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Authors

Shaheen, Susan
Shen, Diwen
Martin, Elliot

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UNDERSTANDING CARSHARING RISK AND INSURANCE CLAIMS IN THE UNITED STATES

Susan Shaheen, Ph.D. (Corresponding author)
Adjunct Professor, Civil and Environmental Engineering
Co-Director, Transportation Sustainability Research Center
University of California, Berkeley
408 McLaughlin Hall, Berkeley, CA 94720
510.642.9168, sshaheen@berkeley.edu

Diwen Shen
Student Researcher
Transportation Sustainability Research Center
University of California, Berkeley
1301 S. 46th Street, Bldg. 190, Richmond, CA 94804-4648
510.610.5132, stevendshen@berkeley.edu

Elliot Martin, Ph.D.
Assistant Research Engineer
Transportation Sustainability Research Center
University of California, Berkeley
1301 S. 46th Street, Bldg. 190, Richmond, CA 94804-4648
510.665.3576, elliot@berkeley.edu

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ABSTRACT
Carsharing offers consumers short-term access to vehicles, which facilitates better mobility and reduces the need for personal vehicle ownership. Carsharing does not require consumers to have automobile insurance. Instead, carsharing operators insure their members and are responsible for the risks and liabilities associated with vehicle use. Carsharing operators are burdened with obtaining cost-effective insurance under a usage model that lacks massive actuarial data and analysis. This study analyzes 28 operator years of trips and claims data from six carsharing operators in the United States (U.S.), with data spanning a time range of 2008 to 2015. A total of 328,726 valid trips and 125 valid insurance claims occurred during this period. From this data, we estimate crash risk, measured on per mile and per insured vehicle year basis. We estimate the average cost per insured-vehicle year of carsharing insurance to be US$789 for operators in our study. Substantially heightened risk is observed for older drivers above age 65 compared to other age brackets as well as national averages. Teenage and young adult drivers of ages 18-25, who traditionally have the highest risk, had only moderately higher risk compared to adults, which is likely due to driving experience and clean driving record requirements prior to obtaining membership. Mid-age adults of ages 30-65 had the lowest risk in all measures, as found in nationwide data. However, the actual risk of carsharing vehicles will vary by usage patterns and (other) unobserved factors; actual costs will also vary by insurance policy.

INTRODUCTION

Carsharing—short-term private vehicle access without the cost and responsibilities of ownership—is the pioneering form of shared mobility within the emerging sharing economy. Instead of owning one or more vehicles, a household or business accesses a fleet of shared vehicles on an as-needed basis by joining an organization that maintains a fleet of cars and light trucks in a network of locations. Generally, each time they use a vehicle, participants pay an all-inclusive cost covering the expenses of gas, maintenance, and insurance.

One of the main advantages of carsharing is that insurance is included with membership. Most often, the carsharing operator is insured for drivers using their vehicles. The auto insurance policy is a contract between the carsharing operator and the insurance company. In 2002, U.S. shared vehicle operators reported carrying insurance policies with US$500 to US$1,000 deductibles, and US$1-2 million in liability limits (*1*). By 2008, U.S. carsharing organizations paid average premiums of US$2,459 per insured vehicle year for those that had expanded to college or university markets and US$1,480 for other operators (*2*). This is much higher compared to the national combined average premium of US$908 in the same year, which includes payouts for all collision, liability, and comprehensive coverage claims but does not include deductibles (*3*). High cost and lack of available insurance options have resulted in a number of high profile program fines and closures. For example, in 2014, New York's Department of Financial Services (DFS) fined peer-to-peer (p2p) carsharing operator RelayRides (now named Turo) US$200,000 for false advertising, unlicensed insurance activity, and other violations. DFS ordered RelayRides to cease operations, claiming that the company misrepresented insurance risks to consumers when users could be financially responsible for accidents or thefts while using the service.

This paper provides the results of a North American carsharing insurance study. From September 2014 to July 2015, data were collected and analyzed from six North American carsharing operators. In the sections that follow, we provide an overview of carsharing insurance in the U.S. Given the lack of studies on carsharing crashes and their costs, we look at the corresponding patterns for all automobiles in the nation, with an emphasis on measuring crash risk for each driver age and gender group. Finally, we examine potential biases when comparing carsharing drivers with the average U.S. driver. The data collected and analyzed include information on vehicle activity, vehicle accidents, and accident costs experienced by carsharing operators. We have supplemented these findings with expert interviews and a literature review.

BACKGROUND AND PREVIOUS RESEARCH

Surveys of U.S. carsharing operators (*1*, *2, 4*) reported that high insurance costs were significant deterrents to market entry and expansion between 2002 and 2004. A 2002 survey of 18 U.S. shared vehicle organizations (*1*), which included 11 carsharing organizations, five station car programs, and two carsharing research pilots, recorded that insurance premiums ranged between US$1,200-$6,000 per vehicle-year, with US$1-2 million in liability limits and US$500-$1,000 deductibles. On average, 17 collision claims occurred per 100 insured vehicle years, costing US$600 to $900 per claim. No bodily injury liability or medical payment claims had been reported. During this period, the majority of such operators paid premiums of US$4,800-$6,000/vehicle per year, which was three to four times as high as pre-2002 levels. Insurance costs made up around 20% to 48% of operators' total costs, and a high amount of staff time was dedicated to obtaining affordable insurance coverage. These high costs were associated with the 9/11 attacks, an economic climate that made insurers less likely to explore new markets such as shared vehicles, as well as unknown risks of this unclassified risk category and costs of developing a new classification category. By 2005, insurance availability expanded but premiums remained high (*4*). This was partially because of the expansion of carsharing to those under age 21 on university campuses. Finding affordable insurance for younger drivers (typically 18-21 or 18-25 years old) was challenging, and self-insurance—drivers providing their own insurance policies—was common for these age brackets. By 2008, availability and affordability of carsharing insurance increased for all market segments, although operators that expanded to college and university markets experienced higher costs compared to others—an average of US$2,459 compared to US$1,480 per insured vehicle-year (*2*). Insurance companies, carsharing operators, and governmental representatives referred to insurance costs as a "capital drain" and called for cooperation on claims history data to "remove uncertainty … (from) liability and risk" (*6*). Other potential solutions for reducing insurance costs included lowering liability limits, self insurance, students using parents' insurance policies, forming insurance pools, and switching to pay-as-you-drive insurance among others (*1*, *4*, *2*).

Currently, Dixit et al. (2014) (*7*) is the only study on vehicle crashes of a carsharing operator, evaluating GoGet, in Sydney. Through a self-reported survey, Dixit et al. reported that crash involvement was higher for carsharing drivers who used cars more frequently, owned no cars, had more past accidents, chose lower insurance deductibles, and had shorter durations of holding licenses. When a crash occurred, the likelihood of being at-fault was higher for carsharing drivers who did not use cars on the weekend, drove less than 1,000 km (621 miles) in the last year, rarely used a car, and held domestic driving licenses. Finally, members who had lower than AUD$300 (US$219 as of 2015) insurance deductibles were more likely to be involved in crashes, possibly indicating adverse selection (where higher risk agents chose to have higher coverage), and moral hazard (where agents take on more risk because someone else bears the costs). Deductible levels were not correlated with fault assignment. Unfortunately, the severity and costs of the carsharing crashes were not known. Building on prior work, we review the broader scope of studies and data of nationwide automobile crashes in the U.S. to provide comparative insights on carsharing crashes and their costs in the section below.

Frequencies of Automobile Crashes

Several studies of automobile crashes examined crash rates based on driver age and gender. One recent study (*8*) used 2008 National Highway Traffic Safety Administration crash data and measured crash involvement rates ("crash rates") of all police-reported crashes per million miles traveled. They are, from highest to lowest: 1) teenagers of ages 16-17 (around 20-30 crashes), 2) younger adults of ages 18-29 (around 9-10 crashes), 3) old drivers of ages above 80 (around 5-8 crashes), and 4) adults of ages 40-69 (around 2.5-3 crashes). Females had marginally higher crash rates than males except for ages 19-30, but males had higher fatal crash rates per mile than females in almost all age brackets. The higher risk of males was most pronounced for those of ages 16-29 and above 85. These age and gender patterns are similar to those in 1990 and 1996 data of the same source (*9*, *10*). While police reports offer some of the most comprehensive data for collisions, previous research has noted these tend to underreport crashes, and only around 35% to 60% of hospital recorded accidents are reported to the police; crash report rates also differ by age, gender, race, as well as injury severity (*11*, *12*, *13*).

It has long been known that teenagers and older drivers drive less than other age brackets, but they possess disproportionately high crash and fatality rates. Teenagers, especially between ages 16-17 have had consistently higher risk due to the lack of experience and riskier driving behavior (*14*). The duration of holding a license was a powerful predictor of risk for all age brackets, and for novice teenage drivers the crash risk was particularly high in the first 18 months of licensure (*15*). Fatal crashes for teenager drivers were more likely to be caused by driver error, speeding, and single-vehicle crashes, compared to other age brackets (*16*). Other risk factors for teenagers included: nighttime and weekend driving, driving in high-density areas, "driving for fun," alcohol use and less parental restrictions on alcohol, having teenage passengers, less seatbelt use, and lower student grade point averages (*17*, *19*). Old drivers have elevated fatal crash rates due to increased fragility and impaired cognitive, perceptual, and physical capabilities (*21*, *22*). Old drivers are low-mileage drivers and tend to make shorter, riskier trips often in city driving conditions rather than highways or other road types, thus leading to higher crash rates per mile traveled (*23*).

Costs of Automobile Crashes

There are three main types of insurance coverage for vehicle damage in crashes: 1) collision coverage for physical damage to the vehicle, if the insured is at fault; 2) property damage liability coverage for physical damage that at-fault drivers cause to the property of other parties; and 3) comprehensive coverage for theft and vehicle damage not caused by crashes (*24*). Based on 2002 to 2004 model-year private passenger vehicles, the most frequent claim type was collision, followed by property damage liability. Each crash incident may involve multiple claim types. For each insured vehicle year, collision claims had the highest total costs, followed by liability claims. Bodily injury liability claims, while the least frequent, were much more costly per claim when they occurred compared to any other claim type.

Claim rates and costs vary across rated driver age for each claim type, as reported by the Highway Loss Data Institute. Collision claim rates varied between 5.5 and 12 per 100 insured vehicle years depending on age, averaging around US$170 to $620 per year for each vehicle (*25*). Most collision claims were relatively small, but the few larger claims made up the majority of costs (*26*, *27*)—about 30% of claims were smaller than US$1,000, about 50% smaller than US$2,000, and only about 10% above US$10,000, but claims above $10,000 made up 50% of total dollars paid. These figures do not include deductibles paid by consumers, which typically ranged from US$250 to $500. On average, there were 3.2 property damage liability claims per 100 insured vehicle years, averaging US$2,867 per claim and US$91 per insured vehicle year. For both collision and property damage liability claims, drivers of ages 60-69 had the lowest claim frequencies, losses per claim, and losses per insured vehicle year. Teenagers of ages 16-19 had the highest claim rates and losses per insured vehicle year (around 100% to 200% higher than the lowest group). These results are in-line with crash rate patterns previously discussed. In terms of comprehensive coverage claims for "small, four-door automobiles," the total cost per insured vehicle year was US$101, including around US$4 for theft and US$9 for glass damage (*28*).

Bodily injury claims usually include: 1) liability coverage for injuries caused by at-fault drivers to other persons and 2) medical payment coverage for injuries of the insured driver and their passengers (*24*). Bodily injury liability claims rates were on average 0.91 per 100 insured vehicle years, averaging US$11,088 per claim and US$101 per insured vehicle year (*29*). Bodily injury liability claim rates were lowest for drivers of ages 60-69, and they were highest for teenagers of ages 16-19 (around 200% to 300% higher than the lowest group), followed by young adults of ages 20-24 (around 150% to 200% higher) and drivers older than 85 (around 30% to 150% higher). Costs per claim were lowest for young adults of ages 20-24, and they were highest for older drivers (around 15% to 40% higher than the lowest group), followed by teenage drivers (around 20% higher). Medical payment claim rates were 1.12 per 100 insured vehicle years, an average of US$3,709 per claim and US$42 per insured vehicle year (*30*). States with no-fault insurance systems typically use personal injury protection coverage in lieu of medical payment coverage, and such states usually have higher claim rates and costs mainly due to higher medical costs compared to other states and moral hazard (*25*, *31*, *32*).

Potential Bias

A prediction of crash rates exclusively using age and gender as explanatory variables has been found to be biased. Data from 1990 showed that males had higher fatal crash rates per year than females, the difference disappeared when controlling for average annual miles traveled (*9*). Furthermore, the relationship between crash rate and distance driven is not linear, and drivers who inherently drive less are assessed to be riskier on a per mile basis (*23*, *33*). For example, studies of data in the Netherlands and Finland showed that for drivers driving relatively high mileages each year, the older the driver, the lower the crash rate; however, for drivers driving a relatively low total mileage each year, crash rates increased by age starting at about age 65, and the pattern was most notable for old drivers above age 75 (*34*, *35*). Mileage-based crash statistics may also be biased because low-mileage drivers tend to drive more in urban areas, which have higher risk, and high mileage drivers tend to drive more on highways, which have lower risk (*23*, *36*). Controlling for driver experience, among other factors, is also important in such analysis. In addition, moral hazard arising from more generous insurance policies (deductibles and premiums) could lead to higher crash rates and costs (*37*, *38*, *39*). Due to data limitations, these problems will remain unresolved in our study. Finally, the profile of carsharing trips and drivers is different from the general population. According to a 2005 survey of City CarShare in San Francisco, if carsharing was not available, 30.1% of trips would not have been made, and only 4.7% would have been made by respondents driving themselves (*40*). The risk of carsharing is thus potentially different from those captured by current national surveys, and new data and analysis are needed.

METHODOLOGY

This study analyzed data from six U.S. carsharing operators, who collectively provided a total of 28 operator years of claims data for collision, liability, and comprehensive coverage claims (over the time frame ranging from 2008 to 2015). The majority of claims are collision and property damage liability claims. In addition, data were also provided on all trips that occurred during the corresponding "operator years." For each trip, the data included reservation start time, trip distance (in miles), trip duration (in hours), and driver and vehicle IDs—from which we were able to obtain information on driver age, gender, and vehicle make and model. We estimated claim rates and costs per trip, mile, hour, vehicle year, as well as the cost per claim for each demographic group defined by driver age and gender. Note that we calculated the total number of vehicle years for each operator based on the number of vehicles active each month, since vehicles are constantly added or removed across a fleet.

The crash data provided by operators came in two forms. Three operators provided insurance claims and costs through loss-run reports by their insurance provider, which included fault, cause, driver, insurance payouts to the operator and to third parties, and any other expenses. These payout amounts did not include deductibles, which were obtained separately, and ranged from US$500 to $2,000. The other three operators provided crash and cost data through custom spreadsheets. We requested operators provide the "cost to the insurance company" for each claim, which included payouts to the operator and payouts to third parties. In order to make costs comparable among operators with different deductible levels, we chose US$1,000 as a hypothetical deductible level for all operators and calculated costs for each claim under this assumption. The US$1,000 threshold was chosen since four of the six operators had US$1,000 deductibles for at least some years (if not all years) during the study period. The original claim costs were adjusted according to the difference between US$1,000 and their original deductible level. The limitation to this approach is that if an operator had a deductible higher than US$1,000 (e.g., US$2,000), claims with total costs lower than US$2,000 but higher than $1,000 would likely not be reported. For such cases, we referred to details in custom claims records to make our best estimates. On the other hand, operators with deductibles lower than US$1,000 would tend to report more claims than they would, if their deductible was US$1,000. We assume claims that cost only marginally above the US$1,000 deductible level would not be reported to the insurance company. We define such claims to be those with total costs less than US$1,200 or less than $200 above the hypothetical deductible level. A total of four out of the 129 original claims were removed as a result. This decision was made based on actual reporting thresholds observed in operators that provided such data.

The data had some natural gaps. First, four of the 125 claims were caused by "vandalism" or a "falling tree branch." For these claims, no driver age or gender data were available. We assume these claims were covered under comprehensive coverage, independent of driver demographics, and thus we excluded them when calculating crash rates and costs by driver age and gender. Second, some operators provided "non-payout" claims in the data they provided, which are claims that did not incur significant costs and/or were not reported to insurance companies. The threshold for recording these non-significant crashes likely differed among operators based on their record keeping. Typically, official loss-run reports provided by insurance companies contained less claims than custom crash records provided by operators. Through a standardization of deductible amounts, we did our best to normalize reporting thresholds among different operators. Finally, the non-response rates for age and gender were 16.6% in the trip data and 16.8% in the crash data. Notably, one of the largest operators did not record gender data for 76.7% of total trips. Our final estimates of claim rates and costs for each age and gender group were adjusted assuming data "missing at random."

RESULTS

In this section, we provide: 1) an overview of the carsharing vehicles/trips included in this study, 2) an analysis of claims and costs by age and gender, and 3) a comparison with national data.

Overview

Next, we provide a summary of trip and crash data for five operators that have complete data between 2012 and 2014, as well as an overall summary for all six operators using all available data between 2008 and 2015 (Table 1). Among all operators in our study, 334 vehicles were active from 2008 to 2015, consisting of 328,726 valid trips. Each trip is defined as a completed "reservation" when a driver uses and returns a carsharing vehicle. The average trip distance was 25.27 miles (40.67 km), and the average duration of reservation was 3.79 hours. The average total distance traveled by each vehicle was 11,327 miles (18,229 km) per year, not including any maintenance trips. In comparison, the national average mileage traveled per vehicle was 11,244 miles (18,100 km) for cars in 2013, according to the Federal Highway Administration (FHWA)

(*3*). Thus, the vehicles operated by carsharing organizations in our study had similar annual mileages to the national average. However, as previously discussed, the actual exposure to crash risk is also determined by other unobserved factors, such as population density, road type, and time of day. Among all carsharing trips, 50% were made by female drivers, 27% were made by young adults of ages 18-25, 2% were made by older drivers at or above age 66, and the average age of all drivers (weighted by trips) was 35.2 years old. From 2012 to 2014, the number of active vehicles, trips, and the proportion of the youngest and oldest age bracket drivers (weighted by trips) all increased. During the same period, average trip distance and duration of reservation decreased. Across the 28 operator years of available data between 2008 and 2015, we estimate that 125 valid crash claims occurred, costing insurance providers US$578,801, assuming US$1,000 deductibles. The average cost per claim was US$4,630, and the median was US$2,189. The average cost per carsharing trip was US$1.76, and the average cost per mile was US$0.07. During 2012 and 2014, the number of claims and their costs generally increased at an upward trend, consistent with the national trend for automobile claims (*3*). The average number of crash claims was 17.05 per 100 insured vehicle years. The average cost to insurance providers per insured vehicle year was US$789.

In comparison, the national average expenditure per insured vehicle, which refers to total written premiums (not actual payouts) for liability, collision, and comprehensive coverage, was US$815 in 2012, assuming typical premiums of US$250 to $1,000 nationally (*3, 25*). There were large variations among states. For instance, New Jersey had the highest average expenditures of US$1,220 per insured vehicle year, while Idaho had the lowest of US$535 per insured vehicle year (*25*). In a more recent study, the average expenditure per insured vehicle year is estimated to be US$1,071 for small sedans in 2015, assuming a "full-coverage policy for a married 47-year-old male with a good driving record, living in a small city, commuting three to 10 miles daily to work, with a US$500 deductible for collision and a US$100 deductible for comprehensive coverage." (*41*) It is important to note that the assumed deductible in this study is US$1,000, which is higher than the typical national amount mentioned above. A higher deductible is naturally associated with lower insurer costs. Overall, given different assumptions of driver, trip, deductible levels, other insurance policy characteristics, and the small sample of crashes, it is difficult to judge how carsharing crash risk compares to the average insured vehicle in the U.S. using the above summary alone.

Claims and Costs by Age and Gender

Trip and crash characteristics vary substantially by driver age and gender. In terms of the total number of trips made in our dataset, trips were made by drivers of ages 21-25 (around 70,000 trips), followed by ages 26-30 (60,000 trips), 30-35 (around 49,000 trips), and ages 36-40 (around 30,000 trips). Remaining age brackets had about 20,000 trips or less. The total number of trips made decreased drastically for each age bracket over age 50, and those above age 70 made the least trips (around 2,000 trips). Females made more trips than males except for ages 21-40 and above 70. In terms of trip distance, drivers above age 70 had the highest average distance per trip (around 31 miles or 50 km), and those of ages 18-20 had the lowest (around 23 miles or 37 km); average trip distance decreased as age decreased. Females had consistently lower average trip distances for all age brackets except 56-65, although the gap narrowed as age increased. Age brackets above age 60 had smaller sample sizes compared to other age brackets. For total trips, the sample was still sizable (15,900), but only seven claims occurred combined across all three age brackets.

Similar to trip patterns, age brackets 21-25 and 26-30 had the highest number of total claims and costs (Figure 1). However, the highest costs per claim were observed for age brackets 61-65 and above 70 (around US$12,000 per claim but note that this was from one claim), followed by 41-45 (around US$8,000 per claim) and 18-20 (around US$6,000 per claim). In general, costs per claim were highest for older drivers and decreased as age declined until increasing again for teenagers. The costs per claim for female drivers were lower than for males in almost all age brackets. Most age categories had less than 10 claims when disaggregated into five-year age brackets.

The above summary by age and gender does not account for the different levels of exposure to crash risk of each demographic group. To control for exposure, we measure claims and costs by the number of miles traveled instead of the number of trips. In comparison, we also measure claims and costs by trip duration, which yields similar results compared to using miles. Overall, there were 15.24 claims per million miles traveled, costing US$71,411/million miles. Claims and costs were highest for older drivers of ages 65+ (around 40 claims/million miles, costing US$250,000-$500,000/million miles), followed by younger drivers of ages 18-30 (around 16-20 claims/million miles, costing US$70,000-$100,000/million miles). In general, claim rates and costs were lowest for the middle age range of 31-65. The lowest claim frequency was observed for age bracket 61-65 (four claims/million miles), and the lowest cost was observed for age bracket 31-35 (around US$20,000/million miles).

On average, the crash claim rate for females was 13.8 per million miles, costing US$45,700 per million miles, both lower than for males, which had an average crash claim rate of 16.6 per million miles, costing US$93,600 per million miles. However, the relatively low risk of females was generally observed only for age brackets below 26 or above 65, and mature adult women in the remaining age brackets had generally higher risk than males of the same age. This may be due to women making shorter trips on dense, urban roads compared to males—inflating crash rates and costs on a per mile basis. If male and female drivers had similar mileages and drove similar road conditions, males would reflect consistently higher risk (*23*).

Carsharing membership has several requirements. Operators generally require members to be at or above age 18. For individuals aged 18-20, two operators require them to be self insured or use their parents' insurance policies. Thus, actual costs and claims will be lower for teenagers for these operators, as the insurance company of the operator will not have to cover this high-risk age bracket. Three operators require members to have at least two years of prior driving experience, and two operators require at least one year of experience. All require no or few past accidents. Such rules apply for teenage drivers as well. In addition, one operator set a grade point average minimum of 3.0 for college students of ages 18-20 when obtaining membership. Thus, carsharing operators in this study excluded the highest-risk age bracket of ages 16-17, and their screening process will only allow members with experience and a clean safety record to join. According to the literature, such factors are significant predictors of future crash rates and costs. In terms of deductibles, regardless of the actual deductible levels for the operators' insurance policies, most operators have member deductibles of US$500 ("damage fee") that need to be paid in every member-fault incident. For three operators, members can waive the damage fee through a higher hourly rate or equivalent.

National Comparison

In this section, we compare estimated claim rates and costs from the six carsharing operators with available national data (Figure 2). We review data from the Highway Loss Data

Institute (2007) (*25*), which provided collision claim rates and costs, property damage liability, bodily injury liability, and medical payment claim costs for 2002-2004 model private passenger vehicles. To estimate costs, we also assess comprehensive coverage claim costs from the same source (2014) (*28*) for 2011-2013 model four-door midsized private passenger vehicles, estimated to be US$114 per insured vehicle year and generally not associated with driver age and gender. Data in the current study includes a total of 733 active vehicle years of crash and trip data. We divided claims and costs by age bracket based on the categories provided by the Highway Loss Data Institute, and we allocated the 733 vehicle years to each age bracket based on their total reservation hours. Note that the current study did not include any drivers of age 16-17 or above 79. Also note that national claim rates are for collision claims only, while claim rates for the current study are for all valid claims except comprehensive coverage claims.

We found overall higher crash rates in most age brackets especially for old drivers above age 65, followed by younger drivers. Mid-age adult drivers had the lowest crash rates, agreeing with the national average (*8*, *25*). Importantly, the national police-reported crash rate is biased downward because not all crashes are reported to the police, and data were also on the earlier end of the range (2007-2008). Crash costs are generally comparable to national data, with the exception that older drivers at or above age 65 had much higher costs than the national average, and these old drivers had higher risk than teenagers as well, counter to national patterns. Teenage drivers of ages 18-19 in our carsharing study also had higher costs when compared to the national average for the age bracket of 16-19, even though it is known that 18-19 year olds have much lower risk than 16-17 year olds. The above results are reasonable since nationwide both teenagers and old drivers are infrequent drivers despite possessing high risk. When carsharing vehicles are frequently used by these high-risk drivers, the amount of claims and costs incurred per vehicle year rises compared to privately-owned vehicles. It is also possible that carsharing members, especially old drivers, possess unforeseen higher risks in carsharing due to different driver experience levels, road conditions, and other personal and travel characteristics compared to the usual private vehicle driver that are unseen in these data.

One final limitation to the above analysis is that very few serious bodily injuries and no fatal crashes occurred in our dataset. This is a fortunate outcome for carsharing members but one that limits the ability of the data to draw conclusions regarding the risk level of carsharing in this category. According to a past study (*27*), bodily injury crashes were two to three times as costly as collision claims when they occur. However, fatal crash rates, for example, are estimated to be only 0.01-0.05 per million miles traveled, and it is likely that the 28 operator years of data are not enough to have a representative sample of such crashes.

CONCLUSION

Over the 28 operator years of data, a total of 328,726 valid carsharing trips occurred, along with a total of 125 valid insurance claims. For every one million miles (1.6 million km) driven by members, 15 claims occurred, costing about US$69,000 per million miles to insurance companies under US$1,000 deductibles. Older drivers above age 65 had disproportionally higher risk per mile compared to all other age brackets and much higher risk compared to national averages. However, low mileage bias, as discussed earlier, may play a role in this result. While older drivers had a small number of claims, their trip and mileage numbers were much lower than other age brackets. Teenage and young adult drivers of ages 18-25 had only moderately heightened risk, even though they traditionally have the highest risk among all age brackets in the national data. This is likely due to requirements regarding driving experience and clean driving records to obtain a carsharing membership. The lowest risk age bracket was 30-65, which is in line with nationwide patterns. Overall, the average insurance payout per insured vehicle year was US$789, under US$1,000 deductibles. In comparison, national averages range from around US$500 to $1,200 depending on the state, based on the latest 2012 data. However, this does not mean carsharing vehicles are either safer or riskier compared to typical insured vehicles due to different assumptions in driver, trip, and insurance policy characteristics. Using age and gender as sole predictors of crash risk should also be cautioned. Future research should build on this study by considering these unobserved factors, especially in areas where carsharing drivers and trips might be different from typical private vehicle drivers and trips.

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LIST OF TABLES

LIST OF FIGURES

TABLE 1 Summary of Trip and Crash Data

	2012	2013	2014	Total 2008-2015
Data Availability (Operator Years)	5	5	5	28
Summary of Trip Data				
Active Vehicles	137	192	209	334
Trips	62,563	68,703	78,456	328,726
Average Trip Distance (Miles)	24.93	24.46	23.50	25.27
Average Trip Distance (Km)	40.12	39.36	37.82	40.67
Median Trip Distance (Miles)	13	12	12	13
Median Trip Distance (Km)	21	19	19	21
Average Trip Duration (Hrs)	3.65	3.67	3.55	3.79
Median Trip Duration (Hrs)	2.25	2.25	2.00	2.25
Proportion of Female Trips	0.50	0.49	0.50	0.50
Average Age of Drivers When Trips Occurred	35.43	35.64	34.88	35.20
Proportion: Ages 18-25	0.26	0.25	0.28	0.27
Proportion: Ages 66+	0.01	0.02	0.03	0.02
Summary of Crash Data				
Total Claims	23	22	32	125
Total Costs ($)	108,658	75,203	172,492	578,801
Average Cost Per Claim ($)	4,724	3,418	5,390	4,630
Median Cost Per Claim ($)	2,204	2,416	1,751	2,189
Average Distance Traveled per Insured Vehicle Year (Miles)	13,153	11,717	10,333	11,327
Average Distance Traveled per Insured Vehicle Year (km)	21,168	18,857	16,629	18,229
Average Cost per Insured Vehicle Year ($)	916	524	967	789

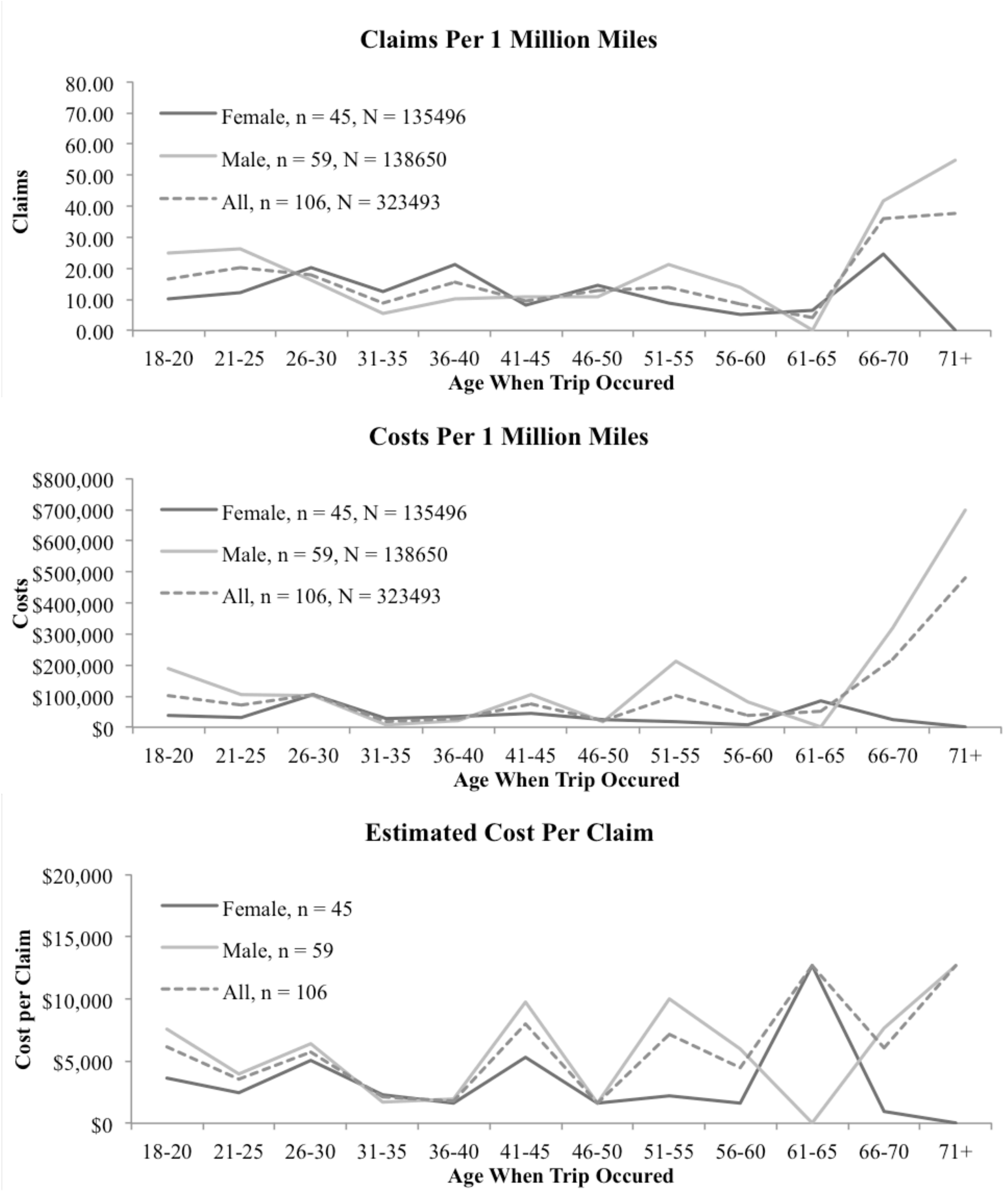

FIGURE 1 Estimated Claim Rates and Costs.

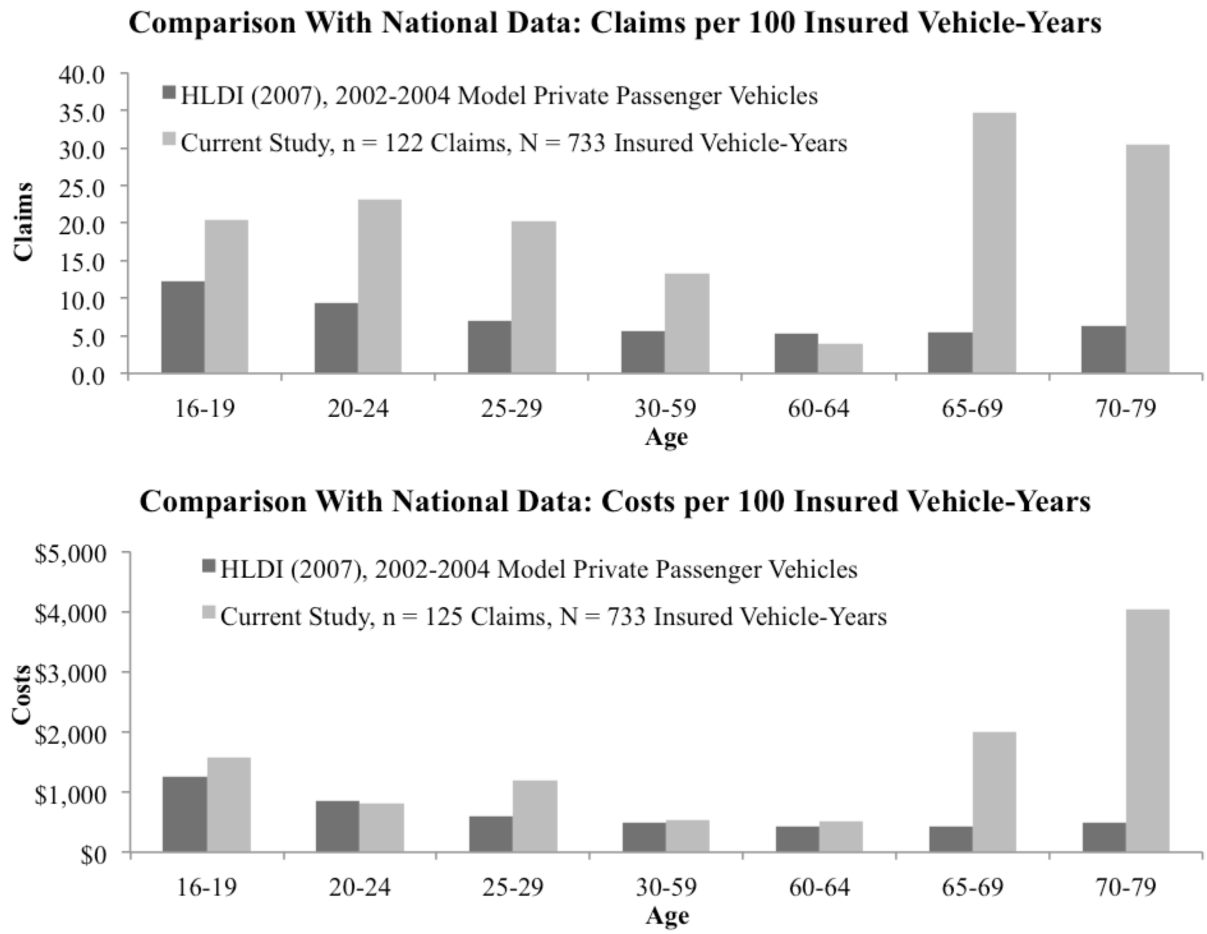

FIGURE 2 Comparison of Claim Rates and Costs with National Averages (Source: Highway Loss Data Institute (HLDI), 2007 and 2014 (*25, 28*) for Costs).