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Examining Prevalence of Nonmedical Prescription Opioid Use by Race and Ethnicity from 2015-2018 among a National Sample

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Wheaton College (IL)

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Thesis Committee Chair: Natalie Crawford, PhD

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Rollins School of Public Health of Emory University
In partial fulfillment of the requirements for the degree of
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Abstract

Prescription opioids (POs) continue to account for almost a quarter of all drug overdose (OD) deaths. For over a decade, White rural Americans have disproportionately experienced opioid OD. However, Black and Latino Americans in urban and suburban areas have recently experienced alarming increases in opioid OD compared to White populations. Recent data are needed to understand shifts in PO use among Black and Latino populations. Using 2015-2018 National Survey on Drug Use and Health data, we examined the current socio-demographic, mental health and substance use correlates of non-medical prescription opioid (NMPO) use by race and ethnicity. Data cleaning and analysis was performed in SAS version 9.4. Preliminary results of this nationally representative sample (n=154,350) suggest that NMPO remains significantly higher among White (4.46%) compared to Black (3.75%) and Latino (4.13%) populations. Significant correlates of NMPO between racial and within racial groups included lower education, unemployment, never being married, lacking health insurance, depression, psychological distress, and the use of other licit and illicit substances including alcohol. Urbanicity was only significantly higher among White urban (4.54%; p=0.02) compared to White rural residents (4.04%), suggesting an important shift in our prior epidemiology. These preliminary results suggest that the opioid crisis may be evolving and has grown to impact Blacks and Hispanics to a greater degree than previously understood. Understanding current differences in NMPO use across racial and ethnic groups is critical to thwarting further spread of this epidemic.

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Table of Contents

Introduction

Drug overdose is the leading cause of death among US adults under the age of 50, with 70,237 drug overdose deaths in 2017, and of those drug overdose deaths 67.8%—or 47,600 deaths—involved opioids (CDC, 2019a). From 2016 to 2017, the age-adjusted overdose death rate for all drug use increased 9.6%, largely attributable to the steady and ongoing growth of the opioid epidemic since the 1990s (CDC, 2019a). In fact, of the 702,568 drug overdose deaths from 1999 to 2017, opioids were involved in 56.8% (Scholl et al., 2019). Among the many types of opioids, prescription opioids have historically been responsible for the bulk of opioid-involved overdose deaths and caused the highest number of overdose deaths in any year from 1999-2015 (The Henry J. Kaiser Family Foundation, 2020). From 1999 to 2017, approximately 215,000 people died of a prescription opioid drug overdose, which is 30.6% of all drug overdose deaths during that period (CDC, 2019b). Despite rapid growth in fentanyl-related overdose deaths in the last 5 years, prescription opioids were still involved in 23.7% of all drug overdose deaths and accounted for an average 46 deaths every day in 2017 (CDC, 2019b). An estimated 1.7 million Americans had a substance use disorder related to prescription opioids in 2017, with 21-29% of people who were prescribed opioids for chronic pain misusing them (National Institute on Drug Abuse, 2019; Vowles et al., 2019). Prescription opioid use not only leads to misuse and addiction, they also account for 70% of fatal prescription drug overdoses (Jones et al., 2013).

Effects of Opioids on the Body

Opioids can be categorized broadly into natural and synthetic groups. Natural opioids, also termed opiates, include derivatives found naturally in or modified from poppy seed pods, such as opium, morphine, and heroin. Synthetic opioids include more chemically derived and

altered products such as oxycodone, oxycontin, methadone, along with the more potent fentanyl. Fentanyl is a pain medication designed for cancer patients and has many chemical analogues that range in potency from 100-10,000 times that of morphine (Vardanyan & Hruby, 2014; United Nations Office on Drugs and Crime, 2017; CDC, 2019b). Opioids chemically bind to opioid receptors throughout the peripheral and central nervous systems, which causes the release of endorphins that both mask perceptions of pain and increase feelings of euphoria (Ghelardini et al., 2015; Mayo Clinic Staff, 2018). Opioid binding also influences a chemical cascade that releases dopamine, a chemical important in the body's reward system; consistent triggering of this reward system can lead to addiction.

Economic Impact of Prescription Opioid Abuse

The economic and societal costs of prescription opioid abuse are staggering; estimates for 2001 put the total cost at $8.6 billion and in 2007, just six years later, the total cost had risen to $55.7 billion (Birnbaum et al., 2011; Oderda et al., 2015). More recent estimates have found the total economic burden of prescription opioid abuse to be $78.5 billion in 2013, with excess costs of opioid abuse being anywhere from $10,000 to $20,000 per patient (Florence et al., 2016; Kirson et al., 2017). More than a third (36.8%) of these costs, or $28.9 billion, is attributable to increases in healthcare and substance abuse treatment costs (Florence et al., 2016). Lost productivity hours due to premature death, incarceration, and reduced productive output due to addiction/disability amounted to an economic cost of approximately $42 billion or 53.5% (Florence et al., 2016). The remaining 9.7% of the economic cost is attributable to increased criminal justice costs (Florence et al., 2016). More recent numbers are likely even higher as the opioid epidemic has continued to grow and evolve since 2013, particularly as this year marks the

beginning of the new wave of synthetic opioids and the spike in overdose deaths they have caused. Furthermore, these estimates only account for the economic costs of prescription opioid abuse and not the recent increases in both heroin and synthetic opioid use.

Overall Trends in Opioid Deaths and Use

In 2001, opioids were related to 0.4% of all deaths in the United States, or 1 in 255 deaths, but by 2016 they were involved in 1.5% of all deaths, or 1 in 65, a 292% increase (Gomes et al., 2018). From 2001 to 2016, opioid involved deaths have led to 1,681,359 years of lost life, with 66.9% of those lost years of life attributable to men (Gomes et al., 2018). In fact, 67.5% of all opioid involved deaths in 2016 were among men (Gomes et al., 2018). The epidemic has also disproportionately impacted individuals ages 15-24 and 24-35, with 12.4% and 20.0% of all deaths in each age group, respectively, attributable to opioids (Gomes et al., 2018).

Overdose deaths involving an opioid have increased dramatically in recent years, rising 90% (25,052 cases to 47,600 cases) from 2013-2017, largely driven by deaths involving highly potent synthetic opioids (Gladden et al., 2019). Preliminary data from 25 US states show that from July 2017 to June 2018, synthetic opioid involved overdose deaths increased 11.1% while all other opioid types indicate small decreases in overdose deaths, including prescription opioid involved deaths which fell by 6.6% (Gladden et al., 2019). Polysubstance use is also contributing to more opioid overdose deaths as 62.6% of all opioid overdose deaths from July 2017 to June 2018 also involved one or more combinations of methamphetamine, cocaine, and benzodiazepines (Gladden et al., 2019). In 2011, 18.8% of patients entering drug treatment for opioids also reported past month methamphetamine use; by 2017, that number had risen to 34.2% (Ellis et al., 2018). From 2011-2017, co-use of methamphetamine and opioids grew the

most among females (97.8%), Whites (100.6%), and urban residents (123.0%) (Ellis et al., 2018).

According to 2015 NSDUH estimates, past year NMPO use prevalence was 4.7% nationally, which represented 11.5 million Americans (Han et al., 2017). Prevalence of misuse was higher among adults reporting prescription opioid use with 12.5% reporting misuse and 2.1% meeting criteria for a SUD in the past year (Han et al., 2017). Of adults reporting NMPO use, the majority (59.9%) were using drugs without a prescription, while 22.2% were taking opioids prescribed to them in greater amounts than directed by a healthcare provider, 14.6% took them more often than directed, and 13.1% used them longer than directed (Han et al., 2017). However, it is important to note that these categories are not mutually exclusive and a respondent at different periods in the past year could have performed one or more of the behaviors listed. Among adults reporting only NMPO use and not a SUD, 66.3% said they misused prescription opioids to relieve physical pain, 11.2% did so to relax, and 10.8% did so primarily to get high (Han et al., 2017).

Trends in Opioid Overdose Deaths By Sex, Age, and Geography

The opioid epidemic has historically impacted males to a greater extent than females. In 2017, 67.9% of all opioid-involved overdose deaths were men and the overall overdose death rate was more than twice as high in men compared to women, 20.4 vs 9.4 (Scholl et al., 2019). Regarding prescription opioids specifically, the rates of overdose deaths among men and women were 6.1 and 4.2, respectively, in 2017 (CDC, 2019b). Still, women have experienced comparable relative growth in opioid-involved overdose deaths in recent years. From 2016 to 2017, the relative change in overall opioid-involved overdose deaths was only 2.1% less in

women (12.7 vs 10.6), and men saw a statistically significant 2.7% decrease in heroin involved overdose death while women saw an increase of 4.2% (Scholl et al., 2019).

Individuals aged 25-34 remain the age group with the highest overdose rate at 29.1 in 2017, but those between the ages of 35-44 and 45-54 had similarly high overdose death rates of 27.3 and 24.1, respectively (Scholl et al., 2019). Geographically, the opioid epidemic continues to impact areas in and around Appalachia the most, with some of the highest overdose rates in the country in states like West Virginia. Ohio, and North Carolina (Scholl et al., 2019). But, growing evidence is showing drastic increases in secondary geographic populations in suburban and urban areas. However, middle aged Blacks and Hispanics in particular geographic regions are at the greatest risk of an opioid overdose (Lippold et al., 2019). Therefore in order to truly mitigate the opioid epidemic, research and interventions must have wide-ranging approaches that address people in their unique combination of race and ethnicity, age, sex, and geographic categories.

Trends in Opioid Overdose Deaths By Race and Ethnicity

Since its start in the 1990s, the opioid epidemic has disproportionately affected different racial and ethnic groups. Rates for opioid-involved deaths among non-Hispanic Whites and American Indian/Alaskan Natives were three times higher than among non-Hispanic Blacks and Hispanics in 2008 (Paulozzi et al., 2011). As of 2017, disparities in prescription opioid overdose death rates have narrowed. Non-Hispanic Whites still have the highest rate of all opioid-involved overdose deaths at 19.4 in 2017 compared to 12.9 in Blacks, but rates of overdose deaths attributable to prescription opioids were now closer with 6.9 in Whites and 3.5 in Blacks (Scholl et al., 2019). Compared to rates in non-Hispanic Whites, rates of all opioid-involved deaths have

remained relatively constant for Hispanics at 6.8 in 2017, while rates in American Indian/Alaskan Natives are still high at 15.7 (Scholl et al., 2019). Prescription opioid overdose death rates are still low for Hispanics at 2.2, while American Indian/Alaskan Natives had the highest rate of any race/ethnic group at 7.2 in 2017 (Scholl et al., 2019).

From 2016 to 2017, the greatest relative change in overall opioid-involved overdose deaths occurred among Blacks (25.2%), which was more than double the relative change among Hispanics (11.5%) and non-Hispanic Whites (10.9%) (Scholl et al., 2019). While there was no statistically significant relative change in prescription opioid-involved overdose deaths among Blacks, there were significant relative changes among Blacks specifically involving heroin (8.9%) and synthetic opioids such as fentanyl (60.7%) (Scholl et al., 2019). In 2017, 59.8% (28,466) of all opioid involved overdose deaths involved synthetic opioids, with fentanyl in particular being increasingly mixed with heroin, cocaine, methamphetamine, and counterfeit prescription pills over the last five years (Lippold et al., 2019). In large central metropolitan areas, among people ages 45 to 54, synthetic opioids were involved in 70% of all opioid overdose deaths among Blacks, compared to 56% among Hispanics and 54.2% among Whites (Lippold et al., 2019).

Synthetic opioids, including fentanyl, have led to increases in overdose death rates among Blacks and Hispanics, with risks higher among specific age and geographic categories. From 2015-2017 in large central metropolitan areas, the largest absolute and percentage increases in rates of overall opioid-involved overdose deaths occurred among blacks with rates increasing from 11.8 to 24.0, a rate change increase of 103% (Lippold et al., 2019). Also in large central metropolitan areas, blacks also had the largest absolute and percentage increases in rates of opioid-involved overdose deaths involving synthetic opioids with rates increasing from 3.6 in

2015 to 16.6 in 2017, a rate change increase of 361% (Lippold et al., 2019). Comparatively, whites experienced a smaller rate change in both overall opioid-involved overdose deaths (18.2 in 2015 to 24.6 in 2017, a 35% increase) and opioid-involved overdose deaths involving synthetic opioid (4.7 in 2015 to 13.7 in 2017, a 192% increase). Therefore, rates in 2017 of overall opioid-involved overdose deaths were almost the same among white and black residents of large central metropolitan areas (24.6 vs 24.0, respectively), while blacks had significantly higher synthetic opioid involved overdose deaths (16.6 vs 13.7).

This sharp increase in both categories of opioid-involved overdose deaths among blacks residing in large central metropolitan areas is largely driven by increases among those aged 45-54 and 55-64 (Lippold et al., 2019). In fact, blacks in both age groups had larger absolute and percentage increases in their rates compared to every other race and age category across all geographic categories, except for Whites ages 25-34 living in large fringe metro areas who had about the same rates (Lippold et al., 2019). Overall opioid-involved overdose deaths among Blacks aged 45-54 increased from 19.3 in 2015 to 41.9 in 2017, a 117% increase in rate (Lippold et al., 2019). Overdose deaths involving synthetic opioids among Blacks aged 45-54 increased from 5.7 in 2015 to 29.4 in 2017, a 416% increase in rate (Lippold et al., 2019).

In large fringe metropolitan areas, similar patterns exist with Black residents experiencing the largest rate change in both overall opioid-involved overdose deaths (7.2 in 2015 to 14.4 in 2017, a 100% rate increase) and opioid-involved overdose deaths involving synthetic opioids (2.5 in 2015 to 10.8 in 2017, a 332% rate increase) (Lippold et al., 2019). Hispanics in this geographical category also experienced large increases in overall opioid-involved overdose deaths (5.7 in 2015 to 10.0 in 2015, a 75% increase) and opioid-involved overdose deaths involving synthetic opioids (1.7 in 2015 to 6.7 in 2017, a 294% increase) (Lippold et al., 2019).

When looking at age, Hispanics between 45 and 54 experienced a rate increase of opioid-involved overdose deaths involving synthetic opioids of 1.5 in 2015 to 8.0 in 2017, a 433% increase which was the largest percentage increase of any age or race category among large fringe metropolitan residents (Lippold et al., 2019). Whites again saw smaller increases in opioid overdose death rates from 2015-2017. Rates of opioid-involved overdose deaths increased from 2015-2017 among whites (17.8 to 26.7, a 50% increase) and rates of opioid-involved overdose deaths involving synthetic opioids increased from 6.1 to 17.5, a 187% increase (Lippold et al., 2019).

Finally, in medium and small metropolitan areas patterns in overdose death rates varied much more by race and ethnicity. Blacks still experienced the highest opioid-involved overdose death rate increase (7.3 vs 13.3, an 82% increase) compared to Whites (16.4 vs 21.9, a 34% increase) and Hispanics (7.3 vs 9.9, a 36% increase) (Lippold et al., 2019). For opioid-involved overdose deaths involving synthetic opioids, Hispanics experienced the largest rate change percentage of 262% with a rate increase of 1.3 to 4.7, followed by Blacks (2.6 to 8.9, a 242% increase), but both groups still showed much lower rates compared to Whites (4.8 to 12.6, a 163% increase) (Lippold et al., 2019).

With recent literature suggesting racial demographic changes in opioid deaths, a new examination of current data regarding opioid use is needed to see if similar changes are occurring. As prescription opioids have historically been the leading cause of drug overdose until recent years and still account for almost a quarter of all drug overdose deaths (CDC, 2019a; Scholl et al., 2019), their role in racial demographic changes in opioid deaths has not been fully examined. However, before examining any potential racial shifts in prescription opioid use in recent years, a greater understanding of the racialized history surrounding the prescribing of

opioids is needed. Understanding this historical context both highlights the need to examine prescription opioid use and contextualizes any findings.

Related Factors Influencing Black Experiences of the Opioid Epidemic

Greater increases in both heroin and synthetic opioid-involved overdose deaths among Blacks are likely attributable, at least in part, to institutionalized racism in healthcare. From 1999 to about 2015, prescription opioids were the main opioid being abused and were responsible for the majority of overdose deaths (The Henry J. Kaiser Family Foundation, 2020). Lower accessibility to prescription opioids among Black populations throughout the 2000s compared to Whites is one contributing factor of lower opioid use and overdose rates until recent years. In a meta-analysis conducted by Meghani et al. (2012), Blacks were 29% less likely to be prescribed opioids compared to whites. One non-peer reviewed, counterfactual analysis estimates that racial stereotypes among medical providers may have led to 14,124 less prescription opioid deaths among Blacks from 1999-2017 (Frakt & Monkovic, 2019). These racial stereotypes include the false beliefs that Black patients are more likely to become addicted to or sell their prescription opioids, while other stereotypes propose that Black patients have a higher biological threshold for pain than Whites, which is untrue but still believed by many medical students (Hoffman et al., 2016; Mende-Siedlecki et al., 2019; Frakt & Monkovic, 2019). Other studies have confirmed that Black patients are significantly more likely to have un/under-treated pain due to biased prescribing practices (Hoffman et al., 2016; Cintron & Morrison, 2006). Therefore, while Black patients may have been less likely to experience addiction and death due to their more limited access to prescription opioids, this also means their pain was likely more undertreated. Early disparities in opioid deaths by race and ethnicity have decreased significantly today, but the

persistence of these disparities tell a double-edged narrative, one where racial minorities were initially less likely to face addiction and death but also were they were more likely to live with untreated pain.

The History of Opioids In America

The modern opioid epidemic has been raging in the US since the 1990s and has evolved multiple times in the past three decades. The Centers for Disease Control and Prevention have defined three distinct waves of the opioid epidemic to help understand epidemiological changes in trends. Each of these waves marks the beginning of drastic increases in a specific subtype of opioid; it does not mean that the opioid in the preceding wave no longer plays a significant role in contributing to overall opioid overdose deaths. The timing of the first wave of the opioid epidemic is widely debated to have begun in the early to mid 1990s with the rise in prescription opioid involved overdose deaths. The second wave of the opioid epidemic began in 2010 with a significant increase in heroin involved overdose deaths, and the third wave of the opioid epidemic began in 2013 with the rise of synthetic opioids, specifically fentanyl, which currently accounts for the most opioid overdose deaths. While the modern opioid epidemic is the largest the United States has ever experienced, it is not the only national opioid epidemic in our history. To truly understand the modern opioid epidemic and why opioid use is racialized today, one must understand past drug epidemics and how we have addressed them.

America's First Opioid Epidemic

In response to the hundreds of thousands injured during the US Civil War, opium was planted throughout the southern states of Virginia, Georgia, and South Carolina for the

development of morphine (Quinones, 2015: 52). Demand for opium continued to grow after the war's end in 1865, in part because many of the surviving veterans had become addicted to the pain-relieving drug. It was common practice during and after the war for physicians to leave extra morphine and hypodermic needles for veterans to self-medicate; few worried about addiction because the inventor of the hypodermic needle, Dr. Alexander Wood, had declared that injecting morphine could not lead to addiction (Macy, 2018: 22). From 1860 to the turn of the century, opium also became a common ingredient in many patented medications for everyday ailments. From soothing elixirs for fussy babies to tranquilizers for women's anxiousness, the drug was marketed heavily as a panacea (Daly, 2014: 1; Quinones, 2015: 53). From a mere $3.5 million in sales in 1859, patented medications were generating almost $75 million in sales by 1900 (Quinones, 2015: 53). With no prescription required and availability at almost any neighborhood pharmacy, injecting morphine became a part of everyday life both for America's elite and the middle class (Macy, 2018: 22). In 1898, Heinrich Dreser, a Bayer Laboratory chemist, first synthesized heroin in pill and elixir forms, which were also marketed for many applications including menstrual pain, treatment for tuberculosis, and even as an antidiarrheal (Macy, 2018: 24; Quinones, 2015: 53).

While addiction was already clearly present among morphine-using veterans following the Civil War (Macy, 2018: 22), heroin led to a spike in addiction due to its increased potency. The inclusion of heroin or morphine in everyday products was in part because better alternatives did not yet exist. Nevertheless, there was also a societal willingness to ignore growing addiction in favor of the often termed "magical" capacities of the drug. By 1900 there were an estimated 300,000 addicts and the country was experiencing an opioid epidemic (Daly, 2014: 1). Unable to ignore the problem any longer, the US government passed the Harrison Narcotics Act in 1914.

The act largely attempted to regulate and tax opiates, but it also gave police the ability to arrest physicians who prescribed to a person experiencing addiction (Quinones, 2015: 54). Fear of arrest led to less prescribing by physicians leaving black market sources the only alternative. People experiencing opioid addiction were socially marginalized, labeled morally deficient, and often were arrested rather than treated. Public opinion about opium and heroin had changed, and now "junkies"— those who sold scrap metals to purchase heroin on the black market—were outcasts in society (Macy, 2018: 25).

The infamous Narcotic Farms were established in 1935 in Lexington, Kentucky and 1938 in Fortworth, Texas under the belief that hard labor was the best treatment for people addicted to opioids (Quinones, 2015: 76). The prisons were run by Dr. Larence Kolb Sr. who had published many pivotal articles during the 1920s, arguing that addiction only occurred in people with personality defects (Macy, 2018: 270). In an effort to restore their image and develop a magical opiate that was truly non addictive, physicians and researchers tested many drugs on the Narcotic Farms inmates for more than 40 years (Quinones, 2015: 78). Aside from their inability to give consent, it is unknown how many prisoners were injured or killed by these drug tests. This magical opioid, with powerful pain relief and no addictive qualities, has still not been found, but the pursuit of it has led to the creation of opioids with ever increasing potency and potential for harm. In the 1970s, the drug tests were finally ended when the US Senate's Church Committee learned that the CIA was testing the effects of LSD on inmates (Quinones, 2015: 79).

From the 1970s to the 1980s, pharmaceutical companies and physicians began developing opioids for cancer pain. At the same time, Jan Stjernsward, a Swedish oncologist recently appointed the new cancer chief of the World Health Organization (WHO), declared morphine an "essential drug" making relief from pain an international human right (Quinones,

2015: 81). This WHO endorsement of morphine led to a thirty-fold increase in the global use of morphine from 1980-2011 (Quinones, 2015: 82). Yet 90% of that growth in consumption of morphine was in the wealthiest countries which represented only 20% of the world population (Quinones, 2015: 82). This began the "pain revolution" and patient pain was now viewed as a long maligned human right. In 1984, just a few years after the WHO endorsement, Purdue Pharma synthesized MS Contin (the early precursor to oxycontin), a timed-release morphine pill to meet the new demand for the pain revolution (Macy, 2018: 20).

During this same period, the war on drugs was ramping up and emphasized a criminal justice approach to drug use. The political and media rhetoric surrounding the federal government's approach to drug epidemics at the time was highly militarized, as was the police response which both contrast sharply with current rhetoric about opioids being an "epidemic" and emphasis on treatment over criminalization. This difference in rhetoric is integral to how people who use drugs are defined, either as those with some sort of sickness and in need of help, or those who are enemies in a war, which implies they are dangerous or "super predators." During the crack epidemic of the 1980s, journalist perpetuated narratives from the early 1900s of the "negro cocaine fiend" by depicting people who used crack as violent, erratic, and dangerous while limiting much of their reporting to areas with more racial minorities (Hartman & Golub, 1999). Racialized legislation such as the 1986 Anti-Drug Abuse Act set up mandatory drug offense minimums of 5 years without parole for possession of 5 grams of crack compared to the same sentence for 500 grams of powder cocaine, despite no scientific or physiological justification for the discrepancy in sentencing (Hart, 2014). The legislation disproportionately impacted Blacks and fueled mass incarceration. From stop and frisk policies to mandatory minimums, Black and Hispanic communities were disproportionately targeted by the war on

drugs. As the foundation of the current opioid epidemic was being laid, the difference in how the country would eventually respond to it was also being shaped. Criminalization of opioids would be less likely both because the population impacted had more power in society and the epidemic would come from medical professionals.

During the pain revolution, a small letter to the editor, now referred to simply as "Porter and Jick" was published in the 1980 edition of the New England Journal of Medicine (NEJM). The one paragraph, non-peer reviewed letter notes that among a sample of almost 12,000 patients who had been prescribed an opioid, "only four cases of reasonably well documented addiction [were noted] in patients who had no history of addiction. The addiction was considered major in only one instance" (Porter and Jick, 1980). The sample was of patients who had been administered small amounts of opioids while they were inpatients at the hospital and almost no robust analysis had been performed (Quinones, 2015: 107). The paragraph ends with, "We conclude that despite widespread use of narcotic drugs in hospitals, the development of addiction is rare in medical patients with no history of addiction" (Porter and Jick, 1980).

The finding that less than 1% of patients had become addicted to opioids, particularly in a journal with the prestige of the NEJM, was cited by the National Institutes for Health, medical school professors, and most importantly pharmaceutical companies marketing the new drug OxyContin (Quinones, 2015: 107). The problem was that almost no one had actually read the well-known "article" and questioned its findings. With the pain revolution leading to the adoption of pain as the "fifth vital sign," insurance companies pushing for shorter visit times, and a new emphasis on pain management and patient satisfaction through Press Ganey patient surveys, physicians were pressured to prescribe more opioids (Macy, 2018: 29; Quinones, 2015: 96). At the same time, pharmaceutical representatives were pushing drugs like OxyContin and

Oxycodone heavily and citing the less than 1% risk of addiction from "Porter and Jick." Encouraged with $70,000 yearly bonuses and $20,000 cash prizes and luxury vacations for top sellers, Purdue pharmaceutical reps "wined and dined" physicians to sell oxycontin; in fact, sales representative bonuses soared from $1 million in 1996 when OxyContin was first sold to $40 million in 2001 (Macy, 2018: 33, 47). With pressure to treat patients' pain, the risk of addiction being marginal, widespread applicability of opioids from chronic pain to postoperative pain following wisdom tooth removal, and greater protections from prosecution for physicians the modern opioid epidemic was born. From 2002 to 2011, there were 25 million non-medical prescription opioid (NMPO) initiates which fueled exponential growth in both overdose and addiction rates (Mital et al., 2018). In 2010, enough hydrocodone was prescribed to give every American at the time a normal 5 mg dose every four hours for a month (Paulozzi et al., 2011).

Prescribing of all opioids and particularly high-dosage opioids has decreased since 2012 (CDC, 2019c). In 2012 the prescription rates of all opioids and high-dosage opioids were 81.3 and 8.3 per 100 people, respectively, and decreased to 58.5 and 5 per 100 people, respectively, by 2017 (CDC, 2019c). Nevertheless, overprescribing remains a problem that can lead to easy access. A 2018 study found that leftover opioids were present in 30% of households and another study found that 70% of participants received opioids from a friend (Garbutt et al., 2019; Levy, 2007). Balancing the need to make opioids accessible to patients who truly need them while also limiting their potential for abuse continues to be a challenge.

Study Purpose

Utilizing 2015-2018 National Survey on Drug Use and Health (NSDUH) data, we examined current trends in non-medical prescription opioid (NMPO) use by demographic,

substance use, and mental health characteristics. NMPO is defined as the use of opioid pain relievers that have not been prescribed or that are taken only for the experience or feeling that they cause (U.S. Department of Health and Human Services, 2019). We investigated all demographic, substance use, and mental health characteristics stratifying by race/ethnicity to determine if any differences in NMPO use existed between groups. Furthermore, we analyzed trends in overall opioid use over the four years of nationally representative data.

Building on the findings of Lippold et al. (2019) regarding race and ethnicity differences of synthetic opioid use and mortality, we sought to examine race and ethnic differences in nonmedical use of prescription opioids. We hypothesized that despite representing a smaller proportion of the general population, NMPO use among Black users is comparable to NMPO use among White users. Greater understanding of NMPO use rates and demographic factors among Black opioid users will inform targeted interventions for a population largely overlooked when discussing the opioid epidemic. Furthermore, understanding the unique characteristics and needs of Black opioid users will inform treatment needs and instruct interventions to prevent transition from prescription opioids to heroin and synthetic opioids.

II. Literature Review

Methodology

An extensive search of existing literature regarding trends in prescription opioid misuse by various demographic and mental health variables was performed in November 2019 via the PubMed database. Search terms included non-medical, nonmedical, misuse*, disorder, opioid*, opiate*, survey*, cross-section*, study, studies, longitudinal, cohort*, multicohort*, United State*, US, and U.S. The search was limited to studies published in English, set in the United

States, and published within the last 10 years. Reviews and theoretical studies were excluded. The initial search generated 3,048 studies which were then narrowed down to 82 papers after title and abstract screening via the Covidence software (Veritas Health Innovation, n.d.). Rejected studies were not set in the United States and focused exclusively on adolescent opioid use or specific populations such as veterans. Some studies were also rejected as they examined illicit drug use broadly and did not specify statistics for opioids or specifically prescription opioids. Other rejected studies included genetic studies, studies with state level data that was collected in the early 2000s, and studies focused exclusively on surgery cohorts.

Studies that examined opioid use trends among the general adult population by race/ethnicity, gender, sex, geographic, mental health, and other demographic variables were selected. Furthermore, studies with nationally representative data from 2010 or later were included. When nationally representative studies with data from 2010 or later were not present for specific relationships of interest, such as smoking and NMPO use, we chose nationally representative studies with older data. For NMPO use among special populations, in this case Black incarcerated adults in Kentucky, one study was included as no nationally representative studies could be found examining the same relationship. This examination of this special population was important for contextualizing current knowledge of NMPO use by race and ethnicity and therefore was included in addition to the study examining state-level NMPO use. A full text screening was performed to narrow the 82 studies to 18 which were included in the literature review. The 64 rejected studies did not meet the previously described inclusion criteria upon full text review.

NMPO Use Differences Based on Race and Ethnicity

According to 2015 NSDUH data, prevalence of past year NMPO use among Black adults (4.38%) was comparable to Whites (4.84%) (Nicholson & Ford, 2018). This finding differs from much of the literature where Whites had much higher prevalence of NMPO use (Kerridge et al., 2015; Parker et al., 2018; Wall et al., 2018). However, Black and White NMPO users had different relationships to a number of covariates. A gender gap in risk of NMPO use was found to exist among Blacks but not Whites, with Black men being 39% more likely to report NMPO use compared to Black women (Nicholson & Ford, 2018). In addition, Black respondents receiving any form of government assistance were significantly more likely to report NMPO use, but no significant relationship was found among Whites (Nicholson & Ford, 2018). Educational attainment was only significant among Blacks, with participants who graduated from high school and those with some college education significantly less likely to report NMPO use (Nicholson & Ford, 2018). Other covariates were found to only be significant among White NMPO users. Whites over the age of 49 were less likely to report NMPO use compared to 18-25-year olds, while Whites who attended church on a regular basis were 44% less likely to report NMPO use (Nicholson & Ford, 2018). Whites not in the workforce had lower likelihood of NMPO use compared to unemployed Whites, but not significant relationship existed for employment status and NMPO use risk among Black respondents (Nicholson & Ford, 2018). Finally, a few covariates were particularly important for both racial groups. Both Blacks and Whites reporting Major Depressive Episode (MDE) were 2.23 and 1.67 times more likely to report NMPO use, respectively (Nicholson & Ford, 2018). Illicit drug use other than prescription opioids was associated with 4.82 times and 5.50 times greater NMPO use among Blacks and Whites, respectively (Nicholson & Ford, 2018). Geographic residence and marital status were not

significant among Blacks or Whites, however other study findings tell a different story as will be examined later (Nicholson & Ford, 2018).

A major limitation of national surveillance studies like the NSDUH are that incarcerated individuals are not included. When estimating differences in NMPO use by race and ethnicity it is critical to account for incarcerated individuals, particularly since mass incarceration disproportionately affects Black and Hispanic individuals (James & Jordan, 2018). Knighton et al. (2018) used cross-sectional data from the Criminal Justice Kentucky Treatment Outcome Study, specifically five cohorts from 2010-2014 (N=4,021) who were enrolled in corrections-based SUD treatment in prison, jail, or in the community across the state of Kentucky. While this study is not nationally representative, it is the first of its kind and can shed some light on what may be missing from NSDUH based estimates of NMPO use by race and ethnicity.

Among the sample (N=4,021), 20.5% of participants reported NMPO use in the year prior to incarceration, which is much higher than both national estimates (4.4% in 2016) and estimates among all non-institutionalized Blacks (9.1% in 2015) (Han et al., 2017; Knighton et al., 2018). Over 40% of the sample was unemployed in the year prior to incarceration, with participants having an average of 13.25 years of education (Knighton et al., 2018). Mental health symptoms had an average score of 20.59 (range from 0 - 75) with higher scores signifying more frequent psychological distress (Knighton et al., 2018). In the strictest adjusted model, each year increase in age was associated with a 3% decrease in likelihood of reporting NMPO use; while, each year increase in education, was associated with a 5% increased likelihood of NMPO use (Knighton et al., 2018). This is likely related to the very low educational attainment levels among the sample, as most research shows higher educational attainment is protective against NMPO use (Marsh et al., 2018; Martins et al., 2015). Finally, every one unit increase in mental health

symptom score was associated with a 3% increased likelihood of reporting NMPO use (Knighton et al., 2018). Again, while this study is not nationally representative, it provides insight into how special populations excluded from national surveillance data like the NSDUH are missing. With much higher unemployment rates, prevalence of NMPO use, and mental health symptoms among incarcerated Black men in Kentucky, a state impacted more than most by the opioid epidemic, estimates from national studies are missing a group in particular need of specialized prevention and treatment.

Regarding treatment, Pouget et al. (2017) used nationwide data of 69,140 patients newly admitted for opioid treatment 2005-2016 to assess prevalence of past month heroin and NMPO use. The sample was 79.4% white, 8.1% black, and 9.5% Hispanic (Pouget et al., 2017). Overall trends showed initially high prevalence of heroin use among Hispanics and Blacks and lower prevalence of NMPO use compared to Whites (Pouget et al., 2017). Over time, heroin use decreased significantly among Blacks while rising significantly among Whites (Pouget et al., 2017). In 2005, past month heroin use prior to enrollment at a treatment center was 93% and 91% among Black and Hispanic respondents, respectively. By 2016, past month heroin use prior to enrollment at a treatment center had decreased to 70% among Blacks and 77% among Hispanics in 2016 (Pouget et al., 2017). In 2016, there was no statistically significant difference in past month heroin use prior to enrollment at a treatment center between White and Black respondents, while Hispanic respondents were 28% more likely to use heroin then Whites (Pouget et al., 2017).

In 2005, NMPO use was 79% among Whites, 36% among Blacks, and 30% among Hispanics, with trends differing among each group (Pouget et al., 2017). White and Black respondents saw a peak in NMPO use in 2010 at 88% and 57%, respectively. Whites saw a

consistent decrease from 88% in 2010 to 65% in 2016 (Pouget et al., 2017). Black individuals enrolling at treatment centers reported initially less NMPO use in 2014 (NMPO use had decreased to 40%) but then NMPO use increased to 49% by 2016 (Pouget et al., 2017). Hispanics saw a peak in NMPO use in 2009 at 58%, with a steady decrease since to 34% in 2016 (Pouget et al., 2017). In 2016, Blacks and Hispanics were 25% and 48%, respectively, less likely than Whites to report NMPO use, down from 54% and 62%, respectively, in 2005 (Pouget et al., 2017). Oxycodone was the most common prescription opioid misused among Black respondents, accounting for 63% of NMPO use in 2016 compared to 33.3% of NMPO use in 2005 (Pouget et al., 2017). Still, a major limitation of this study is the disproportionate access, financially and geographically, and affordability of substance use treatment particularly since White people are more likely to have health insurance compared to Black and Hispanic individuals (James & Jordan, 2018). If anything, these estimates may be low for Blacks and Hispanics due to the difference in access to and affordability of treatment.

Sex Specific Differences in NMPO Use

Males and females have historically felt the impact of NMPO use and the opioid epidemic differently, but trends in NMPO use by sex continue to evolve thus creating a need for more current information. Available literature includes data up to 2014, and while the opioid epidemic has changed in the last six years, some literature findings may remain consistent and are nonetheless valuable.

According to NSDUH data from 2007-2014, both men and women experienced a linear increase in past year heroin use and a quadratic decrease in past year NMPO use (Marsh et al., 2018). While males were more likely to report heroin and NMPO use in the past 12 months, rates of each substance use are different for each sex (Marsh et al., 2018; Wall et al., 2018). Heroin

use was increasing at a faster rate among women, almost double the rate of men (15 vs 8 per 100,000) (Marsh et al., 2018). Furthermore, NMPO use was decreasing at a slower rate among women (6 vs 7 per 100,000) (Marsh et al., 2018). Together, these trends suggest that women are significantly more at risk of the adverse health outcomes associated with heroin and NMPO use. Data from the third wave of the National Epidemiologic Survey on Alcohol and Related Conditions, collected from 2012-2013, also found higher prevalence of past 12 month and lifetime NMPO use among men at 4.4% and 13%, respectively, compared to 3.9% and 9.8% among women (Kerridge et al., 2015). However, despite differences in NMPO use, NMPO use disorder, either in the past 12 months or lifetime prevalence, did not differ significantly by gender. Both men and women had a past 12-month prevalence of the disorder at 0.9% and lifetime prevalence of about 2% (Kerridge et al., 2015).

Both prevalence of NMPO use and disorder decreased with age, regardless of sex, and were lower among racial and ethnic minorities compared to non-Hispanic Whites (Kerridge et al., 2015). NMPO use was comparable across racial minorities when stratifying by sex, with the exception of Native American men who had significantly higher past 12-month NMPO use (9.3%; SE 2.60) compared to Native American women (3.5%; SE 1.06) (Kerridge et al., 2015). Similarly, Native Americans were the only racial minority group with significant differences in NMPO use disorder prevalence by sex, with men having a prevalence of 2.8% (SE: 1.37) compared to 0.5% (SE: 0.26) among women (Kerridge et al., 2015). Among all men, past 12-month NMPO use disorder was associated with less than a high school diploma, an annual income of less than $35,000, and being aged 18-29 years (Kerridge et al., 2015). A number of other correlates for NMPO use and disorder were found regardless of sex. Across genders, NMPO use and disorder was associated with PTSD, schizotypal and antisocial personality

disorders, and other substance disorders (Kerridge et al., 2015). Males were more likely to also have associated major depressive disorder, bipolar 1 disorder, and persistent depressive symptoms with either NMPO use and disorder (Kerridge et al., 2015). Not surprisingly, disability increased with both NMPO use frequency and disorder severity (Kerridge et al., 2015).

Consistent with other study findings, Marsh et al. (2018) found risk factors for NMPO use included being white, lower income, younger age, lower educational achievement, having received mental health treatment, having no health insurance, and past year substance use of alcohol, marijuana, heroin, and cocaine. Age and alcohol use were significant risk factors unique to NMPO use, while county size and crack cocaine use were unique risk factors to heroin use (Marsh et al., 2018). Of all correlates, heroin was found to be the most significant risk factor for NMPO use, a finding likely related to other literature that shows co-use of both opioids can be common (Marsh et al., 2018).

In fact, polysubstance use may be one of the more important sex specific differences in NMPO use. According to NSDUH data from 2005-2014, among all women who had used NMPO in the past 30 days, 89% reported polysubstance use while 11% reported only NMPO use (Jarlenski et al., 2017). While the study excluded males in their sample, which limits our ability to compare polysubstance use, the very high prevalence among women is nonetheless striking. The most common other substances used in conjunction with NMPO were cigarettes, with 52.6% reporting smoking more than 5 cigarettes a day, 49.7% reporting binge drinking, and 32.4% reporting marijuana use (Jarlenski et al., 2017). When further stratified by race/ethnicity, polysubstance use that included NMPO was highest among non-Hispanic White women at 19.8% compared to non-white women at 6.3% (Jarlenski et al., 2017). Polysubstance use was also higher among women with less than a high school diploma (13.2%) compared to women

with higher education (8.2%) (Jarlenski et al., 2017). Finally, polysubstance use trends were similar among pregnant women which is of concern as cigarettes, alcohol, marijuana, and other substances can increase many health risks both to mother and fetus (Jarlenski et al., 2017). However, here again there are important limitations of the study to note. The unweighted sample size of pregnant women who had used NMPO in the past 30 days was only 101 individuals (Jarlenski et al., 2017). Therefore, the findings related to pregnant women should be viewed critically and with caution. Furthermore, aside from Hispanics it is unclear which race/ethnic groups were included in the ”Non-White and Hispanic” category.

Age Specific Patterns in NMPO Use and Disorder

Hu et al. (2017) examined patterns in NMPO use and disorder among 2002-2014 NSDUH respondents ages 12-34. Across all birth cohorts, past year prevalence of NMPO use was found to increase during adolescence by 4.8%, peak during young adulthood at 7.6%, and decline thereafter to 6.0% (Hu et al., 2017). Prevalence of substance use disorder among past year NMPO users was comparable among adolescents and young adults (13.5% vs 15.1%), but was significantly greater among adults ages 26-34 at 23.5% (Hu et al., 2017). However, as the opioid epidemic grew, prevalence of substance use disorders grew significantly among certain age groups over time. Among past year NMPO users ages 22-25, 12.5% met criteria for a substance use disorder in 2002-2005; by 2014 the percentage grew to 17.7% (Hu et al., 2017). A similar pattern occurred among 30-34-year-old past year NMPO users who experienced an increase from 10.8% in 2002-2005 to 21.3% by 2014 (Hu et al., 2017). Odds of past year NMPO use were 3.4 times higher among 18-21-year olds compared to adolescents ages 12-13 (Hu et al.,

2017). However, the decrease in odds of past year NMPO use was significant, with respondents 30-34 having almost half the odds as 18-21-year olds (Hu et al., 2017).

Significant differences in both NMPO use and disorder existed based on birth cohort. More recent birth cohorts, born in 1996 or later, had the lowest odds of NMPO use in the past year (Hu et al., 2017). NMPO use prevalence increased from the 1972-1979 to the 1984-1987 cohorts but gradually declined in future birth cohorts (Hu et al., 2017). Among respondents born in the 1984-1987 cohort, 13.4% reported past year NMPO use when they were 18-21 years of age; the same finding was only 7.8% among the 18-21-year olds born in the 1996-1999 cohort (Hu et al., 2017).

Pathways of drug involvement also differ by birth cohort. Examining 2013-2014 NSDUH, Wall et al. (2018) found that the most common sequence of drug use among all generations started with either alcohol or cigarette use, followed by marijuana use then either NMPO or cocaine use. Millennials were almost twice as likely to report using NMPO after marijuana use, while Generation X and Baby Boomers were two and three times, respectively, more likely to report cocaine use (Wall et al., 2018). Nevertheless, the largest percentage of NMPO initiates were among Baby Boomers and Generation X respondents, at 4.0% and 2.8% respectively (Wall et al., 2018). Drug initiation sequences did not differ among males and females, but more pathways were significant for white users (Wall et al., 2018). Among those having used marijuana, Whites and African Americans were more likely to use NMPO than cocaine next in their drug initiation sequence (Wall et al., 2018). Furthermore, whites that used either cocaine or NMPO were more likely to have progressed to heroin thereafter (Wall et al., 2018). Finally, it is important to note that a limitation of both of these studies is that the cross-sectional nature of the NSDUH may not accurately capture maturational changes. Examining age

differences in a cross-sectional study may confound cohort differences, period effects, and developmental changes (Wall et al., 2018).

NMPO Use and Related Mental Health Trends

According to NSDUH data from 2011-2012, about 2.5 times as many respondents who reported past year NMPO use also met the criteria of past year major depressive episode (MDE) compared to respondents who did not report NMPO use, both among adolescents (19.9% vs 7.9%) and adults (15.2% vs 6.4%) (Fink et al., 2015). Other literature has also found that individuals who reported having a MDE were almost twice as prevalent (16.2% vs 9.6%) among those also reporting NMPO use, while suicidal ideation was more than two times as prevalent (21.5% vs 9.7%) (Han et al., 2017). Comorbidity of MDE and NMPO use was slightly more prevalent in adolescents at 1.2% compared to adults at 0.7% (Fink et al., 2015). When stratifying by sex, adolescent females reported twice as much MDE alone (73.1% vs 26.9%) and NMPO use with MDE (74.3% vs 25.8%) compared to adolescent boys (Fink et al., 2015). However, adolescent males reported slightly higher NMPO use (54% vs 46%) (Fink et al., 2015). For adults, the same patterns were seen as with adolescents (Fink et al., 2015). In terms of odds, women were 3.2 times (adolescent) and 1.9 times (adult) more likely than men to report MDE alone (Fink et al., 2015). For having NMPO use and comorbid MDE, women were 3.7 times (adolescent) and 2.1 times (adult) more likely than men (Fink et al., 2015).

Of all variables, past year drug use other than NMPO and alcohol use disorder were the strongest factors associated with NMPO use, MDE, and NMPO use with comorbid MDE (Fink et al., 2015). Adults reporting past year drug use other than NMPO were 15.9 times more likely to report NMPO use with comorbid MDE, 6.6 times more likely to report NMPO use alone, and 2.5 times more likely to report MDE alone (Fink et al., 2015). Adults with alcohol use disorder

were 4.5 times more likely to report NMPO use with comorbid MDE, 3 times more likely to report NMPO use alone, and 2.7 times more likely to report MDE alone (Fink et al., 2015). Bilevicius et al. (2018) examined the relationship between past year PTSD and opioid use disorder (OUD) based on type of pain (musculoskeletal, digestive, and nerve pain) using data from the 2012-2013 National Epidemiologic Survey on Alcohol and Related Conditions. In the unadjusted model, OUD was significantly associated with chronic pain, PTSD, or having both conditions across musculoskeletal, digestive, and nerve pain (Bilevicius et al., 2018). In the adjusted model, musculoskeletal and nerve pain conditions continued to be significantly associated with OUD, both when a person had only one of the pain conditions and when they had comorbid PTSD (Bilevicius et al., 2018). In fact, having musculoskeletal pain and comorbid PTSD was associated with 4.2 times increased odds of OUD, while nerve pain and comorbid PTSD was associated with 3.1 times increased odds of OUD (Bilevicius et al., 2018). Digestive pain alone or with comorbid PTSD did not show significant relationships with OUD (Bilevicius et al., 2018).

Educational Achievement and NMPO Use

Higher education is an important factor for maturation and has previously been shown to decrease substance use and provide more opportunities for treatment (Martins et al., 2015). Educational achievement is an important risk factor for NMPO use as it is also related to annual income, employment status, residential status, and many other factors. Understanding the role of educational achievement, particularly when stratified by race/ethnicity and sex, is crucial for understanding the populations most in need of intervention.

According to 2015 NSDUH data looking at adolescents and young adults' educational achievement is another important risk factor for NMPO use. Among adolescents, those not in

school had the highest opioid use and prescription drug misuse rates with 33.8% reporting past year NMPO use (Schepis et al., 2018). While not examined in this study, adolescents not attending school may have less supervision and more access to opioids than students enrolled in school leading to higher NMPO use. Students exhibiting poor school adjustment showed comparable elevated rates to participants not in school for prescription drug misuse, whether opioids or stimulants, nonmedical misuse, and substance use disorder symptoms (Schepis et al., 2018). These findings highlight the impact prescription opioid misuse can have, especially at an early age. In addition, it is important to recognize that failure to complete high school and prescription opioid misuse exist in a bilateral relationship; either one can predicate the other which stresses the importance of early screening and intervention for NMPO use (Schepis et al., 2018).

Among young adults using opioids, participants not in school again showed the highest rates of any opioid use, prescription drug misuse, prescription drug misuse type, and substance use disorder symptoms compared to full-time college attendees and college graduates (Schepis et al., 2018). Interestingly, full-time college students and college graduates were found to have higher prescription drug misuse related to stimulants but not opioids (Schepis et al., 2018). This finding is likely due to the perceived benefits to studying and academic performance associated with stimulant use, but many questions remain about what factors might encourage opioid use among less educated individuals. Other literature examining 2008-2010 NSDUH data also found that young adults not attending college with at least a high school degree and those with less than a high school degree were found to have a higher prevalence of past year NMPO use (Martins et al., 2015). Again, college attending young adults were found to have lower NMPO use and higher prescription stimulant use compared to young adults not in school (Martins et al., 2015).

Among NMPO users, there was a significant difference in use patterns and educational attainment when stratified by gender and race/ethnicity. Women with a high school degree but not enrolled in college had a significantly higher risk of having an opioid substance use disorder compared to the men of their educational category (Martins et al., 2015). Women were also just as likely to have opioid dependence as men, even though women were less likely to report past year NMPO use (Martins et al., 2015). Regarding race and ethnicity, Hispanic, non-Hispanic Black, non-Hispanic multiracial, and Asian populations showed no statistically significant difference in risk for NMPO dependence across educational attainment categories (Martins et al., 2015). This contrasts with non-Hispanic White populations, where both those who had less than a high school degree and those with no more than a high school degree showed higher NMPO and opioid dependence rates compared to Whites with higher educational attainment (Martins et al., 2015). Therefore, among non-Hispanic White NMPO users, educational attainment may be a more important factor associated with opioid use than for other racial and ethnic groups. Still, it is important to note that these findings may be influenced by the greater prevalence of NMPO use among non-Hispanic Whites in general, but especially in rural areas where educational attainment is lower compared to suburban and metropolitan areas (Martins et al., 2015).

It is important to note that in both studies, no distinction was made between attending a two- or four-year college, and there may be some differences that exist between these groups. Furthermore, reasons why men and women are not in college can vary and may be associated with why someone develops NMPO use or disorder. Still, both studies stress the need for targeted prevention outside of schools to address young adults with low educational attainment who are at a greater risk of NMPO use.

Employment Status and NMPO Use

Perlmutter et al (2017) examined NSDUH data from 2011-2013 for trends in NMPO use and employment status among adults 26 years or older. The prevalence of NMPO use was 3.48% in the sample, but was highest among unemployed respondents with 6.91%, almost double that of those employed full time at 3.84% (Perlmutter et al., 2017). Unemployed respondents were 1.45 times more likely to report NMPO use in the past year compared to respondents employed full-time (Perlmutter et al., 2017). Respondents categorized as not in the workforce were 18% less likely to have reported NMPO use in the past year (Perlmutter et al., 2017). This is likely in part attributable to the homemakers and retirees that are included in this employment category as they occupy certain roles in family and social networks, such as parenting and marriage, that may attenuate the risk NMPO use (Perlmutter et al., 2017).

In the adjusted regression model, respondents who reported either NMPO use or non-medical prescription stimulant use in the past year were 10 times more likely to also report the other drug use (Perlmutter et al., 2017). This finding is consistent with other literature on polysubstance use that includes opioids (Jarlenski et al., 2017; Rigg & Nicholson, 2019). As seen in other literature (Marsh et al., 2018; Kerridge et al., 2015), males were 1.35 times more likely to report NMPO use than females (Perlmutter et al., 2017). Regarding age, an overall inverse association was found where increasing age was associated with reduced risk of NMPO use (Perlmutter et al., 2017). Respondents over the age of 49 were three to six times less likely to report NMPO use in the past year compared to respondents 26-34 years of age (Perlmutter et al., 2017). Non-Whites were 20% less likely to report NMPO use in the past year compared to non-Hispanic whites, but this finding should be interpreted in light of operationalization limitations (Perlmutter et al., 2017).

A number of potential issues exist regarding the operationalization of some covariates need further explanation. First, race/ethnicity was dichotomized into non-Hispanic White and combined non-white races which negates differences across race/ethnicity. Second, education was not included due to small sample size and while it is correlated with employment status it is not a full replacement. Finally, Perlmutter et al (2017) chose to dichotomize marital status into married and non-married due to "similar use patterns among non-married subgroups" which ultimately prevents a fuller understanding of differences in NMPO use by marital status.

Geographic Differences in NMPO Use Trends

When examining 2011-2012 NSDUH data, Rigg and Monnat (2015) found that rural respondents were 33% less likely to report past year NMPO use compared to urban respondents. Greater NMPO use was also associated with being White, younger, single, having children living in the household, lower income, receiving government assistance, lower education, high psychological distress, and use of illicit drugs, alcohol, and tobacco before the age of 18 (Rigg and Monnat, 2015). Rural respondents were more likely to be white, married, older, have both lower income and education, receive government assistance, have attended more than 24 church services, rate their health as poor or fair, and started smoking before the age of 18 (Rigg and Monnat, 2015). Rural respondents were also found to have lower prevalence of NMPO use than expected based on their educational attainment alone, likely due to the influence of other factors including a greater likelihood of being older, married, and religious (Rigg and Monnat, 2015). If rural respondents had the same levels of education as urban respondents, rural respondents would have odds of past year NMPO use 25% less than their urban peers (Rigg and Monnat, 2015).

Rigg and Nicholson (2019) examined NMPO use among Black adults based on geographic residence using 2012-2016 NSDUH data. No significant differences in past year NMPO use prevalence were found to exist between urban (4.19%) and rural (3.43%) Black Americans (Rigg & Nicholson, 2019), a surprising finding as previous research has generally shown significant differences in NMPO use based on geographic residence (Rigg and Monnat, 2015). Among rural Black participants, a number of covariates were associated with increased odds of past year NMPO use. Black rural respondents with an annual income of less than $20,000 were 2.9 times more likely to report NMPO use (Rigg & Nicholson, 2019). Among rural Black respondents, having health insurance was associated with 2.47 times increased odds of NMPO use, while odds were also higher for government assistance receipt (2.54), past year tobacco use (1.98), marijuana use (2.02), and other prescription drug use or misuse (7.36) (Rigg & Nicholson, 2019).

Among rural Black participants, a few correlates were associated with decreased odds of past year NMPO use including, being 35-49 (0.46) or over 50 years of age (0.36) and higher levels of religiosity (0.66) (Rigg & Nicholson, 2019). Black respondents living in rural areas were also more likely to have less than a high school diploma, be older, be married, not be in the labor force, and have worse self-reported health (Riggs & Nicholson, 2019). Urban Black participants were more likely to report easier access to illicit drugs and past year misuse of other prescription drugs, both risk factors that elsewhere have been shown to significantly increase risk of NMPO use (Rigg and Monnat, 2015; Riggs & Nicholson, 2019). Among urban Black residents, higher education, more religiosity, and being between 35-49 years of age were also all protective factors (Rigg & Nicholson, 2019). Over all there was surprisingly little difference in

both prevalence and risk factors of NMPO use among Blacks in urban and rural areas, which is important for filling in current gaps in the literature regarding NMPO use and race.

NMPO Use and Smoking

Parker et al. (2018) focused on daily smokers in the 2006-2014 NSDUH as they are both at greater risk of negative health outcomes from smoking and struggle to achieve cessation compared to less frequent smokers. Utilizing two nicotine dependence scales, the Nicotine Dependence Syndrome Scale (NDSS) and the Fagerstroöm Test of Nicotine Dependence (FTND), a higher prevalence of nicotine dependence was found among opioid dependent smokers (Parker et al., 2018). 80.6% and 78.9% of opioid dependent daily smokers met the NDSS and FTND criteria, respectively, compared to 56.6% and 64.1% of daily smokers not dependent on opioids (Parker et al., 2018). In the adjusted logistic regression, opioid dependent daily smokers had two times greater odds of nicotine dependence compared to non-opioid dependent daily smokers (Parker et al., 2018). In fact, the strongest associations were found between opioid dependence and nicotine dependence, greater than associations for other substance dependence, depression, anxiety, and race/ethnicity (Parker et al., 2018). In addition, smokers without a substance use disorder were four times more likely to attain cessation outcomes compared to smokers with a substance use disorder (Parker et al., 2018). Smoking is thus a crucial risk factor for opioid misuse.

Recent data on smoking, nicotine dependence, and NMPO use have not been published, creating a gap in current understanding. Zale et al. (2015) examined 2009 NSDUH data and found daily and intermittent (4-27 days in the past month) smokers were more than three times more likely to have NMPO use in the past year compared to respondents who had never smoked. Daily smokers were 4.82 times and intermittent smokers 2.96 times more likely to meet the

criteria for opioid abuse/dependence for the past year (Zale et al., 2015). Even after stratifying by gender, male and female daily smokers were more likely to meet past year opioid abuse/dependence criteria compared to non-smokers (Zale et al., 2015). Interestingly, this pattern held for female former daily smokers (prior daily smoking but no smoking in the past year) but not for male former daily smokers (Zale et al., 2015).

Age of smoking onset was also a significant predictor of past year NMPO use. Among daily smokers, those who reported smoking onset before the age of 14 were 2.32 times to have engaged in NMPO use in the past year compared to daily smokers who began smoking after the age of 18 (Zale et al., 2015). However, no association was found between age at smoking onset and past year opioid abuse/dependence, neither for the total sample or when stratifying by gender (Zale et al., 2015). In addition, the number of cigarettes smoked per day was an important factor. Female respondents who smoked more than 16 cigarettes per day were almost twice as likely to report past year NMPO use and to have met opioid abuse/dependence criteria, but no statistically significant relationship was seen in males or the total sample (Zale et al., 2015). Consistent with findings from Parker et al. (2018), daily smokers who scored high on the Fagerstroöm Test of Nicotine Dependence (FTND) were 2.51 more likely to have met past year opioid abuse/dependence criteria compared to non-smokers; this pattern held among the total sample and when stratifying by gender (Zale et al., 2015).

Conclusion

Overall, the currently available literature regarding NMPO use and related demographic and substance use variables is slightly outdated. The majority of literature examined above is based on data from 2010-2015 with few national studies examining more current data.

Additionally, the current understanding of how trends in NMPO use and related variables defers by race and ethnicity is even more limited. A number of studies did not stratify their analysis by race and ethnicity while some that did, operationalized race/ethnicity as White vs Non-White which limits the utility of their findings. Nevertheless, some literature does suggest that NMPO use may be comparable between Whites and Blacks (Nicholson and Ford, 2018) and that no significant differences exist based on geographic residence among Black adults (Rigg and Nicholson, 2019). Prevalence of NMPO use and disorder appear to decrease with age, regardless of sex, and both were lower among racial and ethnic minorities compared to non-Hispanic Whites (Kerridge et al., 2015). Both past year and lifetime NMPO use are higher among men at 4.4% and 13%, respectively, compared to 3.9% and 9.8% among women (Kerridge et al., 2015). Finally, NMPO use among recently incarcerated Black men in Kentucky was found to be significantly higher than both national prevalence and prevalence among Blacks in the general population (Han et al., 2017; Knighton et al., 2018). More literature is needed to further examine trends in NMPO use by race/ethnicity, particularly among national samples and using the most current data available.

III. Methods

Data Source and Study Design

We examined data from the 2015-2018 National Survey on Drug Use and Health (NSDUH), an annual and nationally representative survey administered by the Substance Abuse and Mental Health Services Administration (SAMHSA). With approximately 70,000 interviews every year, the NSDUH obtains information on tobacco, alcohol, and drug use as well as the mental health of people over the age of 12 (National Survey on Drug Use and Health, n.d.). The

NSDUH employs a cross-sectional, complex survey study design that randomly selects different households once annually.

Recruitment and sample

Participants are recruited from the civilian population and cannot be actively serving in the armed forces, institutionalized, or incarcerated at the time of survey administration (Substance Abuse and Mental Health Services Administration, 2019). Interviews are conducted in participants' homes and the NSDUH is administered via a computer with an interviewer. Each person who resides in a home in enrolled as a participant and answers most survey questions individually and in private, however some questions are read and answers are input by the interviewer (Substance Abuse and Mental Health Services Administration, n.d.). NSDUH uses a complex, multi-stage, stratified probability sampling design of census tracts, census block groups, and area segments across all 50 states and the District of Columbia (Substance Abuse and Mental Health Services Administration, 2019). While respondents ages 12-25 are oversampled in each NSDUH year compared to other age groups, it does not appear that oversampling occurred on the basis of race or ethnicity (Substance Abuse and Mental Health Services Administration, 2019).

A detailed summary of the sampling methodology as well as definitions of sampling measures for the 2015-2018 NSDUH surveys can be found on the SAMHSA website and within the corresponding codebook (Substance Abuse and Mental Health Services Administration, 2019; Center for Behavioral Health Statistics and Quality, 2019; Center for Behavioral Health Statistics and Quality, 2018a; Center for Behavioral Health Statistics and Quality, 2018b; Center for Behavioral Health Statistics and Quality, 2018c). Response rates for the 2015, 2016, 2017,

and 2018 NSDUHs varied from 66.56% to 69.66% (Substance Abuse and Mental Health Services Administration, 2019). Data for this analysis was accessed via the Substance Abuse and Mental Health Data Archive on the SAMHSA website. Since 2002 the NSDUH has provided a $30 incentive for participants to help increase response rates and thank respondents for their time (Center for Behavioral Health Statistics and Quality, 2019). The NSDUH is publicly available data therefore this project did not require Emory University IRB approval.

Data collection and survey instrument

For this study, the sample was restricted to respondents over the age of 17, data from 2015-2018, and to respondents who answered questions about their most recent prescription pain reliever misuse. Prescription pain reliever misuse (or NMPO use) was assessed using the questions: "Have you ever, even once, used any prescription pain reliever in any way a doctor did not direct you to use it?", "In the past 30 days, that is, from [Date Fill] up to and including today, did you use [Name of Pain Reliever] in any way a doctor did not direct you to use [Pain Reliever Number Fill]?" and all of the past 12 month misuse of specific pain reliever variables corresponding to pain relievers such as OxyContin (Center for Behavioral Health Statistics and Quality, 2019). Questions about recent prescription pain reliever misuse were consistent across all of the datasets. The NSDUH survey originally categorized respondents into those who misused a prescription pain reliever within the last 30 days, more than 30 days but within the past 12 months, and more than 12 months ago. Other responses are for missing values or for those logically assigned to one of the three aforementioned categories. For our purposes, prescription pain reliever misuse was re-coded into a dichotomous variable with categories of

“yes” or “no” to having misused any pain reliever in the past 12 months. The overall sample size from the 2015-2018 data was 154,350 respondents.

The sample was restricted to data from 2015-2018 both to address a gap in the literature utilizing current data but also because in 2015 the NSDUH survey underwent a partial redesign, making some questions incompatible with previous years. Questions pertaining to prescription opioids were redefined and asked differently, with a greater emphasis on measuring misuse within the past 12 months as opposed to lifetime misuse (Center for Behavioral Health Statistics and Quality, 2015). This change not only provides more useful data for policymakers and researchers, it also limits recall bias (Center for Behavioral Health Statistics and Quality, 2015). Misuse of prescription drugs, including prescription opioids, was defined in the pre-2015 NSDUH surveys as using a drug “that was not prescribed for you or that you took only for the experience or feeling it caused" (Center for Behavioral Health Statistics and Quality, 2015). The 2015 NSDUH definition of misuse of prescription drugs is use “in any way a doctor did not direct you to use it/them” (Center for Behavioral Health Statistics and Quality, 2015). Examples of NMPO use include use without a prescription and use in greater amounts, more frequently, or for a longer duration than directed (Center for Behavioral Health Statistics and Quality, 2015). A more detailed explanation of other changes in the 2015 NSDUH redesign can be found on the SAMHSA website (Center for Behavioral Health Statistics and Quality, 2015).

Description of variables

A number of demographic, mental health, and substance use variables related to pain reliever misuse were analyzed. Race and ethnicity was based on responses to the questions, “Are you of Hispanic, Latino, or Spanish origin or descent?” and “Which of these groups describes

you?" with respondents selecting one or more provided race groups (Center for Behavioral Health Statistics and Quality, 2017). Race and Ethnicity was categorized into three groups, "White," "Black," and "Hispanic" with sample size being too small to include other races and ethnicities. An "all other races or ethnicities" category was not included as such operationalization prohibits meaningful interpretation of results. Age was coded to exclude 12-17-year-old respondents and consisted of categories of 18-25, 26-34, 35-49, 50-64, and 65 or older. Residential geography was coded as a dichotomous variable with the categories of "Rural" and "Urban." Education was coded to exclude 12-17-year-old respondents, with final categories including "Less than a high-school diploma," "High School graduate," "Some college or an associate's degree," and "College graduate or bachelor's degree." Employment categories included "Employed full time," "Employed part time," "Unemployed," and "Other (including not in the labor force)." Marital status was comprised of the categories "Married," "Widowed," "Divorced/Separated," and "Never been married." Health insurance was a dichotomous variable of whether or not a respondent had any health insurance.

All substance use and mental health variables were coded to be dichotomous variables of "yes" or "no" and were a measure of that behavior or condition in regard to the past 12 months. The two mental health variables measured the presence of Major Depressive Episode and Psychological distress in the past year. Tobacco use was assessed from the questions: "Now think about the past 30 days, that is, from [Date Fill] up to and including today. During the past 30 days, have you smoked part or all of a cigarette?" and "How long has it been since you last smoked part or all of a cigarette?" (Center for Behavioral Health Statistics and Quality, 2019). Alcohol abuse and drug abuse not including marijuana or opioids were defined based on the DSM-IV definition of abuse and if participants stated their substance use created major

problems in their home, work, or school life, their use was frequent and encouraged dangerous behavior, their use lead to trouble with law enforcement, and their use created problems with the social relationships or they continued use despite damage to their social relationships (American Psychiatric Association, 2000; Center for Behavioral Health Statistics and Quality, 2019).

The illicit drug variables, measuring illicit drug use other than marijuana or opioids and illicit drug abuse other than marijuana or opioids, were created by combining multiple variables. For both variables, our analysis examined any use of cocaine, tranquilizers, stimulants, sedatives, methamphetamine, hallucinogens, and inhalants. Since all of these variables already were coded as "0" or "1", a new variable measuring any illicit drug use in the past 12 months was simply the sum of them all; if a person reported use of any of these illicit substances they would have a score of 1 or greater which was coded as affirmative of past year illicit drug use.

Statistical Analysis

To begin the analysis, the 2002 to 2017 combined dataset and the 2018 dataset were downloaded from the SAMHSA website. The downloaded transport files were assigned a filename and the formats were removed to make coding more convenient (See **Appendix A**). The statistical analysis was completed in SAS 9.4. Each dataset was restricted to the years of interest, with a character year variable being made in the 2018 dataset, and then the datasets were combined. Because the 2002-2017 and 2018 datasets were limited to different lengths in their variables (lengths of 4 and 8) the combined dataset had some variables that were truncated. Each variable used in the analysis was evaluated and no issues were found related to truncation. The combined dataset was then restricted to respondents over the age of 17 and those responding to the pain reliever misuse measure. A common weight variable had to be created that could be

used across both datasets and this variable was a one-year weight. The full SAS code used for the analysis can be found in **Appendix B**.

Prevalence data including frequencies and weighted percentages with their respective confidence intervals were calculated for the overall sample and by race (see Table 1). The bivariate analysis was done in a similar way of generating cross tables for NMPO use by each variable and then race-specific estimates (see Table 2). Again, unweighted frequencies and weighted percentages with confidence intervals were calculated. In addition, a logistic regression was performed to generate the associated p-values of NMPO use with each variable across the three race and ethnicity groups. Finally, three models were run to assess the association between NMPO use and race: an unadjusted model, an adjusted model controlling for geographic residence, education, employment, and health insurance, and another adjusted model with the addition of age and sex to the variables included in the first adjusted model.

IV. Journal Manuscript

Abstract

Prescription opioids (POs) continue to account for almost a quarter of all drug overdose (OD) deaths. For over a decade, White rural Americans have disproportionately experienced opioid OD. However, Black and Latino Americans in urban and suburban areas have recently experienced alarming increases in opioid OD compared to White populations. Recent data are needed to understand shifts in PO use among Black and Latino populations. Using 2015-2018 National Survey on Drug Use and Health data, we examined the current socio-demographic, mental health and substance use correlates of non-medical prescription opioid (NMPO) use by race and ethnicity. Data cleaning and analysis was performed in SAS version 9.4. Preliminary

results of this nationally representative sample (n=154,350) suggest that NMPO remains significantly higher among White (4.46%) compared to Black (3.75%) and Latino (4.13%) populations. Significant correlates of NMPO between racial and within racial groups included lower education, unemployment, never being married, lacking health insurance, depression, psychological distress, and the use of other licit and illicit substances including alcohol. Urbanicity was only significantly higher among White urban (4.54%; p=0.02) compared to White rural residents (4.04%), suggesting an important shift in our prior epidemiology. These preliminary results suggest that the opioid crisis may be evolving and has grown to impact Blacks and Hispanics to a greater degree than previously understood. Understanding current differences in NMPO use across racial and ethnic groups is critical to thwarting further spread of this epidemic.

1. Introduction

Drug overdose is the leading cause of death among US adults under the age of 50, with 70,237 drug overdose deaths in 2017, and of those drug overdose deaths 67.8%—or 47,600 deaths—involved opioids (CDC, 2019a). From 2016 to 2017, the age-adjusted overdose death rate for all drug use increased 9.6%, largely attributable to the steady and ongoing growth of the opioid epidemic since the 1990s (CDC, 2019a). In fact, of the 702,568 drug overdose deaths from 1999 to 2017, opioids were involved in 56.8% (Scholl et al., 2019). Among the many types of opioids, prescription opioids have historically been responsible for the bulk of opioid-involved overdose deaths and caused the highest number of overdose deaths in any year from 1999-2015 (The Henry J. Kaiser Family Foundation, 2020). From 1999 to 2017, approximately 215,000 people died of a prescription opioid drug overdose, which is 30.6% of all drug overdose deaths during that period (CDC, 2019b). Despite rapid growth in fentanyl-related overdose deaths in the

last five years, prescription opioids were still involved in 23.7% of all drug overdose deaths and accounted for an average 46 deaths every day in 2017 (CDC, 2019b). An estimated 1.7 million Americans had a substance use disorder related to prescription opioids in 2017, with 21-29% of people who were prescribed opioids for chronic pain misusing them (National Institute on Drug Abuse, 2019; Vowles et al., 2019). Prescription opioid use not only leads to misuse and addiction, they also account for 70% of fatal prescription drug overdoses (Jones et al., 2013).

Since its start in the 1990s, the opioid epidemic has disproportionately affected different racial and ethnic groups. Rates for opioid-involved deaths among non-Hispanic Whites and American Indian/Alaskan Natives were three times higher than among non-Hispanic Blacks and Hispanics in 2008 (Paulozzi et al., 2011). As of 2017, disparities in prescription opioid overdose death rates have narrowed. Non-Hispanic Whites still have the highest rate of all opioid-involved overdose deaths at 19.4 in 2017 compared to 12.9 in Blacks, but rates of overdose deaths attributable to prescription opioids were now closer with 6.9 in Whites and 3.5 in Blacks (Scholl et al., 2019). Compared to rates in non-Hispanic Whites, rates of all opioid-involved deaths have remained relatively constant for Hispanics at 6.8 in 2017, while rates in American Indian/Alaskan Natives are still high at 15.7 (Scholl et al., 2019). Prescription opioid overdose death rates are still low for Hispanics at 2.2, while American Indian/Alaskan Natives had the highest rate of any race and ethnic group at 7.2 in 2017 (Scholl et al., 2019).

From 2016 to 2017, the greatest relative change in overall opioid-involved overdose deaths occurred among Blacks (25.2%), which was more than double the relative change among Hispanics (11.5%) and non-Hispanic Whites (10.9%) (Scholl et al., 2019). While there was no statistically significant relative change in prescription opioid-involved overdose deaths among Blacks, there were significant relative changes among Blacks specifically involving heroin

(8.9%) and synthetic opioids such as fentanyl (60.7%) (Scholl et al., 2019). In 2017, 59.8% (28,466) of all opioid involved overdose deaths involved synthetic opioids, with fentanyl in particular being increasingly mixed with heroin, cocaine, methamphetamine, and counterfeit prescription pills over the last five years (Lippold et al., 2019). In large central metropolitan areas, among people ages 45 to 54, synthetic opioids were involved in 70% of all opioid overdose deaths among Blacks, compared to 56% among Hispanics and 54.2% among Whites (Lippold et al., 2019).

Synthetic opioids, including fentanyl, have led to increases in overdose death rates among Blacks and Hispanics, with risks higher among specific age and geographic categories. From 2015-2017 in large central metropolitan areas, the largest absolute and percentage increases in rates of overall opioid-involved overdose deaths occurred among blacks with rates increasing from 11.8 to 24.0, a rate change increase of 103% (Lippold et al., 2019). Also in large central metropolitan areas, blacks also had the largest absolute and percentage increases in rates of opioid-involved overdose deaths involving synthetic opioids with rates increasing from 3.6 in 2015 to 16.6 in 2017, a rate change increase of 361% (Lippold et al., 2019). Comparatively, whites experienced a smaller rate change in both overall opioid-involved overdose deaths (18.2 in 2015 to 24.6 in 2017, a 35% increase) and opioid-involved overdose deaths involving synthetic opioid (4.7 in 2015 to 13.7 in 2017, a 192% increase). Therefore, rates in 2017 of overall opioid-involved overdose deaths were almost the same among white and black residents of large central metropolitan areas (24.6 vs 24.0, respectively), while blacks had significantly higher synthetic opioid involved overdose deaths (16.6 vs 13.7).

This sharp increase in both categories of opioid-involved overdose deaths among blacks residing in large central metropolitan areas is largely driven by increases among those aged 45-

54 and 55-64 (Lippold et al., 2019). In fact, blacks in both age groups had larger absolute and percentage increases in their rates compared to every other race and age category across all geographic categories, except for Whites ages 25-34 living in large fringe metro areas who had about the same rates (Lippold et al., 2019). Overall opioid-involved overdose deaths among Blacks aged 45-54 increased from 19.3 in 2015 to 41.9 in 2017, a 117% increase in rate (Lippold et al., 2019). Overdose deaths involving synthetic opioids among Blacks aged 45-54 increased from 5.7 in 2015 to 29.4 in 2017, a 416% increase in rate (Lippold et al., 2019).

In large fringe metropolitan areas, similar patterns exist with Black residents experiencing the largest rate change in both overall opioid-involved overdose deaths (7.2 in 2015 to 14.4 in 2017, a 100% rate increase) and opioid-involved overdose deaths involving synthetic opioids (2.5 in 2015 to 10.8 in 2017, a 332% rate increase) (Lippold et al., 2019). Hispanics in this geographical category also experienced large increases in overall opioid-involved overdose deaths (5.7 in 2015 to 10.0 in 2015, a 75% increase) and opioid-involved overdose deaths involving synthetic opioids (1.7 in 2015 to 6.7 in 2017, a 294% increase) (Lippold et al., 2019). From 2015 to 2017, the rate of synthetic opioid overdose deaths jumped from 1.5 to 8.0, a 433% increase, among Hispanics ages 45 to 54, which was the greatest percentage increase of any age or race category among large fringe metropolitan residents (Lippold et al., 2019). Whites again saw smaller increases in opioid overdose death rates from 2015-2017. Rates of opioid-involved overdose deaths increased from 2015-2017 among Whites (17.8 to 26.7, a 50% increase) and rates of opioid-involved overdose deaths involving synthetic opioids increased from 6.1 to 17.5, a 187% increase (Lippold et al., 2019). Finally, in medium and small metropolitan areas patterns in overdose death rates varied much more by race and ethnicity. Blacks still experienced the highest opioid-involved overdose death rate increase (7.3 vs 13.3, an 82% increase) compared to

Whites (16.4 vs 21.9, a 34% increase) and Hispanics (7.3 vs 9.9, a 36% increase) (Lippold et al., 2019). For opioid-involved overdose deaths involving synthetic opioids, Hispanics experienced the largest rate change percentage of 262% with a rate increase of 1.3 to 4.7, followed by Blacks (2.6 to 8.9, a 242% increase), but both groups still showed much lower rates compared to Whites (4.8 to 12.6, a 163% increase) (Lippold et al., 2019).

While most available literature has found Whites had much higher prevalence of NMPO use compared to other race and ethnic groups (Kerridge et al., 2015; Parker et al., 2018; Wall et al., 2018) more recent studies have suggested this may no longer be the case. According to 2015 NSDUH data, prevalence of past year NMPO use among Black adults (4.38%) was comparable to Whites (4.84%) (Nicholson & Ford, 2018). Rigg and Nicholson (2019) examined NMPO use among Black adults based on geographic residence using 2012-2016 NSDUH data. No significant differences in past year NMPO use prevalence were found to exist between urban (4.19%) and rural (3.43%) Blacks (Rigg & Nicholson, 2019), a surprising finding as previous research has generally shown significant differences in NMPO use based on geographic residence across all race and ethnic groups (Rigg and Monnat, 2015). Among rural Black participants, a number of covariates were associated with increased odds of past year NMPO use including an annual income of less than $20,000, having health insurance, receiving government assistance, past year tobacco use, marijuana use, and other prescription drug use or misuse (Rigg & Nicholson, 2019). Other studies have found that special populations, such as those incarcerated, have significantly higher NMPO use. Knighton et al. (2018) found that Black men who were incarcerated in Kentucky had a past year NMPO prevalence of 20.5% much higher than both national estimates (4.4% in 2016) and estimates among all non-institutionalized Black populations (9.1% in 2015) (Han et al., 2017). This is important as many national surveys do not

account for special populations, such as those incarcerated, institutionalized, or homeless. As mass incarceration disproportionately impacts Black and Hispanic populations and findings like Knighton et al. (2018) suggests higher NMPO use among these populations compared to the general population, more research is needed to investigate NMPO use by race and ethnicity.

We examined current trends in non-medical prescription opioid (NMPO) use by demographic, substance use, and mental health characteristics. NMPO is defined as the use of opioid pain relievers that have not been prescribed or that are taken only for the experience or feeling that they cause (U.S. Department of Health and Human Services, 2019). We investigated all demographic, substance use, and mental health characteristics stratifying by race and ethnicity to determine if any differences in NMPO use existed between groups. Building on the findings of Lippold et al. (2019) regarding race and ethnicity differences of synthetic opioid use and mortality, we sought to examine race and ethnic differences in nonmedical use of prescription opioids. We hypothesized that despite representing a smaller proportion of the general population, NMPO use among Black users is comparable to NMPO use among White users. Greater understanding of NMPO use rates and demographic factors among Black opioid users will inform targeted interventions for a population largely overlooked when discussing the opioid epidemic. Furthermore, understanding the unique characteristics and needs of Black opioid users will inform treatment needs and instruct interventions to prevent NMPO use.

2. Methods

2.1. Data

The current study examined the 2015-2018 National Survey on Drug Use and Health (NSDUH), an annual and nationally representative survey with approximately 70,000 interviews every year. The NSDUH obtains information on tobacco, alcohol, and drug use along with

mental health of people over the age of 12 (National Survey on Drug Use and Health, n.d.). The sample is recruited from the civilian population and excludes those institutionalized, incarcerated, or actively serving in the armed forces at the time of survey administration (Substance Abuse and Mental Health Services Administration, 2019). Interviews are conducted in participants' homes with survey administration being done primarily via computer, but some questions are read and answers are input by an interviewer (Substance Abuse and Mental Health Services Administration, n.d.). NSDUH uses a complex, multi-stage, stratified probability sampling design of census tracts, census block groups, and area segments across all 50 states and the District of Columbia (Substance Abuse and Mental Health Services Administration, 2019). While respondents ages 12-25 are oversampled in each NSDUH year compared to other age groups, oversampling did not occur on the basis of race or ethnicity (Substance Abuse and Mental Health Services Administration, 2019).

A thorough summary of sampling methodology and sampling measure definitions for the 2015-2018 NSDUH surveys can be found elsewhere (Substance Abuse and Mental Health Services Administration, 2019; Center for Behavioral Health Statistics and Quality, 2019; Center for Behavioral Health Statistics and Quality, 2018a; Center for Behavioral Health Statistics and Quality, 2018b; Center for Behavioral Health Statistics and Quality, 2018c). Response rates for the 2015, 2016, 2017, and 2018 NSDUHs varied from 66.56% to 69.66% (Substance Abuse and Mental Health Services Administration, 2019). Data for this analysis was accessed via the Substance Abuse and Mental Health Data Archive on the SAMHSA website.

2.2. Measures

For this study, the sample was restricted to respondents over the age of 17, data from 2015-2018, and to respondents who answered questions about their most recent prescription pain reliever misuse. Prescription pain reliever misuse (or NMPO use) was assessed using the questions: “Have you ever, even once, used any prescription pain reliever in any way a doctor did not direct you to use it?”, “In the past 30 days, that is, from [Date Fill] up to and including today, did you use [Name of Pain Reliever] in any way a doctor did not direct you to use [Pain Reliever Number Fill]?” and all of the past 12 month misuse of specific pain reliever variables corresponding to pain relievers such as OxyContin (Center for Behavioral Health Statistics and Quality, 2019). For our purposes, prescription pain reliever misuse was re-coded into a dichotomous variable with categories of “yes” or “no” to having misused any pain reliever in the past 12 months. 678 individuals refused to answer the above questions regarding NMPO use, leaving an overall sample size of 154,350 respondents from the 2015-2018 data.

In 2015 the NSDUH survey underwent a partial redesign with questions pertaining to prescription opioids redefined with a greater emphasis on measuring misuse within the past 12 months as opposed to lifetime misuse (Center for Behavioral Health Statistics and Quality, 2015). The 2015 NSDUH definition of misuse of prescription drugs is use “in any way a doctor did not direct you to use them” with respondents provided with specific examples including a) using another person’s prescription b) greater amount, frequency, or duration of use than told, and c) use in any other way not recommended by a medical provider (Center for Behavioral Health Statistics and Quality, 2015).

A number of demographic covariates were included in the analysis. Demographic variables included race and ethnicity (White, Black, Hispanic), sex (male, female), age (18-25,

26-34, 35-49, 50-64, 65+), geographic residence (urban, non-urban), education (less than high school, high school graduate, some college/associates, college graduate), employment status (full time, part time, unemployed, other including not in the work force), and health insurance coverage (covered, not covered). Additional demographic, substance use, and mental health covariates are provided in supplementary tables 1 and 2 but were not included in the analytic models.

2.3. Statistical Analyses

To examine prevalence of NMPO use by race and ethnicity we calculated frequencies and weighted percentages with their respective confidence intervals for the overall sample and by race (see Table 1). The bivariate analysis was done in a similar way of generating cross tables for NMPO use by each variable and then race-specific estimates (see Table 2). Additionally, logistic regressions were performed to generate p-values of NMPO use with each variable across race and ethnicity groups. Finally, three models were performed to determine if trends in NMPO use differed over time by race/ethnicity: an unadjusted model, an adjusted model controlling for geographic residence, education, employment, and health insurance, and another adjusted model with the addition of age and sex to the variables included in the first adjusted model. All analyses were conducted using SAS 9.4.

3. Results

3.1 Overall Prevalence of NMPO use

Among our adult sample of 154,350 participants, 4.31% reported past year NMPO use (Table 1). The sample was 51.63% female, 69.79% white, 12.89% Black, and 17.32% Hispanic. Participants predominantly resided in urban areas compared to rural areas (85.22% vs 14.78%)

and many were between the ages of 35-49 (24.47%) and 50-64 (25.70%). Regarding educational attainment, 13.26% of the sample had less than a high school diploma, 25.66% had a high school diploma, 31.30% had some college or an associates, and the remaining 29.77% had a college degree. Unemployed participants made up 4.37% of the sample, with 33.21% being in the other category which includes those not in the labor force. Finally, 9.98% of the sample did not have health insurance.

When stratifying these variables by race and ethnicity, past year NMPO prevalence was highest among White participants at 4.46%, followed by Hispanics at 4.13%, and Blacks at 3.75%. Regarding geographic residence, 94.28% of Hispanic and 89.92% of Black respondents were residing in urban areas compared to 82.11% of Whites. White participants reported higher levels of education than Black or Hispanic respondents; 35.25% of Whites reported having a college degree compared to 19.23% of Blacks and 15.56% of Hispanics. Furthermore, 30.52% of Hispanic respondents had less than a high school diploma compared to 16.98% of Blacks and 8.29% of Whites. Unemployment was more than twice as prevalent among Black (8.77%) and Hispanic (6.46%) respondents compared to Whites (3.04%). Finally, lack of health insurance was much more prevalent among Hispanic respondents (22.20%) compared to Black (12.21%) and White (6.54%) respondents.

3.2. Bivariate Results

Among the overall sample, past year NMPO use was significantly different across the three race and ethnicity categories (p value=0.0011) with Whites again having the greatest prevalence of 4.46% (95% CI, 4.28-4.63%), followed by Hispanics at 4.13% (95% CI, 3.85-4.42), and Blacks at 3.75% (95% CI, 3.42-4.08%; Table 2). NMPO use was significantly higher

among males at 4.88% (95% CI, 4.65-5.10%) compared to females at 3.78% (95% CI, 3.65-3.91%). Younger respondents, specifically those 18-25 (7.23%; 95% CI, 6.91-7.55%) and 26-34 (6.77%; 95% CI, 6.44-7.11%), also reported significantly higher NMPO use compared to respondents 50-64 years old (3.35%; 95% CI, 3.04-3.65%) and 65 years or older (1.33%; 95% CI, 1.15-1.51%). Interestingly, urban and rural respondents reported comparable levels of NMPO use, with 4.36% (95% CI, 4.22-4.51) of urban respondents and 4.01% (95% CI, 3.71-4.30%) of rural respondents reporting misuse of prescription opioids in the past year. NMPO use was lowest among college graduates at 3.24% (95% CI, 2.97-3.52%) with comparable prevalence rates among lower educational attainment categories (See Table 2). Unemployed respondents reported the highest NMPO use at 8.59% (95% CI, 7.90-9.27%) with almost half as many full time and part time respondents reporting NMPO use, while the "other" category reported the lowest NMPO use of 3.33% (95% CI, 3.13-3.53%). Those without health insurance were significantly more likely to report NMPO use (6.97%; 95% CI, 6.48-7.46%) compared to those with health insurance (4.01%; 95% CI, 3.89-4.13%).

When stratifying by race and ethnicity, males were again more likely to report NMPO use across all categories. However, a significant gender gap was found among Blacks and Hispanics but not among Whites; 4.55% (95% CI, 4.07-5.03%) of Black men reported NMPO use compared to 3.09% (95% CI, 2.67-3.50%) of Black women, while 4.74% (95% CI, 4.19-5.29%) of Hispanic men reported NMPO use compared to 3.53% (95% CI, 3.14-3.93%) of Hispanic women. However, when comparing prevalence rates of NMPO use by sex and across all race and ethnicity categories, no significant difference was found. In other words, men regardless of race have comparable NMPO use and the same is true for women. There were significantly different prevalence rates across race and ethnicity categories by age (p

value=0.0007) but this appears to be more of a reflection of higher rates among White respondents rather than differences in patterns of NMPO use by age and race. All three race and ethnicity categories showed general trends of individuals aged 18-25 and 26-34 years reporting the most NMPO use, with White respondents in both age groups reporting significantly higher rates compared to their Black and Hispanic counterparts. For Blacks, NMPO use generally decreased with higher educational achievement. Yet among Whites, NMPO use was highest among those with less than a high school diploma (5.46%; 95% CI, 4.88-6.03%) and those with either some college education or an associate's degree (5.23%; 95% CI, 4.93-5.52%). Hispanics had low NMPO use among those with less than a high school diploma (3.42%; 95% CI, 2.95-3.90%) with increased use among high school graduates (4.28%; 95% CI, 3.61-4.95%) and those with either some college education or an associate's degree (5.35%; 95% CI, 4.75-5.96%).

No significant difference in NMPO use existed across race and ethnicity groups in regard to geographic residence (p value=0.4049). However, rural Hispanics had high NMPO use (4.43%; 95% CI, 3.38-5.49%) second only to urban Whites (4.55%; 95% CI, 4.34-4.76%). Significant differences in NMPO use existed across race and ethnicity groups in regard to employment status. Unemployed respondents had the highest NMPO use within each race and ethnicity category, but white unemployed respondents had much higher prevalence at 10.54% (95% CI, 9.21-11.87%) compared to unemployed Black (5.91%; 95% CI, 4.63-7.20%) and unemployed Hispanic respondents (7.58%; 95% CI, 6.19-8.97%). Finally, prevalence of NMPO use differed significantly based on health insurance status across race and ethnicity categories (p value=<.0001). White respondents without health insurance reported NMPO prevalence of 9.46% (95% CI, 8.54-10.38%), compared to 6.04% (95% CI, 5.08-7.00%) among Blacks without health insurance and 4.38% (95% CI, 3.72-5.03%) among Hispanics without health insurance.

3.3. Regression Results

As seen in Table 3, our unadjusted model examining the association between race and ethnicity and NMPO use across the four years of data show no significant difference (p value= 0.9434). When adjusting for the covariates of education, employment, rurality, and health insurance there remained no significant difference (p value= 0.9420). Finally, we ran another adjusted model accounting for the same four covariates with the addition of sex and age which also showed no significant difference (p value=0.9484). Nevertheless, by graphing the predicted probabilities of NMPO use by race and ethnicity and year, we can qualitatively conclude that rates of NMPO use have decreased each year among all race and ethnicity groups. Furthermore, the lack of significant differences between race and ethnicity groups across all three models suggested that no racial disparities exist in measured decreases in NMPO use.

4. Discussion

The aim of this study was to examine patterns of NMPO use among White, Black, and Hispanic individuals utilizing nationally representative data from 2015-2018. Based on other literature showing increased synthetic opioid use among Blacks (Lippold et al., 2019), we hypothesized that NMPO use among non-white individuals had risen in recent years and was comparable to use among Whites. We found significant differences in NMPO use across race and ethnicity categories, which is consistent with other literature showing greatest NMPO use prevalence among Whites (Kerridge et al., 2015; Parker et al., 2018; Wall et al., 2018). However, we found prevalence was still high among Blacks, while Hispanics showed comparable use rates to Whites. For all race and ethnicity groups the predicted probability of past-year NMPO use, in

both unadjusted and adjusted models, has consistently decreased from 2015-2018 and no disparities in that measured decrease appear to exist.

Consistent with findings from Nicholson and Ford (2018), we found a gender gap in NMPO use with Black males reporting more use and no gender gap among Whites. Furthermore, our study found that Hispanic men reported significantly higher NMPO use compared to Hispanic women, a population not included in the analysis done by Nicholson and Ford (2018) and most literature. Some findings have shown that NMPO use is decreasing faster among men than among women while women are also at higher risk of heroin use (Marsh et al., 2018). If this finding is consistent, it provides important context for our results. While men report higher NMPO use and therefore need targeted prevention and treatment programs, women cannot be overlooked as a special population also in need.

In contrast to other studies showing lower NMPO use among rural participants (Rigg and Monnat, 2015), our study found no significant difference among the race and ethnicity groups related to geographic residence. This suggests that either rural NMPO use has increased for all groups in recent years, particularly among Black and Hispanic populations or that urban NMPO use has decreased to a level comparable with rural areas. However, more recent studies have found results that support our findings. Rigg and Nicholson (2019) found no significant differences in NMPO use among urban and rural Black respondents from 2012-2016 NSDUH data. Our findings show that this trend has held from 2017-2018, and is also consistent among White and Hispanic populations. In fact, rural Hispanics had greater NMPO use than urban Hispanics and their prevalence was almost as high as urban Whites, the group with the most NMPO use. Based on these findings, public health interventions should be targeting rural

Hispanics just as much as urban Whites otherwise disparities in rates of overall NMPO use decrease may begin to appear.

Our study found that White, unemployed individuals had much higher NMPO use compared to their Black and Hispanic counterparts. While it is unsurprising that unemployed individuals reported the highest NMPO use regardless of race and ethnicity compared to other employment statuses, as this is consistent with other findings (Perlmutter et al., 2017; Nicholson & Ford, 2018), we did not expect to see such high rates among Whites. The higher rates of NMPO use among unemployed Whites compared to their Black and Hispanic counterparts may be a reflection of disparities in access to prescription opioids, whether directly from a medical provider or from a friend or family member. It may also be that high NMPO use among unemployed Whites is a reflection of higher NMPO use in rural areas, areas that have also experienced high unemployment since the 2008 recession and are home to many more Whites than minority populations. Future research is needed to confirm these theories and to inform how best to intervene among unemployed NMPO users.

The NSDUH is the primary national, self-reported survey on drug use behavior in the nation but it does have some important limitations. The NSDUH is susceptible to non-response bias, both due to its cross-sectional study design and focus on substance use. Non-response bias can mask important differences between those who answer and those who don't answer elements of the survey. Social desirability bias among participants could make them less likely to either answer a question or to answer it honestly, while a respondent's memory could also impact their answers. The NSDUH is administered using Audio Computer-Assisted Self-Interviewing (ACASI) software where respondents listen to prerecorded questions and answer via a computer, a process that increases privacy and helps limit social desirability bias (Population Council, n.d.).

About 3% of the US population is excluded from the NSDUH because they are actively serving in the military, institutionalized, or imprisoned (Center for Behavioral Health Statistics and Quality, 2019). There may be significant differences in drug use behavior among these sub-populations meaning that estimates generated may be slightly different if they had been included (Center for Behavioral Health Statistics and Quality, 2019). This is a major limitation as Knighton et al. (2018) have found rates of past year NMPO use among Black incarcerated men were 20.5%, much higher than national estimates and estimates among non-institutionalized Blacks (Han et al., 20 17). Finally, we were unable to examine trends in heroin and synthetic opioid use due to insufficient sample sizes. Understanding trends in other opioid use is needed to better contextualize our findings.

To our knowledge this study is the first to examine NMPO use by race and ethnicity with the most current, nationally representative data available. Our findings help address gaps in current literature specifically regarding national patterns of NMPO use from 2015-2018, as most literature available examines national data from 2015 or earlier. Literature with more current data is largely focused at the county or state level which limits generalizability of findings. In addition to providing more current and national trends our robust sample size of 154,350 participants allowed us to examine patterns of NMPO use across Whites, Blacks, and Hispanics. Literature is particularly limited when examining NMPO use by race and available studies are often outdated. Finally, our study provides a more current understanding of how a number of key covariates are associated with NMPO use and race and ethnicity which may help guide targeted interventions for sub-populations at risk.

As our study found that NMPO use has decreased among White, Black, and Hispanic populations in recent years, future studies should further examine the implications of this

finding. A number of policies across the country have been implemented to reduce access to prescription opioids, specifically limiting the amount prescribed and the number of refills. There may also be increased availability of other opioids and changes in opioid use behavior favoring heroin and synthetic opioids for the stronger high they provide. While examination of synthetic opioid and heroin use was not statistically feasible in our sample due to small sample sizes, other studies should examine trends in both types of opioids. It may be that while NMPO use is decreasing nationally, individuals are being pushed to heroin and synthetic opioids to satisfy their addiction, which due to the greater potency of these opioids could lead to more overdose deaths. Future studies should also examine the driving factors influencing opioid use among Black and Hispanic populations. Literature examining the LatinX experience and NMPO use is far too absent, as few articles examine race alone and those that do typically only examine the White and Black experience. As our findings show that NMPO use was second highest among rural Hispanics, more research is needed to tailor public health interventions for this sub-population. Minority populations have been understudied in relation to opioid use, as the epidemic has been largely whitewashed in both popular news and academic literature (James & Jordan, 2018). A richer and current understanding of minority opioid use is needed to develop effective, culturally relevant, and comprehensive public health interventions. Greater understanding of structural barriers and the intersectional experience of minority individuals misusing opioids is needed to tailor implementation of prevention strategies, such as Narcan education and distribution and syringe exchange programs.

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V. Results and Conclusions

Descriptive Results

Among our adult sample of 154,350 participants, 4.31% reported past year NMPO use (**Table 1**). The sample was 51.63% female, 69.79% white, 12.89% Black, and 17.32% Hispanic. Participants predominantly resided in urban areas compared to rural areas (85.22% vs 14.78%) and many were between the ages of 35-49 (24.47%) and 50-64 (25.70%). Regarding educational attainment, 13.26% of the sample had less than a high school diploma, 25.66% had a high school diploma, 31.30% had some college or an associates, and the remaining 29.77% had a college degree. Unemployed participants made up 4.37% of the sample, with 33.21% being in the other category which includes those not in the labor force. Finally, 9.98% of the sample did not have health insurance.

When stratifying these variables by race and ethnicity, past year NMPO prevalence was highest among White participants at 4.46%, followed by Hispanics at 4.13%, and Blacks at 3.75%. Regarding geographic residence, 94.28% of Hispanic and 89.92% of Black respondents were residing in urban areas compared to 82.11% of Whites. White participants reported higher levels of education than Black or Hispanic respondents; 35.25% of Whites reported having a college degree compared to 19.23% of Blacks and 15.56% of Hispanics. Furthermore, 30.52% of Hispanic respondents had less than a high school diploma compared to 16.98% of Blacks and 8.29% of Whites. Unemployment was more than twice as prevalent among Black (8.77%) and Hispanic (6.46%) respondents compared to Whites (3.04%). Finally, lack of health insurance was much more prevalent among Hispanic respondents (22.20%) compared to Black (12.21%) and White (6.54%) respondents.

Bivariate Results

Among the overall sample, past year NMPO use was significantly different across the three race and ethnicity categories (p value=0.0011) with Whites again having the greatest prevalence of 4.46% (95% CI, 4.28-4.63%), followed by Hispanics at 4.13% (95% CI, 3.85-4.42), and Blacks at 3.75% (95% CI, 3.42-4.08%; **Table 2**). NMPO use was significantly higher among males at 4.88% (95% CI, 4.65-5.10%) compared to females at 3.78% (95% CI, 3.65-3.91%). Younger respondents, specifically those 18-25 (7.23%; 95% CI, 6.91-7.55%) and 26-34 (6.77%; 95% CI, 6.44-7.11%), also reported significantly higher NMPO use compared to respondents 50-64 years old (3.35%; 95% CI, 3.04-3.65%) and 65 years or older (1.33%; 95% CI, 1.15-1.51%). Interestingly, urban and rural respondents reported comparable levels of NMPO use, with 4.36% (95% CI, 4.22-4.51) of urban respondents and 4.01% (95% CI, 3.71-4.30%) of rural respondents reporting misuse of prescription opioids in the past year. NMPO use was lowest among college graduates at 3.24% (95% CI, 2.97-3.52%) with comparable prevalence rates among lower educational attainment categories (See **Table 2**). Unemployed respondents reported the highest NMPO use at 8.59% (95% CI, 7.90-9.27%) with almost half as many full time and part time respondents reporting NMPO use, while the "other" category reported the lowest NMPO use of 3.33% (95% CI, 3.13-3.53%). Those without health insurance were significantly more likely to report NMPO use (6.97%; 95% CI, 6.48-7.46%) compared to those with health insurance (4.01%; 95% CI, 3.89-4.13%).

When stratifying by race and ethnicity, males were again more likely to report NMPO use across all categories. However, a significant gender gap was found among Blacks and Hispanics but not among Whites; 4.55% (95% CI, 4.07-5.03%) of Black men reported NMPO use compared to 3.09% (95% CI, 2.67-3.50%) of Black women, while 4.74% (95% CI, 4.19-

5.29%) of Hispanic men reported NMPO use compared to 3.53% (95% CI, 3.14-3.93%) of Hispanic women. However, when comparing prevalence rates of NMPO use by sex and across all race/ethnicity categories, no significant difference was found. In other words, men regardless of race have comparable NMPO use and the same is true for women. There were significantly different prevalence rates across race/ethnicity categories by age (p value=0.0007) but this appears to be more of a reflection of higher rates among White respondents rather than differences in patterns of NMPO use by age and race. All three race/ethnicity categories showed general trends of individuals aged 18-25 and 26-34 years reporting the most NMPO use, with White respondents in both age groups reporting significantly higher rates compared to their Black and Hispanic counterparts. For Blacks, NMPO use generally decreased with higher educational achievement. Yet among Whites, NMPO use was highest among those with less than a high school diploma (5.46%; 95% CI, 4.88-6.03%) and those with either some college education or an associate's degree (5.23%; 95% CI, 4.93-5.52%). Hispanics had low NMPO use among those with less than a high school diploma (3.42%; 95% CI, 2.95-3.90%) with increased use among high school graduates (4.28%; 95% CI, 3.61-4.95%) and those with either some college education or an associate's degree (5.35%; 95% CI, 4.75-5.96%).

No significant difference in NMPO use existed across race/ethnicity groups in regard to geographic residence (p value=0.4049). However, rural Hispanics had high NMPO use (4.43%; 95% CI, 3.38-5.49%) second only to urban Whites (4.55%; 95% CI, 4.34-4.76%). Significant differences in NMPO use existed across race/ethnicity groups in regard to employment status. Unemployed respondents had the highest NMPO use within each race/ethnicity category, but white unemployed respondents had much higher prevalence at 10.54% (95% CI, 9.21-11.87%) compared to unemployed Black (5.91%; 95% CI, 4.63-7.20%) and unemployed Hispanic

respondents (7.58%; 95% CI, 6.19-8.97%). Finally, prevalence of NMPO use differed significantly based on health insurance status across race/ethnicity categories (p value=<.0001). White respondents without health insurance reported NMPO prevalence of 9.46% (95% CI, 8.54-10.38%), compared to 6.04% (95% CI, 5.08-7.00%) among Blacks without health insurance and 4.38% (95% CI, 3.72-5.03%) among Hispanics without health insurance.

Regression Results

As seen in **Table 3**, our unadjusted model examining the association between race/ethnicity and NMPO use across the four years of data show no significant difference (p value= 0.9434). When adjusting for the covariates of education, employment, rurality, and health insurance there remained no significant difference (p value= 0.9420). Finally, we ran another adjusted model accounting for the same four covariates with the addition of sex and age which also showed no significant difference (p value=0.9484). Nevertheless, by graphing the predicted probabilities of NMPO use by race/ethnicity and year, we can qualitatively conclude that rates of NMPO use have decreased each year among all race/ethnicity groups. Furthermore, the lack of significant differences between race/ethnicity groups across all three models suggested that no disparities exist in measured decreases in NMPO use.

Discussion

The aim of this study was to examine patterns of NMPO use among White, Black, and Hispanic individuals utilizing nationally representative data from 2015-2018. Based on findings showing increased synthetic opioid use among Blacks, we hypothesized that NMPO use among non-white individuals had risen in recent years and was comparable to use among Whites. We

found significant differences in NMPO use across race and ethnicity categories, however prevalence was still high among Blacks while Hispanics showed comparable use rates to Whites. Our findings are therefore consistent with other literature showing highest NMPO use prevalence among Whites (Kerridge et al., 2015; Parker et al., 2018; Wall et al., 2018), however we found high use among Hispanics which differs from previous literature. For all race and ethnicity groups the predicted probability of past-year NMPO use, in both unadjusted and adjusted models, has consistently decreased from 2015-2018 and no disparities in that measured decrease appear to exist.

Consistent with findings from Nicholson and Ford (2018), we found a gender gap in NMPO use with Black males reporting more use and no gender gap among Whites. Adding to these findings, our study also found that Hispanic men reported significantly higher NMPO use compared to Hispanic women, a population not included in the analysis done by Nicholson and Ford (2018). Some findings have shown that NMPO use is decreasing faster among men than among women while women are also at higher risk of heroin use (Marsh et al., 2018). If this finding is consistent, it provides important context for our results. While men report higher NMPO use and therefore need targeted prevention and treatment programs, women cannot be overlooked as a special population also in need.

In contrast to other studies showing lower NMPO use among rural participants (Rigg and Monnat, 2015), our study found no significant difference among the race/ethnicity groups related to geographic residence. This suggests that either rural NMPO use has increased for all groups in recent years, particularly among Black and Hispanic populations or that urban NMPO use has decreased to a level comparable with rural areas. However, more recent studies have found results that support our findings. Rigg and Nicholson (2019) found no significant differences in

NMPO use among urban and rural Black respondents from 2012-2016 NSDUH data. Our findings show that this trend has held from 2017-2018, and is also consistent among White and Hispanic populations. In fact, rural Hispanics had greater NMPO use than urban Hispanics and their prevalence was almost as high as urban Whites, the group with the most NMPO use. Based on these findings, public health interventions should be targeting rural Hispanics just as much as urban Whites otherwise disparities in rates of overall NMPO use decrease may begin to appear. Our final major finding is that White, unemployed individuals had much higher NMPO use compared to their Black and Hispanic counterparts. While it is unsurprising that unemployed individuals reported the highest NMPO use regardless of race/ethnicity compared to other employment statuses, as this is consistent with other findings (Perlmutter et al., 2017; Nicholson & Ford, 2018), we did not expect to see such high rates among Whites. The higher rates of NMPO use among unemployed Whites compared to their Black and Hispanic counterparts may be a reflection of disparities in access to prescription opioids, whether directly from a medically a provider or from a friend or family member. It may also be that high NMPO use among unemployed Whites is a reflection of higher NMPO use in rural areas, areas that have also experienced high unemployment since the 2008 recession and are home to many more Whites than minority populations. Future research is needed to confirm these theories and to inform how best to intervene among unemployed NMPO users.

Limitations

The NSDUH is the primary national, self-reported survey on drug use behavior in the nation but it does have some important limitations. As with all cross-sectional study designs, the NSDUH is susceptible to non-response bias, perhaps to an even greater extent due to the surveys

focus on drug use. Social desirability bias among participants could make them less likely to either answer a question or to answer it honestly, while a respondent's memory could also impact their answers. Non-response bias can mask important differences between those who answer and those who don't answer elements of the survey. The NSDUH is administered using Audio Computer-Assisted Self-Interviewing (ACASI) software where respondents listen to prerecorded questions and answer via a computer, a process that increases privacy and helps limit social desirability bias (Population Council, n.d.). In regards to the questions about NMPO use in this analysis only 678 individuals refused to answer, meaning that non-response bias likely had limited impact on our sample. Due to the cross-sectional study design, the NSDUH is unable to examine individual level trends over time. This limits the kinds of research questions that can be examined using the data. Finally, about 3% of the US population is excluded from the sample because they are actively serving in the military, institutionalized, or imprisoned (Center for Behavioral Health Statistics and Quality, 2019). There may be significant differences in drug use behavior among these sub-populations meaning that estimates generated may be slightly different if they had been included (Center for Behavioral Health Statistics and Quality, 2019). This is a major limitation as Knighton et al. (2018) have found rates of past year NMPO use among Black incarcerated men were 20.5%, much higher than national estimates and estimates among non-institutionalized Blacks (Han et al., 20 17). Finally, we were unable to examine trends in heroin and synthetic opioid use due to insufficient sample sizes. Understanding trends in other opioid use is needed to better contextualize our findings.

Strengths

To our knowledge this study is the first to examine NMPO use by race/ethnicity with the most current, nationally representative data available. Our findings help address gaps in current literature specifically regarding national patterns of NMPO use from 2015-2018, as most literature available examines national data from 2015 or earlier. Furthermore, literature with more current data is largely focused at the county or state level which limits generalizability of findings. In addition to providing more current and national trends our robust sample size of 154,350 participants allowed us to examine patterns of NMPO use across Whites, Blacks, and Hispanics. Literature is particularly limited when examining NMPO use by race and available studies are often outdated. Finally, our study provides more current understanding of how a number of key covariates are associated with NMPO use and race/ethnicity. In particular, our findings showing no difference between rural and urban NMPO use both overall and when stratifying by race/ethnicity show how the opioid epidemic has evolved in recent years.

Next Steps and Public Health Impact

As our study found that NMPO use has decreased among White, Black, and Hispanic populations in recent years, future studies should further examine the implications of this finding. Future studies should examine potential effects of this decrease. A number of policies across the country have been implemented to reduce access to prescription opioids, specifically limiting the amount prescribed and the number of refills. There may also be increased availability of other opioids and changes in opioid use behavior favoring heroin and synthetic opioids for the stronger high they provide. While examination of synthetic opioid and heroin use was not statistically feasible in our sample, other studies should examine trends in both types of

opioids. It may be that while NMPO use is decreasing nationally, individuals are being pushed to heroin and synthetic opioids to satisfy their addiction, which due to the greater potency of these opioids could lead to more overdose deaths. Future studies should also examine the driving factors influencing opioid use among Black and Hispanic populations. Literature examining the LatinX experience and NMPO use is far too absent, as few articles examine race alone and those that do typically only examine the White and Black experience. As our findings show that NMPO use was second highest among rural Hispanics, more research is needed to tailor public health interventions for this sub-population. Minority populations have been understudied in relation to opioid use, as the epidemic has been largely whitewashed in both popular news and academic literature. A richer and current understanding of minority opioid use is needed to develop effective, culturally relevant, and comprehensive public health interventions. Greater understanding of structural barriers and the intersectional experience of minority individuals misusing opioids is needed to tailor implementation of prevention strategies, such as Narcan education and distribution and syringe exchange programs.

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Table 1: Demographics of Sample Population Overall and by Race/ethnicity (N=154,350)

	Overall		White		Black		Hispanic	
	N	% weighted	n	% weighted	n	% weighted	n	% weighted
	154350	100	103527	69.79	21551	12.89	29272	17.32
Non-medical Prescription Opioid Use								
Yes	8289	4.31	5820	4.46	987	3.75	1482	4.13
No	146061	95.69	97707	95.54	20564	96.25	27790	95.87
Sex								
Male	71589	48.37	48747	48.60	9399	45.28	13443	49.75
Female	82761	51.63	54780	51.40	12152	54.72	15829	50.25
Age								
18-25	49221	13.78	29800	11.88	7785	16.70	11636	19.26
26-34	31426	15.60	20342	14.00	4498	17.51	6586	20.57
35-49	40888	24.47	27777	22.77	5469	25.84	7642	30.30
50-64	18808	25.70	13946	27.38	2490	24.83	2372	19.57
65+	14007	20.45	11662	23.95	1309	15.12	1036	10.29
Rurality								
Urban	123764	85.22	78015	82.11	19149	89.92	26600	94.28
Non-urban	30586	14.78	25512	17.89	2402	10.08	2672	5.72
Education								
Less than High School	20725	13.26	9131	8.29	3531	16.98	8063	30.52
High School Graduate	41469	25.66	25679	24.44	7182	31.67	8608	26.12
Some College/ Associates	51980	31.30	35771	32.02	7332	32.12	8877	27.80
College graduate	40176	29.77	32946	35.25	3506	19.23	3724	15.56
Employment Status								
Full time	80861	49.30	56048	49.39	10281	47.41	14532	50.36
Part time	24150	13.12	16706	13.65	3038	11.56	4406	12.13
Unemployed	9197	4.37	4385	3.04	2525	8.77	2287	6.46
Other (Including not in labor force)	40142	33.21	26388	33.92	5707	32.26	8047	31.04
Health Insurance (Missing=1038)								
Yes	135240	90.02	94896	93.46	18344	87.79	22000	77.80
No	18072	9.98	8088	6.54	2972	12.21	7012	22.20
Year								
2015	39054	24.70	25959	24.90	5480	24.49	7615	24.07
2016	38458	24.91	25937	25.01	5462	24.75	7059	24.62
2017	38209	25.14	25840	25.04	5218	25.33	7151	25.40
2018	38629	25.25	25791	25.05	5391	25.43	7447	25.91

Table 2: NMPO Use of Sample Population Overall and by Race/ethnicity (N= 154,350)

	Overall		White		Black		Hispanic		P-value
	N	Weighted % (95% CI)	n	Weighted % (95% CI)	n	Weighted % (95% CI)	n	Weighted % (95% CI)	
	154350	100	5820	4.46 (4.28-4.63)	987	3.75 (3.42-4.08)	1482	4.13 (3.85-4.42)	0.0011
Sex									
Male	4321	4.88 (4.65-5.10)	3034	4.97 (4.66-5.27)	516	4.55 (4.07-5.03)	771	4.74 (4.19-5.29)	0.1706
Female	3968	3.78 (3.65-3.91)	2786	3.97 (3.81-4.13)	471	3.09 (2.67-3.50)	711	3.53 (3.14-3.93)	
Age									
18-25	3554	7.23 (6.91-7.55)	2365	8.02 (7.61-8.42)	448	5.73 (5.18-6.28)	741	6.24 (5.47-7.00)	0.0007
26-34	2060	6.77 (6.44-7.11)	1449	7.47 (7.01-7.92)	247	5.58 (4.72-6.44)	364	5.62 (4.82-6.42)	
35-49	1878	4.60 (4.35-4.85)	1405	5.37 (5.03-5.71)	186	2.91 (2.42-3.39)	287	3.35 (2.85-3.85)	
50-64	611	3.35 (3.04-3.65)	461	3.44 (3.09-3.79)	86	3.56 (2.61-4.50)	64	2.64 (1.81-3.46)	
65+	186	1.33 (1.15-1.51)	140	1.23 (0.99-1.47)	-	-	-	-	
Rurality									
Urban	6687	4.36 (4.22-4.51)	4494	4.55 (4.34-4.76)	873	3.80 (3.43-4.17)	1320	4.12 (3.82-4.41)	0.4049
Non-urban	1602	4.01 (3.71-4.30)	1326	4.04 (3.71-4.38)	114	3.31 (2.55-4.08)	162	4.43 (3.38-5.49)	
Education									
Less than High School	1322	4.66 (4.33-5.00)	726	5.46 (4.88-6.03)	231	5.54 (4.57-6.51)	365	3.42 (2.95-3.90)	0.0001
High School Graduate	2391	4.47 (4.18-4.76)	1608	4.71 (4.37-5.04)	336	3.69 (3.18-4.20)	447	4.28 (3.61-4.95)	
Some College/ Associates	3123	5.05 (4.80-5.29)	2264	5.23 (4.93-5.52)	330	3.73 (3.16-4.30)	529	5.35 (4.75-5.96)	
College graduate	1453	3.24 (2.97-3.52)	1222	3.35 (3.04-3.67)	90	2.30 (1.67-2.93)	141	3.10 (2.41-3.79)	
Employment Status									
Full time	4157	4.47 (4.27-4.67)	3038	4.77 (4.50-5.05)	418	3.43 (2.99-3.88)	701	4.01 (3.58-4.44)	<.0001
Part time	1340	4.77 (4.43-5.11)	984	4.94 (4.53-5.36)	143	4.10 (3.07-5.14)	213	4.44 (3.58-5.31)	
Unemployed	893	8.59 (7.90-9.27)	541	10.54 (9.21-11.87)	168	5.91 (4.63-7.20)	184	7.58 (6.19-8.97)	
Other (Including not in	1899	3.33 (3.13-3.53)	1257	3.26 (3.02-3.50)	258	3.50 (2.98-4.02)	384	3.50 (2.97-4.02)	

labor force)									
Health Insurance									
Yes	6926	4.01 (3.89-4.13)	4993	4.10 (3.94-4.26)	813	3.43 (3.07-3.78)	1120	4.06 (3.70-4.42)	<.0001
No	1314	6.97 (6.48-7.46)	798	9.46 (8.54-10.38)	166	6.04 (5.08-7.00)	350	4.38 (3.72-5.03)	
Year									
2015	2408	4.81 (4.52-5.09)	1665	4.89 (4.55-5.24)	290	4.21 (3.41-5.01)	453	4.90 (4.13-5.67)	0.9434
2016	2090	4.47 (4.18-4.75)	1488	4.62 (4.23-5.00)	245	3.80 (3.10-4.50)	357	4.35 (3.69-5.00)	
2017	2050	4.16 (3.92-4.39)	1448	4.36 (4.06-4.67)	249	3.53 (2.95-4.11)	353	3.81 (3.12-4.50)	
2018	1741	3.82 (3.57-4.08)	1219	3.96 (3.64-4.28)	203	3.48 (2.74-4.21)	319	3.54 (2.87-4.21)	

Note: Data cells with 50 or less participants were suppressed.

Table 3 Models: Predicted Probabilities of NMPO Use by Year and Race/Ethnicity

Unadjusted Model					
	2015	**2016**	**2017**	**2018**	**P Value**
Black	0.042116	0.0379944	0.0353329	0.0347664	0.9434
Hispanic	0.048988	0.0434764	0.0380826	0.0353812	
White	0.0489457	0.046162	0.0436335	0.0395928	
Adjusted Model 1					
Black	0.0444125	0.0406051	0.0365189	0.0372209	0.9420
Hispanic	0.050521	0.044967	0.0395863	0.0362735	
White	0.0511162	0.0483236	0.0458461	0.0414103	
Adjusted Model 2					
Black	0.0514745	0.047591	0.0429456	0.0432968	0.9484
Hispanic	0.0572577	0.0510843	0.0452416	0.041734	
White	0.0624009	0.0587338	0.0560884	0.0506586	

Table 1 Supplementary: Other Demographics of Sample Population Overall and by Race/ethnicity

(N=154,350)

	Overall		White		Black		Hispanic	
	N	% weighted	n	% weighted	n	% weighted	n	% weighted
	154350	100	103527	69.79	21551	12.89	29272	17.32
Marital Status								
Married	64341	51.70	48169	56.12	5129	32.84	11043	47.89
Widowed	4994	5.99	3776	6.63	713	6.21	505	3.29
Divorced / Separated	17156	14.18	11773	13.94	2495	16.52	2888	13.43
Never Married	67859	28.13	39809	23.31	13214	44.43	14836	35.39
Substance abuse and Mental Health								
Any tobacco use (Missing=246)								
Yes	43672	24.07	31243	24.91	5650	24.41	6779	20.41
No	110432	75.93	72170	75.09	15852	75.59	22410	79.59
Alcohol Abuse								
Yes	5750	2.84	4111	2.93	593	2.34	1046	2.86
No	148600	97.16	99416	97.07	20958	97.66	28226	97.14
Major Depressive Episode (Missing=1661)								
Yes	13533	7.03	10069	7.70	1384	5.37	2080	5.55
No	139156	92.97	92542	92.30	19840	94.63	26774	94.45
Psychological Distress								
Yes	23111	11.09	16412	11.53	2769	9.68	3930	10.38
No	131239	88.91	87115	88.47	18782	90.32	25342	89.62
Illicit drug <u>use</u> other than opioids and marijuana								
Yes	14117	6.62	10470	7.13	1294	4.78	2353	5.96
No	140233	93.38	93057	92.87	20257	95.22	26919	94.04
Illicit drug <u>abuse</u> other than opioids and marijuana								
Yes	759	0.33	546	0.34	75	0.30	138	0.34
No	153591	99.67	102981	99.66	21476	99.70	29134	99.66
Had an STD in the past 12 months (Missing=704)								
Yes	3982	2.08	2459	2.00	858	2.88	665	1.80
No	149664	97.92	100759	98.00	20495	97.12	28410	98.20

Table 2 Supplementary: Other NMPO Use of Sample Population Overall and by Race/ethnicity (N= 154,350)

	Overall		White		Black		Hispanic		P-value
	N	Weighted % (95% CI)	n	Weighted % (95% CI)	n	Weighted % (95% CI)	n	Weighted % (95% CI)	
	154350	100	5820	4.46 (4.28-4.63)	987	3.75 (3.42-4.08)	1482	4.13 (3.85-4.42)	0.0011
Marital Status									
Married	2215	2.97 (2.81-3.13)	1690	3.05 (2.84-3.26)	152	2.49 (1.99-2.99)	373	2.83 (2.41-3.24)	0.0089
Widowed	174	2.52 (2.04-3.01)	107	2.17 (1.59-2.75)	36	3.35 (1.92-4.77)	31	4.27 (1.59-6.96)	
Divorced / Separated	969	4.78 (4.39-5.18)	751	5.48 (4.99-5.96)	91	3.26 (2.33-4.19)	127	3.29 (2.38-4.20)	
Never Married	4931	6.92 (6.62-7.21)	3272	7.89 (7.49-8.28)	708	4.92 (4.44-5.40)	951	6.21 (5.57-6.85)	
Substance abuse and Mental Health									
Any tobacco use									
Yes	4819	9.34 (8.99-9.68)	3581	9.71 (9.28-10.15)	516	7.74 (6.97-8.51)	722	8.90 (7.82-9.98)	0.1115
No	3459	2.72 (2.58-2.85)	2234	2.71 (2.55-2.88)	468	2.46 (2.10-2.82)	757	2.92 (2.63-3.20)	
Alcohol Abuse									
Yes	833	12.70 (11.60-13.80)	621	13.04 (11.64-14.43)	69	9.66 (7.38-11.93)	143	13.17 (9.76-16.58)	0.3355
No	7456	4.07 (3.95-4.18)	5199	4.20 (4.03-4.36)	918	3.61 (3.29-3.93)	1339	3.87 (3.58-4.16)	
Major Depressive Episode									
Yes	1706	11.50 (10.68-12.33)	1336	12.05 (11.15-12.95)	121	8.42 (6.57-10.26)	249	10.65 (8.93-12.37)	0.0921
No	6431	3.73 (3.60-3.85)	4398	3.79 (3.62-3.96)	842	3.47 (3.14-3.80)	1191	3.66 (3.35-3.96)	
Psychological Distress									
Yes	2975	12.17 (11.58-12.76)	2227	12.83 (12.08-13.57)	298	10.96 (9.39-12.54)	450	10.06 (8.65-11.48)	0.0304
No	5314	3.33 (3.20-3.46)	3593	3.37 (3.19-3.54)	689	2.98 (2.68-3.27)	1032	3.45 (3.15-3.75)	
Illicit drug <u>use</u> other than opioids and marijuana									
Yes	4010	27.75 (26.58-28.92)	3056	28.65 (27.39-29.92)	329	24.79 (21.22-28.37)	625	25.14 (22.14-28.14)	0.0215
No	4279	2.65 (2.54-2.75)	2764	2.60 (2.46-2.74)	658	2.69 (2.40-2.99)	857	2.80 (2.56-3.05)	
Illicit drug <u>abuse</u> other than opioids and marijuana									
Yes	343	40.41	265	45.63	22	28.18	56	27.52	0.0197

		(35.43-45.39)		(40.11-51.16)		(14.29-42.08)		(17.50-37.54)	
No	7946	4.19 (4.07-4.31)	5555	4.32 (4.15-4.49)	965	3.68 (3.35-4.00)	1426	4.05 (3.76-4.34)	
Had an STD in the past 12 months									
Yes	508	10.84 (9.84-11.84)	353	11.35 (10.02-12.67)	82	10.36 (7.22-13.50)	73	9.13 (5.83-12.43)	0.6405
No	7706	4.15 (4.03-4.27)	5434	4.31 (4.14-4.48)	885	3.53 (3.21-3.85)	1387	3.99 (3.70-4.28)	

Appendix A: SAS Code for Data Importing

```
Libname class "H:\Thesis\Data";
*have to actually assign the transport file itself to its own "filename" acts like a keyword for SAS to point at the file
Think of it as a libname for a specific file, instead of a folder;
filename tranfile 'H:\Thesis\Data\NSDUH.stc';

/*actually read the transport file into SAS format, notice it also created a format catalog
The formats are hard coded into the SAS data file, so you can't use it without the format catalog active in SAS*/
proc cimport library=class infile=tranfile;
run;

/*Requiring hard coded formats is stupid, and I hate it. Harder to see what we are doing, and requires us to keep track of multiple files.
Instead, lets strip the formats out so we can use the file like normal*/
PROC DATASETS lib=class;
MODIFY Concatpuf_0217_031919;
FORMAT _all_;
INFORMAT _all_;
RUN;
QUIT;
*Now that data is imported and formats are removed, I am copying the SAS supplement to clean data;
* SAS DATA STEP;
LIBNAME class "H:\Thesis\Data";
DATA class.clean_data;
SET class.concatpuf_0217_031919;

* USER-DEFINED MISSING VALUES RECODE;

*** Need to adjust for the two character variables. ***;
 IF (GQTYPE  <= "-9") THEN GQTYPE  = " ";
 IF (GQTYPE2 <= "-9") THEN GQTYPE2 = " ";

*Importing 2018 Dataset;
Libname class "H:\Thesis\Data\2018 NSDUH";

filename tranfile 'H:\Thesis\Data\NSDUH2018.stc';
```

```
proc cimport library=class infile=tranfile;
run;

PROC DATASETS lib=class;
MODIFY PUF2018_100819;
FORMAT _all_;
INFORMAT _all_;
RUN;
QUIT;

LIBNAME class "H:\Thesis\Data";
DATA class.data2018;
SET class.PUF2018_100819;
run;
```

Appendix B: SAS Code for Analysis

```
libname class "H:\Thesis\Data";

Data one;
set class.puf2018_100819;
YEAR_numeric=2018;
YEAR=put(YEAR_numeric,4.);
run;

DATA two;
set class.concatpuf_0217_031919;
if year in (2015,2016,2017);
run;

Data combined;
set one two;
run;

*Checking to see if possible truncation effected any variables in analysis. Switched out all
variables to check (See excel doc);
proc freq data=one;
table ABUSEPYINH;
run;

proc freq data=two;
table ABUSEPYINH;
run;

proc freq data=combined;
table ABUSEPYINH;
run;

/*restrict to adults and pain reliever users*/

DATA restricted;
Set combined;
if catag6>1 ;
*Non-medical prescription opioids, yes or no in the past 12 months;
if PNRNMREC in (3,83,91) then NMPO_only=0;
if PNRNMREC in (1,2,8,11) then NMPO_only=1;
if PNRNMREC in (-9,9,98) then NMPO_only=.;

if NMPO_only in (0,1);
run;
```

*Recoded variables;

Data final;
set restricted;
*Race;
if NEWRACE2 in (**1**) then race_cat="White";
if NEWRACE2 in (**2**) then race_cat="Black";
if NEWRACE2 in (**3**,**4**,**5**,**6**) then DELETE;
if NEWRACE2 in (**7**) then race_cat="Hispanic";

*Age;
if CATAG6 in (**2**) then age_cat=**1**;
if CATAG6 in (**3**) then age_cat=**2**;
if CATAG6 in (**4**) then age_cat=**3**;
if CATAG6 in (**5**) then age_cat=**4**;
if CATAG6 in (**6**) then age_cat=**5**;
if CATAG6 in (**-9**) then age_cat=**.**;

*Rurality, 1=urban, 2=non-urban;
if coutyp4 in (**1**) then rural_cat=**1**;
if coutyp4 in (**2**) then rural_cat=**1**;
if coutyp4 in (**3**) then rural_cat=**2**;
if coutyp4 in (**-9**) then rural_cat=**.**;

*Highest level of educational attainment. 1=less than HS, 2=HS grad, 3=Some college/Associates degree,
4=college grad, 5=12-17 yrs old;
if EDUHIGHCAT in (**1**) then edu_cat=**1**;
if EDUHIGHCAT in (**2**) then edu_cat=**2**;
if EDUHIGHCAT in (**3**) then edu_cat=**3**;
if EDUHIGHCAT in (**4**) then edu_cat=**4**;
if EDUHIGHCAT in (**5**,**-9**) then edu_cat=**.**;

*Employment Status. 1=employed full time, 2=employed part time, 3=unemployed, 4=other(including not in the labor force);
if IRWRKSTAT in (**1**) then employment_cat=**1**;
if IRWRKSTAT in (**2**) then employment_cat=**2**;
if IRWRKSTAT in (**3**) then employment_cat=**3**;
if IRWRKSTAT in (**4**) then employment_cat=**4**;
if IRWRKSTAT in (**-9**,**99**) then employment_cat=**.**;

*Marital Status. 1=married, 2=widowed, 3=divorced or separated, 4=never been married;
if year=**2015** then mar_cat=IRMARITSTAT;
if year NE **2015** then mar_cat=IRMARIT;

*Covered by any health insurance 0=No, 1=yes;

```
if ANYHLTI2 in (1) then HI_cat=1;
if ANYHLTI2 in (2) then HI_cat=0;
if ANYHLTI2 in (94,97,98) then HI_cat=.;

*Yes/No have you smoked in past 12 months, 0=No, 1=yes;
if CIGREC in (3,4,14,91) then cig_cat=0;
if CIGREC in (1,2,8,11) then cig_cat=1;
if CIGREC in (9,19,29,39) then cig_cat=.;

*Adult past year major depressive episode, 0=No, 1=yes;
if AMDEYR in (2) then depress_cat=0;
if AMDEYR in (1) then depress_cat=1;
if AMDEYR=. then depress_cat=.;
if AMDEYR in (-9) then depress_cat=.;

*Illicit drug use other than marijuana and opioids, 0=No, 1=yes;
otherdrugs=COCYR+TRQNMYR+STMNMYR+SEDNMYR+METHAMYR+HALLUCYR+IN
HALYR;
if otherdrugs=0 then DU_cat=0;
if otherdrugs>=1 then DU_cat=1;

*Illicit drug abuse other than marijuana and opioids in the past 12 months, 0=No, 1=yes;
numb_otherdrugs=ABUSECOC+ABUSEPYTRQ+ABUSEPYSTM+ABUSEPYSED+ABUSEP
YMTH+ABUSEPYHAL+ABUSEPYINH;
if numb_otherdrugs=0 then DA_cat=0;
if numb_otherdrugs>=1 then DA_cat=1;

* Had an STD in the past 12 months, 0=no, 1=yes;
if STDANYYR in (2) then STD_cat=0;
if STDANYYR in (1) then STD_cat=1;
if STDANYYR in (-9,85,94,97,98) then STD_cat=.;

*# OF TIMES BEEN TREATED IN EMER ROOM PAST 12 MOS recoded to remove missing
values;
if NMERTMT2 in (985,994,997,998) then NMERTMT2=.;

*Need to make weight variable consistent;
if year=2018 then wt=ANALWT_C;
if year in (2015,2016,2017) then wt=ANALWC1;

run;

*Checking to make sure variables are used for the years 2015-2018;

proc surveyfreq data=final;
strata VESTR;
```

```
cluster VEREP;
weight wt;
table year*(NMPO_only IRSEX age_cat race_cat rural_cat edu_cat employment_cat mar_cat
HI_cat cig_cat abusealc depress_cat spdyr DU_cat DA_cat STD_cat NMERTMT2);
run;


*These are the variables that make up the illicit drug use and abuse other than opioids and
marijuana variables;
proc surveyfreq data=final;
strata VESTR ;
cluster VEREP ;
weight wt ;
table year*(COCYR TRQNMYR STMNMYR SEDNMYR METHAMYR HALLUCYR
INHALYR);
run;

proc surveyfreq data=final;
strata VESTR ;
cluster VEREP ;
weight wt ;
table year*(ABUSECOC ABUSEPYTRQ ABUSEPYSTM ABUSEPYSED ABUSEPYMTH
ABUSEPYHAL ABUSEPYINH);
run;


*Starting analysis for table 1;

*Overall column;
proc surveyfreq data=final;
strata VESTR ;
cluster VEREP ;
weight wt ;
table NMPO_only IRSEX age_cat race_cat rural_cat edu_cat employment_cat mar_cat
HI_cat cig_cat abusealc depress_cat spdyr DU_cat DA_cat STD_cat year/ row;
run;


*Columns 2,3,4 (White, Black, Hispanic);
proc surveyfreq data=final;
strata VESTR ;
cluster VEREP ;
weight wt ;
table race_cat*(NMPO_only IRSEX age_cat rural_cat edu_cat employment_cat mar_cat
HI_cat cig_cat abusealc depress_cat spdyr DU_cat DA_cat STD_cat year)/ row cl;
run;
```

```
*Table 2: Bivariate Analysis;

*Overall;
*P value on the far left - may delete;
proc surveyfreq data=final;
strata VESTR ;
cluster VEREP ;
weight wt ;
table  NMPO_only*(race_cat IRSEX age_cat rural_cat edu_cat employment_cat mar_cat
HI_cat cig_cat abusealc depress_cat spdyr DU_cat DA_cat STD_cat year)/ col cl chisq;
run;

*Columns for White, Black, Hispanic;
*Getting p-values for each race;
proc surveyfreq data=final;
strata VESTR ;
cluster VEREP ;
weight wt ;
table race_cat*NMPO_only*(IRSEX age_cat rural_cat edu_cat employment_cat mar_cat
HI_cat cig_cat abusealc depress_cat spdyr DU_cat DA_cat STD_cat year)/ row col cl chisq;
run;

*getting p-value across all levels (far right p value in tables), look at type 3 test for interaction;
Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) IRSEX (param=ref
ref=FIRST);
model NMPO_only=race_cat IRSEX IRSEX*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) age_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat age_cat age_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
```

```
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) rural_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat rural_cat rural_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) edu_cat (param=ref
ref=LAST);
model NMPO_only=race_cat edu_cat edu_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) employment_cat
(param=ref ref=FIRST);
model NMPO_only=race_cat employment_cat employment_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat  (param=ref ref=LAST) mar_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat mar_cat mar_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) HI_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat HI_cat HI_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
```

```
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) cig_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat cig_cat cig_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) abusealc (param=ref
ref=FIRST);
model NMPO_only=race_cat abusealc abusealc*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) depress_cat
(param=ref ref=FIRST);
model NMPO_only=race_cat depress_cat depress_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) spdyr (param=ref
ref=FIRST);
model NMPO_only=race_cat spdyr spdyr*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) DU_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat DU_cat DU_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
```

```
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) DA_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat DA_cat DA_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) STD_cat (param=ref
ref=FIRST);
model NMPO_only=race_cat STD_cat STD_cat*race_cat;
run;

Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=FIRST) race_cat (param=ref ref=LAST) year (param=ref
ref=FIRST);
model NMPO_only=race_cat year year*race_cat;
run;

*Models;
Ods pdf file="H:\Thesis\ModelOutput";
*Unadjusted Model 1;
Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=LAST) race_cat (param=ref ref=LAST) year (param=ref
ref=FIRST);
model NMPO_only (desc)=race_cat year race_cat*year;
output out=look pred=pred_probs;
run;

proc means data=look;
class race_cat year;
var pred_probs;
run;

*Adjusted Model 2;
Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
```

```
class NMPO_only (param=ref ref=LAST) race_cat (param=ref ref=LAST) year (param=ref
ref=FIRST) edu_cat (param=ref ref=FIRST) employment_cat (param=ref ref=FIRST)
rural_cat (param=ref ref=FIRST) HI_cat (param=ref ref=FIRST);
model NMPO_only (desc)=race_cat year race_cat*year edu_cat employment_cat rural_cat
HI_cat;
output out=look pred=pred_probs;
run;

proc means data=look;
class race_cat year;
var pred_probs;
run;

*Adjusted Model 3 (Add age and Sex);
Proc surveylogistic data=final;
cluster VEREP;
strata VESTR;
weight wt ;
class NMPO_only (param=ref ref=LAST) race_cat (param=ref ref=LAST) year (param=ref
ref=FIRST) edu_cat (param=ref ref=FIRST) employment_cat (param=ref ref=FIRST)
rural_cat (param=ref ref=FIRST) HI_cat (param=ref ref=FIRST) IRSEX (param=ref ref=FIRST)
age_cat (param=ref ref=FIRST);
model NMPO_only (desc)=race_cat year race_cat*year edu_cat employment_cat rural_cat
HI_cat IRSEX age_cat;
output out=look pred=pred_probs;
run;

proc means data=look;
class race_cat year;
var pred_probs;
run;

ods pdf close;
```