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Driving exposure by driver age in Michigan

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ABSTRACT

Background: This study compared driving exposure between two high-crash-risk groups (16–17 and 18-24-year-olds), with a low-crash-risk group (35-64-year-olds). In addition, patterns of association between driving exposure measures and demographic and driving behavior variables were examined. *Methods:* Respondent's total miles, minutes, and trips driven were calculated within a 48-hour period, using state-wide survey data collected in 2004 and 2005. *Results:* The youngest drivers drove fewer miles and minutes, but a comparable number of trips as the two older groups. Employment and high vehicle access were associated with greater driving exposure for 16-17-year-olds and 18-24-year-olds. Employment, high household income, large household size, and low vehicle access were associated with greater driving exposure for 35-64-year-olds. More driving was done alone than with passengers present and during the day than at night across all ages. There was a positive association between two driving exposure measures (miles and minutes driven) and demographic and driving behavior variables, which did not extend to trips driven. *Discussion:* Driving exposure is directly related to stage of life. The entire sample of 16-17-year-old respondents were in high school, which directly influenced their driving times, destinations, and purpose. Those aged 18–24 years displayed driving behavior patterns that were closer to the older drivers, while retaining some differences. The oldest drivers were likely to be shouldering the greatest household responsibilities, and their greater driving exposure may reflect this reality. *Impact on industry:* These findings provide new information about driving exposure for two high-risk and one low-risk group of drivers. They also raise concern over potential workplace safety issues related to teens' higher driving exposure, and concomitant crash risk, related to being employed. Future research should examine this issue more carefully so that evidence based recommendations can be made to enhance the safety of teens who are employed, especially those who are employed as drivers.

1. Background

Motor-vehicle crashes are the leading cause of death and a leading cause of non-fatal injury among teenagers and young adults in the United States (National Highway Traffic Safety Administration [NHTSA], 2008). For every mile driven, 16-19-year-olds are four times more likely to crash than older drivers. Crash risk is highest at age 16 (Williams, 2003), with the crash rate per mile driven nearly twice as high for 16-year-olds as for 18-19-year-olds (Insurance Institute for Highway Safety [IIHS], 2009). Understanding young driver exposure has been identified as a national priority (Transportation Research Board, 2008). Knowing how much exposure vulnerable driver populations have to high-risk conditions is critical to the formulation of effective intervention and prevention strategies.

Travel surveys such as the National Household Travel Survey (NHTS; U.S. Department of Transportation: Bureau of Transportation Statistics, 2006) obtain information about amount, type, and distance of travel of a representative sample of U.S. drivers that have been used to estimate exposure for subgroups of drivers. The number of teens sampled, however, is relatively small and insufficient to allow a detailed analysis by specific geographic region, such as the state-level. Moreover, the NHTS does not obtain demographic information on non-household passengers (U.S. Department of Transportation: Bureau of Transportation Statistics, 2006).

Previous studies have informed understanding of young drivers' exposure (Ehsani, Shope, Bingham, Sunbury & Kweon, 2010) and how it relates to crash risk (Williams, 2003). Recent studies have begun to examine the amount and conditions of travel, as well as driver and passenger behaviors, using in-vehicle recording devices (Farmer, Kirley & McCartt, 2010; Neale, Dingus, Klauer, Sudweeks & Goodman, 2005; Stutts et al., 2005). However, little is known about how the youngest drivers' exposure compares with other age groups.

This study seeks to build on earlier research focusing exclusively on 16-17-year-olds (Ehsani et al., 2010) by quantifying driving exposure across three age groups with varying levels of crash risk (National Highway Traffic Safety Administration [NHTSA], 2010b): 16–17 years (highest risk), 18–24 years (high risk), and 35–64 years (lowest risk)

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using three measures of driving exposure (miles, minutes, and trips). The second objective of this paper is to compare patterns of association between the three driving exposure measures and demographic and driving behavior variables.

2. Method

2.1. Sample

Michigan Department of Transportation (MDOT) data from a state-wide self-reported survey of 14,315 households conducted between February 2004 and March 2005 (Michigan Department of Transportation, 2009) were analyzed. The state of Michigan was divided into seven clusters, and within each cluster sampling was stratified according to the household size, the number of vehicles in the household, and the number of workers in the household. Recruitment was conducted in two stages. First, a pre-recruitment letter was sent to a sample of households obtained by matching a sample of random telephone numbers with residential addresses. The pre-recruitment letter informed household residents of the study objectives and notified them that they would be contacted and asked to participate. Second, a household member age 18 or older was contacted by telephone to determine each household's eligibility for participation and to invite them to participate in the survey. For those agreeing to participate, the person contacted was designated as the primary respondent for the household. Phone numbers that could not be matched to an address were still included in the survey sampling frame and used for recruitment calls.

Households were requested to report the travel characteristics for every member (including children) in travel diaries during a consecutive 48-hour travel period. The primary respondent for each household provided the basic demographic information (age, working status) for every member of the household during the recruitment call. More detailed information, such as school and work-specific information (name, address, etc.) as well as personal travel information, was included in the individual travel diary completed by each family member. The travel diaries were limited to travel occurring on weekdays between Monday and Thursday during the academic school year, meaning that travel diaries during summer, Fridays and weekends, and school holiday periods were not obtained.

Each household member had four options for providing their individual travel diary information: in person on the telephone, by proxy on the telephone (i.e., primary respondent provided the travel information recorded by the individual), by mail, or via a dedicated website. The majority of 16-17-year-olds (60.2%) chose to provide their travel diary information via the primary respondent on the telephone, followed by mail (33.6%), in-person on the telephone (5.1%), and online (1.0%). The majority of 18-24-year-olds (51.0%) also provided their travel diary information via the primary respondent on the telephone, followed by mail (28.7%), in person on the telephone (20.0%), and online (0.4%). In contrast, the majority of 35-74-year-olds (52.7%) provided their travel information in person on the telephone, followed by mail (24.9%), via the primary respondent on the telephone (22.1%), and online (0.3%). No significant difference in driving exposure estimates was found by reporting mode.

The response rate for eligible households was 48.6% based on the American Association for Public Opinion Research response rate 3 method (American Association for Public Opinion Research, 2008). For each completed individual response, origin and destination points for reported trips were geo-coded by MDOT and a consultant. Permission to use the data for research purposes was granted by MDOT in a written agreement dated November 12, 2008. The survey conducted by the state did not seek Institutional Review Board approval; however, the University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board approved the research reported in this manuscript. The sample for this study consisted of individuals aged 16–17, 18–24, and 35–64 years who reported driving a 'motor vehicle, van or truck' within the 48-hour survey period.

2.2. Measures

2.2.1. Driving exposure

Driving exposure was quantified using three measures: minutes of driving, miles driven, and number of trips taken within the 48-hour survey period. Minutes of driving and number of trips taken were reported by respondents in their travel diaries. Miles driven were calculated by the authors using origin and destination coordinate data points projected onto a road network of Michigan using ArcGIS version 9.3. The shortest on-road route between origin and destination points was used to calculate miles driven using Network Analyst.

The survey instrument defined a trip as going from one location to the next. Hence, leaving home and picking up a friend, then a stop at the store, followed by arrival at a destination would be considered three trips. Driving time was quantified by asking respondents: 'when did you leave location 1' followed by the question 'when did you arrive at location 2.'

Individual trips of greater than 120 minutes were excluded from the analysis (n = 3 for 16-17-year-olds, n = 18 for 18-24-year-olds, n = 181 for 35-64-year-olds). The proportion of trips over 120 minutes constituted 3% of all trips overall, and 1% of trips for 16–17 year-olds. As outliers, these cases were likely to be qualitatively distinct from the majority of trips and to not represent typical daily driving.

In addition, respondents were asked their mode of transportation. If traveling by car, van, or truck, respondents were asked if they were the driver or a passenger. If they reported driving, the presence and number of passengers were also reported, including if any passenger was from the respondent's household.

2.2.2. Demographic variables

Age was structured by aggregated age groupings, rather than individual years. The 16- to 17- and 18- to 24-year-old age groups were retained while the 35- to 44-, 45- to 54-, and 55- to 64-year-old age groups were combined to provide a comparison group for which crash risk is at a lifetime low (National Highway Traffic Safety Administration [NHTSA], 2005). A total of 583 16-17-year-olds, 1,250 18-24-year-olds, and 20,367 35-64-year-olds fit the inclusion criteria. A random sample of 5,000 of the 35-64-year-olds was drawn for inclusion in the analyses, and did not differ significantly from the remainder of the 35-64-year-old drivers for any variables used in the analysis.

An individual was considered employed if he or she reported being a full-time or part-time worker. Those who reported being unpaid or volunteer workers, not working, and "not applicable" because they were too young were classified as not employed. Household income was dichotomized as below U.S. $50,000 = 0 and U.S. $50,000 and greater = 1. This dichotomization was based on Michigan's 2004 and 2005 median household income of $47,724 (State of Michigan, 2009).

Rural or urban residence was defined for these analyses according to the Rural Urban Commuting Area Codes (RUCAs). The RUCA codes are a 10-tiered classification system that uses population size and commuting relationships at the census tract level as the basic building blocks (Hailu & VanEenwyk, 2009). The 10-level code was designed to be aggregated so that they suited the specific needs of separate studies, depending on relevant aspects of connectivity, rural and urban settlement, and isolation (Hart, Larson & Lishner, 2005).

In this study, residences were geocoded and matched to their corresponding census tract to establish the RUCA code for each household. A residence was considered urban if the census tract had a RUCA code between 1 and 3, and rural if the census tract had a RUCA code between 4 and 10. RUCA codes 1 to 3 correspond to commuting flows occurring within urban cores of 50,000 inhabitants or greater, as well as