Journal of Transport & Health 9 (2018) 161–168

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth

Reversal of the road death trend in the U.S. in 2015–2016: An examination of the climate and economic hypotheses

Leon S. Robertson

Yale University School of Public Health, 3551 S. Via de la Grulla, Green Valley, AZ 85622, United States

ARTICLE INFO

Keywords:
Road deaths
Climate
Unemployment
Motor vehicle mix
Aging population
Gas prices
Insurance

ABSTRACT

Previous research attributed the reversal in the trend of road death rates in the U.S. during 2015 primarily to increase in road use related to higher temperature but another study said it was due to reduced unemployment. Road deaths increased again during 2016 extending the reversal. This study examines the association of road deaths per population among the 48 contiguous U.S. states to average annual temperature, precipitation, unemployment, insurance cost, gasoline prices, registered vehicles per population, mix of types of vehicles and median age of the population using logistic regression. Least squares regression is used to examine the association of miles traveled per vehicle to average annual temperatures, unemployment, insurance costs and gasoline prices. The association of national unemployment trend and road death trend is examined using least squares regression.

Per population, road deaths are more frequent where average monthly temperatures are higher consistently from year to year. Predictions of road deaths using only national trends in unemployment and vehicle miles traveled are unreliable. The association of unemployment with road deaths per population among U.S. states is different in recessions than when the economy has largely recovered. When unemployment is declining, road deaths are reduced, other thing being equal, likely due in part to increased sales of new vehicles with improved safety technology as prosperity increases. Miles driven per vehicle among U.S. states are higher in warmer states but are unrelated to unemployment, insurance costs, and gasoline prices. Teenaged licensure declines as insurance costs, gasoline prices and unemployment increases in selected years. The increase in deaths during 2015–2016 was mainly related to warming temperatures, lower gasoline prices and increased use of trucks as a percent of registered vehicles, not reduced unemployment.

1. Introduction

Age-adjusted road deaths rates per population in the U.S. declined about 50 percent from 1980 to 2014 (Robertson, 2015). The trend abruptly reversed during 2015–2016. Based on counts in the Fatality Analysis Reporting System (FARS), there were 34,910 road deaths in 2015 and 37,230 in 2016 in the 48 contiguous U.S. states, 7.2 percent and 14.4 percent respectively more than the 32,553 deaths in 2014. Recent research found that warmer average daily temperatures were strongly associated with higher rates of road deaths per population potentially exposed to those temperatures on a given day in urban areas of the U.S. during 2014. Miles traveled per person increased in association with rising temperatures and walking or pedal cycling on roads likely increased as well. Based on a logistic regression model of proxies for risk factors, the increase in deaths in 2015 was mainly associated with increasing temperatures among the urban areas controlling statistically for other risk factors (Robertson, 2017). A study of the national trends in

E-mail address: nanlee252000@yahoo.com.

https://doi.org/10.1016/j.jth.2018.04.005
Received 2 January 2018; Received in revised form 27 March 2018; Accepted 13 April 2018
Available online 25 April 2018

unemployment and road deaths reported that the increase in deaths in 2015 “can be tied primarily to the improving economy” (Farmer, 2017). One of these conclusions is certainly incorrect and both could be.

Previous research on weather in relation to road death risk focused mainly on the effects of rain and snow (e.g., Eisenberg and Warner, 2005; Lee, et al., 2015). These studies emphasized risk given that people are on the roads and did not analyze the potential effect of temperature and precipitation on exposure, that is, the decision to stay indoors during periods of colder temperatures or precipitation. Examination of average monthly temperatures among U.S. states indicated that increased miles driven and higher road death rates per population among the contiguous 48 U.S. states were associated with warmer annual temperatures averaged monthly. The magnitude of the correlation was similar to that found using average daily temperature and fatalities per potentially exposed population at those temperatures in the 100 most populous urban counties. Little fidelity of the correlation of temperature and death rates was lost using monthly data among the states (Robertson, 2018). The weather stations that report temperature are concentrated in or near population centers so that the data are not substantially affected by readings from thinly populated desert and mountain areas (National Oceanic and Atmospheric Administration, 2017a).

Numerous studies of time series of road deaths in various countries found that road deaths decline temporarily during economic recessions – the recession indicator usually being unemployment (e.g., Haque, 1993; Wegman, et al., 2017). Several theories and studies have suggested that stress, changes in alcohol use and reduction in commercial truck traffic explain the correlation (e.g., Leigh and Waldon 1991; Cotti and Tefft, 2011; He, 2016). One study found fluctuations in gross domestic product (GDP) per capita, physicians per population, urbanization and vehicles per population related to fluctuations in road deaths but unemployment was not so related when the other factors were controlled statistically (Razaei et al., 2015). Since GDP contraction for two or more quarters is the definition of recession, lack of additional effect of unemployment is not surprising. In contrast to the time series studies, comparison of average road death rates during 1999–2003 with average unemployment among U.S. states indicates higher road deaths rates in states with high unemployment when controlling other risk factors statistically (Greenwalt, 2006).

The main issue addressed here is not death reductions during recessions but the factors that contributed to an abrupt reversal in the trend of road deaths five years after unemployment peaked. The U.S. unemployment rate declined rather steadily from 10 percent in October, 2010 to 5.6 percent in December, 2014 (Bureau of Labor Statistics, 2018a) while age adjusted road death rates were declining as well, contrary to the theory that reduced unemployment would increase the deaths. Unemployment declined less than a percentage point during 2015–2016 but road deaths increased 14 percent.

Additional factors correlated to changes in fatal crash rates in time are changes in motorized vehicle mix (cars, trucks, motorcycles, and busses), vehicle density per population, age distribution of the population, insurance expenditures, gasoline prices and increased use of electronic devices while driving. Pickup trucks and truck based “sports utility vehicles” that are heavier than most passenger cars increase the deaths of occupants of other vehicles (White, 2004) and have higher rollover death rates than passenger cars because of too high a center of gravity relative to track width (Snyder, et al., 1980). Motorcycles have a death rate 34 times that of other vehicles per mile traveled (Lin and Kraus, 2009). Trucks, busses and motorcycles kill more pedestrians per mile driven than passenger cars (Paulozzi, 2005). Research on the introduction of required liability insurance by states in the 20th Century correlated the requirement with an increase in road deaths, inferring that insured drivers were less cautious (Cohen and Dehejia, 2004). Road death rates fluctuate inversely to gasoline prices (Grabowski and Morrissey, 2004). Use of electronic devices while driving increases risk (e.g., Wilson and Simpson, 2010) but a national probability sample of observations of drivers indicates that use of electronic devices while driving declined steadily from 5.2 percent in 2012 to 3.3 percent in 2016 (National Highway Traffic Safety Administration, 2017). The data are not available state by state but the decline in use of such devices indicates that use of electronic devices is unlikely to have increased road deaths in 2015–2016.

The death rate per population varies widely among U.S. states. In 2016, for example, 14 states had death rates of 15 per 100,000 populations or more while 16 states had rates of 10 or less (Insurance Institute for Highway Safety, 2018a, 2018b). The use of state data allows more refined estimates of the association of road deaths to changes in most of the mentioned risk factors. The purpose of this study is to better distinguish the role of increased temperatures, declining unemployment and changes in the other mentioned factors as predictors of the increased death rates in 2015–2016.

2. Material and methods

I examined the death rates per months of potential exposure to average monthly temperatures for subsets of road deaths – car and truck occupants, pedestrians, motorcyclists and pedal cyclists – combining 2011–2016 data to reduce variability related to small numbers at extreme temperatures. I employed least squares regression to examine the association of national trends in unemployment, vehicle miles traveled, linear trend and deaths. I also used least squares regression to examine the miles driven per vehicle among the states in relation to average annual temperature, precipitation, unemployment, insurance expenditures and gasoline prices. I used logistic regression models based on 2015–2016 data, separately, to estimate the total number of deaths that would have occurred if each of the variables in the model had not changed from the previous year (Selvin, 1991). In addition to temperature, precipitation, unemployment and insurance expenditures, I included vehicles per population in each state, percent trucks of registered vehicles, percent motorcycles of registered vehicles and percent busses of registered vehicles. The data sources are listed in Table 1.

When I found the association of unemployment and road death risk among U.S. states in 2014–2016 inverse to that reported in studies claiming a negative correlation, I examined the relationship of unemployment and road death risk as well as the other risk factors among the states for each year from 2000 through 2016. I counted fatalities during 2000–2016 in the files of the Fatal Analysis Reporting System (FARS), a census of U.S. road deaths gathered by the National Highway Traffic Safety Administration (2000–2016)