Poster presentation

US Bicycle Traffic Fatalities: Trends & Characteristics

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Abstract:

Using the Fatality Analysis Reporting System database maintained by the National Highway Traffic Safety Administration, nearly 4000 bicycle fatalities recorded on American roads during the period 1994-98 are examined with respect to a number of demographic and environmental variables. Among the most important are the age distribution and gender split of the victims, seasonal variations, light condition at time of crash (day, night, or twilight), type of road involved (urban vs rural, major vs minor, etc), and location (link vs junction). Short-term and long-term secular variations are also evaluated, and compared with similar data from other transport modes (pedestrians, motorcyclists, and motor vehicle occupants in general) to illustrate how traffic fatality trends continue to evolve among US bicyclists, and how they have been influenced by the profound demographic revolution in American cycling characteristics observed over the past several decades. Some suggestions are also presented for dealing with the most serious and identifiable traffic safety problems, particularly those involving bicyclists out riding after dark.

INTRODUCTION:

FIGURE 1 **US Traffic Fatalities: 1975 - 1998**

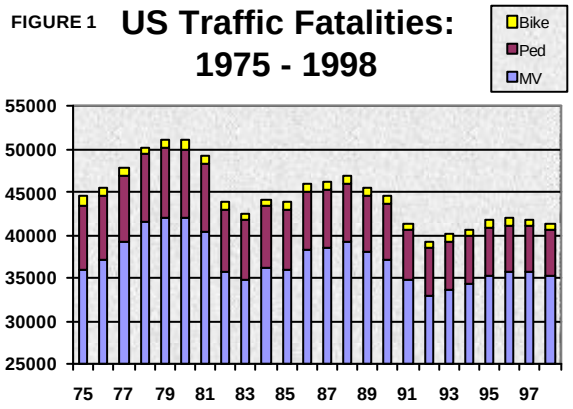


Figure 1 provides an overview of US traffic fatalities since 1975, the first year such data began being collected by NHTSA from the various states on standardized FARS forms. Traffic fatalities in the US have long been dominated by motor vehicle occupants, much more so than in virtually any other society. Note that bicyclists have seldom constituted much more than 2% of the total.

FIGURE 2 **Fatality Trends: 1975=100%**

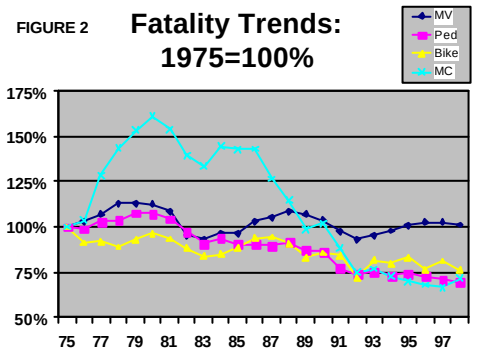


Figure 2 illustrates the long-term fatality trends in the various modes since 1975, using that year as a basis for comparison.

DEMOGRAPHIC REVOLUTION:

FIGURE 3 **Bike Fatalities: 1975 - 1998**

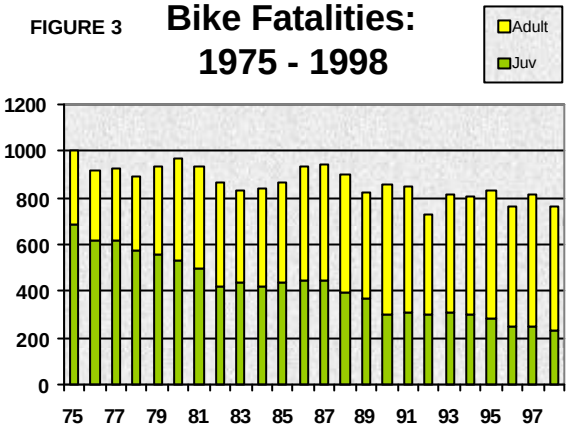


Figure 3 looks at the number of bicycle traffic fatalities on a year-by-year basis since 1975, and shows how the relative number between "adults" (aged 16 or over) and "juveniles" (under 16) has radically changed—even while the total number has been gradually declining.

FIGURE 4 **Bike Fatality Trends by Age Group**

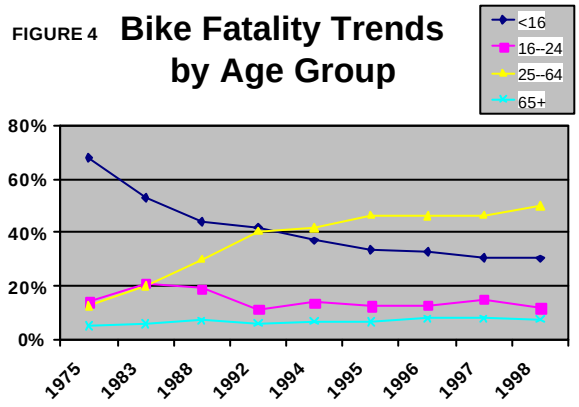


Figure 4 examines this demographic revolution in more detail, tracing the relative share of total bicycle fatalities over time within four broadly defined age groups: juveniles (<16), young adults (16-24), mature adults (25-64), and seniors (65+).

Unlike most countries, cycling in the US has long been regarded as primarily an activity of childhood, to be left behind once one became old enough to acquire a driver's license and access to an automobile. Back in 1975 over 2/3 of all bicycle traffic fatalities were juveniles while mature adults were just 1/8 of the total. Over the past several decades however, the number of children encouraged to take up cycling has fallen dramatically, while the number of mature adult cyclists has grown at a somewhat slower rate to partially offset what would otherwise be an enormous decline in bicycle fatalities. As of 1998, just 30% of all bicycle fatalities were still juveniles, while mature adults now make up 50% of the total.

FIGURE 5 **Age Dist of Fatalities Relative to Population**

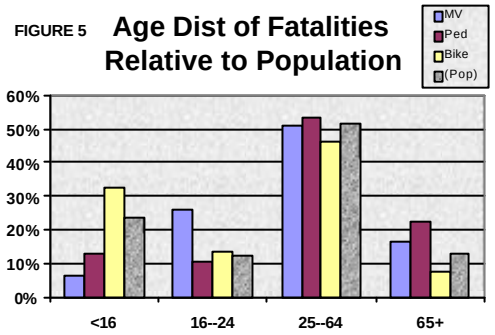


Figure 5 shows the current age distribution of bicycle fatalities relative to motor vehicle occupants (MV), pedestrians, and the population in general (note that in this and all other non-trend figures, the fatality data depicted is an average derived from the 1994-98 FARS online database). Despite the demographic revolution described above, note that juveniles are still considerably over-represented in bicycle fatalities, just as young adults are in MV fatalities, and seniors are in pedestrian fatalities. Likewise, note that juveniles are considerably under-represented in terms of MV fatalities, and to a lesser degree pedestrian fatalities; and that seniors are

under-represented in terms of bicycle fatalities.

FIGURE 6 **Bike & Ped Share of Fatalities by Age Group**

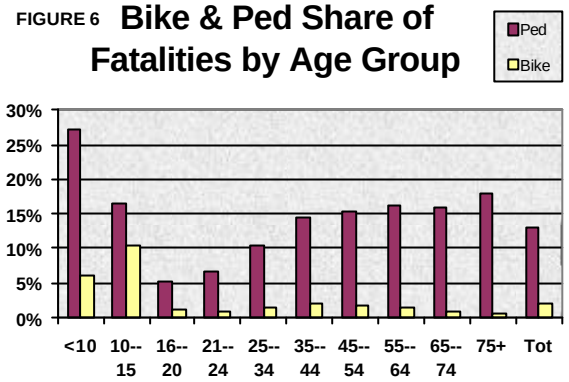


Figure 6 shows the relative share of bicycle and pedestrian fatalities of total traffic fatalities within each specific age group. Note that with the exception of the juvenile age groups, bicycle fatalities constitute just 1-2% of total traffic fatalities in all other age groups; and even in the 10-15 age group, bicycle fatalities are still just 10% of the total and continuing to shrink.

GENDER:

FIGURE 7 **Female Fatality % Trend by Mode**

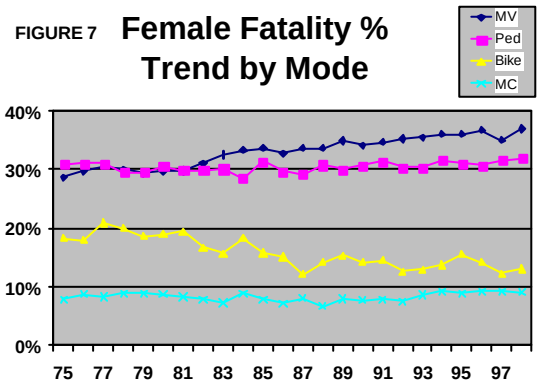


Figure 7 illustrates the gender split within the various traffic fatality modes, and how it has evolved over time. Note that while the gender split has remained fairly stable for pedestrians and motorcyclists (31% and 9% female involvement respectively), and has decreased for motor vehicle occupants (from 28% to 37% female involvement since 1975), it has actually increased with respect to bicyclists (from 20% female involvement in the late 1970's to just 12-13% currently).

FIGURE 8 **Female Fatality % by Age Group**

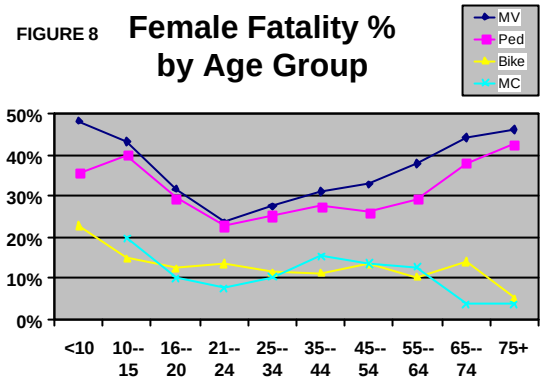


Figure 8 points out how the gender split varies with age for the different fatality modes, and rather remarkably how females in the mature adult age groups (25-64) constitute a smaller percentage of bicycle fatalities compared with any other mode, including the traditionally male-dominated motorcycle fatalities.

FIGURE 9 **Bike Fatality Day % by Age & Gender**

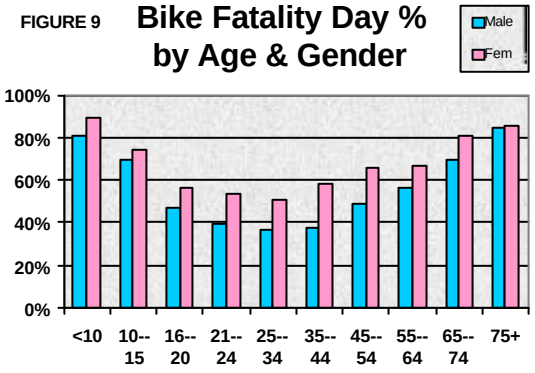


Figure 9 demonstrates the greater likelihood that female bicycle fatalities will occur during daylight compared with their male

counterparts for all age groups except the very oldest.

DAY vs NIGHT:

FIGURE 10 **Daylight Fatality % by Age & Mode**

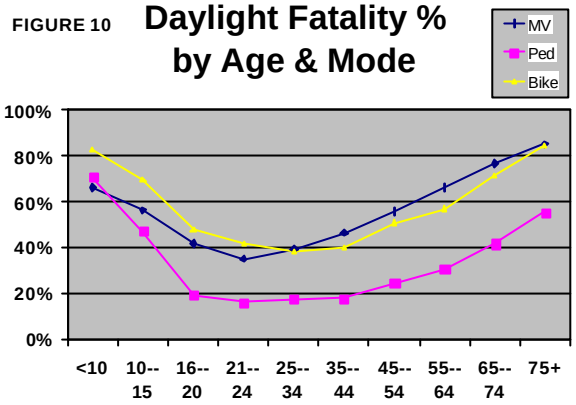


Figure 10 takes the age dependent relationship for day vs night bicycle fatalities seen in Figure 9 and compares it with similar relationships for pedestrians and motor vehicle occupants. Note that all modes start out at the youngest ages with very high daylight involvement rates, but that this plunges quite rapidly during the teenage years and bottoms out in the 20's and 30's before seeing a gradual rise again in the older age groups. While pedestrians have by far the greatest relative involvement with nighttime fatalities, except for the very youngest age group, note that for all ages 25 and older a smaller fraction of bicycle fatalities take place in daylight than for motor vehicle occupants.

This is quite remarkable in view of the much smaller fraction of cycling that takes place at night relative to motor vehicle use. Unlike most countries in which the majority of cycling is transportational or utilitarian in nature, the vast majority of cycling in the US is either primarily for recreation or exercise, or is still being over-represented by juveniles. Neither of these groups tend to do any significant riding at night (probably on the order of 5% or less), which leaves few adult bicycle commuters or utilitarian riders that would have nighttime exposure rates comparable to motorists or transportational cyclists elsewhere.

FIGURE 11 **Nighttime Fatality % Trend by Mode**

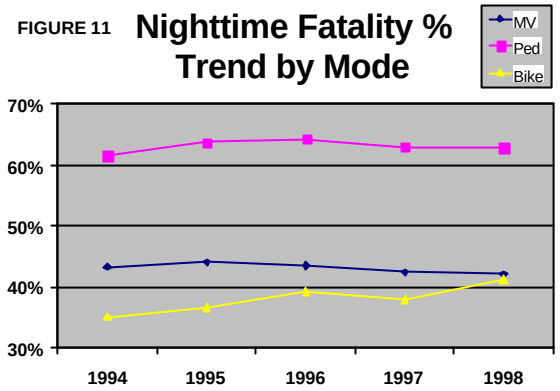


Figure 11 indicates that the problem with nighttime cycling fatalities is growing worse in recent years. Nighttime involvement rates have remained fairly stable since 1994 for both pedestrians (62-63%) and motor vehicle occupants (43-42%), but they have climbed substantially for bicyclists—from 35% to 41%. While the various state vehicle codes require bicyclists riding after dark to use both a front light and rear reflectors, only a few also require an active taillight as well. Unfortunately, efforts to enforce the use of any required safety equipment among nighttime cyclists have largely been nonexistent or ineffective in the US, with the result that only a relatively small fraction of such cyclists regularly use proper lights at night (little exposure data on this point has apparently been collected thus far, but it is probably well under 30%).

FIGURE 12 **Nighttime Involvement: Injuries vs Fatalities %**

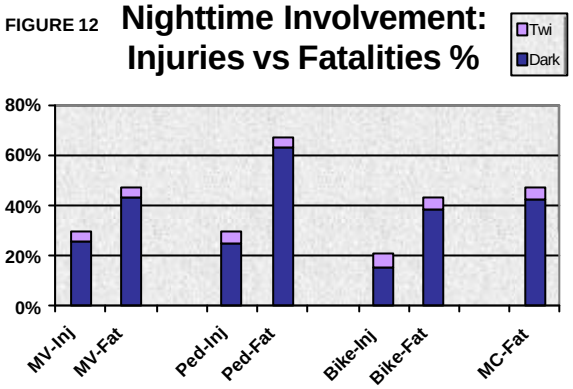


Figure 12 illustrates just how much more severe nighttime traffic crashes tend to be, particularly for pedestrians and bicyclists, based on the ratio between fatalities and injuries involving darkness (injury data for this and later figures based on 1996 UNC study for pedestrians and bicyclists, and on NHTSA's 1998 Traffic Safety Facts).

SEASONAL VARIATION:

FIGURE 13 **Fatality Variation by Month & Mode**

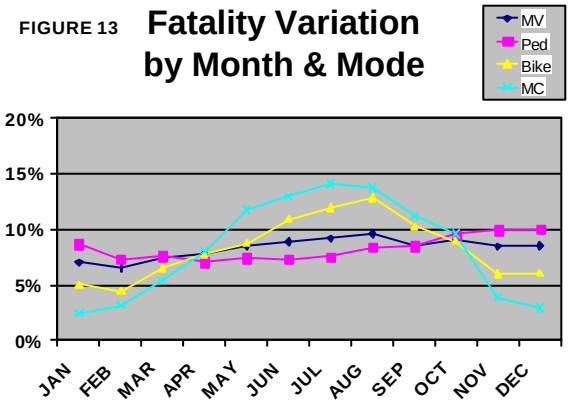


Figure 13 indicates the seasonal variation in bicycle fatalities relative to other modes. Note that while there is a greater concentration of bicycle fatalities in the summer months compared with winter months relative to pedestrian and motor vehicle occupant fatalities, the ratio is still less than that found with motorcycle fatalities.

FIGURE 14 **Adult Bike Fatalities by Month & Light**

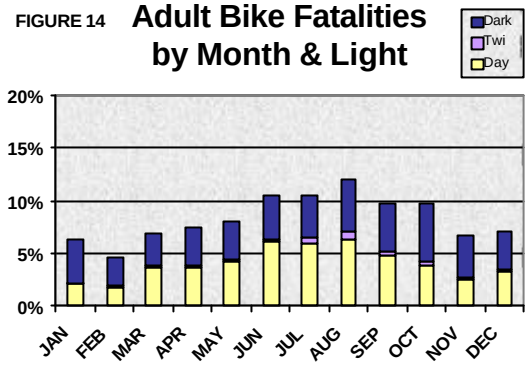
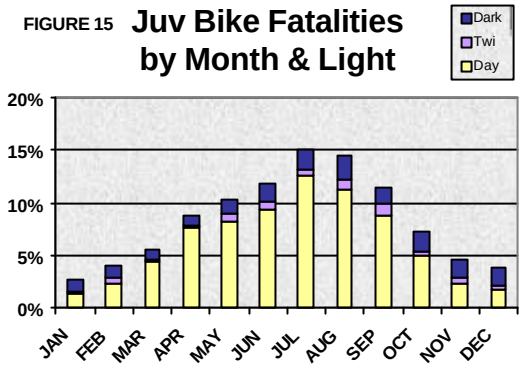


FIGURE 15 **Juv Bike Fatalities by Month & Light**



Figures 14 and 15 demonstrate the considerable differences in seasonal variation between adult and juvenile bicycle fatalities. Note that in both cases the main difference is with the number of daylight fatalities since nighttime fatalities tend to show much smaller seasonal variability.

FIGURE 16 **Weather Factors: Injuries vs Fatalities**

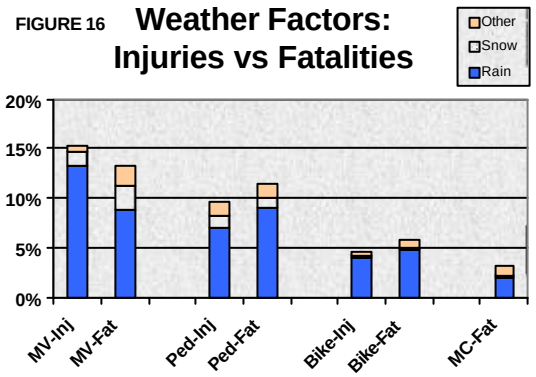


Figure 16 shows to what extent adverse weather factors may play a role in traffic

crashes. Bicyclists are much less likely to be out riding in the rain or snow than pedestrians or motorists, but considerably more likely than motorcyclists. Interestingly, while rain appears to somewhat increase the severity of traffic crashes for both pedestrians and bicyclists, along with the likelihood of motor vehicle crashes in general, it seems to result in less severe consequences for motorists (i.e. a lower fatality to injury ratio).

JUNCTION vs LINK:

FIGURE 17 **Crash Severity by Location & Mode**

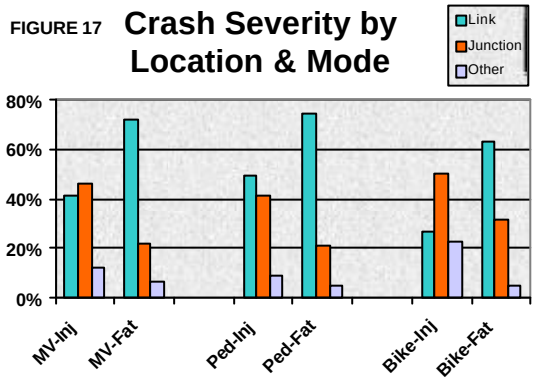


Figure 17 shows the influence of intersections and other roadway features on traffic crashes. Note that intersections are far more involved in the less serious injury-producing crashes than in the more serious fatal crashes for all modes, but particularly so in the case of bicyclists. This is even more evident when driveway and alley-related crashes (the vast majority of "other" under bicycles) are added to the intersection/junction totals. Non-junction "link" crashes account for less than 27% of all injury-producing bicycle traffic crashes, but over 63% of the fatalities.

FIGURE 18 **Bike Fatality Junction % by Road Class & Light**

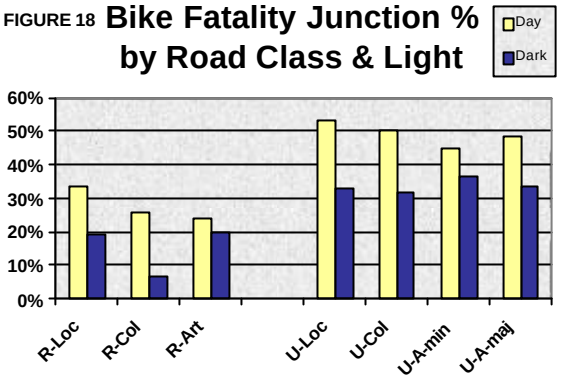


Figure 18 indicates the relative proportion of junction-related bicycle fatalities by both road type (urban vs rural, and local vs collector vs minor and major arterial roads) and light condition (day vs night). Not surprisingly, junction-related fatalities are far more common on urban rather than rural roads, and during daylight instead of after dark. An important point to note is that since nearly 2/3 of all urban nighttime cycling fatalities occur at non-junction locations, motorist overtaking collisions appear to account for a clear majority of these crashes, especially among adult cyclists--unlike the case with urban daytime cycling fatalities where perhaps as few as 1/5 appear to be of this type. Needless to say, the vast majority of rural cycling fatalities also appear to be of the motorist overtaking variety.

SPEED LIMITS:

FIGURE 19 **Rural Fatalities by Speed & Mode**

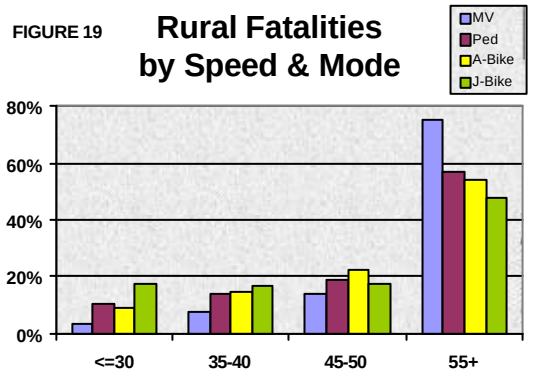
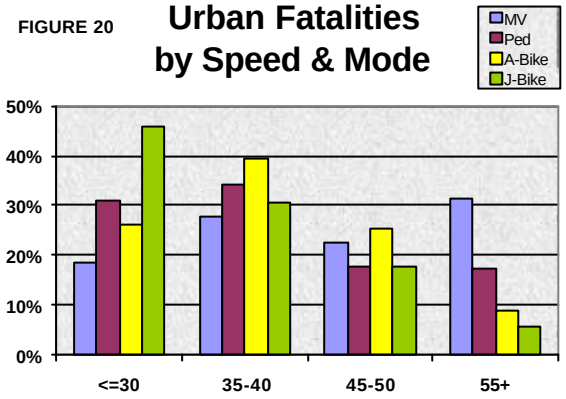


Figure 19 details the relative proportion of fatalities for each mode (motor vehicles, pedestrians, and both adult and juvenile cyclists) occurring on rural roads according to posted speed limit. Note that roads with a 55 mph or greater speed limit (90+ kph) naturally account for the majority of all rural traffic fatalities, overwhelmingly so in the case of motorists; and that juvenile cyclists are relatively over-represented on the slower and more local of rural roads.

FIGURE 20 **Urban Fatalities by Speed & Mode**



Likewise, Figure 20 details the same for urban roads, where juvenile cyclists are again over-represented on the slower and more local roads, and where both adult and juvenile cyclists are considerably under-represented on the fastest urban roads (most of which are freeways or other types of limited-access expressways).

ROAD CLASS:

FIGURE 21 **Adult Bike Fatality % by Road Class & Light**

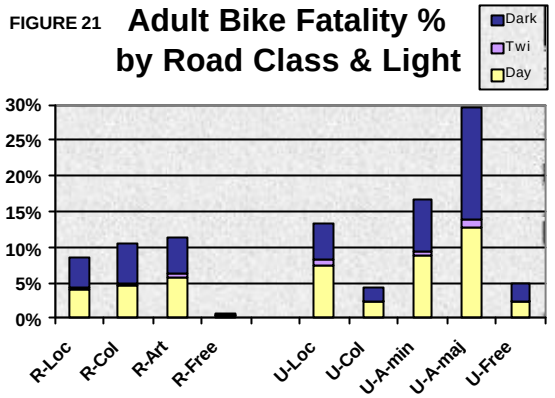


Figure 21 indicates the relative importance of the different road classes in adult cycling fatalities, including a daylight vs darkness breakdown of each type. Note the importance of nighttime urban arterial roads (particularly the major as opposed to minor arterials). Note also the small but significant contribution of urban freeways to adult cycling fatalities, and the stark contrast with the virtually nonexistent contribution from rural freeways.

FIGURE 22 **Juv Bike Fatality % by Road Class & Light**

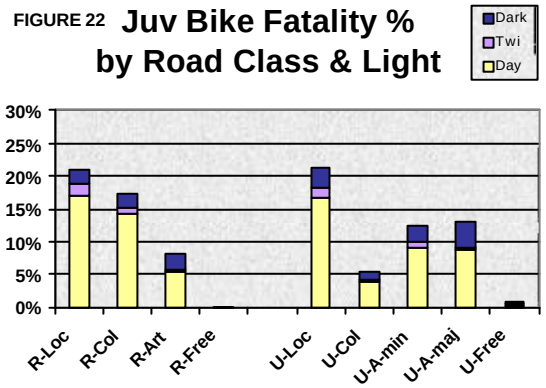


Figure 22 does the same for juvenile cycling fatalities, which tend to be considerably over-represented on local roads, both urban and rural, along with rural collectors, and under-represented on arterial roads. Note that adult cycling fatalities have a much higher tendency to occur on urban rather than rural roads in general (69-31% split)

compared to juvenile cycling fatalities (53-47%), which suggests the decline in juvenile cycling rates has been far more pronounced in urban areas thus far.

SUMMATION:

FIGURE 23 **Bike Fatalities: Urban/Rural & Juv/Adult**

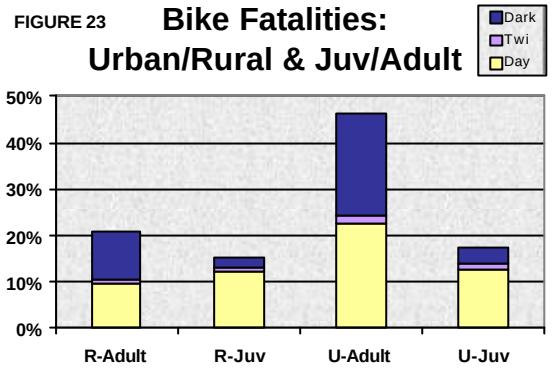


Figure 23 demonstrates that adult urban cyclists now constitute the dominant modality among bicycle traffic fatalities in general, and that nighttime fatalities comprise at least half the problem in this class. This is out of all proportion to the amount of urban cycling actually being done at night, and strongly suggests more attention needs to be given to the entire nighttime bicycle conspicuity problem. The new flashing red LED taillights that have been developed over the past decade appear to offer an excellent technological solution to the problem, but in the absence of any real effort to educate cyclists as to their need, much less any effort to enforce nighttime safety equipment standards among cyclists out riding after dark, it is questionable how much progress can actually be made in curtailing these imminently preventable fatalities.

LIST OF ABBREVIATIONS:

Modes:
Bike = bicyclist
Ped = pedestrian
MC = motorcyclist
MV = motor vehicle occupant (inc MC)

Age Groups:
J = Juv = Juvenile (<16 years old)
A = Adult (16 years and older)

Light Condition:
Day = daylight
Twi = twilight
Dark = nighttime

Severity:
Fat = traffic fatality
Inj = traffic injury

Location:
Junction = intersection of 2 or more roads
Link = roadway between intersections
Other = driveway, ramp, interchange, etc

Road Class:
R = rural
U = urban
Loc = local (minor) road
Col = collector (secondary) road
Art = arterial (primary) road
A-Min = minor (secondary) arterial road
A-Maj = major (principle) arterial road
Free = limited access freeway/expressway

SOURCES:

FARS 1994-98 online database, http://www-fars.nhtsa.dot.gov/fars/fars.cfm

Traffic Safety Facts 1998, http://www.nhtsa.dot.gov/people/ncsa/tsf-1998.pdf

Hunter, et al (UNC, 1996) Pedestrian and Bicycle Crash Types of the Early 1990's. [FHWA-RD-95-163]