

Use of Motorcycle Helmets: Universal Helmet Laws

Summary Evidence Table - Economic Evidence

Study Details	Intervention and Population Characteristics	Helmet Law or Law Change Examined	Effect Size	Program Costs	Healthcare Costs Averted Productivity and Other Losses Averted	Full Economic Summary Measure
<p>Author (Year): Bledsoe et al. (2002)</p> <p>Study Design: Before-after</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): Arkansas (Local)</p> <p>Sample Size: 167 (71 pre-repeal, 96 post-repeal)</p> <p>Data Source: University of Arkansas for Medical Sciences Trauma database - hospital-based charges (method of payment, total charges, and total reimbursement)</p> <p>Time Horizon: 1995-1996 and 1998-1999</p>	<p>Repeal of universal helmet law on July 1, 1997 (reduced to ages 20 and younger)</p>	<p>Non-helmeted patient admissions rose from 25% to 54% of patients after repeal of the law; non-helmeted patients had higher mean head and neck AIS scores and longer ICU length of stay</p>	<p>N/A</p>	<p>Healthcare Costs:</p> <ul style="list-style-type: none"> • Inpatient • Emergency department 	<p>Average hospital charges per patient were higher after the repeal of the universal helmet law (before: \$33,646 vs. after: \$37,265), an increase of 11% per patient on average (1999 US\$ -assumed)</p>
<p>Author (Year): Coben et al. (2007)</p> <p>Study Design: Cross-sectional</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): 33 participating states in HCUP database (capture 80% of all hospital discharges in US) (National)</p> <p>Sample Size: Principal diagnosis of intracranial injury: Universal law = 1,852 (of 16,105 total pts) Partial/No law = 1,570 (of 9,689 total pts) Total IC injuries: 3,422 (of 25,794)</p> <p>Data Source: Hospital discharge summaries and abstracts</p>	<p>Comparing states with Universal vs. Partial or No law at the time of the study</p>	<p>Cases from states without universal helmet laws were 41% more likely to sustain the most severe forms of traumatic brain injury</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient: intracranial injury only 	<p>Little variation in acute medical costs between states with differing helmet laws (<i>may be underestimating cost savings of helmets because all patients included in analyses met threshold of having injuries serious enough to warrant hospitalization; hospital charge data do not include physician professional fees, emergency transportation costs, or subsequent rehabilitation costs</i>)</p> <p>Ex. For Intracranial injury (2001 US\$ -assumed): Universal = \$49,983 Partial/no law = \$44,190 (greatest hospital charge of all injury groups; no statistically significant)</p>

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	<p>Time Horizon: 2001</p>					<p>difference of cost between groups; % w/ this injury was significantly different Universal: 11.5 Partial/None: 16.2)</p>
<p>Author (Year): Dardis et al. (1987)</p> <p>Study Design: Cross-sectional</p> <p>Economic Method: Cost-benefit</p>	<p>Study Location (Scope): National (National)</p> <p>Sample Size: - 2.31 million motorcyclists in no law states (1.848 million registered *1.25 to account for passengers) - 2.49 million motorcyclists in modified law states (1.990 million registered*1.25 to account for passengers)</p> <p>Data Source: FARS data, AIS scores 3-6</p> <p>Time Horizon: 1981 (averaged data from 1980-1982)</p>	<p>Number of injuries combined with direct and indirect costs of injuries to yield estimate of total losses to society from absence of comprehensive state helmet laws in 1981</p>	<p>Estimates for 34% helmet effectiveness and 51% helmet effectiveness</p>	<p>Helmet = \$40, annualized helmet cost (with 10% discount rate) = \$10.55</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Not itemized, may include one or all of the following: Inpatient, ER, Outpatient, Ambulance/medical Transport, Rehabilitation <p>Productivity and other losses:</p> <ul style="list-style-type: none"> • Morbidity and Mortality: Value of production foregone (current or future earnings) and Willingness-to-pay life values 	<p>Cost-to-Benefit Ratio: 0.05-0.09 when life values based on willingness-to-pay, 0.09-0.18 when life values based on the value of production foregone</p>
<p>Author (Year): Dee (2009)</p> <p>Study Design: Cross-sectional</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): National (National)</p> <p>Sample Size: 3.6 million registered motorcyclists (in states without mandatory helmet laws)</p> <p>Time Horizon: 2005, also include estimate for 30 year time horizon</p>	<p>Comparing states with and without universal helmet laws</p>	<p>Mandatory helmet laws could reduce fatalities in states without such laws by 27% (~644 deaths per year)</p>	<p>N/A</p>	<p>Productivity and other losses:</p> <ul style="list-style-type: none"> • Mortality: non-income-related valuation 	<p>Annual benefit of saving 644 lives roughly \$1.6 billion (2005 US\$); \$888 benefit annually for each motorcyclist constrained by new law (about 50% of cyclists or 1.8 million constrained by new law); social benefit is roughly \$14,000 for each motorcyclist who would be required to wear a helmet because of law (discount rate 5%, 30 year time horizon)</p>

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<p>Author (Year): Foldvary et al. (1964)</p> <p>Study Design: Cross-sectional</p> <p>Economic Method: Cost-effectiveness</p>	<p>Study Location (Scope): Victoria, Australia (State-level)</p> <p>Sample Size: 17,783 registered motorcycles</p> <p>Time Horizon: 1961</p>	<p>Mandatory helmet legislation enacted in 1961; wearing rate was 56% before law so 44% of the ~18,000 registered would have to buy a helmet (cost)</p>	<p>Additional lives saved as the result of the last 44% of motorcyclists now being obliged to wear helmets is 15.75 per year</p>	<p>Helmet cost – average: £5 (range: £3.5.0-£9.15.6); cost for 7900 motorcyclists if helmet lasts 5 years = £7,900</p>	<p>Productivity and other losses:</p> <ul style="list-style-type: none"> • Mortality: Lives saved (non-monetary valuation) 	<p>Cost per year of helmets for the 44% of motorcyclists = £7,900. Cost per life saved is £7900/15.75 = ~£500 per life saved (1964 AUE)</p>
<p>Author (Year): French et al. (2009)</p> <p>Study Design: Modeled estimates</p> <p>Economic Method: Benefit-only (only in discussion section)</p>	<p>Study Location (Scope): National (National)</p> <p>Sample Size: 489 lives saved</p> <p>Time Horizon: 2005</p>	<p>Comparing states with and without universal helmet laws</p>	<p>Estimated 489 lives could have been saved if all states had universal helmet law</p>	<p>N/A</p>	<p>Productivity Loss</p> <ul style="list-style-type: none"> • Mortality: non-income-related valuation 	<p>With value of a statistical life set at \$5 million; almost \$2.5 billion could have been saved in mortality costs if the 489 deaths were prevented (2005 US\$)</p>
<p>Author (Year): Hartunian et al. (1983)</p>	<p>Study Location (Scope): 48 contiguous US states (National)</p>	<p>Between 1976-1980, 28 states repealed/weak</p>	<p>516 excess deaths due to repeal or weakening of</p>	<p>N/A</p>	<p>Medical costs</p> <ul style="list-style-type: none"> • Inpatient • Emergency room 	<p>Total economic costs due to helmet-law repeal or weakening; extensive sensitivity analysis 516 excess deaths in 1980</p>

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<p>Study Design: Retrospective cohort</p> <p>Economic Method: Benefit-only</p>	<p>Sample Size: ~25,000 motorcycle fatalities</p> <p>Data Source: Only fatally injured from FARS database</p> <p>Time Horizon: 1975-1980</p>	<p>ened helmet laws</p>	<p>helmet laws</p>		<p>Productivity and other losses:</p> <ul style="list-style-type: none"> • Mortality: Future earnings • Household productivity • Discount rate: 2%, 6%, and 10% • Market-cost/market-value approach: cost of contracting for comparable household services from members of the labor force • Opportunity-cost approach: the wage rates homemakers could receive if they were to seek outside employment • Legal Costs <ul style="list-style-type: none"> ◦ Litigation/court costs ◦ Insurance administration costs • Funeral Expenditures <ul style="list-style-type: none"> ◦ Net funeral costs per capita 	<p>generated ~ \$176.6 million in direct and indirect costs (1980 US\$)</p> <p>Direct costs: \$5.4 million</p> <ul style="list-style-type: none"> • Net funeral: \$2.3 million • Legal/court: \$2.2 million • hospitalization: \$0.6 million • Emergency services: \$0.2 million • Insurance administration: \$0.05 million <p>Indirect costs account for 97% of economic costs because extra deaths occur predominantly among young people (large productivity losses over a lifespan)</p>
<p>Author (Year): Koehler (1978)</p> <p>Study Design: Before-after</p>	<p>Study Location (Scope): Texas, 4 counties (Local; hospital level)</p> <p>Sample Size: 1092 total patients</p> <p>Time Horizon: 1976-1978 (pre-post law)</p>	<p>Comparing before and after the repeal of universal helmet law in Texas August 1977</p>		<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient 	<p>Cost by injury severity higher post repeal than pre (1977 US\$)</p> <ul style="list-style-type: none"> - Parkland county: \$6,451 (pre), \$10,250 (post) - Memorial county: \$3,719 (pre), \$8,416 (post) - Ave cost of accident (survey): pre = \$3,880, post = \$4,112

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<p>Economic Method: Benefit-only</p>						
<p>Author (Year): Mackersie et al. (1995)</p> <p>Study Design: Retrospective cohort</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): San Diego County, CA (Local)</p> <p>Time Horizon: Jan 1985 – Oct 1994</p>	<p>10 year trend analysis of motorcycle helmet use (and other high-risk behaviors; change in law in 1991 captured in high-risk behavior trend data (less non-helmet use after 1991)</p>	<p>100% decrease in hospital charges to public agencies from 1985-1994</p>	<p>N/A</p>	<p>Healthcare cost:</p> <ul style="list-style-type: none"> • Inpatient • Hospital unit charge used as a surrogate for cost and to correct for charge inflation 	<p>Hospital charges were significantly higher for helmet vs. no helmet (5.37 unit charges vs. 7.26 unit charges); 100% decrease in hospital charges to public agencies</p>
<p>Author (Year): Max et al. (1998)</p> <p>Study Design: Before-after</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): California (State-level)</p> <p>Sample Size: 12,228 patients over 3 years</p> <p>Population Characteristics: California hospital discharge data, San Diego county only for ambulance transport, emergency air transport, ED visit, and follow-up ambulatory care visit</p> <p>Time Horizon: 1991-1993</p>	<p>On January 1, 1992, California passed a universal helmet law</p>	<p>Costs for all publicly sponsored pxs (CMS, MedicalCal, federal coverage) decreased by \$8.5 million (30%) in the first 2 years after law were implemented (1993 US\$)</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient • Emergency department • Ambulance medical transport • Rehabilitation cost <p>Productivity and other losses:</p> <ul style="list-style-type: none"> • Mortality: Productivity losses based on market-value approach; present value of lifetime earnings was based on age-specific and gender-specific estimates for CA in 	<p>Costs and productivity losses were higher in 1991 than 1992 or 1993; costs remained similar between 1992 and 1993</p> <p>Total costs: 1991: \$98.1 million 1992: \$63.1 million 1993: \$63.3 million</p> <p>Lost productivity (3% discount rate): 1991: \$603 million 1992: \$380 million 1993: \$345 million</p>

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					1993; both labor market earnings and an imputed value for housekeeping services were included and discounted with a 3% rate <ul style="list-style-type: none"> ○ (discounted at 3%, 4%, and 5%) ● Other: Professional fees, re-hospitalization, and nursing home care costs 	
<p>Author (Year): McSwain et al. (1985)</p> <p>Study Design: Before-after</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): Louisiana - Lake Charles, Baton Rouge, New Orleans (Local)</p> <p>Sample Size: 230 riders with available \$ data</p> <p>Data Source: hospital provided financial data</p> <p>Time Horizon: June-Sept 1981 (during repeal), June-Sept 1982 (after re-enactment)</p>	<p>Re-enactment of mandatory helmet law in Louisiana in June 1982</p>	<p>60% decrease in medical costs per person from 1981 to 1982</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> ● Inpatient ● ER 	<p>Average costs of medical care, <i>excluding physician cost</i> (1982 US\$): 1981: \$2071.78 1982: \$835.40 Costs for those disabled and unable to return to work for a period greater than 30 days was five times greater in 1981 compared to 1982 (1981: \$29,800 1982: \$5,600)</p>
<p>Author (Year): McSwain et al. (1990)</p> <p>Study Design:</p>	<p>Study Location (Scope): Louisiana, Kansas, Texas, 17 other states, other countries (State-level data only for Kansas and Louisiana)</p>	<p>Effects of enactment/repeal of universal helmet laws</p>	<p>N/A</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> ● Not itemized but may include: Inpatient, ER, Outpatient, Ambulance/Medical transport, Rehabilitation 	<p>Costs saved in Kansas annually (1989 US\$): \$744,000; Costs saved in Louisiana annually (1989 US\$): \$233,000</p>

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<p>Modeled estimates</p> <p>Economic Method: Benefits-only</p>	<p>Time Horizon: 1989 (but considered varying time horizons for different studies)</p>					
<p>Author (Year): Mertz et al. (2008)</p> <p>Study Design: Before-after</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): Pennsylvania (State)</p> <p>Sample Size: 2001-2002: 826 injuries and deaths 2004-2005: 1463 injuries and deaths</p> <p>Data Source: Pennsylvania DOT, Pennsylvania Health Care Cost Containment Council</p> <p>Time Horizon: 2001 to 2005</p>	<p>Comparing before and after repeal of universal helmet law in Pennsylvania in 2003 (to partial law covering those younger than 21 years or those with fewer than 2 years riding experience who have not completed a safety program)</p>	<p>Total acute care hospital charges for motorcycle-related head injuries increased 132%, for non-head injuries increased 69%</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient 	<p>Total acute care hospital charges for motorcycle-related head injuries increased from \$53 million in 2001-2002 to \$124 million in 2004-2005, for non-head injuries increased 69% (2005 US\$)</p> <p>Percentage increase in mean charge nearly identical for head vs. non-head injury so assumed that larger increase in charge for head due to the increase in number of head injuries</p>
<p>Author (Year): Muelleman et al. (1992)</p> <p>Study Design: Before-after</p>	<p>Study Location (Scope): Nebraska (State)</p> <p>Sample Size: Admissions or deaths: 1988: N=93 1989: N =43 Sample represented about ~40% of the state</p>	<p>Comparing before and after the re-enactment of universal helmet law on January 1, 1989</p>	<p>Total acute medical charges decreased by 38% after reenactment</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient 	<p>No statistically significant difference in avg. charge per admission; total acute medical charges decreased by \$324,648 after reenactment</p> <p>48% of the total acute medical charges (\$676,722) over both years were either unpaid or paid by government (1989 US\$)</p>

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<p>Economic Method: Benefit only</p>	<p>Time Horizon: 1988 and 1989</p>					
<p>Author (Year): Muller (1980)</p> <p>Study Design: Cross-sectional</p> <p>Economic Method: Cost-benefit</p>	<p>Study Location (Scope): Data estimates from Colorado, South Dakota, Oklahoma (State-level)</p> <p>Sample Size: Modeled estimates; 5.15 million registered motorcyclist estimated in 1975</p> <p>Time Horizon: 1976</p>	<p>Estimating economic impact of US states repealing helmet laws</p>	<p>2500 expected annual motorcycle crashes</p>	<p>Cost of motorcycle helmet: \$30 average (\$11-\$130) (1975 US\$)</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient • ER • Outpatient • Rehabilitation <p>Productivity and other losses averted:</p> <ul style="list-style-type: none"> • Postponed funeral expenses_(\$925, discounted at 7%) 	<p>CB of Helmet Use: Annual gross benefit (mainly from saved medical care and rehabilitation costs) exceeds annual expenditure on helmets by at least \$1.2 million per 100,000 motorcycles (1975 US\$)</p> <p>CB of Helmet law repeal: helmet law repeal contributed to an estimated \$694,255 of additional expenditures in 1975 mostly due to an increase in more severe injuries (offset a little by costs saved from people not buying helmets); estimated that helmet law repeals annually contribute \$16.1 to \$18.0 million of additional medical care/rehabilitation expenditures (1979 \$); if helmet law could extend helmet use to 95%, then enactment could save ~\$532,735 per 100,00 motorcycles per year</p>
<p>Author (Year): Naumann et al. (2012)</p> <p>Study Design: Modeled estimates</p>	<p>Study Location (Scope): National (National)</p> <p>Sample Size: 8.2 million registered motorcycles in 2010</p> <p>Time Horizon: 2010</p>	<p>Comparing states with and without universal helmet laws; Costs saved per rider from helmet use (medical and emergency</p>	<p>Savings for helmet use in states with universal helmet laws were nearly four times greater than in states without such</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient • ER • Outpatient • Ambulance transport • Rehabilitation <p>Productivity and other losses:</p> <ul style="list-style-type: none"> • Morbidity 	<p>Savings for helmet-use in states w/ universal helmet laws were \$725 per registered rider; savings in states without such law were \$198 per rider (2010 US\$)</p> <p>Costs saved per fatality: \$1,212,800 Costs save per serious injury: \$171,753 Costs saved per minor injury: 7,523</p>

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Economic Method: Benefit-only		services)	laws		<ul style="list-style-type: none"> • Mortality • Excluded property damage and travel delay costs 	
Author (Year): NHTSA (2011) Study Design: Modeled estimates Economic Method: Benefit-only	Study Location (Scope): National (National) Sample Size: 2007 fatalities: 5,174 2008 fatalities: 5,290 Time Horizon: 2007 - 2008	Comparing states with and without universal helmet laws; Costs saved due to helmet use; additional costs savable at 100% helmet use	N/A	N/A	Healthcare costs <ul style="list-style-type: none"> • Not itemized but may include: Inpatient, ER, Ambulance/emergency transport Productivity and other losses: <ul style="list-style-type: none"> • Morbidity • Mortality • Litigation 	Economic savings due to helmet use approx. \$2.9 billion in 2008, with additional \$1.3 billion costs savable if there had been 100% helmet use (2008 US\$)
Author (Year): Rice et al. (1989) Study Design: Cross-sectional Economic Method: Cost-benefit	Study Location (Scope): National (National) Sample Size: Estimated 2,714 fatalities (1985) and nonfatal head injury to death ratio was 3:1; 24% reduction in deaths with laws leads to 651 fewer deaths and 1953 fewer head injuries Population Characteristics: National Surveys, estimates for value of life; The major data sources used in estimating numbers of injuries are the National Mortality Detail File (for	Injury prevention study which included component on introducing motorcycle helmet use laws	Estimated 24% reduction in deaths with enactment of universal helmet law	Median cost of helmet: \$170 (1989 US\$) Study assumes 50% of owners of registered motorcycles would need to buy helmet = \$296 million	Productivity losses: <ul style="list-style-type: none"> • Mortality: Market-value approach and Willingness-to-pay approach 	With mandatory helmet law, US would save \$97 million (accounts for cost of helmet) (1985 US\$) CBR 1.33 (calculated by Hyder 2007 and Econ Team); using willingness-to-pay approach, savings would be \$1.2 billion (accounts for cost of helmet), CBR 5.07 (calculated by Hyder 2007 and Econ Team) Caveat: Authors do not consider analysis a full cost-benefit analysis because certain costs and benefits that are not translatable into dollars are not included (intervention costs, pain and suffering, economic productivity of caregiving)

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	<p>deaths), the National Hospital Discharge Survey (for live hospital discharges), and the National Health Interview Survey (for less severe, nonhospitalized injuries).</p> <p>Time Horizon: 1985</p>					
<p>Author (Year): Sass et al. (2000)</p> <p>Study Design: Panel data (longitudinal) 22 years</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): National (National)</p> <p>Sample Size: 1100 annual observations from 50 states</p> <p>Time Horizon: 1976-1997</p>	<p>Assessing changes over time throughout the US of helmet laws; Total costs saved if all states had helmet law vs no states had helmet law</p>	<p>763 additional lives could be saved if all states had helmet law (vs. if no state has helmet law)</p>	<p>N/A</p>	<p>Productivity losses:</p> <ul style="list-style-type: none"> • Mortality: non-income-related valuation 	<p>Fatality differential was 763 (all helmet law vs. all no helmet), with VSL \$3 million, \$2.29 billion; equivalent to \$605 per registered motorcycle (1993 US\$ - assumed)</p>
<p>Author (Year): Turner et al. (2004)</p> <p>Study Design: Before-after</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): Florida (Local)</p> <p>Sample Size: Six trauma centers (30%) and two additional centers provided data; 3 main trauma centers for data sources (Halifax, Holmes, Memorial)</p> <p>Time Horizon: 1999-2002</p>	<p>Universal law repealed on July 1, 2000 (those 21 and older with \$10,000 in medical insurance can ride helmetless)</p>	<p>Helmet use rate percentage points declined between 12% and 51% after repeal of the universal helmet law</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> • Inpatient 	<p>Non-helmeted patients incurred higher avg charges (\$34,021-\$55,055) in period following law change for all injuries compared to helmeted patients (\$25,288-\$41,311)</p> <p>Non-helmeted patients incurred higher avg charges (\$32,426-\$44,053) in period following law change for head injuries compared to helmeted patients (\$28,602-\$31,437) (2002 US\$)</p>

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<p>Author (Year): Ulmer et al. (2005)</p> <p>Study Design: Before-after</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): Florida (State-level)</p> <p>Sample Size: Hospital discharge data (~240 acute care hospitals in the State); info only on motorcyclists admitted for treatment</p> <p>Time Horizon: 1998-2002</p>	<p>Repeal of Florida universal helmet law (to 21 and up with \$10,000 insurance no helmet requirement)</p>	<p>Total gross costs charged to acute care hospital admitted motorcyclists with principal diagnosis of head/brain/skull injury more than doubled</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> Inpatient 	<p>Total gross costs charged to acute care hospital admitted motorcyclists with principal diagnosis of head/brain/skull injury increased from \$21 million to \$50 million (1998 US\$)</p> <p>Post law, 75% of head/brain/skull injured admitted were charged ~\$12,000 or more (would not be covered by the \$10,000 health insurance requirement)</p> <p>Average total acute care costs per patient for head/brain/skull injuries: 30 months pre law: \$34,518 30 months post law: \$39,877 Head/Brain/Skull and Neck/Spine injuries the most expensive per case</p>
<p>Author (Year): Weiss (1992)</p> <p>Study Design: Modeled from cross-sectional sample</p> <p>Economic Method: Benefit-only</p>	<p>Study Location (Scope): Los Angeles, CA (Local)</p> <p>Sample Size: HMC (Harborview Medical center) cost data on 105 patients</p> <p>Time Horizon: 1985</p>	<p>Estimating cost savings if universal helmet law were enacted</p>	<p>N/A</p>	<p>N/A</p>	<p>Healthcare costs:</p> <ul style="list-style-type: none"> Inpatient 	<p>With introduction of helmet law, cost savings would be \$751,000 or \$1,710 per rider (1985 US\$)</p>