—one left turn and one straight (at intersection), and same direction—both moving, and less frequently, entering an alley or driveway. The greatest reduction in motorcycle accidents is in the first two types followed by entering an alley or driveway.

These four most frequent accident types may be further classified into two categories: (a) headlight of motorcycle in field of view of opposing driver and (b) taillight of motorcycle in field of view of following driver. Both opposite direction—one left turn and one straight and angle accident types fall into the first category, same direction—both moving falls into the second category, and entering alley or driveway may be in either depending on whether the alley or driveway is on the left or on the right and whether the other vehicle is traveling in the same or opposite direction. The first category has the greatest accident reduction followed by the combination of the two categories (entering alley or driveway). The second category has the least accident reduction.

Thus, it appears that motorcycle accidents in which the motorcycle headlight is in the field of view of the driver of an opposing vehicle are reduced more than are motorcycle accidents in which the taillight is in the field of view of the driver of a following vehicle. This indicates that motorcycle headlights are much more valuable as an accident-reducing measure than are taillights. This was corroborated by the motorcycle noticeability experiments conducted as part of the study (see other reports in this Record).

Table 15 compares total motorcycle accidents, motorcycle registrations, and motorcycle accident rates per 10,000 motorcycles in the states with headlight laws and in the control states. In some cases, the accident and accident rate data

TABLE 14

WISCONSIN AND MINNESOTA ACCIDENT DATA

State	Number of Motorcycle Accidents[a]		Reduction[b]	
	1967	1968	Number	Percent
Wisconsin	1,897	1,016	881	46
Minnesota	521	569	(48)	(9)

State	Motorcycle Registrations		Change	
	1967	1968	Number	Percent
Wisconsin	60,774	60,091	-683	-1
Minnesota	55,887	60,832	+4,945	+9

State	Motorcycle Accident Rate[a] per 10,000 Motorcycles		Reduction	
	1967	1968	Number	Percent
Wisconsin	312	169	143	46
Minnesota	93	93	0	0

[a]For last 6 months of 1967 and 1968.

[b]Figures represent reductions unless parenthesized; parenthesized figures are increases.

TABLE 15

SUMMARY OF MOTORCYCLE ACCIDENT DATA

States	Number of Motorcycle Accidents		Reduction	
	Before Law	After Law	Number	Percent
With headlight laws	4,705	2,823	1,882	40
Control	5,503	5,328	175	3

States	Motorcycle Registrations		Change	
	Before Law	After Law	Number	Percent
With headlight laws	172,760	180,571	+7,811	+5
Control	225,948	240,376	+14,428	+6

States	Motorcycle Accident Rate per 10,000 Motorcycles		Reduction	
	Before Law	After Law	Number	Percent
With headlight laws	272	156	116	43
Control	244	222	22	9

comparisons between the states are for different time periods; therefore, the totals are not directly comparable although the percentage of changes are.

Total motorcycle accidents were reduced 40 percent in the four states with headlight laws as opposed to only 3 percent in the control states. These figures are 43 percent and 9 percent respectively when normalized by motorcycle registrations. Both differences are significant at the 0.01 level.

Table 16 compares daylight and darkness reductions for the four states before and after daytime headlight laws became effective. Dawn and dusk accidents (where these data were broken out) and accidents for which the light condition was not known have not been included under daylight or darkness but are included in the total for for each state.

TABLE 16

DAYLIGHT AND DARKNESS MOTORCYCLE ACCIDENTS IN STATES WITH HEADLIGHT LAWS

States and Light Condition	Number of Motorcycle Accidents		Reduction	
	Before Law	After Law	Number	Percent
Indiana—total	2,028	1,165	863	43
Daylight	1,450	809	641	44
Darkness	487	289	198	41
Montana—total	235	212	23	10
Daylight	189	160	29	15
Darkness	43	35	8	19
Oregon—total	545	430	115	21
Daylight	452	349	103	23
Darkness	93	81	12	13
Wisconsin—total	1,897	1,016	881	46
Daylight	1,262	650	612	48
Darkness	525	312	213	41
Total	4,705	2,823	1,882	40.0
Daylight	3,353	1,968	1,385	41.3
Darkness	1,148	717	431	37.5
Normalized by Registrations				
Total	272	156	116	42.6
Daylight	194	109	85	43.8
Darkness	66	40	26	39.4

The totals of the four states show that daylight accidents were reduced 41.3 percent, whereas nighttime accidents were reduced 37.5 percent. This difference of 3.8 percent, which indicates the effect of daylight headlight operation, is significant at the 0.1 level. The difference is 4.4 percent when normalized by total motorcycle registrations.

The data from these four states prior to passage of headlight laws indicate that approximately 75 percent of the motorcycle accidents occur in the daytime. Based on the total of 252,000 motorcycle accidents in the United States in 1968 (2), 188,000 occurred in the daytime.

If the 3.8 percent figure is applied to the total of daytime motorcycle accidents in the United States, a reduction of 7,140 can be achieved. The cost of all motorcycle accidents was between about $550 million and $805 million in 1968 or $2,000 to $3,200 per motorcycle accident (2, 14, 15). If daytime motorcycle headlight laws were adopted on a nationwide basis, the total yearly savings in reduced motorcycle accidents would be approximately $15.7 million to $22.8 million. Based on a registration of 2,100,547 motorcycles in 1968 (11), these savings range from approximately $7.50 to $10.90 per motorcycle per year.

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