

# A GIS Analysis of Motor Vehicle Injuries in Ventura County, California

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## Abstract

An analysis of motor vehicle injuries in Ventura County, California, revealed a variety of spatial patterns that depend on the age of the victims. Vehicle injury data were selected from 25,000 transport records collected by Ventura County Emergency Medical Services (EMS) and were geocoded. Of 3,275 motor vehicle injuries in 1996 requiring emergency transport, 554 were to 15- to 19-year-olds. This age group represents only 7% of the population but incurred 17% of vehicular injuries. While no address information was recorded, each record contained a Thomas Brothers map book grid coordinate, which was geocoded using an Avenue script for ArcView 3.0a. The locations of these injuries were aggregated using kernel filtering in ArcView Spatial Analyst to produce a density surface on a 200-meter grid. The collocation of the three greatest peaks in teenage motor vehicle injuries with the three large high schools in the county is notable, and has been used by health educators and EMS to target education and prevention efforts. In addition, an experimental Web site has been set up so that the data can be interactively explored on the Internet.

Keywords: injury, motor vehicle, Internet, Ventura County, public health

## Introduction

Motor vehicle accidents were the cause of more than half of all injuries requiring emergency medical transport in Ventura County, California, in 1996. With the cooperation of the Ventura County Emergency Medical Services (EMS) office, the Ventura County Health Department performed a geographic and statistical analysis on selected injury data collected on persons who were transported by ambulance to hospitals. The aim was to quantify the number and location of injuries to children and teenagers due to motor vehicles. An additional goal was to create a prototype Web site, where the map data could be queried online and different aspects of the dataset could be explored.

## Data

Out of over 30,000 EMS runs in Ventura County in 1996, 9,542 were to transport persons with injuries. (The data collected were actually from the beginning of December 1995 through the end of November 1996.) Of those 9,542, 4,907 were classified as "MV," or injuries received in motor vehicles. Another 1,563 were attributed to falls. Gunshot wounds, stabbings, and assaults accounted for 1,783 more. Of the rest, 380 were simply

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classified as "other," while the balance was attributed to pedestrian injuries from cars, burns, near-drownings, and other causes.

## Analysis

A spatial analysis was performed on the data using locational information coded for the scene of each injury. As part of the dispatch process, a map grid coordinate for each run was entered from the Thomas Brothers map book (1). While no address information was available, these half-mile grid cells provide sufficient resolution for certain kinds of analysis, including the production of countywide maps. The analysis was performed with ArcView 3.0 and ArcView Spatial Analyst (ESRI, Redlands, CA), along with custom software written to convert the Thomas Bros. grid references to locations on the map.

The center of each grid cell was coded with an attached value for each of the injury types investigated. This resulted in a map with a regular grid of points whose size was displayed proportionate to the number of specified injuries recorded in that area. This is an effective mapping technique for small numbers of occurrences. For large numbers, a different analytic technique, kernel filtering, was utilized. This involved interpolating the value of each grid point to create a smooth surface representing an estimated value for every place on the map. These values were then classed to create a choropleth map.

For presentation on the Internet, the data have been stored on a Web server running ESRI's ArcView Internet Map Server. (The demonstration Web site can be found at <http://asosan.geog.ucsb.edu/maps/vtainjury.html>.) This application comes with a Java applet that allows users of properly configured Web browsers to view and query the data at a variety of scales. For users of ArcView GIS, the MapCafe Java applet presents map layers in a familiar format. A sample of previously performed analyses can be viewed along with other layers, such as streets, high schools, and political boundaries. These analytic layers (or "themes," in ArcView parlance) can be individually turned on or off to create different map views.

## Results

Overall, the geographic distribution of motor vehicle injuries in Ventura County is similar to the spatial distribution of people (see theme "MV accident density per sq. km" at the demonstration Web site). This means that the rate of injury is relatively constant from place to place. Exceptions to this appear in rural areas with busy highways. For instance, Highway 126 east of Fillmore has far more injuries than would be expected based on the size of the local population (see theme "MV injury per 100k pop"). Obviously, however, this highway and other rural roads serve more than the local population, and it is likely that those injured were not local residents. (We cannot verify this, however, because the home addresses of the victims were not recorded in this dataset.)

This general pattern is slightly different when only injuries to children and teenagers are considered (see theme "u20 MV PA injuries per sq. km"). As might be expected, these show more local foci, and a pattern emerges that reflects the locations of schools. This pattern is further reinforced when only motor vehicle injuries to teenagers 15–19 years are mapped (see theme "MV injuries to 15–19 year olds"). Over half of all

motor vehicle injuries to children and teenagers are incurred by this age group. While adolescents of this age represent only about 7% of the population, they incur nearly 17% of the injuries.

Distinctive peaks occur on the map on Moorpark Road near Thousand Oaks High School in Thousand Oaks, and at the intersection of Ventura Road and Gonzales, near Oxnard High in Oxnard. This last place was the site of 17 injuries to teenagers, nearly twice as many as any other single location on the map.

An examination of the numbers of injuries to teenagers compared with juveniles of other ages shows a striking increase once they become old enough to hold a license (Table 1). There is no such corresponding increase in injuries to pedestrian teenagers (Table 2).

**Table 1** Motor Vehicle Injuries, Ventura County, CA, 1996

	Age (years)				Sum
	0-4	5-9	10-14	15-19	
Girls	41	36	69	259	405
Boys	44	33	39	259	375
Sum	85	69	108	518	

Source: (2)

**Table 2** Pedestrian-Auto Injuries, Ventura County, CA, 1996

	Age (years)				Sum
	0-4	5-9	10-14	15-19	
Girls	11	5	23	16	55
Boys	14	26	34	25	99
Sum	25	31	57	41	

Source: (2)

## Discussion

The overall motor vehicle injury rate for different places in Ventura County is mostly a function of population. There is little difference from city to city in the aggregate. When specific areas are examined, however, there are distinctive local differences. Because of the nature of the data collected for this report, it is not generally possible to locate specific accident sites. In certain cases, however, such as with the data for injuries near Ventura Road and Gonzales in Oxnard, it may be reasonable to assume that most of the accidents in that area occurred at the intersection of those two streets.

When data for specific sub-populations such as teenagers are viewed, the pattern of injuries becomes more distinct from the population distribution. In this case, the spatial behavior of teenagers is revealed in relation to high schools through their motor vehicle injuries. This offers the potential for traffic enforcement, emergency preparedness, and education directed at these specific groups and places.

Presentation of these data in map form on the Internet allows users with many different interests and responsibilities to adjust their view of the county data to fit their specific needs. While there may be a variety of underlying causes for the patterns revealed in these data, the potential for understanding them may be increased by both the presentation and distribution schemes described here.

## References

1. Thomas Brothers. 1998. *1998 Ventura County Thomas guide*. <http://store.thomas.com/thomasbros/3053.html>.
2. Ventura County Emergency Medical Services. 1996. Vehicle injury data. Ventura County Emergency Medical Services, Ventura County, CA.