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Traumatic Bicycle Injuries in a Masters Club

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“Bicycling is, and always will be, a very dangerous sport regardless of whether a person is racing, in a group, or by himself. Other than a helmet, a rider has absolutely no protection. Automobiles are a constant threat. Road conditions are often detrimental to cycling even though they have improved over the last few years. Unfortunately cyclists themselves are part of the problem—running stop signs, ignoring signals, and engaging in insults with drivers. Yet in spite of the dangers, this sport has a fascination that to me no other sport gives. Yes, I know I will crash and while I will do all in my power to avoid it, I will not give up any forms of my riding.”

Gordy Shields, Cyclo-Vet, National Champion, US Record Holder, age 84

Key Points

- A survey of traumatic injuries was conducted in a well-established Masters bicycling club.
- Response rate was 95%.
- The survey is based on 81 respondents.
- 72% of riders sustained at least one disabling injury, for a total of 1.8 disabling injuries per rider. The disabling injury rate was 1 per 57,600 miles ridden.
- The average rider has missed 17.1 days of work due to bicycling injuries.
- There were 1.4 broken helmets per person.
- At least 34% of riders sustained a concussion. Only one rider was not wearing a helmet at the time of injury.
- There were more than 2.5 incidents per rider requiring physician consultation, including 1.2 broken bones per rider.
- Road rash, or abrasions, occurred approximately 5.7 times per rider studied.
- Motor vehicle accidents accounted for 37% of road riding injuries.
- The serious injury rate for mountain biking was roughly twice that of road riding.
- 35% of riders feel that they have had a life-threatening injury.
- There have been three bicycling-related deaths in the club since it was formed in 1983.

Introduction

Members of the San Diego Cyclo-Vets bicycle club, an urban-based masters group were surveyed about their experience and opinions concerning traumatic bicycle injuries.

The Cyclo-Vets club was founded in 1983. The club is one of the longest established and most successful masters racing clubs in the United States. Riders are of varied fitness and skill levels. Many have joined as non-racers, trained within the club, and have become National Champions. Cyclo-Vet riders have won more than 100 National Championships. About half of its members race; about 10% of its members race more than 15 races per year.

Target Population

The study population was limited to club members who had the following characteristics:

1. Registered as of March 1, 2003.
2. Club member in 2002.
3. Over the age of 18 (excluded one potential participant).
4. Bicycle rider (excluded one potential participant).
5. Valid e-mail or telephone contact (excluded two potential participants).

The author excluded himself from the study.

Based on these limitations, there were 85 eligible participants.

Ascertainment and Group Size

Notice of the survey was posted on the Cyclo-Vet club website (<http://www.cyclo-vets.org/>) in March 2003 and the survey instrument was available and downloadable on the arniebakercycling.com website. The survey instrument is available for review at arniebakercycling.com¹.

The survey instrument was e-mailed to nonresponders four times: in April, May, June, and August 2003. If no response was received after four mailings, members were telephoned in August and September 2003.

The final response rate was 81 out of 85, or 95%.

There were 23 basic questions. Most were YES/NO. Where injuries occurred, respondents were invited to expand on what had occurred. Percentages quoted in results are based on riders who responded to particular questions. Almost all participants answered every question. The response rate to every basic question was greater than 95%.

Individual Response Details

The individual responses of every rider to every basic question are available at http://arniebakercycling.com/handouts/hm_fa_traumatic_injuries.htm.

Riders were asked for permission to post identifying data. 67% agreed. Riders who have agreed to the use of identifying data are identified.

Population Demographics

Survey participants had been riding as adults an average of 14.2 years. The range reported was 1 to 46 years.

The annual average miles ridden was 6,386. The range was 500 to 16,800 miles. 90%+ of survey participants reported their annual and lifetime volume in miles, 8% reported their volume in hours, and 2% did not answer the question. Where volume was reported in hours, it was converted to miles, for the purposes of this study, at the rate of one hour equals 14 miles, rounded to the nearest 100 miles.

The lifetime average miles ridden was 102,000. The range was 5,000 to 500,000 miles. Where the lifetime number of miles was not reported, it was calculated as miles per year X years ridden.

Most participants spent the majority of their riding time on road bicycles. Mountain bike riding accounted for 429,000 miles, 5.7% of total miles ridden. 18% of participants used mountain bikes more than 10% of miles ridden.

79% of the participants were male, 21% were female.

Participants were considered racers if they had a racing license. 81% of the study participants met this definition. The average number of reported racing years was 9.5. The average reported lifetime number of races was 88. The range was 2 to 500 races. The median (middle number) was 50 races. Almost all of the participants raced masters, or age-graded racing. Three participants raced mountain bikes, one professionally.

Results

Medical Care

79% of the participants had been seen in an emergency room, urgent care center, or otherwise by a physician for traumatic injuries. 33% had been admitted to hospital and 15% to an intensive care unit.

Fractures

54% of the survey participants sustained broken bones in bicycling-related crashes. Many riders had multiple fractures. Where number of ribs fractured was unspecified, 2 ribs were assumed fractured. Where number of fingers was unspecified, 2 digits were assumed fractured.

Of a total of 80 respondents answering the question, 43 riders reported a total of 95 broken bones; 1.2 bones per respondent.

¹ http://arniebakercycling.com/handouts/hm_fa_traumatic_injuries.htm

The reported fractures are as follows:

Bone Area	Breaks / 100 Riders	Actual Number	Notes: Rider Identified Bones
Collarbone	28	22	
Upper extremity	25	20	Shoulder blade, arm, elbow, forearm, wrist, or hand, fingers
Ribs	25	20	
Lower extremities	13	11	Thigh, leg, ankle, or foot
Vertebral	13	11	
Pelvis	6	5	Pelvis, sacrum
Head	6	5	Facial bone, skull
Other	1	1	Sternum
Total	114*	95	

* The actual vs. computed total differs by due to rounding.

Head Injury

45% of participants reported having sustained a head injury. 34% reported concussion, with 9% reporting more than one. One rider reported having had a subdural hematoma (a form of bleeding in the skull) necessitating neurosurgery for evacuation.

Broken Helmets

74% of 80 respondents reported breaking one or more helmets. The total number of broken helmets was 112, averaging 1.4 broken helmets per respondent surveyed.

Disability

72% of 78 participants reported injuries resulting in missing work and/or riding.

1.8 disabling injuries per rider surveyed were recorded. The total number of disabling incidents was 138.

There was one disabling injury for every 57,600 miles ridden.

In comparison, I have estimated the disabling injury rate based on injuries sustained during the 2002 Tour de France, the world's premier bicycle race, at 1 per 44,000 miles².

Road Rash

90% of 77 participants reported having had road rash, or abrasions.

The total number of crashes resulting in road rash was estimated at 5.7 per rider. Riders were given ranges to estimate the number of times they had had road rash: 0, 1-3, 4-7, 8-12, 13-20, and >20. For the purposes of estimating the total number of times riders had experienced road rash, the average of the ranges was used to estimate incidence. For the five individuals who experienced road rash more than 20 times, the incidence was estimated at 25 events.

Deaths

59% of 78 respondents had friends or knew of riders within Cyclo-Vets or their other riding groups who had died of injuries riding a bicycle.

14% knew two or more riders. 5% noted three or more deaths in their survey responses.

Three Cyclo-Vet club riders have died in bicycle vs. motor vehicle accidents since the club was founded in 1983. 50% of participants had been members of the club since the first death. No study participants identified all three decedents by name. One or two who identified three rider deaths may have been referring to these riders. 45% of participants noted one or two of these deaths.

For a more detailed review about local, regional, national and international bicycling-related deaths see Appendices C and D.

Causes of Injuries

Riders were asked about their injuries and what happened. Some responded to this open-ended question by giving details of their injuries. Others responded with the events precipitating their injuries.

² Bicycling Injury in the Tour de France. http://arniebakercycling.com/handouts/hm_injury_2002_tdf.htm

The events surrounding 104 injuries were reported in general or specific detail.

89% of injuries occurred on the road. 11% occurred mountain biking.

Mountain biking was estimated to account for 5.7% of miles ridden. Relative to miles ridden, mountain biking injuries accounted for roughly twice as many injuries as road riding.

Road Injuries

69% of road riding occurred riding alone. 31% occurred while riding in groups.

Solo Injuries

37% of road riding injuries were caused by crashes with motor vehicles. Common reported mechanisms included a passing vehicle turning in front, oncoming vehicle turning in front, vehicle passing too close, vehicles pulling trailers, vehicles making U-turns, head-on crashes.

9% of road riding injuries were due to surface hazards such as potholes, rocks, uneven surfaces, or dogs.

12% of road riding injuries were due to operator or skill errors, including two crashes with dogs, cornering too fast, adjusting bicycle parts such as computer sensors while riding,.

10% of road riding injuries were caused by mechanical problems such as tire blow out, broken chain, or broken fork.

2% of road riding injuries were unclassified, including a rollerblader who punched the rider.

Group Injuries

17% of road riding injuries occurred in a paceline. Proximity crashes, crashing into other crashed riders, and group-hidden surface hazards (such as a kitchen sink!) accounted for most injuries.

12% of road riding injuries occurred in racing, generally criteriums.

3% of road riding injuries were unclassified, including a heart attack and dehydration while riding.

Mountain Bike Injuries

These were by and large solo injuries related to loss of control/skill errors, often while descending.

Summary

	% of Total	% of Road	Absolute Number
Total	100		104
Road	89	100	93
Solo	62	69	64
Motor Vehicle	33	37	34
Hazards	8	9	8
Skill	11	12	11
Mechanical	9	10	9
Other	2	2	2
Group	28	31	29
Paceline	15	17	16
Racing	11	12	11
Other	2	3	2
Mountain Bike	11		11

Road vs. Mountain Bike

Road Injuries

Perception of Risk

35% of riders felt they had had a life-threatening injury.

Riders were asked about how often they had had a close call. “Even though nothing may have happened, how many times have you been involved in a bicycling situation where you said to yourself: ‘That was close. I could have been killed or seriously injured?’” 8% of participants reported none. 28% reported too many to count or more than 20, for example saying such occurrences take place at least weekly.

Riders were asked if they would be surprised if two riders were injured at a criterium event and sustained broken collarbones. 91% of participants said they would not be surprised at such an occurrence. Several remarked that they had been present when precisely this scenario occurred.

Riders were asked whether they felt that bicycling was more or less dangerous than other aerobic sports. 72 riders responded to this series of questions. The response to various sports was as follows:

Alternative Sport	% Felt Bicycling More Dangerous
Running	92%
Swimming	92%
Aerobics	89%
Weight/strength training	92%
Soccer	59%
Football	22%
Baseball	85%
Hiking	91%
Mountaineering	32%

Bias

5% of eligible participants did not reply to any portion of the survey. There were no noted differences between early or late responders in terms of demographics or injury rates.

The results and estimates in this study are likely underestimates of the true incidence of traumatic bicycling injuries. Here are some reasons why:

- Riders underreport their injuries. They may have forgotten some of them.
- As evidence of underreporting, consider that riders were asked if they knew any club members who had died. There have been three. One of the three deaths was an out-of-town club member. Of 40 respondents who had been club members since 1995, the year in which the first Cyclo-Vet died, none identified all three deaths. Five identified two deaths. Of a sample of 10 of those riders interviewed after completion of the survey, all know of at least two of the deaths. Four knew of all three.
- The figures given for concussion are minimum figures: Riders reporting having had a concussion generally knew that diagnosis because they had been given it by a physician.
 - Many riders were unaware that concussion is diagnosed when a head injury results in loss of consciousness, confusion, memory loss, or persistent headaches. Here's evidence:
 - a. Five riders reported confusion, memory loss, or persistent headaches after injuries in one section of the survey yet denied having had a head injury.
 - b. The last seven riders surveyed responded to telephone contact rather than the electronic survey instrument. All of these had had a concussion. Only four initially considered that they had had a head injury or a concussion. But on specific questioning, all admitted to loss of consciousness, confusion, memory loss, or at least several days of headaches following a bicycling accident.
- Riders who have had serious injuries and stopped riding have dropped out of the Cyclo-Vets club.

Limitations, Comments, and Summary

This is a report of a survey of the San Diego Cyclo-Vets, a well-established Masters bicycling club. The response rate to the survey was 95%. The survey is based on 81 riders.

The injury rates reported reflect only on this group, and may not be applicable to cycling groups or individuals in general, or to similar riders in other parts of the country or in other countries.

72% of riders sustained a disabling injury. There were a total of 138 disabling injuries, or 1.8 for every rider surveyed. The disabling injury rate was 1 per 57,600 miles ridden.

The average rider has missed 17.1 days of work due to bicycling injuries.

In discussing disability rates above, I noted my previously published analysis of the disability rate of riders in the 2002 Tour de France. Their disabling injury rate was roughly of the same order of magnitude.

Club riders may be safer or less prone to crashes than general recreational riders. (For club riders, racing is more dangerous per mile than general riding). The Massachusetts Bicycle Coalition³ quotes figures of one crash per 10,000 miles for the safest group—club riders.

There were 1.4 broken helmets per person. At least 34% of riders sustained a concussion. Only one rider was not wearing a helmet at the time of injury.

³ <http://www.massbikeboston.org/resources/stats.htm>

There were more than 2.5 incidents per rider requiring physician consultation, including 1.2 broken bones per rider. Road rash, or abrasions, occurred approximately 5.7 times per rider studied. Road rash was used as an indicator of relatively minor injuries—compared with broken bones, head injury, or the need for physician care. Although some riders seek medical care for road rash, and although most of the serious injuries reported above were also associated with road rash, the incidence of road rash is larger.

Motor vehicle accidents accounted for 37% of road riding injuries. Other published reports have noted that motor vehicle accidents account for about 17% of bicycle injuries⁴. The higher incidence in this study may be because only serious injuries, those requiring physician care, were used in determining this rate. The more serious the injury, the more likely motor vehicles are to be involved. After all, almost all road riding fatalities (99%) are due to motor vehicle accidents⁵.

The serious injury rate for mountain biking was estimated to be roughly twice that of road riding based on total miles ridden and relative percentage of miles ridden on road and mountain bike. The relative miles ridden on road vs. mountain bike was determined from responses to the question: “Percentage miles on road / on mountain bike.” It might be argued that it takes longer to ride a mile on a mountain bike than on the road, and so the mountain bike injury rate is *less* than twice that of road relative to *time* spent riding. An informal survey of riders determined that they did not take the question literally: Riders almost always gave percentages based on time, not miles, and so the relative incident of mountain bike injuries relative to road riding injuries is, in fact, *higher*.

35% of riders feel that they have had a life-threatening injury.

There have been three bicycling-related traumatic deaths in the club since it was formed in 1983.

The subjective responses of riders to their perception of cycling risk does not provide a basis for establishing that risk. Rather it allows the reader to assess the congruence of riders’ perception, the readers’ perception, and the results of this study.

Cyclo-Vets and riders in general acknowledge that bicycling can be a dangerous sport. The majority of Cyclo-Vet riders surveyed consider bicycling more dangerous than running, swimming, aerobics, strength training, soccer, baseball, and hiking. More than 90% would not be surprised that a criterium event attracting 500 participants would be associated with two broken collarbones. Many commented that road rash is part of riding.

This study helps define just how dangerous cycling may be.

⁴ Forester, John. *Effective Cycling*. 6th Edition. Cambridge, MA: The MIT Press, 1994. Page 261

⁵ Mellion, Morris B. and Burke, Edmund R, editors. *Clinics in Sports Medicine, Bicycling Injuries*. Philadelphia, PA: W.B. Saunders. 1994. Vol 13 #1, page117.

Appendix A: Survey Instrument

The survey instrument is available at http://arniebakercycling.com/handouts/hm_fa_traumatic_injuries.htm.

Appendix B: Details

A detailed results spreadsheet is available at http://arniebakercycling.com/handouts/hm_fa_traumatic_injuries.htm.

Appendix C: Local & Regional Bicycling-Related Deaths

San Diego Cyclo-Vets

There have been three Cyclo-Vet club members who have died from injuries sustained riding a bicycle, all from bicycle vs. motor vehicle accidents.

Greg Laney, 1995, crossing an intersection with his son. The traffic light did not trip. After several minutes waiting, they crossed when they thought the road was clear. Greg was hit by a car.

Fred Uy, 36, 1996, hit from behind by a vehicle while climbing Fairmont Avenue.

Maurice Johnson, 82, 2002⁶ struck by a car.

California Riders and Racers

It has been estimated that 104 San Diego area and 1,228 California riders were killed by cars between 1986 and 1995⁷. The San Diego area had an estimated population of 2,498,016 in 1990, and a fatality rate of 4.2 per 1,000,000 per year. California had an estimated population of 29,760,021 in 1990 and a fatality rate of 4.1 per 1,000,000 per year.

California riders who died and are well-known to club members include:

Cece Krone, a San Diego bicycle club member, 44, 1999. She was hit from behind by drunk driver⁸.

Norm Hoffman, a Bakersfield racer, 60, 2001. He was hit from behind by 17-year-old driver⁹.

Deaths During Events

Southwest events, or events commonly attended by Cyclo-Vets have had several deaths to riders either during the event or while riding to the event.

- Senior Olympics, St. George, Utah. A race for riders over 50 years of age, 1998.
Dave Richardson, a Southbay Wheelmen, CA rider, 70. He lost control on a descent¹⁰.
- El Tour de Tucson, a century event. 1996.
A rider making his way to the start line was hit by a car on the Interstate 10 access road near the 18th Street underpass.
- Markleeville Death Ride, a recreational ride. 2002.
Scott Lambert, 50, Folsom, CA. He lost control descending.
- Tour de Tucson, a stage race. 2003
Garrett Lemire, 22, Ojai, CA. He swerved into an oncoming lane to avoid rider ahead and had a head-on car crash.
- Guacamole Grand, a San Diego county recreational ride. 2002.
Vilma Vega-Martinez. 38. Anaheim. Lost control of bicycle, and fell into roadway and car¹¹.
- RAAM: Race Across America. A transcontinental endurance race beginning in San Diego. 2003.
Brett Malin, 30, Vail, CO. Made a U-turn on a roadway into an oncoming truck¹².
- PAC Tour training camp, an endurance bicycling cam. 2001.
Rider was hit from behind, sideswiped by a side-view mirror.
- At least five other deaths were noted by club members.

⁶ <http://www.bcmasterscycling.net/page19.html>,

⁷ <http://www.ewg.org/pub/home/reports/bikes/states/CA.pdf>.

⁸ <http://www.bikecal.com/cyclist-killed-again.htm>.

⁹ <http://www.kernsharetheroad.org/Hoffman/index.htm>

¹⁰ <http://www.sbwheelmen.org/RaceSeries-DaveRichardson/DaveRichardsonRaceSeries.html>

¹¹ <http://www.nctimes.net/news/2002/20020415/83257.html>

¹² <http://www.velonews.com/race/dom/articles/4124.0.html>

Appendix D: International Pro Rider Deaths

Deaths During Races

There have been at least 28 deaths in the elite ranks of bicycle racers during races.

- Jose Nicolau 1934 El Tirador track race Crash
- Rafael Pou 1935 El Tirador track race Crash
- Francisco Cepeda 1935 Tour de France Fell down a ravine near Bourg-d'Oisans
- C. Danguillaume 1950 French Championship MVA
- Emilio Marti 1951 Vuelta de Catalunya Crash
- Serge Coppi 1951 Giro del Piamonte Crashed in final kilometer, died next night
- Jose Torres 1952 Toulon circuit Crash
- Francisco Alomar 1956 Vuelta a Galicia Crash
- Stan Ockers 1956 Antwerp track race World Road Champion
- Raul Motos 1958 Vuelta a Portugal Dehydration
- Joaquin Pole 1958 Vuelta a Portugal Dehydration
- Tom Simpson 1967 Tour de France Heart attack, Ventoux, heat and drug related
- Valentin Uriona 1967 Spanish Championships Crash
- Jose Samyn 1969 Zingem criterium Crash
- Jean P. Monsere 1970 GP Retie MVA
- Manuel Galera 1972 Vuelta Andalusia Crash
- J.M. Santisteban 1976 Giro d'Italia MVA
- Pedro J. Huertas 1979 GP Caboalles de Abajo Crash
- Joaquim Agostinho 1984 Vuelta a El Algarve Crashed when he hit a dog
- Emilio Ravasio 1986 Giro d'Italia Crash
- Vicente Mata 1987 Tropheo Luis Puig MVA
- Michel Goffin 1987 Tour del Alto Var Crash
- Fabio Casartelli 1995 Tour de France 15th stage. Fell on a descent
- Jose Antonio Espinosa 1996 Fuenlabrada Fell in team time trial
- Manuel Sanroma 1999 Vuelta a Catalunya Crashed in second stage
- Saul Morales 2000 Tour of Argentina Killed by a truck
- Nicole Reinhart 2000 Arlington Circuit Crashed and hit a tree
- Andrei Kivilev 2003 Paris-Nice 2nd stage. May have tangled handlebars.

Source: Compiled from a Google search August 1, 2003. Major sources:

1. <http://www.cyclingnews.com/news/?id=2003/mar03/mar12news3>
2. <http://marca.recoletos.es/01/02/15/ciclistasfallecidos.html>

Recent Deaths During Training

There have been at least four deaths in the elite-ranks of bicycle racers during training in the past year.

- David Martin 2002 USA Drunk driver
- Luri Aus 2003 Estonia Hit by truck
- Haruko Fujinaka 2003 Japan Mountain bike downhill, in practice
- Graham Bufton 2003 Britain Hit by car