TESTIMONY IN OPPOSITION TO HOUSE BILL 339

Environmental Matters Committee

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One reason to oppose requiring adults to wear a bicycle helmets is that these helmets are only about 20% effective at preventing injuries. That's enough for me to wear a helmet, but that's not good enough for the government to prohibit me from riding my bike if I don't have it handy.

Three types of information inform our understanding of the effectiveness of bicycle helmets: Engineering, case-control studies, and population studies.

The Design.

Bike helmets spread the shock around the skull, so if a rock hits your helmet, it will feel like I slapped the top of your head. And they spread the shock out over time when the foam compresses. So if your helmet hits a brick wall at 20 mph, it will feel as if your head hit some very rigid Styrofoam at 20 mph.

Impact of Helmets on Odds[1] of Injury: Confidence Range

Head Injuries (%decline)			
Case Control Studies			
Lead Author	Year	Low	High
Dorsch[2]	1987	53	88
Thompson[3]	1989	71	93
Spaite[4]	1991	77	100
McDermott[5]	1993	21	53
Maimaris[6]	1994	17	89
Thomas[7]	1994	16	68
Finvers[8]	1996	10	89
Thompson[9]	1996	62	74
Jacobson[10]	1998	30	80
Linn[11]	1998	17	51
Shafi[12]	1998	-209*	39
Hansen (hard)[13]	2003	40	79
Hansen (soft)[14]	2003	-67*	59
Heng[15]	2006	14	66
Amoros[16]	2009	12	56
Assessments Combining all Studies			
Attewell[17]	2001	45	71
Elvik[18]	2011	25	55
Neck Injuries (%increase)			
Attewell[19]	2001	0	86
Elvik[20]	2011	1	72
Head & Neck Injuries (% decline)			
Attewell[21]	2001	41	50
Elvik[22]	2011	2	26

* Negative numbers signify that people wearing helmets had higher rate of injuries.

Bike helmets are a compromise between a motorcycle helmet and nothing. They are designed to work best for the force from simply falling without colliding from a stationary position. So they are most effective for children, pedestrians, and low speeds.

Motorcycle helmets cover your whole head and face, while bike helmets only go down to the middle of the forehead. So if the force strikes lower in the head or face, they protect you, while bike helmets do not. Motorcycle helmets stay on your head, while bike helmets often move during an accident, both because they rely more on their chin straps, and because people mount them incorrectly.[23] Bike helmets often break, which may limit their effectiveness in an accident involving two hits to the head.

Finally, bike helmets increase neck injuries by increasing the radius of your head 25-50%. That increases the probability that your head will be twisted by something that would have missed an unhelmeted head, and also allows greater torque from whatever force is applied.

Case-Control studies

The best way to know the effectiveness of a drug or helmet is to get a representative sample population, and then randomly assign people to the test group or the control group. Such an experiment allows one to reliably estimate effectiveness subject to a statistical margin of error. But we don't know who will be involved in a crash, and if we did, it would be unethical to tell them whether to wear a helmet. Instead, researchers collect data after the fact.

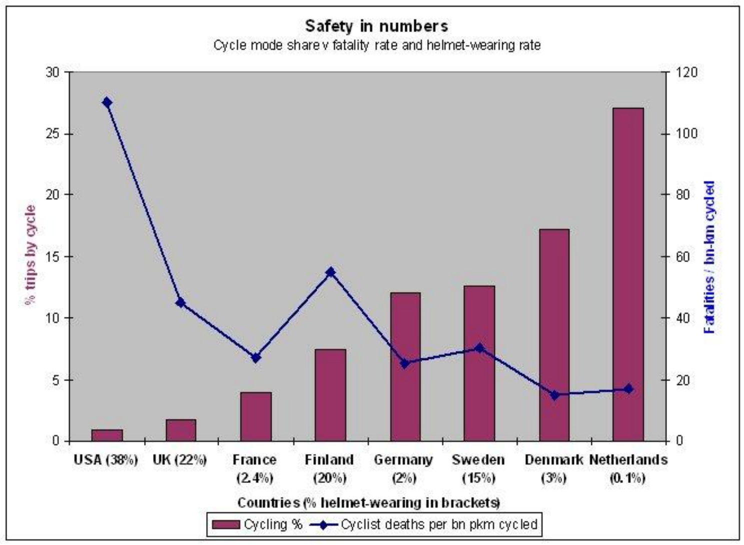
In 1989, Thompson et al. obtained data from Seattle hospitals for two groups of cyclists who went to the hospital after a crash.[24] Only 7% of the first group wore a helmet, and they all had head injuries. But 24% of the second group wore helmets, and none of them had head injuries. Assuming that both groups were the same except for the type of injury they experienced, these results imply that helmets reduced head injuries by 75%. Thompson et al. realized that the two groups were different, ran regression analysis on the data to isolate the effects of helmets and found that helmets were even more effective: 85%.

That study led the researchers to start saying two things that have almost become mantras among many public safety advocates[25] and the new media[26]: "Helmets reduce head injuries by 80%" and "The most important thing you can do to be safe on a bike is wear a helmet."

In the last 24 years, similar studies have found that helmets reduce head injuries, but to a less extent than in the Seattle Study.[27] As the Table shows, a comprehensive synthesis of all studies in 2001 estimated 45-71% effectiveness, but because helmets increase neck injuries, the net effectiveness was 41-50%. Studies in the last decade have estimated that helmets only prevent 20-40% of potential head injuries, so the 2011 synthesis of all studies published finds the helmets reduce head injuries by 25-55% and total injuries by 2-26%, when you include the increased neck injuries. But we still hear the refrain "helmets reduce injuries up to 85%!"

Why have the estimates come down? Mainly because none of these studies are truly controlled experiments: On average, the people that go to the hospital without helmets were more likely than the people with helmets to be drunk, riding at night without lights, have lower income and education, to be riding on the streets rather than a trail, and to have collided with an automobile. The researchers have gotten increasingly sophisticated about trying to isolate some of those factors, but they usually don't have data for all of them.

Population studies



Studies of entire populations are less precise than case-control studies, but they are also less likely to have a biased data set. If we had data on miles biked and total injuries by state or city, an estimate of helmet usage, and decent injury data, we could compare injury rates in cities or states with high helmet use to those with low use---or areas with and without mandatory helmet laws. Unfortunately, while there is some data on injuries, states generally do not keep annual data on miles biked, so valid population studies on helmet effectiveness are not possible.

Such studies have been done in Australia and New Zealand, in response to mandatory helmet laws.[28] Those studies did not detect a significant reduction in injuries attributable to helmets. In one case, there was a large reduction in injuries when the helmet law went into effect, but there was also a proportional reduction in cycling at the same time.

A rough comparison across nations is shown in the Figure. The United States has high rates of fatalities and helmet use, while the Netherlands has low rates of both. This does not mean that helmets increase the risk of injuries. But it does show the helmets are not the most important thing one can do to promote bicycle safety.

Implications for Maryland

This bill should be tabled for two reasons: It isn't needed, and it won't accomplish what the proponents seek to achieve. Maryland had 13 Bicycle deaths in 2010-11, of whom 3 were unhelmeted adult cyclists.[29] But 200 pedestrians have been killed, and they are all traveling slowly enough for the helmets to work. So why aren't we requiring pedestrians to wear helmets?

We have a perfectly good law now, which was a conscious compromise between though who wanted no law and those who wanted to require everybody to wear a helmet. We require children to wear helmets—they are the most vulnerable, have the least judgment and travel at the speeds where helmets do the most good. But adults are presumed responsible enough to know whether to bike home anyway when they can't find their helmet. So why are we re-opening this matter 15 years later? The only new information since then is that the research shows helmets to be less effective than people used to think.

Maryland has 500-600 bicycle injuries per year, but there is no data on what portion of the injured are wearing helmets. Given the national average, we might expect that we have 250-300 head injuries per year, of whom 100 are unhelmeted adults. If the law is as effective as laws oriented toward children, we might expect the share of adults wearing helmets to increase by 18%[30], so that about 20 of these people will now be wearing helmets. Given the effectiveness of helmets, we might expect to see 5-10 fewer head injuries per year. Given that the annual fatality rate of unhelmeted adult cyclists is about 1.5% the head injury rate, the proposed law would be expected to save one life every 6 to 12 years.

Notes and References

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[1] All of the studies cited here report results based on the so-called odds ratio, rather than the relative risk. The odds ratio is based on ratio that someone having a head injury was wearing a helmet, compared with the odds that someone who did not have a head injury was wearing a helmet,. Relative risk, by contrast, measures the probability that someone wearing a helmet will or will not get a head injury. Although the studies only calculate the odds ratio, they often present the results as if they had calculated relative risk. The studies generally do not calculate relative risk because to properly do so under Bayes Theorem, they would need to estimate the unconditional probability of either wearing a helmet or having a head injury when involved in an accident, neither of which can be estimated with the hospital data alone. The approach is so pervasive that we simply follow it here, rather than use the term "odds ratio" which tends to confuse most non-statisticians. This table includes all studies evaluated by Attewell et al. or Elvik, except for one study published in German.

[2] Attewell, R.G., Glase, K., McFadden, M., 2001. Bicycle helmet efficacy: a metaanalysis. Accident Analysis and Prevention 33, 345, 349 Table 3 (citing Dorsch, M.M., Woodward, A.J., Somers, R.L., 1987. Do bicycle safety helmets reduce severity of head injury in real crashes? Accident Analysis Prevention 19, 183–190).

[3] Thompson, R.S., Rivara, F.P., Thompson, D.C., 1989. A case-control study of the effectiveness of bicycle safety helmets. New England Journal Medicine 320, 1361–1367.

[4] Attewell at 349 (citing Spaite, D.W., Murphy, M., Criss, E.A., Valenzuela, T.D., Meislin, H.W., 1991. A prospective analysis of injury severity among helmeted and nonhelmeted bicyclists involved in collisions with motor vehicles. Journal Trauma 31, 1510–1516.)

[5] Id. (citing McDermott, F.T., Lane, J.C., Brazenor, G.A., Debney, E.A., 1993. The effectiveness of bicyclist helmets: a study of 1710 casualties. Journal Trauma 34, 834–845).

[6] Id. (citing Maimaris, C., Summers, C.L., Browning, C., Palmer, C.R., 1994. Injury patterns in cyclists attending an accident and emergency department: a comparison of helmet wearers and non-wearers. British Medical Journal 308, 1537–1540).

[7] Id. (citing Thomas, S., Acton, C., Nixon, J., Battistutta, D., Pitt, W.R., Clark, R., 1994. Effectiveness of bicycle helmets in preventing head injury in children: case control study. British Medical Journal 308, 173–176).

[8] Id. (citing Finvers, K.A., Strother, R.T., Mohtadi, N., 1996. The effect of bicycling helmets in preventing significant bicycle-related injuries in children. Clinical Journal Sport Medicine 6, 102–107).

[9] Id. (citing Thompson, D.C., Rivara, F.P., Thompson, R.S., 1996b. Effectiveness of bicycle safety helmets in preventing head injuries. A case control study. Journal American Medical Association 276, 1968–1973).

[10] Id. (citing Jacobson, G.A., Blizzard, L., Dwyer, T., 1998. Bicycle injuries: road trauma is not the only concern. Australian New Zealand Journal Public Health 22, 451–455).

[11] Id. (citing Linn, S., Smith, D., Sheps, S., 1998. Epidemiology of bicycle injury, head injury and helmet use among children in British Columbia: a five year descriptive study. Injury Prevention 4, 122–125).

[12] Id. (citing Shafi, S., Gilbert, J.C., Loghmanee, F., Allen, J.E., Caty, M.G., Glick, P.L., Carden, S., Azizkhan, R.G., 1998. Impact of bicycle helmet safety legislation on children admitted to a regional pediatric trauma center. Journal Pediatric Surgery 33, 317–321).

[13] Hansen, K.S., Engesæter, L.B., Viste, A., 2003. Protective effect of different types of bicycle helmets. Traffic Injury Prevention 4, 285–290. Considering only the data collected for hard shell helmets.

[14] Id. For soft shell helmets.

[15] Heng, K.W.J., Lee, A.H., Zhu, S., Tham, K.Y., Seow, E., 2006. Helmet use and bicycle-related trauma in patients presenting to an acute hospital in Singapore. Singapore Medical Journal 47, 367–372.

[16] Amoros, E., Chiron, M., Ndiaye, A., Laumon, B., 2009. Cyclistes victimes d'accidents (CVA). Partie 2. Études cas-témoins. Effet du casque sur les blessures à la tête, à la face et au cou. In: Convention InVS J06-24 ,. INRETS, Lyon. Based on logit regression coefficients reported on page 21.

[17] Attewell supra note 2.

[18] Elvik, R. 2001. “Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001.” Accident Analysis and Prevention. 43 (2011) 1245–1251.

[19] Elvik, citing results from Attewell, supra note 2.

[20] Elvik, R. 2001. “Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001.” Accident Analysis and Prevention. 43 (2011) 1245–1251.

[21] Elvik, citing results from Attewell, supra note 2.

[22] Elvik, R. 2001. “Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001.” Accident Analysis and Prevention. 43 (2011) 1245–1251.

[23] Hagel BE, Lee RS, Karkhaneh M, Voaklander D, Rowe BH: Factors associated with incorrect bicycle helmet use. Injury prevention: journal of the International Society for Child and Adolescent Injury Prevention 2010, 16:178–184.

[24] Thompson. R.S., F.R. Rivara, and D.C> Thompson. “A case control study of the effectiveness of bicycle safety helmets.” New England Journal of Medicine 1989:320:1361-67.

[25] E.g. CDC http://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/headinjuries.html (cited Feb 9, 2012) “Wearing a bike helmet reduces the risk of brain injury by 88% and reduces the risk of injury to the face by 65%.” Compare Atwell (showing the odds ratios to be 0.42 and 0.53, respectively, which would mean relative risk reduction of 58% and 47%, respectively had the studies involved a random cross section)” and NHSTA “Traffic Safety Facts: Laws. DOT HS 810 886W (“ Bicycle helmets are 85- to 88-percent effective in mitigating head and brain injuries, making the use of helmets the single most effective way to reduce head injuries and fatalities resulting from bicycle crashes.” http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/810886.pdf (cited on Feb. 9, 2013).

[26] Just this week, these sayings were both repeated in the *Washington Post*. Ashley Halsey III “Maryland bill mandating bike helmets gets a cold shoulder from cyclists” *Washington Post*. February 8, 2013.

[27] See Atwell.

[28] D. L. Robinson. 2006. “No clear evidence from countries that have enforced the wearing of helmets.” 332 *British Medical Journal*. 722-725, and D. L. Robinson, “Head Injuries and Bicycle Helmet Laws.” *Accid. Anal. and Prev*., Vol. 28, No. 4, pp. 463-475.

[29] National Highway Traffic Safety Administration. Fatality Analysis Reporting System database. http://www-fars.nhtsa.dot.gov/QueryTool/QuerySection/Report.asp

[30] G B Rodgers. 2002. “Effects of state helmet laws on bicycle helmet use by children and adolescents.” *Inj Prev* 2002;**8**:42-46.