Journal of Transport & Health 19 (2020) 100933

Contents lists available at ScienceDirect

Journal of Transport & Health

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

Protocol

Individual and geographic variation in Driver's license suspensions: Evidence of disparities by race, ethnicity and income

Nina R. Joyce [a,b,*], Melissa R. Pfeiffer [f], Andrew R. Zullo [a,b,c], Jasjit Ahluwalia [d,e], Allison E. Curry [f,g]

[a] Department of Health Services Policy and Practice, Brown University School of Public Health, Providence, RI, USA
[b] Department of Epidemiology, Brown University School of Public Health, Providence, RI, USA
[c] Center for Gerontology and Healthcare Research, Brown University School of Public Health, Providence, RI, USA
[d] Department of Behavioral and Social Sciences, Brown University School of Public Health, Providence, RI, USA
[e] Center for Addiction and Alcohol Studies, Brown University School of Public Health, Providence, RI, USA
[f] Center for Injury Research and Prevention, The Children's Hospital of Philadelphia, Philadelphia, PA, USA
[g] Division of Emergency Medicine, Department of Pediatrics, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, USA

ARTICLE INFO

Keywords:
Unemployment
Driving
Driver's license suspension
Access to public transportation
Racial and ethnic disparities

ABSTRACT

Introduction: Although access to a motor vehicle is essential for pursuing social and economic opportunity and ensuring health and well-being, states have increasingly used driver's license suspensions as a means of compelling compliance with a variety of laws and regulations unrelated to driving, including failure to pay a fine or appear in court. Little known about the population of suspended drivers and what geographic resources may be available to them to help mitigate the impact of a suspension.

Methods: Using data from the New Jersey Safety Health Outcomes (NJ-SHO) data warehouse 2004–2018, we compared characteristics of suspended drivers, their residential census tract, as well as access to public transportation and jobs, by reason for the suspension (driving or non-driving related). In addition, we examined trends in the incidence and prevalence of driving- and non-driving-related suspensions by sub-type over time.

Results: We found that the vast majority (91%) of license suspensions were for non-driving-related events, with the most common reason for a suspension being failure to pay a fine. Compared to drivers with a driving-related suspension or no suspension, non-driving-related suspended drivers lived in census tracts with a lower household median income, higher proportion of black and Hispanic residents and higher unemployment rates, but also better walkability scores and better access to public transportation and jobs.

Conclusions: Our study contributes to a growing literature that shows, despite public perception that they are meant to address traffic safety, the majority of suspensions are for non-driving-related events. Further, these non-driving-related suspensions are most common in low-income communities and communities with a high-proportion of black and Hispanic residents. Although non-driving-related suspensions are also concentrated in communities with better access to public transportation and nearby jobs, additional work is needed to determine what effect this has for the social and economic well-being of suspended drivers.

* Corresponding author. Department of Health Services Policy and Practice, Brown University School of Public Health, 121 South Main St, Providence, RI, 02192, USA.
E-mail address: Nina_Joyce@brown.edu (N.R. Joyce).

https://doi.org/10.1016/j.jth.2020.100933
Received 16 March 2020; Received in revised form 19 July 2020; Accepted 18 August 2020
Available online 14 September 2020

1. Introduction

In the United States, access to a motor vehicle is essential for pursuing social and economic opportunity. Since the 1950's there has been a sustained decentralization of American residential and economic life, with growing numbers of people and jobs moving out of cities and into suburbs (Glaeser et al., 2001). This migration of people and jobs into lower density and auto-reliant suburbs has led to increasing dependence on the use of motor vehicles for everyday needs and stable employment. Between 2000 and 2012 the total number of jobs in the U.S. rose by 4% in the suburbs while declining 2% in urban areas, resulting in a 7% reduction in the number of jobs within the typical commuting distance (i.e., median distance) in major metro areas (Kneebone and Holmes, 2015). Thus, even with increasing movement of individuals into the suburbs, the increased spatial dispersion of suburban communities means that even when their jobs are also in the suburbs, their commuting distance is extended.

The impact of this "spatial mismatch" (Andersson et al., 2018)—that is, the geographic separation between housing and employment—has been particularly acute for low-income individuals and racial and ethnic minorities. While the number of jobs within commuting distance has declined overall, the decline has been twice as high for Black, Hispanic and low-income individuals (Kneebone and Holmes, 2015; Blumenthal et al., 2011). In addition to jobs, spatial proximity to physicians, health care centers and hospitals is lower in the suburbs due to their sprawling nature. Unlike many urban areas where health care facilities may be accessible via public transportation or walking, access to health care in suburban areas most often requires a vehicle, resulting in a potentially substantial transportation barrier to accessing health care for individuals with limited access to a vehicle (Schnake-Mahl and Sommers, 2017; Silver et al., 2012).

Federal and state agencies have increasingly acknowledged the essential role a motor vehicle plays in modern life, particularly for low-income drivers. For instance, many states now exclude personal vehicles from the asset limit required to qualify for government programs, including Temporary Assistance for Needy Families (TANF) and the Supplemental Nutrition Assistance Program (SNAP). However, these government efforts to allow beneficiaries continued access to their vehicle have focused almost exclusively on supporting physical access to the vehicle itself. In contrast, little to no policy attention has been paid to the issue of driver's licensing, despite the fact that any policy to promote vehicle access will have a limited effect if individuals are not licensed to drive.

A major contributor to non-licensure has been the practice of suspending licenses for events unrelated to traffic safety. Since the 1990's courts have used license suspensions as a means of compelling compliance with a variety of laws and regulations. The result has been an influx of suspensions for non-driving-related offenses, ranging from failure to appear in court or pay a court fee to mandatory suspensions for drug-related convictions and punishment for failure to pay child support (Salas and Ciolfi, 2017a; Aiken, 2012; Carnegie, 2007). While the initial event may be (but is not always) related to driving, such as a citation for a broken taillight, it is the failure to comply with the subsequent fines and fees that results in the suspension. Though these fees can start at as little as $50, they grow rapidly as interest surcharges are applied and court fees accumulate. In California, an initial $100 ticket becomes $480 once all fees and surcharges have been included and rises to $815 if the driver misses the first payment (Lawyers Committee for Civil Rights, 2015). Although no national estimates exist, the limited state-level estimates that exist suggest that 5%–17% of all licensed drivers have a suspended license at any given time, of which up to 80% are for a non-driving-related offense (Carnegie, 2007; Not-Just-a--Ferguson-Probl). Only a small fraction of all suspensions are for the unsafe driving behavior commonly associated with a suspension. For example, suspensions for Driving Under the Influence (DUI) constitute approximately 3% of all suspensions (Carnegie, 2007).

Despite the recognized importance of driving for accessing social and economic opportunities as well as health care, there is little known about the characteristics of suspended drivers or how the prevalence of suspensions has changed over time. Though media attention has highlighted the impact of a suspension through a series of case studies (Alcorn, 2019; Dewan, 2015; Oppel, 2018; Balko, n.d.; Moyer, 2018), a large scale empirical evaluation is still lacking. Such information is particularly relevant to many states considering revising license suspension policies. Since 2017 six states (CA, MI, DC, ID, VA and MN) have revised their license suspension policies given conflicting evidence as to whether non-driving-related suspensions result in expedient collection of the fines and fees they are meant to target.

To address this gap, the objective of this study was to describe individual- and geographic-level variation in the prevalence of both driving- and non-driving-related license suspensions, providing some of the most comprehensive information on drivers with license suspensions to-date.

2. Methods

Data Sources: We analyzed data from the New Jersey Safety and Health Outcomes (NJ-SHO) data warehouse (Curry et al., 2019) —a unique source of linked data from various NJ statewide administrative databases. The warehouse includes NJ's driver licensing database, which contains the complete licensing records for all individuals who held a NJ driver's license from January 2004 through December 2018. Data for each licensee include full name, 15-digit Driver Licensing Number, sex, residential address, and exact dates of birth, initial licensure, final license expiration, and death. The licensing database also includes dates and types of all license suspensions and restorations recorded by the New Jersey Administration of the Courts. We geocoded the most recent (as of December 2018) residential addresses and connected each address with census tract-level measures from the 2017 American Community Survey (ACS) 5-year estimates, economic indicators from the Environmental Protection Agency's (EPA) Smart Location database, and measures of neighborhood walkability and accessibility from the street smart Walk Score algorithm available at WalkScore.com (Walk Score Methodology,).

Analytic Cohort: Our study cohort consisted of all NJ residents ages ≥17 (the minimum licensing age in New Jersey) to 100 who had

a valid license at some point from 2004 through 2018. We constructed a panel dataset with an observation for each calendar-year an individual was alive. Years in which an individual died or had an expired license and thus could not contribute a full year of data were excluded from the analysis. We classified individuals with a suspended license at any point during the year as a suspended driver. When the suspension began in that year we considered it an incident ("new") suspension, and when it was carried over from a previous year we considered it a prevalent ("existing") suspension. Because New Jersey requires drivers to renew their license every four years, some drivers' licenses may expire before the end of the suspension. When this was the case, we prioritized the expiration date over the suspension end date by continuing to exclude all individuals with an expired license for any portion of the year.

Identification of Non-Driving-Related License Suspensions: The NJ-SHO contains a record for every "event" associated with a license, such as suspensions and citations. We identified all suspension "events," including their start and end dates, and then categorized each as driving- or non-driving-related according to two different definitions (Supplemental Table 1). In the first we used a definition established by the New Jersey Department of Transportation (hereafter referred to as the NJDOT definition) (Mehta et al., 2014). In the second we amended the NJDOT definition based on a traffic safety framework, in which we considered suspensions for an activity that could threaten driver, passenger, pedal cyclist or pedestrian safety as driving-related and all other suspensions as non-driving-related (hereafter referred to as the traffic safety (TS) definition). Both definitions classified the suspension as driving or non-driving based on the reason for the suspension, even if it followed an infraction for a different reason. For instance, a suspension for failure to pay a speeding ticket would be considered non-driving-related since the suspension was for the failure to pay, not for the moving violation. The primary difference between the two classification systems was the level of detail. For instance, while the NJDOT definition included "Paperwork" as a non-driving-related offense that included all administrative type suspensions, the TS definition created separate categories for "Failure to Pay" and "Failure to appear (in court)" among others. In addition, while the NJDOT definition classified "Driving with a Suspended License" as driving-related, we classified it in the TS definition as non-driving-related since driving with a suspended license does not inherently threaten vehicle occupant or pedestrian safety. There are over 400 unique codes for suspensions in the NJDOT. However, only a handful of codes compose the majority of suspensions within each sub-classification. Thus, in Supplemental Table 2 we provide the exact codes and definitions that compose 90% of each suspension sub-type.

In each person-year we used a hierarchical approach to classify individuals into one of three mutually exclusive categories: *any* non-driving-related suspension, *only* a driving-related suspension or *no* suspension. According to this definition, some proportion of the non-driving-related suspended drivers may have also had a driving-related suspension. In sensitivity analyses we classify individuals based on the reason for the *first* suspension in that year. Thus, an individual with both a driving- and non-driving-related suspension in 2018 would be classified according to which occurred first.

Covariates: We included age, calculated from date of birth as the age on January 1st, 2018, and sex. Census characteristics included geographic and sociodemographic measures (population density, population in urban areas, household median income, unemployment, race and ethnicity and education level) and vehicle ownership and commuting characteristics (percent of households with no vehicle, mode of transportation and mean commute time to work). In addition, we incorporated measures of neighborhood accessibility based on the Smart Streets algorithm, which included intersection density (higher score indicates more intersections and denser neighborhood), a walkability score and transit score (Carr et al., 2011; Duncan, 2013). Additional information on how these scores are calculated are available at walkscore.com/methodology (Walk Score Methodology,). We also included information on employment accessibility from the EPA Smart Location database, including the number of jobs within 45 min by automobile and by public transit and a measure of employment accessibility by auto and transit in each census tract relative to the census tract with the maximum accessibility in the state ("central index – auto" and "central index – transit") (Smart Location Mapping,).

Statistical Analysis: The annual state-level incidence and prevalence of driving- and non-driving-related suspensions were calculated as the number of licensed drivers with a new suspension or existing suspension, respectively, that had not yet been reinstated, divided by the total number of licensed drivers. When calculating incidence, all prevalent suspensions were excluded from the denominator of licensed drivers in that year. We plotted the incidence and prevalence of suspensions over time by suspension type overall and then for the suspension type subgroups.

We compared individual and geographic characteristics between drivers with a non-driving-related suspension, a driving-related suspension and no suspension. In our primary analysis we defined suspension status according to a hierarchical definition whereas in sensitivity analyses we classified individuals according to the first suspension type, driving- or non-driving-related, they received in that year. We present comparisons for the most recent year of data (2018).

We plotted the relationship between the prevalence of suspensions (driving- and non-driving-related) among licensed drivers in each census tract for a subset of the sociodemographic characteristics of the census tract (% Black, % Hispanic and % unemployed) and a subset of the transportation access measures (% commute by public transportation, % households with no car and the central transit index); additional plots are available from the authors upon request. We fit locally estimated scatterplot smoothing (LOESS) models to visualize the relationship between suspension rates and census tract characteristics, and report the spearman rank order correlation as a measure of the strength of this relationship. Additionally, we provide the prevalence of driving- and non-driving-related suspensions within quintiles of the distribution of census tract characteristics. This analysis was approved by the Institutional Review Board (IRB) at Brown University.

3. Results

From 2004 through 2018 there were a total of 7,666,310 licensed drivers ages 17 through 100 in New Jersey. The prevalence of non-driving-related suspensions ranged from 7.9% in 2004 to 5.0% in 2018, while the prevalence of driving-related suspensions ranged from 1.7% to 0.9% over the same time period. The incidence of both driving- and non-driving-related suspensions was

relatively constant, ranging from 0.6% to 0.4% for driving-related suspensions and 2.8%–2.3% for non-driving-related suspensions (Fig. 1).

Incidence and prevalence of suspensions by sub-type: DUI was the most common reason for a driving-related suspension, constituting 55% of both existing and new driving-related suspensions (Fig. 2). Points violations and failure to submit to an alcohol or drug test (irrespective of whether someone was later deemed to be under the influence of alcohol or drugs) were the second and third most common reasons for a new driving-related suspension, respectively. However, by 2012 suspensions due to failure to submit to an alcohol or drug test were slightly more prevalent than suspensions for points violations, suggesting the duration of the suspension for points violations may have been shorter (New Jersey courts have wide discretion when imposing a suspension, including the duration of the suspension, and thus it is not possible to know from the legal statute if the duration of suspensions differs by sub-type). Failure to pay was the most common reason for both new and existing non-driving-related suspensions across all years, constituting 55% of existing and 58% of new non-driving-related suspensions.

Characteristics of suspended drivers: We compared driver- and census-level characteristics (corresponding to each driver's residential address as of December 2018) by suspension status (driving-related suspension only, any non-driving-related suspension and no suspension; Table 1) for drivers with a license in 2018. Of all 7,666,310 licensed New Jersey drivers in 2018, 424,849 (5.5%) had a suspended license. Of these, 386,929 (91.1%) had a suspension for a non-driving-related reason, for a total of 5.0% of all drivers whose license was suspended for any non-driving-related reason. Almost half (45.0%) of non-driving-related suspensions were newly issued in 2018. In contrast, only 37,920 (0.5%) of all licensed drivers had a driving-related suspension only, of which 48.5% of were new suspensions. Individuals with a non-driving-related suspension were younger than those with a driving-related suspension only (mean of 39.4 compared to 47.3 years old) and were less likely to be male (59.5% compared to 70.3%). Individuals without a suspension were older (mean of 47.2 years old) and less likely to be male (47.4%) than individuals with either a driving-related or non-driving-related suspensions.

Compared to individuals with a driving-related suspension only or no suspension in 2018, those with a non-driving-related suspension lived in census tracts with more Black and Hispanic residents and worse socioeconomic indicators (higher poverty and unemployment rates, lower median income, and fewer residents with a bachelor's degree; Table 1). Though individuals with a non-driving-related suspension lived in census tracts with a greater percentage of households without a vehicle, they also had better access to public transportation and jobs accessible by public transportation and a similar commute time as individuals with a driving-related suspension or no suspension. Non-driving-related suspended drivers were also less likely to live in a rural area and more likely to live in census tracts with a higher walkability and transit scores than individuals with a driving-related suspension. When we classified drivers according to which type of suspension occurred first, we saw no meaningful differences (Supplemental Table 3).

Longitudinal patterns in suspension rates: In 2018, prevalence of driving-related suspensions within a census tract ranged from 0.1% to 5.0% (mean: 0.9%), while non-driving-related suspensions ranged from 0.7% to 33.2% (mean: 6.0%). When we evaluated the association between the prevalence of suspended drivers in a census tract and characteristics of the census tract, we found strong evidence of a relationship for both driving-related and non-driving-related suspensions, though the strength of the association was greater for non-driving-related suspensions (Figs. 3 and 4). We also report the prevalence of suspensions within quintiles of the

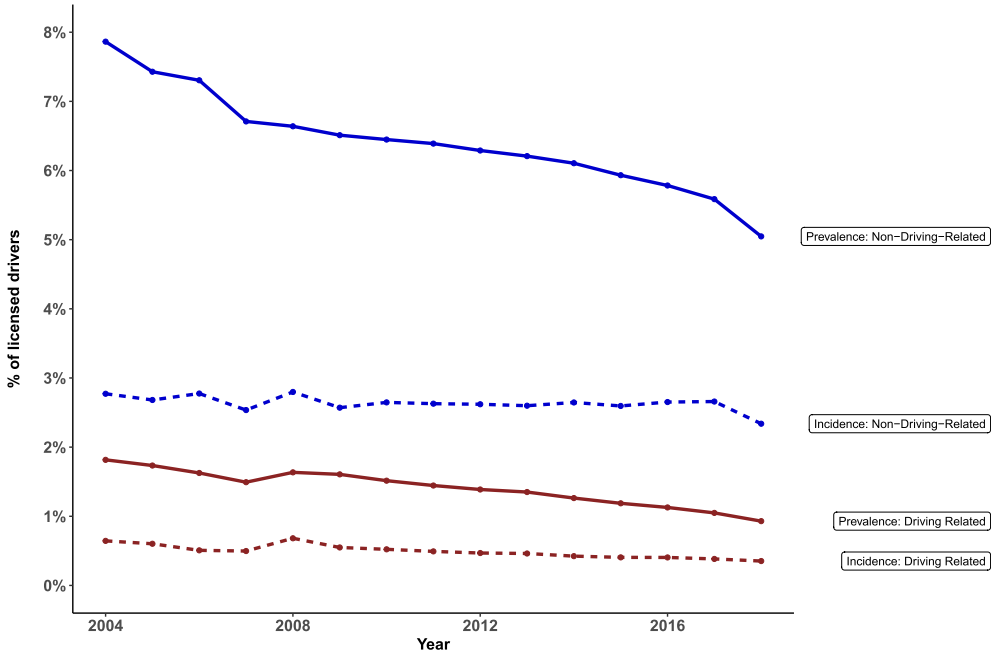

Fig. 1. Annual incidence and prevalence of drivers license suspensions in New Jersey (2004)–2018 by type of suspension.

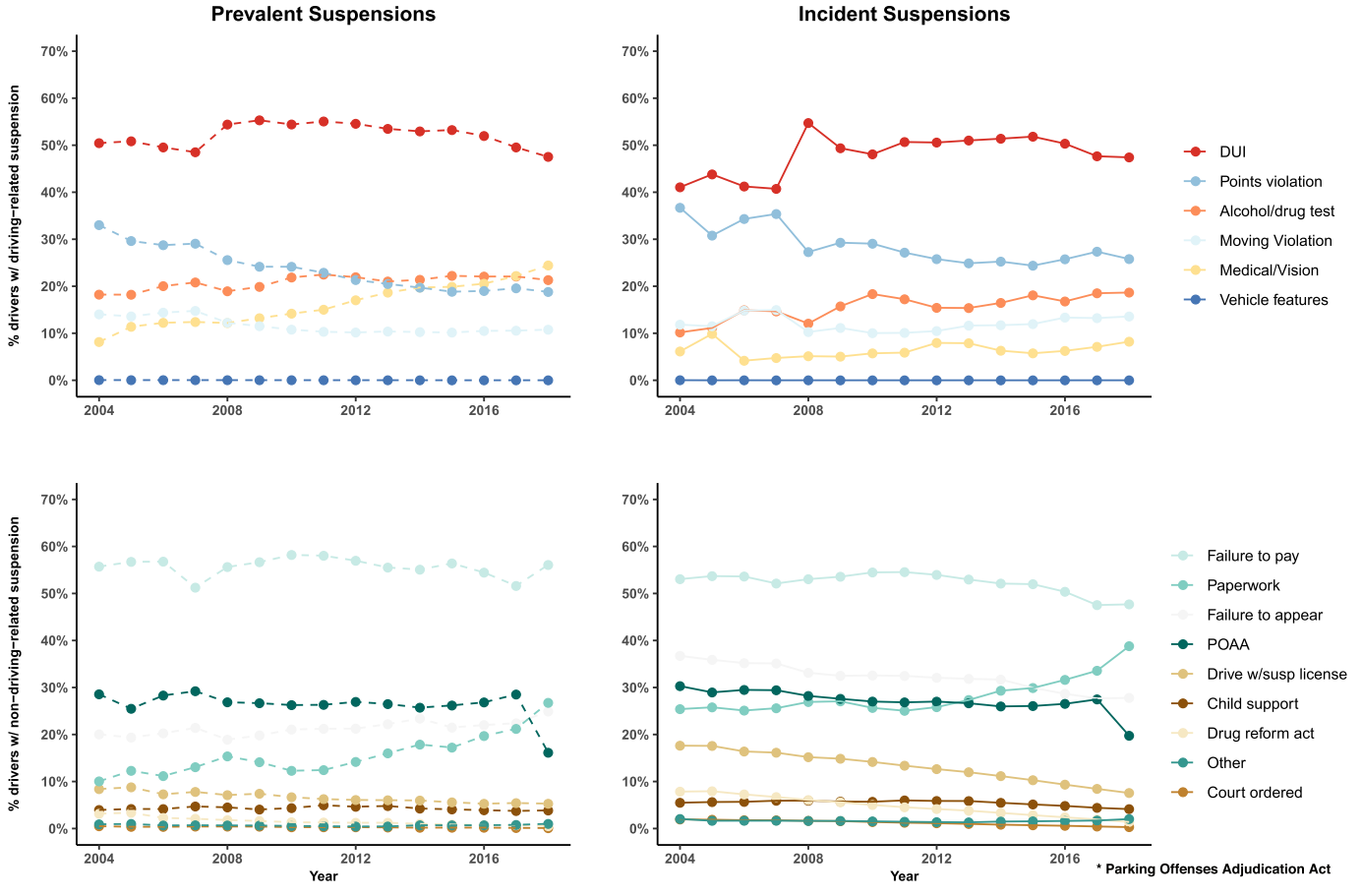

Fig. 2. Incidence and prevalence of suspension sub−types as a percentage of the total number of driving−related and non−driving−related suspensions in 2018.

Table 1
Characteristics of individuals with a valid license in 2018 and the census tract of their home address by suspension status in 2018 (N of licensed drivers = 7,666,310).

	Any non-driving-related suspension	Driving-related suspension only	No suspension
Num. of licensed drivers (% licensed drivers)	386,929 (5.0%)	37,920 (0.5%)	7,241,461
New Suspensions (% suspensions)	173,838 (45.0%)	18,375 (48.5%)	–
Individual Characteristics			
Age (mean/sd)	39.4 (14.0)	47.3 (18.4)	47.2 (17.8)
Male (%)	59.5	70.3	47.4
Census Tract Characteristics			
Sociodemographics (mean/sd)			
Household Median Income	$78,868 ($37,105)	$96,921 ($37,736)	$104,949 ($41,977)
% Rural	4 (14.4)	6.7 (18.6)	5.7 (17.2)
Intersection Score	38.7 (26.1)	32.8 (27.6)	31.6 (26.5)
% Households under poverty line	12.5 (11.4)	7.4 (8.1)	6.9 (7.9)
% Unemployed	5.6 (3.2)	4.6 (2.4)	4.3 (2.3)
% Hispanic	24.5 (22.5)	17.4 (18.7)	16.5 (17.9)
% Non-Hispanic black	21.9 (25.7)	11.1 (16.6)	10.3 (16.2)
% Non-Hispanic white	44.3 (31.4)	61.2 (27.5)	61.1 (26.9)
% Non-Hispanic Asian	7 (10.3)	8.1 (10.8)	9.9 (12.4)
% with High school diploma/GED	85.6 (10.3)	89.7 (8.4)	90.6 (8)
% with Bachelors degree	28.9 (17.4)	36 (17.5)	40.6 (19.1)
Transportation Access and Commuting Patterns (mean/sd)			
% Households with no vehicle	15.7 (15)	9.4 (11)	9.3 (11.3)
% Commute via motor vehicle	69.4 (16.1)	75.3 (13.3)	73.4 (14.5)
% Commute via public transport	12.3 (12.4)	8.5 (9.7)	10.4 (11.7)
Mean commute time (min)	30.3 (6.1)	30.9 (5.7)	31.7 (5.9)
Central index- auto[a]	41.3 (22)	33.6 (22.4)	34.3 (22)
Central index -transit[a]	6.5 (12.8)	3.9 (9.3)	3.7 (8.4)
Jobs within 45 min by auto	282,188 (221,136)	210,864 (195,113)	243,325 (208,590)
Jobs within 45 min by transit	14,714 (19,997)	8516 (15,960)	10,600 (19,951)
Walkability Score of Home Census Tract (%)			
Car dependent	47.7	65.9	65.2
Somewhat walkable	16.8	15.4	14.8
Very walkable	29.8	15.4	15.9
Walker's paradise	6 .0	3.2	4.1
Transportation Availability in Home Census Tract (%)			
Minimal transportation	33.9	51.4	48.5
Good transportation	21.0	9.2	10.3
Some transportation	40.2	37.5	37.7
Excellent transportation	4.5	2.0	3.4
Transit paradise	0.3	0.2	0.2

[a] The central indices are measures of accessibility via auto or transit in the census tract relative to the census tract in the state with the highest accessibility (higher numbers mean greater accessibility).

distribution of census tract characteristics (Table 2). While the prevalence of driving-related suspensions was 2.6 higher (1.3% vs. 0.5%) in the poorest census tracts than the wealthiest tracts, the prevalence of non-driving-related suspensions was 7 times higher (13.4% vs. 1.9%). Patterns were similar in magnitude for all other characteristics examined.

4. Discussion

In this study we evaluated individual and geographic patterns of driving- and non-driving-related license suspensions in New Jersey over a 15-year period. We found that non-driving-related suspensions compose the vast majority of license suspensions over the study period. In addition, we found that individuals with a driving-related suspension were more similar to those without a suspension than to individuals with a non-driving-related suspension with respect to age and the geographic characteristics of their residential census tract. We also found substantial variation in the rate of non-driving-related suspensions by census tract but much less variation in the rate of driving-related suspensions and that while the incidence of both driving and non-driving-related suspensions has remained steady, the prevalence of both has declined, suggesting the length of the suspensions may also be declining. Given the importance of a vehicle for accessing essential services, such as employment and health care, our findings suggest that a portion of the population in New Jersey may face substantial transportation-related barriers due to a suspended license. Further, our results show that these barriers are not equally distributed throughout the population and may be concentrated in specific communities.

Our findings support those of previous reports that have shown significant differences in the prevalence of license suspensions by geographic measures of race, ethnicity and income (Carnegie, 2007; Bingham et al., 2016; Stinnie et al., 1909; Salas and Ciolfi, 2017b). For instance, a report using data from New York state found that license suspensions due to traffic-related debt were nine times higher in the poorest as compared to the wealthiest communities and were up to four times higher in disproportionately Black and Hispanic as compared to disproportionately White communities (Driven by Justice Coalition, 2019). Our work extends these findings in three

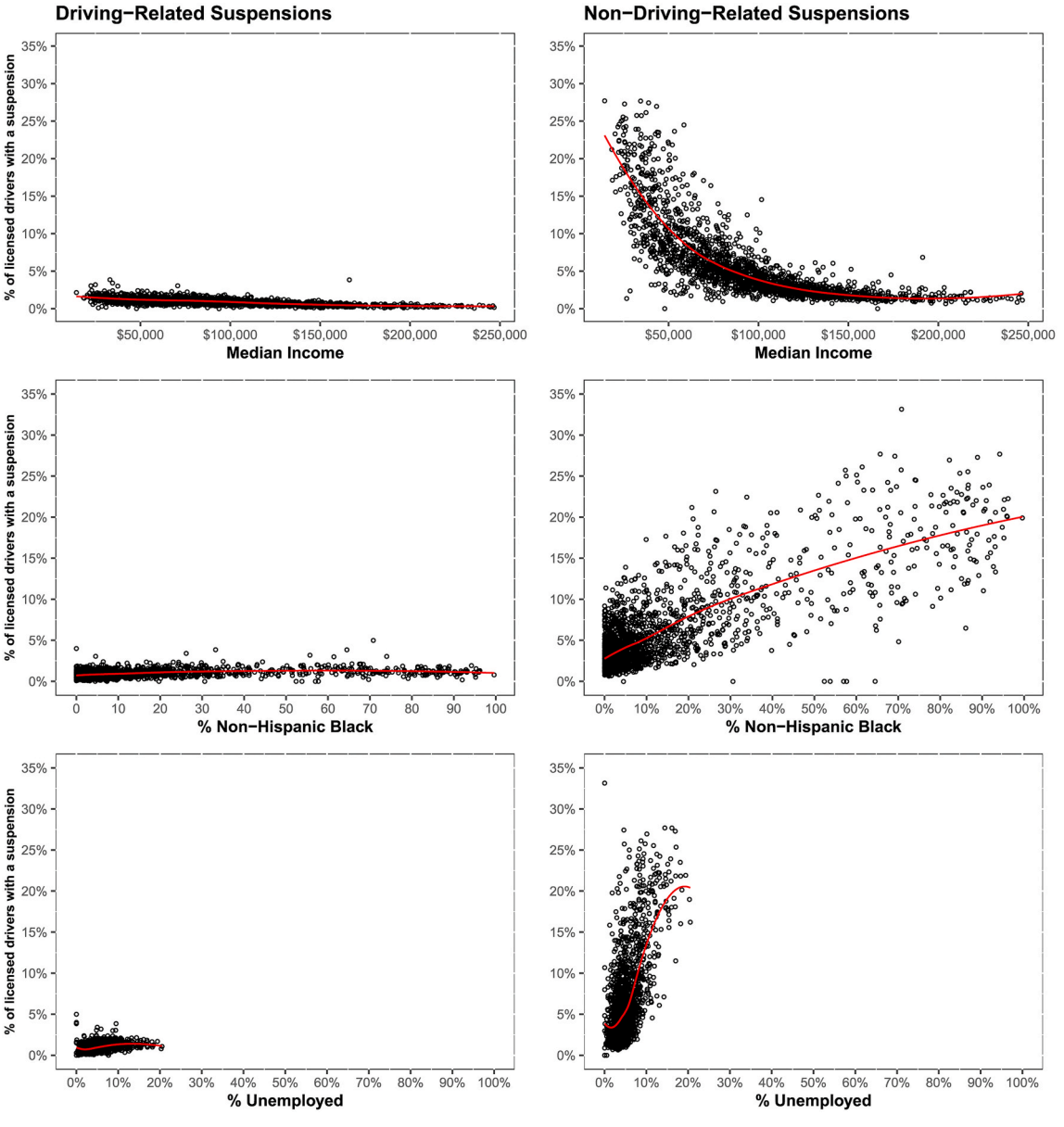

Fig. 3. Correlation between demographics of census tract residents and prevalence of license suspensions.

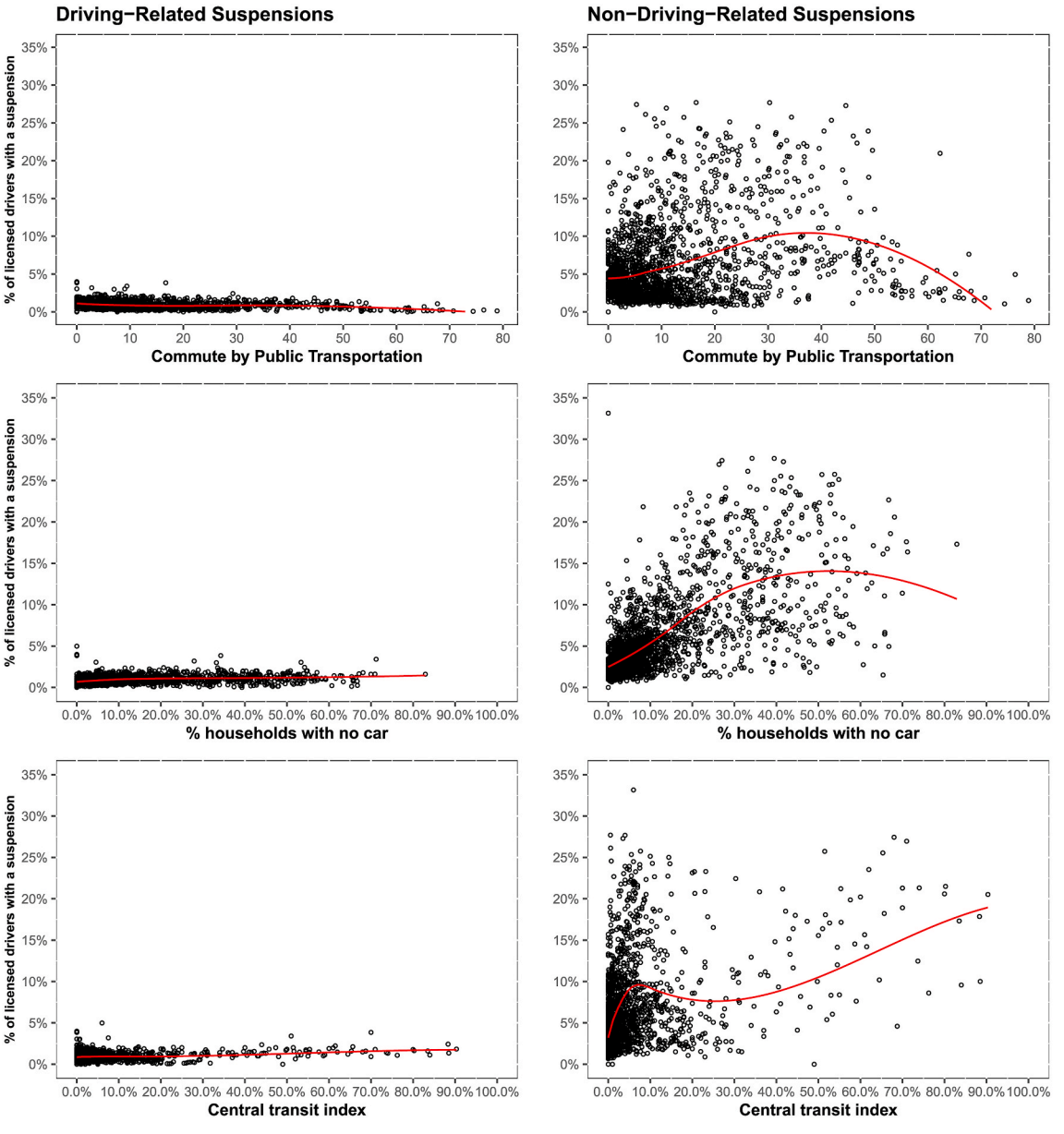

Fig. 4. Correlation between access census tract access to transportation and prevalence of license suspensions.

Table 2
Percent of licensed drivers in each census tract with a driving- or non-driving-related suspension by the quintile of select census characteristics.

Quintile: (Range)	Driving-Related Suspension	Non-Driving-Related Suspension
Median Income		
Q1: ($14,402 - $56,250)	1.3%	13.4%
Q2: ($56,277 - $80,938)	1.1%	6.9%
Q3: ($81,028 - $101,964)	1.0%	4.6%
Q4: ($101,974 - $130,000)	0.8%	3.0%
Q5: ($130,040 - $246,750)	0.5%	1.9%
% Non-Hispanic-black		
Q1: (0.0%–1.2%)	0.7%	2.8%
Q2: (1.2%–3.4%)	0.8%	3.5%
Q3: (3.4%–7.7%)	0.9%	4.2%
Q4: (7.7%–21.1%)	1.0%	6.0%
Q5: (21.1%–99.6%)	1.2%	13.2%
% Unemployed		
Q1: (0.0%–2.7%)	0.7%	3.5%
Q2: (2.7%–3.7%)	0.8%	3.9%
Q3: (3.7%–4.7%)	0.9%	4.7%
Q4: (4.7%–6.4%)	1.0%	5.8%
Q5: (6.5%–20.5%)	1.2%	11.9%
% Commute via Public Transportation		
Q1: (0.0%–2.3%)	1.1%	4.4%
Q2: (2.4%–5.4%)	1.0%	4.7%
Q3: (5.4%–9.8%)	0.9%	5.3%
Q4: (9.9%–19.1%)	0.8%	6.4%
Q5: (19.1%–78.9%)	0.8%	9.0%
% Households with no car		
Q1: (0.0%–0.0%)	0.7%	2.8%
Q2: (0.0%–0.0%)	0.8%	3.2%
Q3: (0.0%–0.1%)	0.9%	4.5%
Q4: (0.1%–0.2%)	1.0%	6.7%
Q5: (0.2%–0.8%)	1.1%	12.4%
Central transit index - automobile		
Q1: (0.0–0.0)	0.8%	3.1%
Q2: (0.0–0.5)	0.9%	3.7%
Q3: (0.5–2.3)	0.9%	5.4%
Q4: (2.3–6.5)	0.9%	8.5%
Q5: (6.5–90.3)	1.0%	9.0%

important ways. First, by using a denominator of licensed drivers as opposed to all residents in the census tract, our findings provide a more precise estimate of the rate of suspensions. Second, we expand our analysis beyond demographics and income and find a positive relationship between prevalence of non-driving-suspensions, job accessibility and access to transportation in the census tract. Finally, we explicitly contrast the characteristics of individuals with driving- and non-driving-related suspensions and find evidence suggesting these are two distinct types of drivers.

License suspensions have traditionally been viewed as a traffic safety measure, and as such have enjoyed widespread public support. Consequently, the negative impact of a suspension is often framed as a necessary trade-off in service to safer roads. Yet, our findings suggest that, in practice, most license suspensions have little to do with safety and more to do with incentivizing drivers to pay a fine or comply with a regulation. Given the potential impact of a suspension, it is important for state legislatures to consider if the tradeoff is still worthwhile when safety is not the primary concern. Though our study was unable to look at the long-term consequences, several news articles over the past five years have highlighted the spiral that a suspension can trigger (Alcorn, 2019; Dewan, 2015; Oppel, 2018). Without a license many individuals are unable to keep their job, making it difficult to pay back the initial fine let alone the growing interest. In a 2004 survey of recently suspended drivers, 42% reported losing their jobs as a result of their suspension; of these, 45% were unable to find new employment. Among those who were able to obtain new employment, 88% reported a decrease in income (Carnegie, 2007). In contrast, a program in Phoenix, Arizona that allowed suspended drivers to legally drive as long as they make payments towards their traffic debt on a schedule tailored to their budget found that 53% of participants were able to obtain a new job because of the program with 41% reporting an increase in income (The City of Phoneix Municipal Court's Compliance Assistance Program, 2016).

In addition to employment, suspensions may also affect access to health care. Approximately 3.6 million people miss or delay health care due to transportation barriers, and lacking access to a vehicle is one of the most commonly reported barriers (Syed et al., 2013). While we did not examine the effects of a suspension on health outcomes, transportation-related barriers to health care have been shown to be associated with poorer management of chronic conditions and increased use of acute care services for conditions that could be treated in primary care (Kim et al., 2009; Karter et al., 2004). However, how best to address these transportation-related barriers to health care is not always obvious. A recent randomized controlled trial of Medicaid beneficiaries in West Philadelphia examined the effects of offering transportation to medical appointments via the ride-sharing application Lyft on the rate of missed

appointments (Chaiyachati et al., 2018a). The results from the trial found no difference between the intervention and control arm (which was given standard of care consisting of robo-call reminders in the days leading up to the appointment). However, what the trial most saliently highlighted were the challenges in designing a useable and cost-effective system for ensuring reliable transportation for the purpose of accessing health care. For instance, many of the Medicaid beneficiaries in the trial did not have reliable access to, or were uncomfortable using, the technology required to schedule the ride. In addition, less than half of all participants indicated they were interested in a ride-sharing program, and of those who indicated they were interested, again less than half used the program. A point made by the authors of the trial, among others, is that receiving a ride from point A to point B often doesn't address the multi-factorial nature of the transportation barrier and that even in a "more flexible" system, like Lyft's, patients often need a level of flexibility most readily available through access to their own vehicle (Chaiyachati et al., 2018b; Rediger et al., 2018). Thus, with the growing understanding of the importance of reliable access to transportation, additional work is needed to understand if and how license suspensions contribute to transportation-related barriers to care.

Since 2016, six states have passed legislation to end the practice of license suspensions for non-driving-related events and others have taken initial steps to do so. However, supporters of non-driving-related suspensions suggest that it is one of a limited set of tools legislatures have for compelling individuals to comply with regulations or pay a fine. Yet, the exceptionally high rate of suspensions in certain communities, especially low-income communities, calls into question whether non-driving-related suspensions are actually an effective incentive. Unlike suspensions for driving-related offenses, which most often come with a standard suspension term, in virtually all states non-driving-related suspensions are indefinite and only lifted when the suspended driver pays the reinstatement fees (Stinnie et al., 1909). In 2018, the federal reserve estimated that 40% of Americans would be unable to pay an unexpected expense of $400 in an emergency (Board of the Governors of, 2019). Thus, it is likely that instead of choosing not to, many drivers are unable to pay the fine or afford a day off work to attend a court hearing.

Our study had several limitations worth noting. First, other than age and sex, all of our measures are at the census tract level. For instance, while we know that individuals living in lower income tracts are more likely to have a non-driving-related suspension, we cannot determine if individuals with lower incomes are more likely to have a non-driving-related suspension. Thus, while our findings provide information on the geographic distribution of suspensions, individual-level data is needed to identify the specific characteristics of individuals within their neighborhood. Second, our analyses are limited to a single state, possibly limiting the applicability of our findings to other states. However, New Jersey is one of the most diverse states in the U.S., and for those census tract measures in common (race and income) our findings were similar to what was observed in New York, suggesting our results may be relevant for some other states, particularly those with large urban populations. Similarly, although all but six states impose suspensions for non-driving-related offenses, the exact legal framework for the suspensions may differ state-to-state. Thus, additional work may be needed to determine how our findings would translate to a state with a different legal framework. Last, although individuals are required to submit a change of address to the New Jersey Motor Vehicle Commission when they move, it is possible that drivers have changed addresses within the state or even outside of New Jersey without notifying the commission. If they moved to an address in another census tract, this could result in misclassification of their census tract characteristics. Further, if suspended drivers were more or less likely to submit a change of address, then this differential misclassification could bias our findings. However, there are few barriers to changing the residential address for a license as it can be done online for free, we used the most recent address as of December 2018, and only 13% of all individuals in our study reported an address with a different zip-code at any point prior to 2018 suggesting that when individuals do move it is most often within a similar geographic area. Thus we do not expect a significant portion of our population to have a misclassified address.

5. Conclusion

Access to a vehicle is essential for participation in modern society. Thus a suspended license has the potential to severely limit an individual's social and economic opportunity. Our study contributes to a growing literature that shows, despite public perception that they are meant to address traffic safety, the majority of suspensions are for non-driving-related events. Further, these non-driving-related suspensions are most common in low-income communities and communities with a high-proportion of Black and Hispanic residents. Although non-driving-related suspensions are also concentrated in communities with better access to public transportation and nearby jobs, additional work is needed to determine what effect this has, if any, on mitigating the potential impact of a suspension on social and economic well-being.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jth.2020.100933.

Financial disclosure

This work was supported by the Agency for Healthcare Research and Quality award K12 HS022998-03 (PI: Joyce); The Department of Veterans Affairs Office of Academic Affiliations Advanced Fellowship in Health Services Research and Development (PI: Zullo); The National Institute on Aging award R21AG06163 (PI: Zullo); the National Institute of General Medical Sciences award U54GM115677 (PI: Zullo); a pilot project grant from the Brown University Office of the Vice President for Research (PI: Zullo); Eunice Kennedy Shriver National Institute of Child Health and Human Development at the National Institutes of Health Awards R21HD092850 (PI: Curry, CoI: Pfeiffer) and R21HD098276 (PI: Curry); Center of Biomedical Research Excellence (COBRE) award P20GM130414 (PI: Ahluwalia).

The funders had no input on the study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. We acknowledge Kareena Hundal who provided valuable assistance in the classification of suspension types for this paper.

References

Aiken, J., 2012. Reinstating Common Sense: How Driver's License Suspensions for Drug Offenses Unrelated to Driving Are Falling Out of Favor.
Alcorn, T., May 8, 2019. Handcuffed and Arrested for Not Paying a Traffic Ticket. The New York Times.
Andersson, F., Haltiwanger, J.C., Kutzbach, M.J., Pollakowski, H.O., Weinberg, D.H., 2018. Job displacement and the duration of joblessness: the role of spatial mismatch. Rev. Econ. Stat. 100 (2), 203–218.
Balko, R., February 9, 2018. The ongoing criminalization of poverty. The Washington Post.
Bingham, S., Castaldi, M., Herald, M., et al., 2016. Stopped, Fined, Arrested: Racial Bias in Policing and Traffic Courts in California. East Bay Community Law Center.
Blumenthal, P.D., Voedisch, A., Gemzell-Danielsson, K., 2011. Strategies to prevent unintended pregnancy: increasing use of long-acting reversible contraception. Hum. Reprod. Update 17 (1), 121–137.
Board of the Governors of the Federal Reserve System. Report on the Economic Well-Being of U.S. Households in 2018- May 2019, 2019.
Carnegie, J.A., 2007. Driver's License Suspensions, Impacts and Fairness Study. Alan M. Voorhees Transportation Center.
Carr, L.J., Dunsiger, S.I., Marcus, B.H., 2011. Validation of Walk Score for estimating access to walkable amenities. Br. J. Sports Med. 45 (14), 1144–1148.
Chaiyachati, K.H., Hubbard, R.A., Yeager, A., et al., 2018a. Association of rideshare-based transportation services and missed primary care appointments: a clinical trial. JAMA Intern Med 178 (3), 383–389.
Chaiyachati, K.H., Hubbard, R.A., Yeager, A., et al., 2018b. Rideshare-based medical transportation for Medicaid patients and primary care show rates: a difference-in-difference analysis of a pilot program. J. Gen. Intern. Med. 1–6.
Curry, A.E., Pfeiffer, M.R., Carey, M.E., Cook, L.J., 2019. Catalyzing traffic safety advancements via data linkage: development of the New Jersey Safety and Health Outcomes (NJ-SHO) Data Warehouse. Traffic Inj. Prev. 20 (Sup2), S151–S155.
Dewan, S., April 14, 2015. Driver's License Suspensions Create a Cycle of Debt. The New York Times.
Driven by Justice Coalition, 2019. Opportunity suspended: how New York's traffic debt suspension laws disproportionately harm low-income communities and communities of color. https://www.drivenbyjustice.org/. (Accessed 23 May 2019).
Duncan, D.T., 2013. What's your Walk Score(R)?: web-based neighborhood walkability assessment for health promotion and disease prevention. Am. J. Prev. Med. 45 (2), 244–245.
Glaeser, E.L., Kahn, M.E., Arnott, R., Mayer, C., 2001. Decentralized employment and the transformation of the American city [with comments]. In: Brookings-Wharton Papers on Urban Affairs, pp. 1–63.
Karter, A.J., Parker, M.M., Moffet, H.H., et al., 2004. Missed appointments and poor glycemic control: an opportunity to identify high-risk diabetic patients. Med Care 42 (2), 110–115.
Kim, J., Norton, E.C., Stearns, S.C., 2009. Transportation brokerage services and Medicaid beneficiaries' access to care. Health Serv. Res. 44 (1), 145–161.
Kneebone, Elizabeth, Holmes, Natalie, March 2015. The Growing Distance between People and Jobs in Metropolitan America.
Lawyers Committee for Civil Rights, 2015. Not Just a Ferguson Problem: How Traffic Courts Drive Inequality in California.
Mehta, Y., Gabler, H.C., Daniello, A.L., Kusano, S.M., 2014. Restricted-Use Licenses for Suspended NJ Drivers. New Jersey Department of Transportation.
Moyer, J.W., February 9, 2018. More than 7 million people may have lost driver's licenses because of traffic debt. Wash. Post.
Not-Just-a-Ferguson-Problem-How-Traffic-Courts-Drive-Inequality-in-California-4.20.15.pdf.
Oppel Jr., R.A., 2018. Being Poor Can Mean Losing a Driver's License. Not Anymore in Tennessee. The New York Times.
Rediger, K., Albert, M., Miles, D.R.B., 2018. Ridesharing and text messaging for patients with medicaid—further information. JAMA Internal Medicine 178 (6), 867–868.
Salas, M., Ciolfi, A., 2017a. A State-By-State Analysis Of Driver's License Suspension Laws For Failure To Pay Court Debt.
Salas, M., Ciolfi, A., 2017b. Driven by Dollars. A State-By-State Analysis of Driver's License Suspension Laws for Failure to Pay Court Debt. Legal Aid Justice Center.
Schnake-Mahl, A.S., Sommers, B.D., 2017. Health care in the suburbs: an analysis of suburban poverty and health care access. Health Aff. 36 (10), 1777–1785.
Silver, D., Blustein, J., Weitzman, B.C., 2012. Transportation to clinic: findings from a pilot clinic-based survey of low-income suburbanites. J. Immigr. Minority Health 14 (2), 350–355.
Smart Location Mapping. Interactive maps and data for measuring location efficiency and the built environment. https://www.epa.gov/smartgrowth/smart-location-mapping. (Accessed 29 July 2019).
Stinnie, D., Moore, D., Taylor, R., Russo, N., Holcomb, R.D., 1909. The United States District Court for the Western District of Virginia, pp. 315–336.
Syed, S.T., Gerber, B.S., Sharp, L.K., 2013. Traveling towards disease: transportation barriers to health care access. J. Community Health 38 (5), 976–993.
The City of Phoneix Municipal Court's Compliance Assistance Program, 2016. An economic assessment. In: L Wiliam Seidman Research Institute. W P Carey School of Business Arizona State University. June 2, 2017.
Walk score methodology. https://www.walkscore.com/methodology.shtml. (Accessed 29 July 2019).