The Effects of Education and Income on Opioid Use in Kentucky *

Amanda Rorat *400067162*

This paper reports our analysis of opioid prescriptions in Kentucky, USA, and its relationship with income and education at the level of counties. Data were obtained from the Washington Post database and the US Census.

Keywords: opioids, education, income, spatial analysis

Introduction

Suburban neighbourhoods, "suburbs" for short, refer to areas that are almost exclusively zoned for low-density housing ((**airgood-obrycki?**)). For many, these single-family homes were a premium housing available following the second World War to accommodate returning veterans and the consequent Baby Boom population ((**nicolaides2017?**)). The large population increases throughout the United States meant many people wanted to live further away from a now very clustered city center, especially in suburbs that provided more space and "freedom" for inhabitants ((**nicolaides2017?**)). For many, the image of suburbs centered around the white middle class, who were the primary residents of these spaces throughout the Fordist Era ((**florida1988?**)), a postwar period characterized by rapidly increasing automobile usage and suburban sprawl (expanding suburban neighbourhoods).

In the 21st century, many white Americans still reside in white-majority suburban neighbourhoods ((**evenas?**)), indicating the White Flight effect of white people moving to the suburbs could still be occurring to this day ((**crowder2000?**)). Their primary aim would be to leave the inner cities and have physical barriers from black Americans (and other racial minorities) in their residential suburbs ((**florida1988?**)). Policies such as the G.I. Bill aiming to aid returning veterans with getting an education and/or purchasing homes often excluded black veterans ((**riser2023?**)), and racial segregation in buildings being legally permitted until 1964 ((**leffler2014?**)) excluded black Americans from being part of society. However, the built environment quickly became an additional obstacle. Suburban neighbourhoods were primarily designed for private car usage, rather than including accessibility by walking or public transit ((**florida1988?**)). This, along with a shift to curvier roads with fewer entrances into the suburb ((**southworth1993?**)) made the potential mobility of most American suburbs much lower than neighbourhoods within inner cities.

Our study will examine how suburbs, in terms of street patterns and features, made mobility in American suburbia low. Additionally, we will examine how this process was intentionally done to segregate.

Literature Review

An important aspect of the built suburban environment are the various street patterns present. There are various ways to classify the street patterns, and many different variations are present throughout the United States. For instance, (**canadamortgageandhousingcorporation2002?**) found three main street plans in North American suburbia: the conventional loop and cul-de-sac, traditional grid, and residential quadrant. The residential quadrant is best described as an open grid street system, with high accessibility in and out of the community. On the other hand, the conventional loop and cul-de-sac designs feature curved roads and many dead end streets within the neighbourhood. This makes access from outside the community more difficult, especially without a car. The design for such winding sidewalks and streets originate from John Nash and Humphery Repton's designs for some of the first "urban villages", which featured low-density cottages and a "rural style of living" on the outskirts of a city ((**southworth2003?**)). The design became increasingly popular and eventually superseded the grid street design (but not entirely) which was more convenient for railroad connections and meeting the housing demands of early 20th century America ((**southworth1993?**)).

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The traditional grid and residential quadrant styles were found to include more commercial and recreational space than the cul-de-sac design; exemplary of a mixed-use community. Mixed-use zoning which places buildings of various types such as residential, commercial, industrial, etc. together is crucial for neighbourhoods as it promotes walkability and other modes of active transport, local commercial activity, and sociability ((**perrotta?**)). Furthermore, the residential quadrant was able to increase the amount of residential areas while lowering the amount of street spaces occupied, even compared to a traditional grid system ((**southworth2003?**)). An increased affordable housing availability, rather than a large proportion of streets taking up a neighbourhood's space with some low-density housing available, could help combat issues such as poverty ((**blanch2023?**)). Fewer and less wide streets would result in better connectivity between houses, commercial spaces, and places beyond the community; as well as a better walking experience in terms of safety ((**hamidi2023?**)). The increased safety would occur from the streets being narrower and having more stops (rather than continuous roads in the conventional loop and cul-de-sac plans), forcing automobiles to slow down and discouraging heavy vehicle traffic ((**hamidi2023?**)). This, in turn, increases pedestrian and active transit safety exponentially. As mentioned previously, sociability is also a crucial factor in street and community planning. It allows people within communities to come together, interact, and form social bonds. But, this requires streets and places that are open to pedestrians and cannot simply be built, but can be encouraged through urban design, policies, and community engagement in planning ((**yaseen2017?**)). For instance, promoting fewer cars on the streets using discontinuous street patterns would result in fewer car crashes against pedestrians, and could increase the perception of safety by residents ((**hamidi2023?**)). Improving social interactions between people with the help of the built environment could be the first steps towards lowering racial segregation in the United States ((**kollmann2021?**)).

Unfortunately, designing communities for sociability and integration is not a priority in the United States. In the 1930s, heavier street design standards were implemented ((**southworth2003?**)). The thought process by some engineers, architects, and investors was to promote driving cars, which would best be accomplished by expanding the amount of streets and arterial roads ((**southworth2003?**)). Municipal governments and people had little say in this, with those not adhering to the strict regulations receiving less or no Federal funding. Commercial developers specifically would use what is referred to as the "drive-park-shop" model ((**southworth2003?**)). This design features widened streets to promote car usage in the suburbs and offers more parking lot spaces in public and commercial spaces. This very directly encourages people to drive as their main mode of transportation rather than using active travel modes such as walking or biking, or public transportation which was already inadequate (to say the least) in many parts of suburban United States. During this time, roads and parking spaces ended up covering nearly half of developed spaces in American cities ((**southworth2003?**)). In some metropolitan statistical areas such as Los Angeles, this amount was closer to two thirds of built land ((**southworth2003?**)). Rather than promoting inner city development, affordable housing, walkable spaces, and most importantly, non-segregated spaces; resources were wasted towards building and maintaining these extensive, wide roads now found all throughout the urban and suburban United States. This had an egregious effect on sociability, where most people would drive to their workplace and a store then back home without interacting with other people ((**leyden2003?**)). Furthermore, due to the need for large portions of residential zoning, the development of fewer third places (non-work places for people to socialize) occurred, despite them being crucial for people's well-being.

A different study by (**southworth1993?**) observed 5 different street layouts in American suburbia. Similarly, there was a grid ("gridiron") pattern. Additionally, there was also a fragmented parallel, warped parallel, loops and lollipops (most similar to (**canadamortgageandhousingcorporation2002?**) 's conventional loop and cul-de-sac design), and lollipops on a stick street pattern. The grid pattern was found to have the most intersections, which in theory, could lead to higher incidences of car-pedestrian crashes. However, it also features the most access points into the neighbourhood as well as residential or commercial blocks compared to the other four designs. The lollipops on a stick design features the fewest building blocks, intersections, and access points to the neighbourhood. This, along with having the highest number of dead end roads out of the 5 street patterns, discourages people from entering these neighbourhoods as there is simply no reason to. There are few homes, few or no shops, and a majorly unwalkable landscape, which divides the suburb's residents from the outside world. And yet, to its residents, the neighbourhood can resemble nature due to the low-density of housing and greenery present.

This is a very counter-intuitive mindset, since all the cars present needed for one to live in this neighbourhood is anything but natural – with extreme environmental damage and human health impacts from

the internal combustion engines and gas usage. Additionally, the driveways and garages have to be large to accommodate these cars. The greenery present is mostly from lawns or sometimes neighbourhood parks (which lower-income communities or majority black communities have much fewer of in their neighbourhoods due to environmental racism). Front lawns, which originate from medieval era England and France were and still are used as a symbol of wealth ((**yuvalnoah2016?**)). Being able to maintain a lawn, especially the bigger it is, became a way to show one's belonging to a higher socioeconomic status ((**yuvalnoah2016?**)). Additionally, equipment such as lawn-mowers and automatic sprinklers can be expensive to purchase and timely to use, and are much more available to middle-class families within the United States rather than lower-income individuals or families in many other parts of the world. Both home ownership and lawn ownership quickly became associated with the American Dream, an ideal many white Americans strived to achieve ((**zhang2015?**)). Lawn and park access was not just an aesthetic, but was found to greatly impact people's health. (**yang2023?**) found that white-majority neighbourhoods had more greenery, better maintained buildings, and better overall health than black-majority neighbourhoods; which is not by choice but done through mechanisms of segregation.

Another physical factor contributing to racial segregation in the United States is the development of the Interstate Highway System ((**schwager?**)). As an example, prior to the Second World War, Los Angeles had a ring-radial street system where traffic and buildings surround and focus on the central business district ((**brown2009?**)). This eventually evolved into a dense grid pattern to spread out traffic throughout the city, especially since it better connected highways to different parts of the city. Highways were seen as a solution to many urban issues such as dying central business districts that were losing their popularity as well as inner city informal settlements (slums) ((**brown2009?**)). While many initial engineers focused on connectivity of these highways to different parts of the city and to rural spaces, simultaneously ensuring other modes of transport were still accessible, these plans quickly changed. Many of the initial highway line proposals were discarded due to a lack of funding. Redirecting them, often through informal settlements or black communities, would significantly lower the costs in construction and maintenance ((**brown2009?**)). This move was frequently intentional, aiming to clear lower-income neighbourhoods that were seen as less valuable or even a nuisance to the richer, white people and communities ((**heilmann2018?**)). Additionally, in some American cities such as Dallas, having a lower income would often mean having significantly lower public transit access stemming from the infrastructure and zoning changes ((**heilmann2018?**)). This could lead to an even greater level of income and/or racial segregation within cities and communities, as not only is walking limited due to street desigsn, but other public modes of transportation can be inaccessible.

Racial segregation is known to have dire effects on black Americans' mental and physical well being. Many countries and regions such as the United Kingdom have big divisions in housing based on socioeconomic status ((**walker2001?**)). However, the United States has a large divide in housing conditions and neighbourhoods based on race as a major factor as well ((**walker2001?**)). Often, communities with large racial minority populations are situated in areas associated with more health risks. This could put people of colour at risk of exposure to high amounts of pollutants such as NO_2, PM_{10}, SO_2, and carcinogens from the large amounts of cars nearby (due to housing placement near highways, for instance) ((**mitchell2003?**)). This has negative physical health effects on residents, increasing respiratory disease incidences. Furthermore, people in lower socioeconomic statuses are more likely to be victims in car-related injuries and deaths ((**roll2022?**)). Major contributors of this problem include drivers yielding less frequently for black individuals, aging infrastructure and a lack of pedestrian-oriented infrastructure in black-majority and lower-income neighbourhoods ((**roll2022?**)).

On the other hand, there are still many communities that are amalgamated. Compact, high-density developments have better accessibility into the neighbourhood using various modes of transit. Additionally, various housing types, including affordable housing, being available increases the range of people who can afford to live in the area ((**blanch2023?**)). Walking and having accessible third places are a major factor in sociability as well, and through sociability, more integration rather than segregation could be achieved ((**canadamortgageandhousingcorporation2002?**)). The issue lies with American suburbs that have low public transit and walkable access, isolating them from the outside world and other people. To achieve the more integrated communities, several changes can be made. In terms of street connectivity, having more link-to-nodes (road to intersection connections) leads to a decrease in driving ((**marshall2010?**)), as seen in gridiron street patterns due to the shorter roads (less convenient to drive) and increased potential for mobility by walking. Certain street patterns such as the grid street network has an above average

connectivity and density, resulting in more walking and biking within but also out of the neighbourhood ((**marshall2010?**)). A crucial aspect is to maintain these street connections throughout the entire city, not just individual neighbourhoods, which is crucial for more active transport usage. While cars are not the main culprit of segregation issues in the United States, they perpetuate physical design choices in the form of street patterns, which in turn segregates communities and especially shields white people from other racial groups. Including mixed-use designs in communities by adding amenities such as grocery stores and medical centers would increase the utility of the given neighbourhood, encouraging people to visit and live there for various different needs.

References