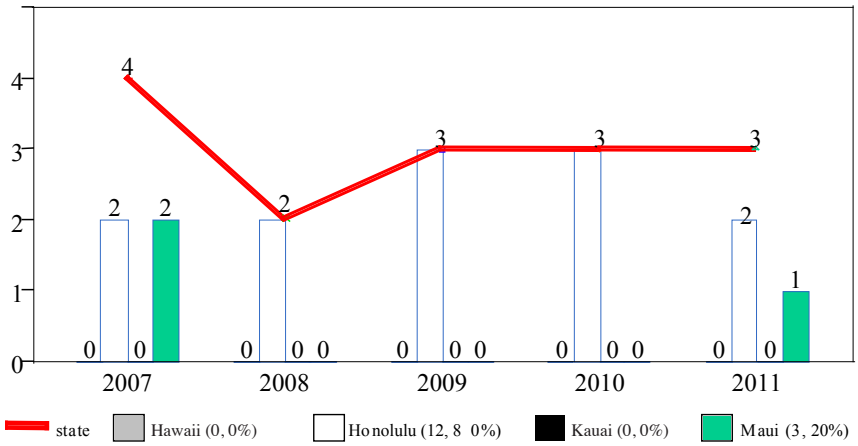
Bicyclists

Fatal injuries

Fatalities among bicyclists were the least common type of fatality from motor vehicle crashes. There were 15 fatalities among resident bicyclists in Hawaii, with the annual total varying between 2 and 4 (Figure 90). Most (80%, or 12) of the victims were injured on Oahu, and the remaining 3 on the island of Maui; there were no deaths on Hawaii or Kauai counties over the 5-year period.

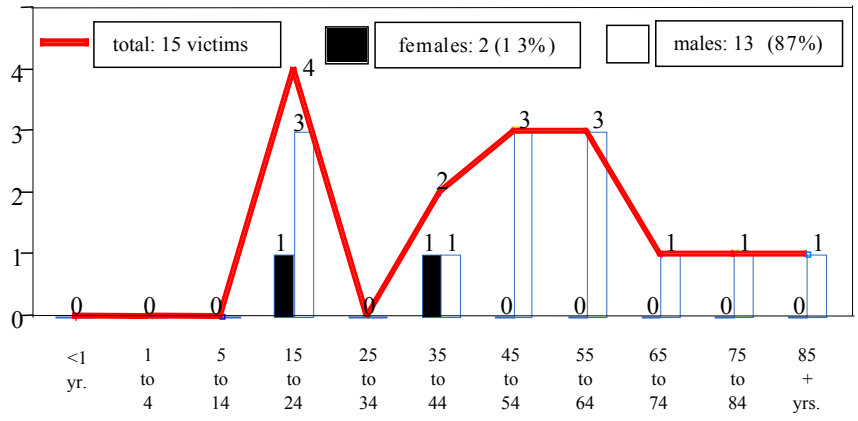
Figure 90. Annual number of bicyclist fatalities among Hawaii residents, by county, 2007-2011.



The age of the victims was broadly distributed over the range of 18 to 86 years (Figure 91). Almost all (87%, or 13) of the victims were males. There were no patterns regarding the month of the crash or the day of the week. About two-thirds (64%, or 9 of 14) of the crashes occurred during daylight hours between 7:31 a.m. to 7:29 p.m., but there were no notable peak times. (This information was missing for 1 crash.)

Only 2 (13%) of the victims were known to be wearing a helmet at the time of the crash. Eleven (73%) were not wearing a helmet, and this information was missing for the remaining 2 bicyclists.

Figure 91. Age and gender distribution of fatally injured bicyclists in Hawaii, 2007-2011.



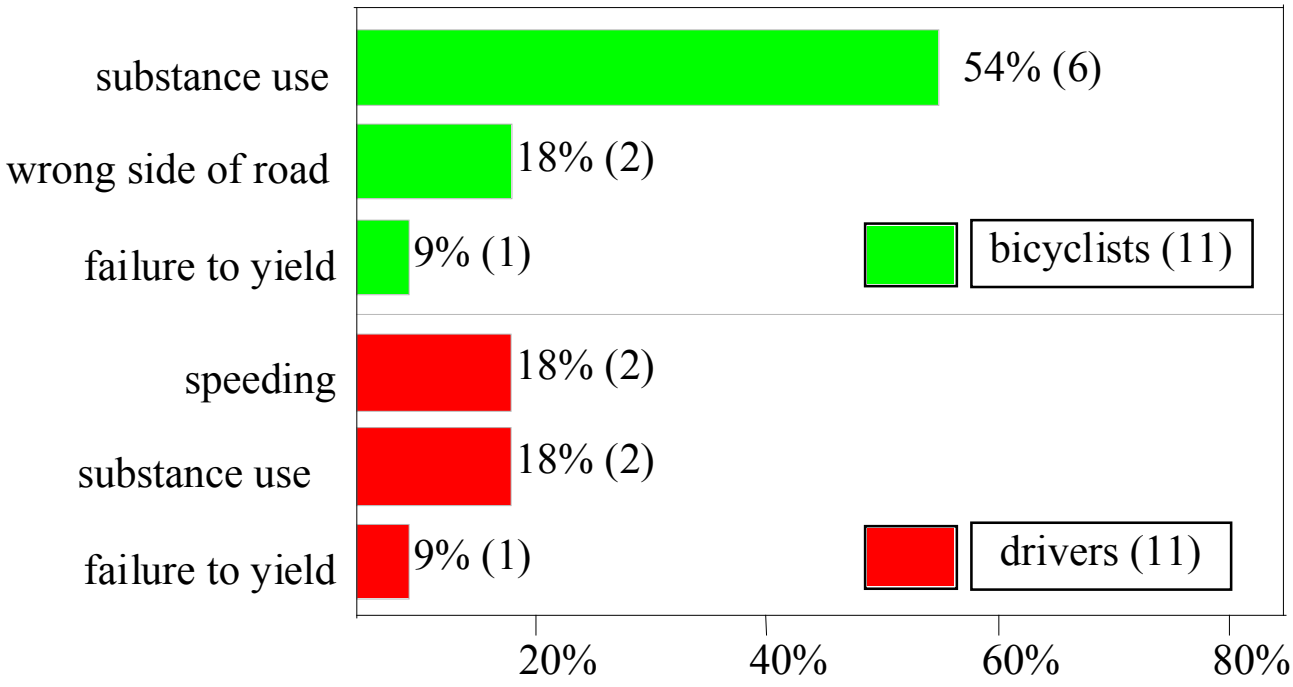
Almost all (13, 87%) of the 15 victims were struck by a motor vehicle. The other bicyclists died as a result of falling off the bicycle. All 11 fatal crashes that involved a motor vehicle from 2007 to 2010 were linked to FARS records. The rest of this section (excluding the maps) will utilize only the data from these 11 deaths.

Most (64%, or 7) of the crashes occurred in a 35 mile per hour zone. One was in a high speed environment (45 mph), and the remaining 3 were in 30 mph or slower zones. Most (64%, or 7) of the crashes occurred on roads with undivided two-way traffic; 3 other crashes were on divided roadways, including 2 on highways, and the remaining crash was on a highway off-ramp. Most (64%, or 7) of the cyclists were hit while on the roadway, with only 2 of those occurring at intersections. Almost all (91%, or 10) of the vehicles involved in the crashes were going straight on the road; 1 vehicle was making a right-hand turn.

Two (18%) of the 11 bicyclists tested positive for alcohol, and 4 (36%) tested positive for drugs, including 2 who had used amphetamines. Overall, about half (54%, or 6) of the victims tested positive for either alcohol or drugs. Only 1 of the 11 drivers involved in the crashes tested positive for alcohol (5 were not tested), and 1 tested positive for drugs (methamphetamine).

Besides substance use among 54% (6) of the bicyclists, 2 were traveling against traffic at the time of the crash and another failed to yield the right-of-way (Figure 92). Four (36%) of the 11 drivers made an error which contributed to the crash, most commonly substance use and speeding (2 instances each).

Figure 92. Contributing factors for fatal bicyclist crashes in Hawaii, by person type, 2007-2010.



The 12 fatal crashes on distributed across 10 districts, with the highest totals (2 deaths each) in the North Shore and Kalihi-Palama districts (Figure 93). There were 3 fatal crashes on the island of Maui, 2 in Wailuku and 1 in Lahaina (Figure 94). There were no fatalities in either Hawaii or Kauai counties over this 5-year period.

Figure 93. Approximate location of fatal bicyclist crashes on Oahu and eastern Oahu (bottom map), 2007-2011.

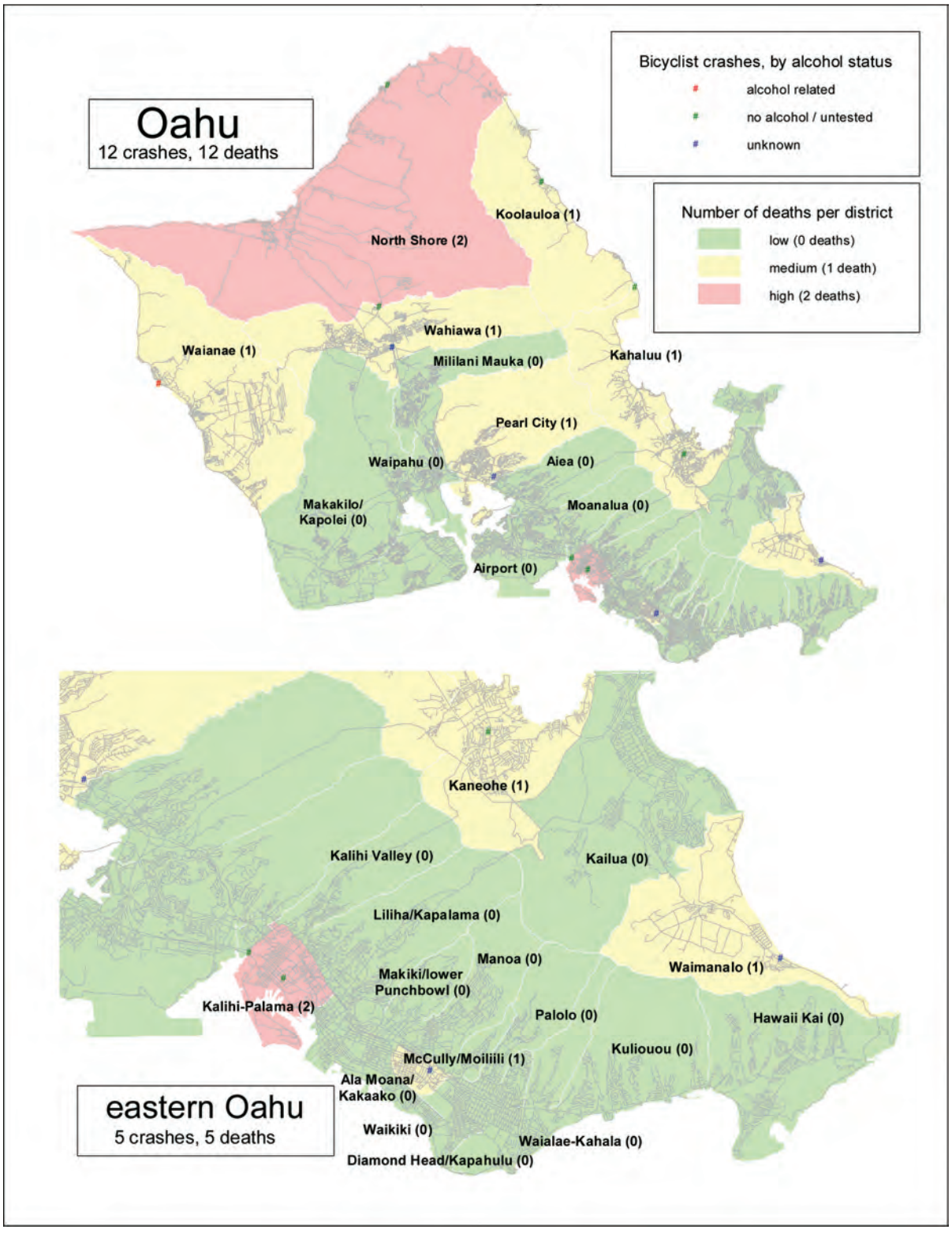
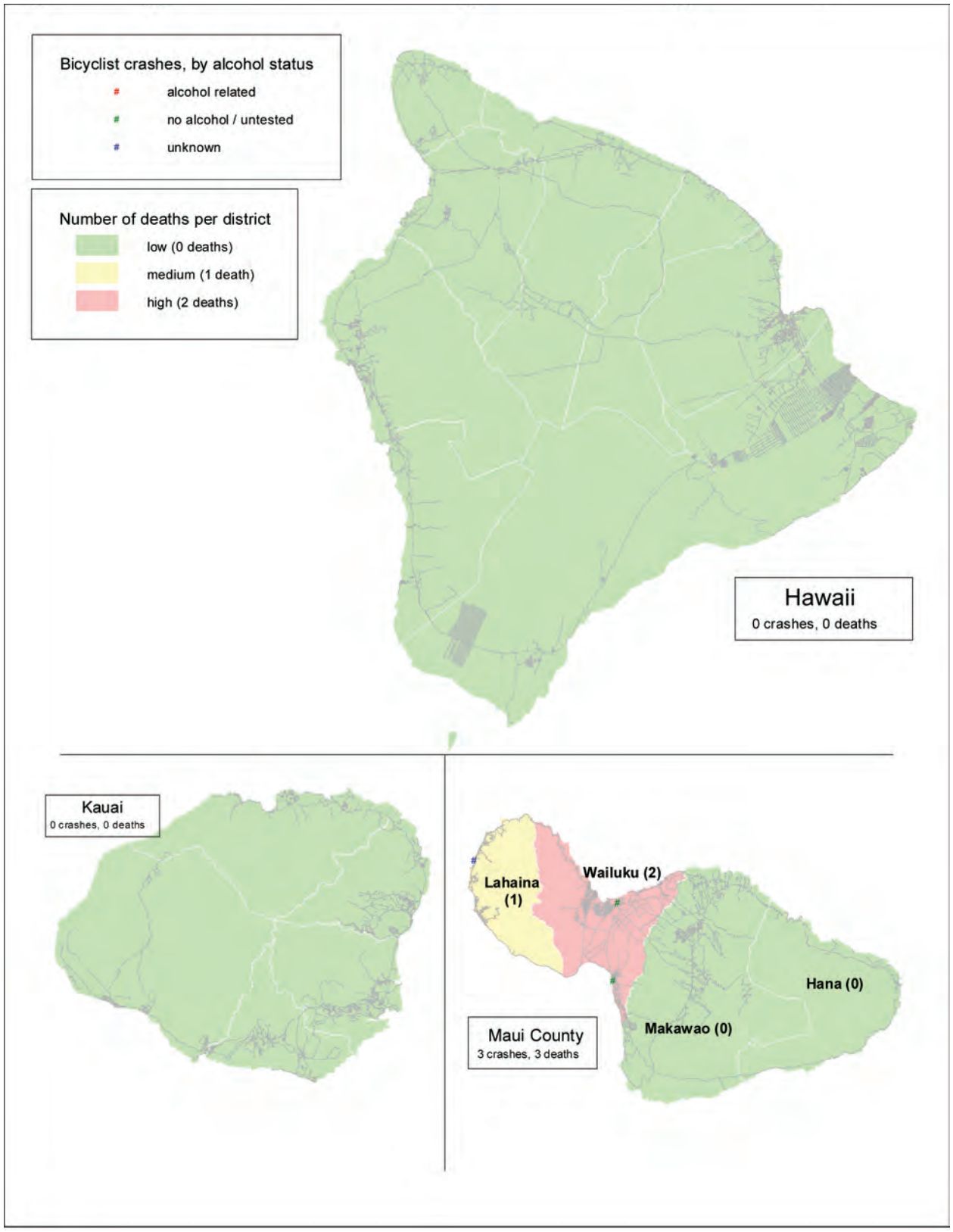


Figure 94. Approximate location of fatal bicyclist crashes on Neighbor Islands, 2007-2011.



Nonfatal injuries

There was a consistent increase in annual number of ED visits for nonfatal injuries among bicyclists over the 2008 to 2011 period (Table 18). There was no apparent trend for the annual number of injuries that required hospitalization. The number of injuries treated in EDs outnumbered those requiring hospitalization by more than a 10-to-1 ratio. Most (75%) of the patients were males, including 80% of those who were hospitalized. Patients who were treated in EDs were significantly younger than those who were hospitalized (average age 27 vs. 39 years, respectively). Almost one-third (32%) of those who were treated in EDs were between 5 and 14 years of age, compared to 20% of those who were hospitalized. Senior residents comprised only about 4% of the patients overall. About two-thirds (63%) of the patients were residents of Honolulu County.

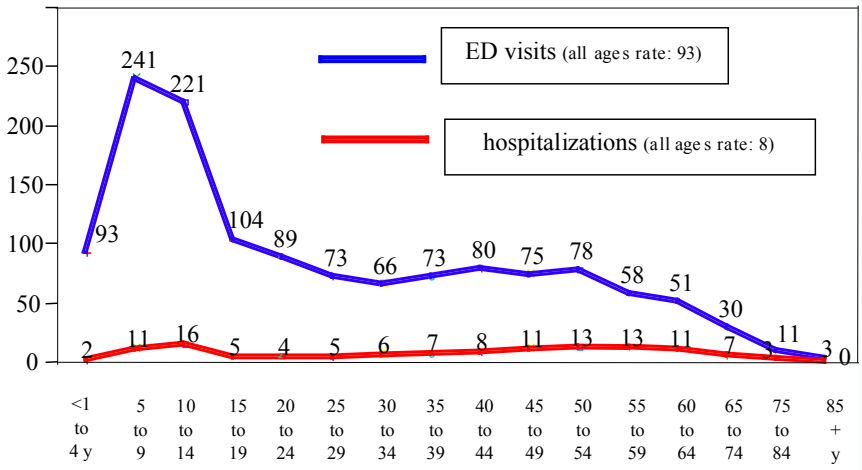
Table 18. Demographic characteristics* of Hawaii residents with nonfatal injuries from bicycle crashes.

	ED visits	hospitalizations	total
Year of admission			
2007	1096	101	1197
2008	1048	121	1169
2009	1091	91	1182
2010	1168	89	1257
2011	1260	121	1381
average annual total	1133	105	1237
Patient gender			
Female	288 (25%)	21 (20%)	309 (25%)
Male	845 (75%)	83 (80%)	928 (75%)
Patient age			
infants	0 (0%)	0 (0%)	0 (0%)
1-4 y	82 (7%)	2 (2%)	84 (7%)
5-14 y	360 (32%)	21 (20%)	381 (31%)
15-24 y	168 (15%)	8 (8%)	176 (14%)
25-34 y	130 (11%)	10 (10%)	140 (11%)
35-44 y	132 (12%)	13 (12%)	144 (12%)
45-54 y	139 (12%)	23 (22%)	162 (13%)
55-64 y	87 (8%)	20 (19%)	106 (9%)
65-74 y	27 (2%)	6 (6%)	33 (3%)
75-84 y	7 (1%)	2 (2%)	9 (1%)
85+ y	1 (0%)	0 (0%)	1 (0%)
County of residence of patient			
Hawaii	185 (16%)	16 (15%)	201 (16%)
Honolulu	715 (63%)	64 (61%)	779 (63%)
Kauai	101 (9%)	8 (8%)	109 (9%)
Maui	131 (12%)	17 (16%)	148 (12%)

*Statistics are annual averages over the 2007-2011 period.

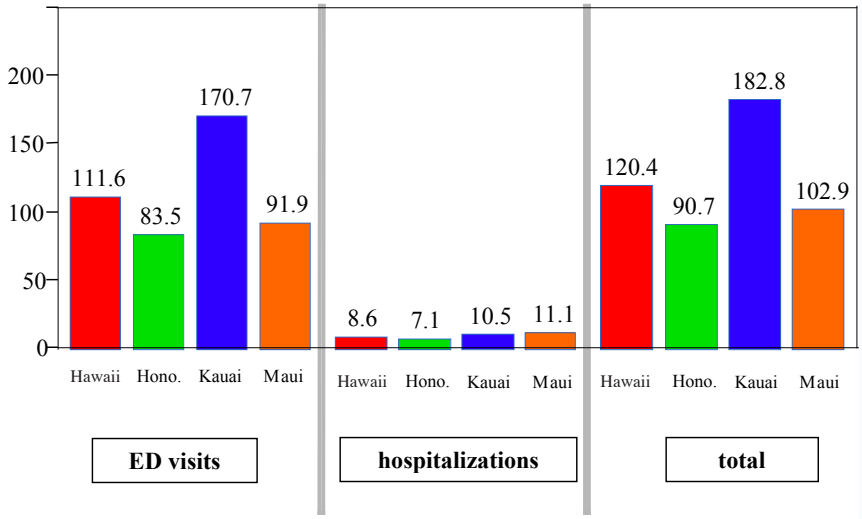
Children aged 5 to 14 years had the highest rates both for injuries treated in EDs and those that required hospitalizations (Figure 95). Combining both types of injuries, rates for 5 to 14 year-olds (244 injuries/100,000 residents) were more than 3 times higher than rates for residents of other ages (74/100,000). Rates for injuries treated at the ED level generally declined among residents aged 50 years and older, while there was a peak in hospitalizations among 45 to 64 year residents.

Figure 95. Average annual rates (per 100,000 residents) of hospitalizations and ED visits for nonfatal injuries from bicycle crashes in Hawaii, by age of patient, 2007-2011.



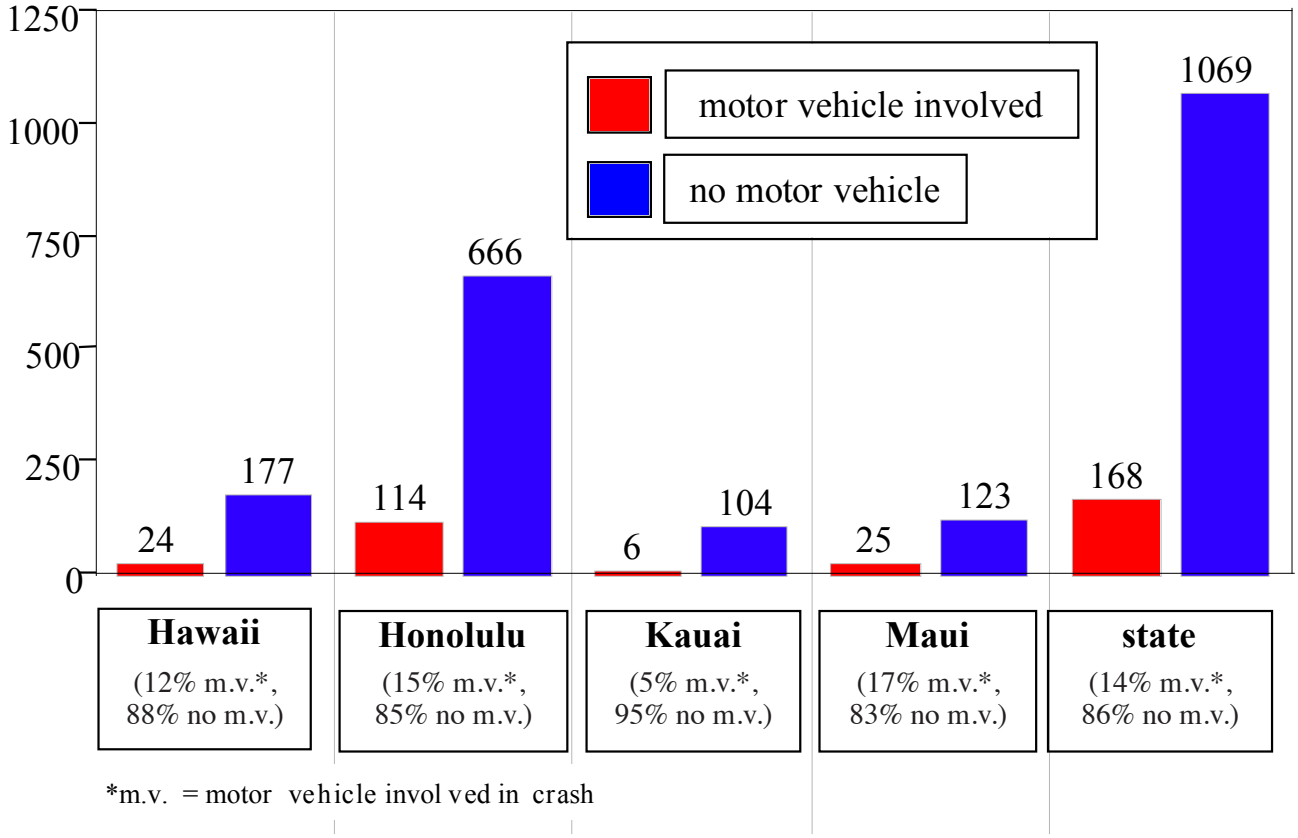
The rate for ED visits for Kauai County residents was significantly higher than the rates for any other county, and approximately double the rate estimates for residents of Honolulu or Maui counties (Figure 96). The rate for Hawaii County residents was also significantly higher than the rates for Honolulu residents, although 35% lower than the rate for residents of Kauai County. Similar relationships were found when comparing rates of all types of injuries (those treated in EDs combined with those requiring hospitalization). There were no significant differences in hospitalization rates between counties.

Figure 96. Age adjusted annual rates (per 100,000 residents) of nonfatal injuries from bicycle crashes, by level of care and county of residence of patient, 2007-2011.



Most (86%) of the injuries resulted from crashes that did not involve a motor vehicle, but were caused by the patient falling off their bicycles or colliding with objects (Figure 97). That proportion was significantly lower among Honolulu and Maui County residents compared to residents of Hawaii or Kauai counties. Proportionally more of the injuries treated in EDs did not involve motor vehicles, compared to crashes requiring hospitalization (88% vs. 71%), perhaps reflecting greater injury severity the latter types of crashes. Forty-percent of the patients who were injured from non-motor vehicle crashes were under 15 years of age, compared to 14% of those who were hit by motor vehicles. Almost all (94%) of the crashes that involved a motor vehicle occurred in traffic environments (i.e. on public roadways).

Figure 97. Average annual number of nonfatal injuries from bicycle crashes in Hawaii, by type of crash and county of residence of patient, 2007-2011.



Although almost all (92%) of the patients were treated in EDs, hospitalizations comprised 32% of the treatment days and 66% of the total medical charges (Table 19). The average hospitalization lasted about 5 days and generated over $36,000 in medical charges. Most (63%) of the hospitalized patients had fractures, including 15% with skull fractures and 20% with leg fractures. Thirty-eight percent of these patients had a traumatic brain injury, compared to 16% of those treated in EDs. Contusions and superficial injuries (26%) and open wounds (25%) were the most common types of injuries among patients treated in EDs, followed by fractures (23%), most commonly of the arms (11%).

Table 19. Clinical characteristics* of Hawaii residents with nonfatal injuries from bicycle crashes.

	ED visits	hospitalizations	total
Length of care and financial charges			
Ave. length of stay (days)	1.0	5.1	1.3
Total number of days	1,133	534	1,667
Average charge	$1,873	$36,192	$4,657
Total charges	$2.1 million	$3.8 million	$5.8 million
Primary injury diagnosis			
fractures	255 (23%)	66 (63%)	321 (26%)
fracture of skull	11 (1%)	16 (15%)	28 (2%)
vertebral column	4 (0%)	4 (4%)	8 (1%)
ribs, pelvis or trunk	70 (6%)	11 (10%)	81 (7%)
humerus	19 (2%)	4 (4%)	23 (2%)
lower arm or hand	116 (10%)	10 (10%)	127 (10%)
femur	2 (0%)	9 (9%)	11 (1%)
lower leg or foot	32 (3%)	11 (11%)	44 (4%)
sprains and strains	96 (8%)	0 (0%)	97 (8%)
internal injuries	59 (5%)	29 (27%)	87 (7%)
open wounds	280 (25%)	5 (5%)	285 (23%)
contusion/superficial	289 (26%)	1 (1%)	291 (23%)
other/unspecified	154 (14%)	3 (3%)	157 (13%)
traumatic brain injury (any priority diagnosis)	184 (16%)	39 (38%)	224 (18%)

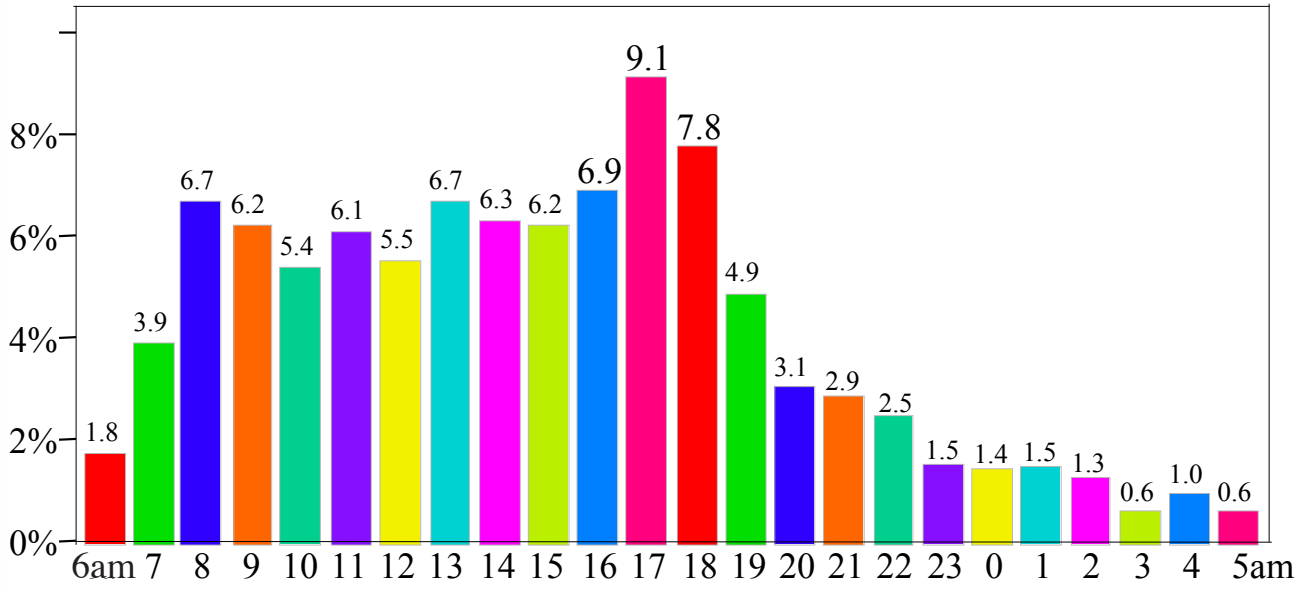
*Statistics are annual averages over the 2007-2011 period.

There were 1,897 EMS records for Hawaii residents who were treated by EMS personnel for occupant injuries over the 2007 to 2011 period. Included in this total were 11 patients who ultimately died from the crashes, since this is an important outcome to examine in terms of helmet usage. (All of these deaths were confirmed by linkage to death certificates.)

The patients were injured in 1,870 separate crashes, as nearly all (99%) crashes involved only a single patient. Most (73%, or 1,366) of the crashes were distributed over the 11-hour period of 7:31 a.m. to 6:29 p.m., with a peak from 4:31 p.m. to 6:29 p.m. (17%, or 318) (Figure 98). This time distribution was similar for crashes that involved motor vehicles and those that only involved bicyclists. Almost one-third (31%, or 583) of the crashes occurred on a weekend, including 17% (311) on Sundays.

Figure 98. Time distribution of EMS-attended bicycle crashes, 2007-2011.

(Horizontal scale indicates time of EMS dispatch, rounded up to nearest hour (military time scale, starting at 6:00am). Vertical scale indicates percent of all crashes with injured bicyclists, rounded to nearest whole number.)



The 4 highest crash locations on Oahu were in the metropolitan Honolulu area, including 134 in the Ala Moana/ Kakaako Neighborhood Board (Figure 99). There were also high numbers in the North Shore and Kailua. South Hilo district had the highest total in Hawaii County, and most of the crashes on the island of Maui were in either Wailuku or Lahaina (Figure 100). There were only 8 crashes on the island of Molokai and 2 on Lanai (not shown on the Figure).

Figure 99. Number of EMS-attended bicycle crashes on Oahu and eastern Oahu (bottom map), by Neighborhood Board, 2007-2011.

(Percent of all EMS-attended crashes in the state is shown in parentheses.)

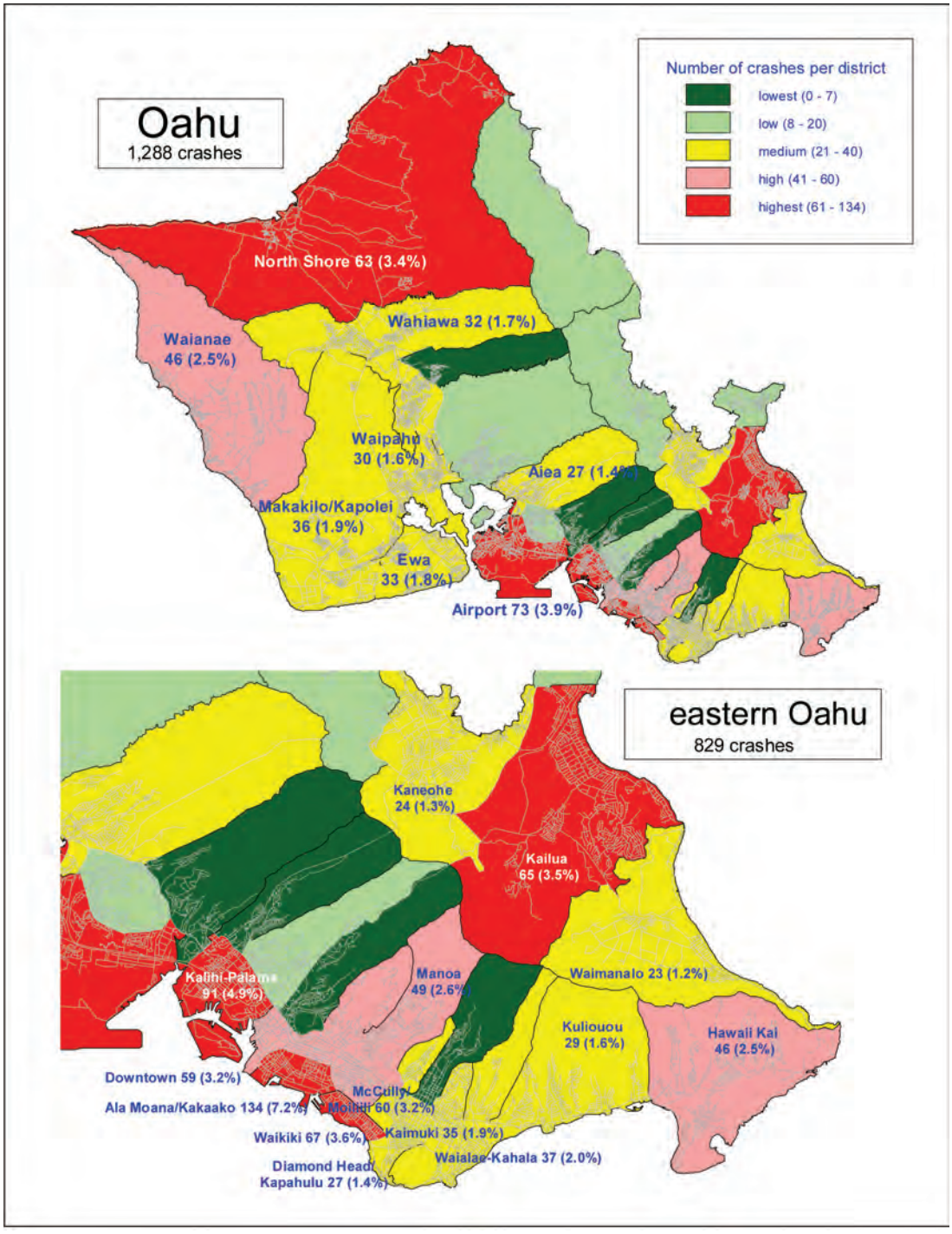
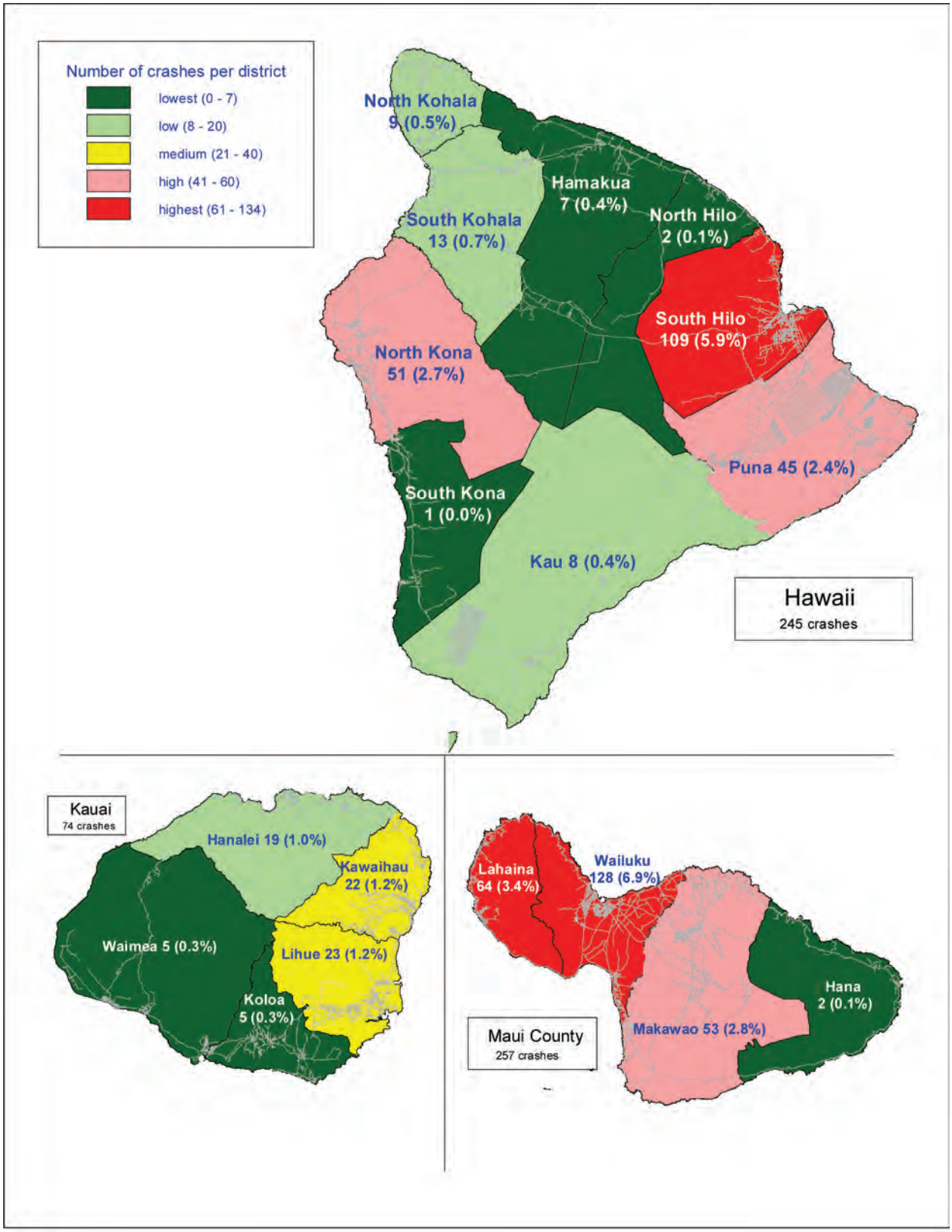


Figure 100. Number of EMS-attended bicycle crashes on Neighbor Islands, by district, 2007-2011.

(Percent of all EMS-attended crashes in the state is shown in parentheses.)

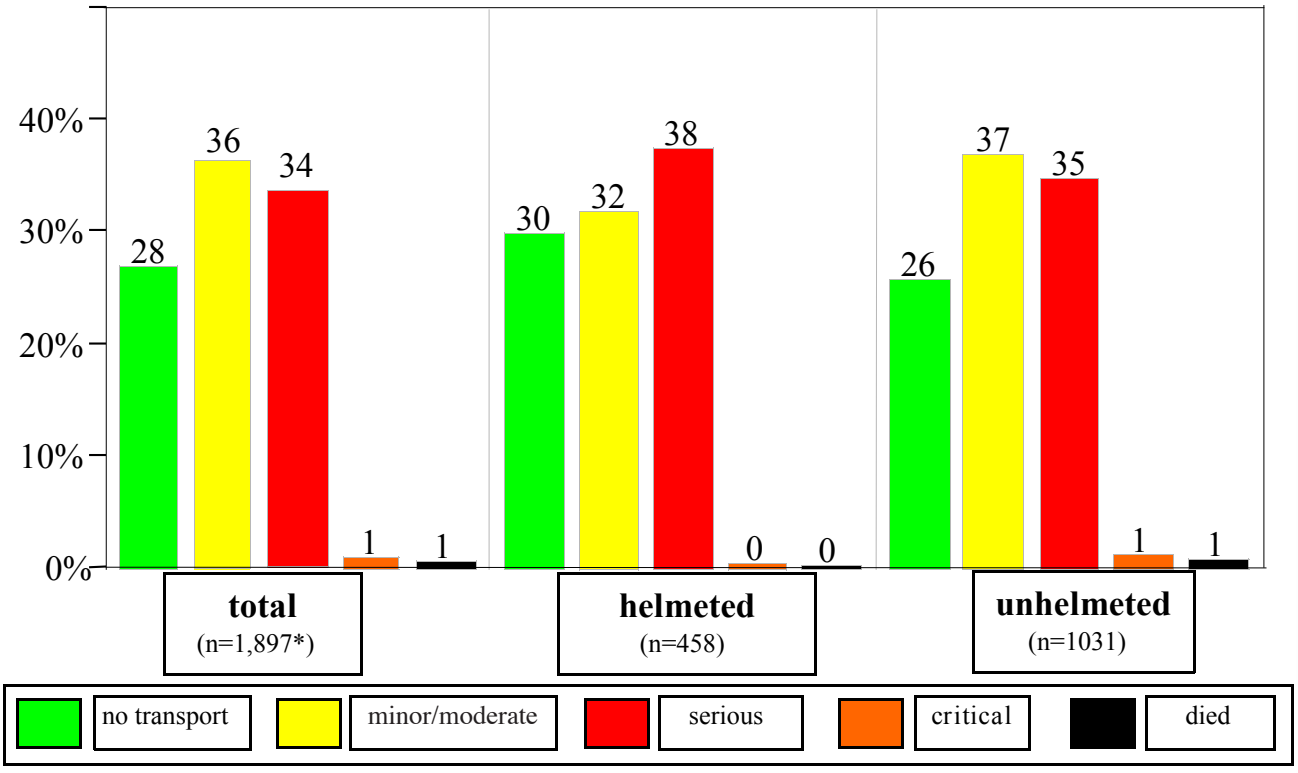


About half (45%, or 856) of the bicyclists were injured in crashes involving a motor vehicle, 29% (554) in crashes involving only bicycles, and 26% (487) in crashes in which this status was not known. Because of software changes, crash type was known for all 1,177 patients injured during the 2009 to 2011 period: 53% of the injuries involved motor vehicles and 47% did not. There was also a significant proportion (22%, or 408) of patients for whom helmet usage was not recorded, although this information was nearly complete for years 2009 and 2010: 27% (187) of the 700 bicyclists wore helmets, 71% (493) did not, and this status was unknown for the remaining 2% (12) of riders. For this 2-year period, helmet usage was more common among bicyclists injured on weekends (33%, vs. 24% for those injured during the week), and in daytime crashes (29% vs. 17%, respectively). Helmeted riders were significantly older (41 years on average, vs. 35 years), and more likely to be female (30%, vs. 23% females among unhelmeted bicyclists).

There were relatively few injuries graded as "critical" (1%, or 18), or which resulted in death (0.6%, or 11) among the injured bicyclists (Figure 101). More than one-quarter (28%) of the patients did not require transport to hospitals, and roughly equal numbers were transported with minor or moderate injuries (36%) or serious injuries (34%). Bicyclists injured in crashes that did not involve motor vehicles were surprisingly less likely to be released at the scene (23%, vs. 32% for those hit by motor vehicles), and more likely to be transported in serious condition (39%, vs. 31%). Crashes involving motor vehicles were significantly more likely to result in fatal injuries (1.2%, or 10 of 856), compared to crashes that only involved bicyclists (0.2%, or 1 of 554), however.

Patient condition was generally comparable between helmeted and unhelmeted bicyclists, except for the most serious injuries. Unhelmeted riders had a significantly higher proportion of "critical" or fatal injuries (2.1%, or 22 of 1031), compared to helmeted riders (0.7%, or 3 of 458). These differences were accentuated among crashes that involved motor vehicles, as the proportion of unhelmeted bicyclists with critical or fatal injuries was 3.1% (17 of 540), compared to 0.9% (2 of 214) among helmeted riders. This difference was only of "borderline" statistical significance, however (p=0.08).

Figure 101. Distribution of injury severity/transport status of bicyclists treated by EMS personnel, by age group, 2007-2011.



*Includes 408 riders with unknown helmet use status.

Probable alcohol use was noted for about 9% of the patients, as EMS personnel documented physical evidence (e.g. containers) at the crash scene, alcohol odor on the patients' breath, or the patient admitted to alcohol consumption (Table 20). Patients who used alcohol were significantly older than other patients and were more likely to be male. Weekend and night time crashes were also more likely among the drinkers. Only 4% of these patients were wearing helmets at the time of the crash, although this status was not known for 32% of these patients. If only the 906 bicyclists with known alcohol and helmet status were considered, helmet use was 5 times higher among those who did not consume alcohol (35%), compared to the drinkers (5%). Patients who had used alcohol had generally worse dispositions, with a significantly lower proportion that were released at the scene and a higher proportion (49%) transported in "serious" condition.

Table 20. Characteristics of bicyclists treated by EMS personnel, by category of alcohol use, 2007-2011.

	Alcohol use (n=171, 9%)	No alcohol use (n=1,033, 54%)	No data/unknown (n=693, 37%)
Average age (years)	42 years	35*	37*
Gender (% male)	86%	74%*	74%*
Helmet usage			
helmeted	4%	27%*	25%*
unhelmeted	64%	49%*	59%
unknown	32%	24%*	16%*
Disposition			
no transport	16%	29%*	30%*
minor/moderate injuries	32%	37%	35%
serious injuries	49%	32%*	33%*
critical injuries	1.2%	0.7%	1.3%
died	1.8%	0.7%	0.1%
Weekend crash (Sat/Sunday)	39%	28%*	34%
Nighttime crash (8 pm - 5 am)	49%	11%*	16%*

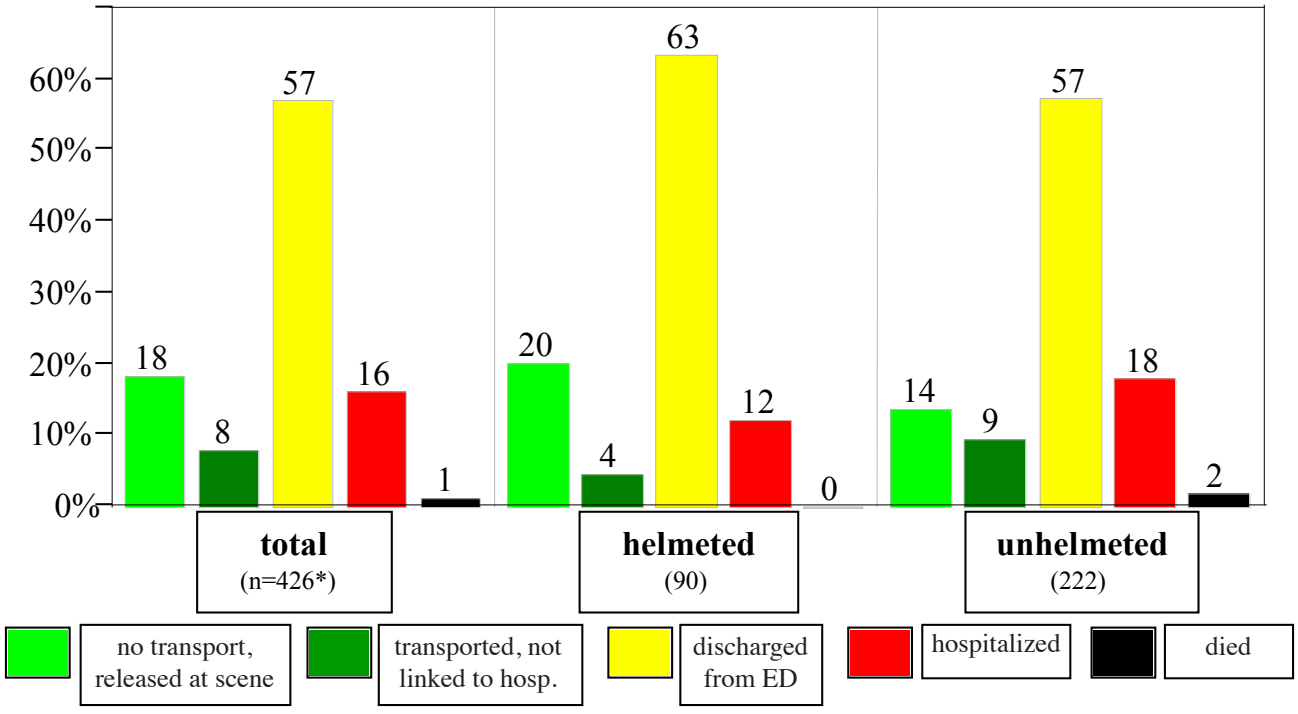
*Indicates statistically significant difference between riders who used alcohol vs. other riders.

This section summarizes results from the 2007 EMS data that was linked to multiple data systems: FARS, death certificates, DOT reports, and hospital records. Only 37% (157) of the 426 EMS records for injured Hawaii residents were probabilistically linked to DOT records, a lower proportion compared to injured occupants (72%, see page 63). This indicates many of these injuries resulted from crashes that did not involve motor vehicles. Hospital records were deterministically linked to 90% (287) of the 319 patients who were transported to hospitals by EMS. Hospital records were also linked to 25 additional EMS patients who refused EMS transport but apparently took private vehicles to hospitals.

Only 21% (90) of the injured bicyclists were known to be wearing helmets at the time of the crash, 52% were not wearing a helmet, and this status was not known for the remaining 27% (114) patients.

About two-thirds (65%) of the bicyclists were eventually discharged from the ED, including 57% for whom ED records could be located (Figure 102). Only 18% were released at the scene, 16% were eventually hospitalized, and 4 (none of whom were wearing helmets) ultimately died from their injuries. Patient disposition was generally better among helmeted bicyclists, as they were more likely to have been released at the scene and less likely to have suffered injuries requiring hospitalization than unhelmeted riders. None of these differences were statistically significant, however. The two groups were also comparable in the incidence of TBI (29% and 28%, respectively), average medical charges, and length of hospitalization. These comparison are limited, however, by the large proportion (27%) of patients with unknown helmet status and the relatively small sample size, especially for serious injuries.

Figure 102. Final medical disposition of bicyclists treated by EMS personnel, by helmet use, 2007



* Includes 114 riders for whom helmet status was not known.

The odds of sustaining an injury that required hospitalization or resulted in death were 80% higher among unhelmeted rides compared to helmeted riders, although this estimate was only of "borderline" statistical significance (p=0.11) (Table 21). (These statistical models did not included the 114 patients with unknown helmet status.) If only crashes that included motor vehicles were included, unhelmeted riders had nearly 4 times (3.7) the odds of a hospitalization or a fatal injury. This estimate was statistically significant, although it was based on only 3 hospitalizations among the helmeted riders and did not include 237 bicyclists (56% of the total) for whom helmet usage or crash type was not known. There was little association between helmet use and the odds of a TBI.

Table 21. Adjusted* odds ratios for adverse medical dispositions among bicyclists treated by EMS personnel, by helmet use, 2007

(Odds ratio 95% confidence intervals given in parentheses.)

	All crashes		Crashes involving motor vehicles	
Restraint group	**number (% of group)**	**odds ratios**	**number (% of group)**	**odds ratios**
Odds of no transport (released at scene) or discharged from ED, vs. hospital admission or death				
helmeted	44/222 (12%)	1.0 (reference)	3/43 (7%)	1.0 (reference)
unhelmeted	11/90 (20%)	1.8 (0.9 – 4.0)	28/138 (20%)	3.7 (1.2 – 16.4)
Odds of traumatic brain injury				
helmeted	20/68 (29%)	1.0 (reference)	5/31 (16%)	1.0 (reference)
unhelmeted	47/168 (28%)	1.0 (0.5 – 1.9)	25/104 (24%)	1.8 (0.6 – 6.0)

*Adjusted for occupant age, gender, and county in which crash occurred.

Trauma Registry data

Only 11% of the injured bicyclists in the HTR had been drinking at the time they were injured (Figure 103). This percentage was nearly three times higher among those hurt in crashes that did not involve a motor vehicle compared to those who were hit by motor vehicles (15% vs. 6%, respectively). Most (87%, or 27) of the 31 riders who tested positive for alcohol had BAC levels of 0.08% or higher. About one-quarter of the bicyclists tested positive for illicit drugs, and this proportion did not differ by the type of crash. Narcotics were the most commonly found illicit drug (17% of patients), followed by THC (13%), and amphetamines (7%). Overall, one-third (33%, or 89) of the 271 patients tested positive for either alcohol or drugs.

Alcohol use was not significantly associated with patient age, gender, or the day of the week of the injury, but alcohol positive bicyclists were twice as likely to have been hurt during nighttime (55%) compared to non-drinkers (25%). None of the 28 bicyclists who had been drinking were wearing a helmet at the time of the crash, compared to 27% usage among those who tested negative for alcohol, and 31% among those who were not tested. Alcohol use was not significantly associated with final disposition of patients.

Figure 103. Alcohol and/or drug use (percent) among bicyclists in the Hawaii Trauma Registry, by type of crash, 2008-2011.