A STATEWIDE ANALYSIS OF THE SOCIAL DETERMINANTS OF OPIOID-RELATED DEATHS IN OLDER ADULTS

by

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This dissertation was prepared under the direction of the candidate's dissertation advisor, Dr. Ruth M. Tappen, Department of Nursing, and has been approved by all members of the supervisory committee. It was submitted to the faculty of the Christine E. Lynn College of Nursing and was accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

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Background: Opioid-related deaths remain a significant public health problem in the United States. Opioids cause approximately 75% of all drug-related deaths. Since 1999, nearly half a million Americans have died from opioid overdoses. In 2018, 9,290 people ≥ 55 years old died from opioid overdoses in the United States. In Florida, more than 1,000 older adults died from opioids (as a cause of death) from 2014-2018. However, there is a dearth of research about the manner of deaths of older adults who used, misused, or abused opioids.

Methods: This secondary analysis utilized data from the Florida Drug and Law Enforcement (FDLE) agency between 2014 - 2018. A generalized linear model with a normal probability distribution was used to examine which social determinants or factors such as race, income, education level, percentage of people in poverty, and population density predicted opioid death rate in Florida. Chi-square statistics were used to determine the association between gender, race, and opioid-related deaths (ORD), and the relationship of the manner of death to the opioid drugs involved. The trend of opioid death rate was also analyzed by Florida county and through the data years 2014 to 2018.

Results: A total of 4,241 cases of decedents $\geq$ 65 years old with opioid-related deaths were analyzed. One thousand seven of them had opioids as a cause of death (COD). Older adults who died from opioids (COD) were primarily non-Hispanic whites (93.04%); 56.50% male versus 43.50% female; 56% died from accidents (unintentional deaths), while 39.92% died from suicides. Most of these deaths happened in metropolitan or urban counties (96.82%). Gender had a significant association with ORD ($p < .001$), and the relationship between the manner of death to the opioid drugs involved showed statistical significance ($p < .001$). Education level was a significant predictor of opioid death rate ($p < .003$).

Conclusion: Opioid-related deaths pose a significant problem in older adults, particularly those deaths that resulted from accidents and suicides. The study results have significant practice implication in promoting patient safety and reducing risks, which calls for a harm reduction program tailored for older adults in affected counties or communities.

DEDICATION

I dedicate this work to all the people out there who combat substance use disorders, particularly opioids, and those who have unfortunately fallen to drug-related deaths. To all the healthcare providers, especially our nurses who untiringly care for the sick and those suffering from pain, your efforts and dedication are not forgotten.

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A STATEWIDE ANALYSIS OF THE SOCIAL DETERMINANTS OF

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CHAPTER 1: INTRODUCTION

The United States is still in the midst of an opioid crisis. Since the opioid epidemic was announced as a national health emergency in October 2017, deaths from drug overdoses remain unabated. There were 70,237 drug overdose deaths in the United States in 2017 alone; 47,600 (67.8%) of this drug-related mortality involved opioids (Wilson et al., 2020). Opioid-related mortality accounts for more than 130 deaths a day (Health Resources and Services Administration [HRSA], 2020). Opioids are a major contributor to this alarming death rate from all drug-caused deaths across different age groups (Rudd et al., 2016), particularly among older adults (Beauchamp et al., 2018; Center for Medicare and Medicaid Services [CMS], 2017). In 2018, 9,290 people $\geq$ 55 years and above died from opioid overdoses in the United States (Kaiser Family Foundation, 2018a). More than half a million Americans had lost their lives from opioid overdoses (including prescription opioids, heroin and synthetic opioids) from 1999 to 2019 (Centers for Disease Control and Prevention [CDC], 2021a).

Failure to address the U.S. opioid crisis comes with a hefty price. Simmons-Duffin (2019) reported that the real cost of this opioid epidemic in the United States had reached $179 billion in 2018 alone, $72.6 billion for overdose death-related costs and $60.4 billion for healthcare costs; while the rest was spent for criminal justice, child and family assistance, and education. Understandably, it is difficult to put some solid numbers or costs on this opioid epidemic's effect on the affected persons, families, and communities. Several resources have been mobilized to mitigate deaths from drug overdoses. For instance, the U.S. Food and Drug Administration approved the use of Medication-Assisted Treatment (MAT) such as Buprenorphine, Naltrexone, and Methadone to reduce the cravings and other addictive effects of opioids, i.e., euphoria (Howard et al., 2019). More than $1 billion in grants has been awarded to study the opioid epidemic in the search for evidence-based solutions to the problem (U.S. Department of Health and Human Services [HHS], n.d.). The CDC developed guidelines for prescribing opioids for chronic pain to enhance communication between providers and patients about the risks and benefits of opioids (CDC, 2016).

These efforts yielded positive results. Gladden et al. (2019) reported an overall decrease in opioid-related deaths by almost 5% in 2018; without co-involvement with illicit opioids such as illicitly manufactured fentanyl (IMF), the opioid-related deaths decreased by 10.6% in 2018. However, IMF deaths saw an 11.1% increase overall in 2018, IMF and heroin co-involved deaths went up 9.4%, fentanyl analogs by 11.4%, and fentanyl analogs and heroin by 33.0% (Gladden et al., 2019). Although this recent report by Gladden and colleagues (2019) covered 25 states in the United States, including Florida, and provided an overview of opioid-related mortality from July-December 2017 to January-June 2018, it did not focus primarily on opioid-related deaths among older adults.

Gomes et al. (2018a) reported that opioid misuse among people $\geq$ 50 years old was expected to double between 2004 to 2020 (from 1.2% to 2.4%) due to the persistent increase in opioid prescriptions. Schieber et al. (2020) reported that people 65 years and older in the United States had the highest increase in opioid prescriptions in 2018 at 25%, about 4.1 prescriptions per person, compared to 19.1% in American adults, or 3.6 opioid prescriptions per person. One reason cited for this prescription increase was the growing number of older adults with opioid use disorder (OUD), where 6 out of 1,000 Medicare beneficiaries were diagnosed with OUD (CMS, 2017). Also, older adults' opioid-related emergency department visits in the United States significantly increased by 112.1% from 2004-2014 (Weiss et al., 2018) while opioid-related deaths among people 55 years and older accounted for 18.4% or 7,762 out of 42,245 opioid-related deaths in the United States in 2016 (Gomes et al., 2018a).

This study focuses on opioid-related deaths (ORD) in older adults in Florida. Older adults in this study, were decedents 65 years old and over. This study aims to describe the social determinants of ORD in people $\geq$ 65 years and above and examine Florida counties' characteristics with the highest number of opioid related deaths. Further, this study addressed a knowledge gap identified in a systematic review conducted by Suriaga and Tappen (2020) about a lack of longitudinal studies on the consequences of opioid use in long-term care. This retrospective study utilized the Florida Department of Law Enforcement (FDLE) Medical Examiners Commission annual drug reports from 2014 to 2018 for secondary data analysis.

Background

Opioid Crisis in the United States: How Did It Start?

The CDC (2021b) reported three waves with which to understand the phenomenon of the opioid crisis in the United States and its pathogenesis. According to the CDC (2021b), the first wave started in the 1990s when there was a surge of opioid prescriptions in the country. The second wave commenced in 2010 when heroin was a significant contributor to drug overdose deaths, and the third wave began in 2013 when drug overdose deaths involved synthetic opioids such as illicitly manufactured fentanyl or IMF (CDC, 2021b).

The surge in opioid prescriptions could be explained in the following manner. In the 1990s, pain was incorporated as a fifth vital sign (along with blood pressure, temperature, respiratory rate, and heart rate) (Morone & Weiner, 2013). Morone and Weiner (2013) reported that when a patient complained of pain, it was expected that the provider must address this subjective symptom. Thus, the national push to adequately manage pain, which was endorsed by the American Pain Society, the Veterans Health Administration, and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), led to excessive opioid prescribing by medical providers (Guy et al., 2017; Morone & Weiner, 2013). And this over-prescription of opioids contributed to an opioid crisis where thousands of people died from an opioid overdose. The age-adjusted drug overdose mortality rate more than doubled from 2000 to 2014, with 3,074 deaths recorded from a drug overdose in 2014 alone (Rudd et al., 2016).

Guy and colleagues (2017) reported that medical providers' excessive prescriptions of opioids are considered the primary reason for the opioid crisis. There are many reasons for opioid prescriptions. The Office of the Surgeon General of the HHS (2018) reported that typically, opioids had been used to treat pain. Reinecke and colleagues (2015) reported that opioids are given for acute and chronic pain and cancer pain symptoms, while Tilly et al. (2017) reported that opioids were prescribed for painful procedures, surgery, and debilitating condition like arthritis. Opioids effectively treat moderate to severe pain, cancer pain, and palliative pain treatment (Galicia-Castillo, 2016), and certain pain not relieved by other pain interventions (Stannard, 2018).

Studies showed that 50 million Americans suffer from chronic pain, with 20 million people with high impact pain (Dahlhamer et al., 2018). The percentage of older adults who complain of pain was higher than the general population (40% vs. 30%) (Le Roux et al., 2016). Chronic pain has been a significant health issue in older adults where pain affects a person's mobility, daily living activities, prolonged suffering, and eventual disability (Dahlhamer et al., 2018; Domenichiello & Ramsden, 2019). Dahlhamer and colleagues (2018) noted that chronic pain is a disabling health problem that has negative effects on individual persons, families, communities, and society in general. If left untreated, it significantly reduces a person's quality of life. Treatment of pain generates high health care costs (Dahlhamer et al., 2018). Rasu and colleagues (2014) reported that the cost of prescription analgesics prescribed for chronic pain totaled $17.8 billion a year.

Strickler and colleagues (2020) conducted a study on opioid prescribing behaviors in eleven states (including Florida) from 2010 to 2016 and found that opioid prescribing rates decreased between 14.9% to 33.0%. Preliminary findings of this study revealed that from 2017 to 2018, deaths from opioids such as fentanyl and fentanyl analogs as the cause of death in Florida showed a sharp decline from 14% to 7.2% for fentanyl, and 12.8% to 7.2% for fentanyl analogs, which is a contrast to the national finding of an 11% increase in illicitly manufactured fentanyl-related deaths of the same year (Gladden et al., 2019). In Florida, deaths from morphine showed a slight decrease from 10.3% in 2017 to 9.1% in 2018 (Florida Drug and Law Enforcement [FDLE], 2019).

The Scope of the Opioid Epidemic and Older Adults

Opioid-related deaths are not only confined to the continental United States. Other countries such as Canada (Public Health Agency in Canada, 2019), United Kingdom (Kimber et al., 2019), and Sweden, for instance (Andersson et al., 2020), also reported increasing rates of opioid mortality. The World Health Organization (WHO, 2018) reported that an estimated 34 million people worldwide had used opioids, and about 27 million people had opioid use disorders in 2016. Out of 450,000 people who died from drug overdoses in 2015, approximately 118,000 people died from opioid use disorders (WHO, 2018).

Let's look at the opioid-related deaths recorded in other countries. In Scotland, 1,187 people died from drug-related overdoses in 2018, which involved one or more opiates, including heroin, morphine, and methadone (Kimber et al., 2019). There was a 6% increase in drug-related deaths in Scotland from 1,187 in 2018 to 1,264 in 2019, in which more than half of the total drug-related deaths involved heroin and morphine (National Records of Scotland, 2020). In England, there were 1,829 opioid-related deaths in 2017 (doubled from 2007) (Kimber et al., 2019). Meanwhile, Canada has more than 13,900 opioid-related deaths from January 2016-June 2019 (Public Health Agency of Canada, 2019). In Australia, opioid deaths increased by 21.9 per million in 2001 to 36.2 per million in 2012 (Roxburg et al., 2017); and Sweden recorded a 181% increase in drug-related deaths from 2006 to 2014 (2.77 to 7.79 per 100,000 people), which could be attributed to prescription opioids (Fugelstad et al., 2019).

The United Nations Office on Drugs and Crime (2019) reported that opioids accounted for two thirds of drug-related deaths globally, which was 30% higher than a decade ago. Also, the United Nations Office on Drugs and Crimes (2019) reported that drug use among older adults has been increasing faster than the younger population, drug use disorders among older adults received little attention. The Substance Abuse and Mental Health Services Administration (SAMSHA) (2017) acknowledged that although the percentage of opioid misuse among older adults (50 years old and over) was smaller compared to the younger population (18-25 years old), 2.0% vs. 8.1%, opioid misuse among older adults was higher in 2014 than in 2002-2011. The Agency for Healthcare Research and Quality or AHRQ (2019) reported a national opioid crisis in older adults.

The Adverse Effects of Opioids

Meanwhile, Reinecke and colleagues (2015) reported that opioids alone are not effective in reducing pain intensity. Opioids also have adverse effects that pose a significant threat to one's health and well-being. Opioid overdose can lead to sedation, respiratory depression, confusion, constipation, toxicity (National Institute on Drug Abuse [NIDA], 2020a), and fractures in older adults (Saunders et al., 2010).

Aldomovar and Nahata (2019) reported that older adults who use opioids chronically (or those having at least 84 days or more supply of opioids) are more likely to use other drugs such as muscle relaxants and benzodiazepines, which could complicate the problem of an opioid’s adverse effects. This practice of using other medications to counteract the adverse effects of opioids, such as antiemetics, leads to polypharmacy (Masnoon et al., 2017; Rochon, 2019), increasing the risks of drug-to-drug interactions (Lam, 2019), and contributing to increased emergency room visits and increased hospitalizations (Owens et al., 2014; Weiss et al., 2018). Opioid prescription misuse could result in serious medical outcomes, including death (West & Dart, 2016). In addition, opioid-related deaths have contributed to a drop in U.S. life expectancy from 78.9 in 2014 to 78.6 in 2016 (Stein, 2017). Life expectancy is a vital indicator of a country's overall well-being (Stein, 2017).

Understanding the Etiology of Opioid-Related Deaths

Schiller and Mechanic (2019) reported that pain is the primary reason that people seek medical care. Pain can vary from acute to chronic pain, from nociceptive to neuropathic pain depending upon nature, location, and pain duration. While acute pain is usually of short duration (usually lasts less than 3 months to 6 months), chronic pain persists and lasts for weeks, months, and even years (National Institute of Neurological Disorders and Stroke, n.d.). Opioids are often prescribed for moderate and severe pain (Schiller & Mechanic, 2019). In older adults with persistent pain, opioids should be prescribed at the lowest possible dose to prevent adverse effects (Galicia-Castillo, 2016). Tilly and colleagues (2017) reported that older adults pose higher risks for adverse effects from opioid misuse, including injury, hospitalizations, emergency room visits, and death.

Schiller and Mechanic (2019) reported a similar finding from the CDC (2019) about the etiology of opioid-related deaths: overprescribing opioids. In 2017, CDC (2019) further reported that more than 17% of Americans had an opioid prescription, or 58 opioid prescriptions per 100 Americans. Chronic opioid use could have cumulative changes in the brain chemistry, leading to drug tolerance or a need for a higher dosage to achieve the same result (Mercadante et al., 2019). Opioid overdose happens when there is an over-stimulation of the opiate pathways, which leads to decreased respiratory effort or respiratory depression, and possibly death (Schiller & Mechanic, 2019). The etiology of opioid overdose is summarized as follows: complications of substance abuse, unintentional overdose, intentional overdose, and therapeutic drug error (Schiller & Mechanic, 2019). On the other hand, the risks for opioid overdose are often found in the following persons: those that take more opioids than what is prescribed, return to use after cessation, those with severe medical and psychiatric conditions such as depression, HIV, and lung/liver disease, those who combine opioids with sedative drugs, male gender, younger (20-40), and non-Hispanic whites (Schiller & Mechanic, 2019). These findings are vital in the understanding of opioid overdose and the rising opioid-related mortality.

Opioid-Related Deaths in Florida

There are two compelling reasons why this researcher chose to study opioid-related deaths among older adults in Florida. First, Florida was one of the top states in the United States being affected by the opioid crisis. Lee et al. (2014) reported that Florida was at the center of the country's prescription drug epidemic. Although there was a 5% reduction in drug-related deaths in Florida from 2017 to 2018 and a 13% reduction in opioid-related deaths from 2017 to 2018; other opioids were found as the cause of death increased; for instance, codeine increased from 69 to 85 deaths and hydromorphone from 175 to 193 deaths from 2017 to 2018 respectively (FDLE, 2018; FDLE 2019). Further, morphine occurrences increased from 5.7% in 2017 to 6.3% in 2018 in Florida (FDLE, 2018; FDLE, 2019).

Kiang and colleagues (2019) reported the geographical distribution of opioid-related deaths (ORD) across the country by opioid type from 1999-2016. Florida was one of the three hot spot states for ORD where the age-adjusted mortality rate (or risk of dying relative to a general population) more than doubled every 2 years (the other states were the District of Columbia and Pennsylvania) (Kiang et al., 2019).

The second reason is that Florida ranks among the top states in the United States with the highest percentage of adults 65 and older—20.5% of its total population in 2018, second only to Maine with 20.6% (Himes & Kilduff, 2019). Regarding the total number of adults aged 65 and above, Florida ranks second with 4,358 per thousand, with California first with 5,669 per thousand, and Texas third with 3,602 per thousand.

Kennedy-Hendricks et al. (2016) examined opioid overdose deaths in Florida, focusing on the pill mill crackdown. Parallel with the increase in opioid prescriptions and rise in pill mills in Florida from 2003 to 2010, there was also a sudden increase in mortality rate from prescription opioid overdoses (Kennedy-Hendricks et al., 2016). This study revealed that the government's efforts in cracking down pill mills, and suspension of Drug Enforcement Administration (DEA) registrations of some pain clinics and providers involved in opioid prescription misuse had resulted in a reduction of opioid-related deaths (Kennedy-Hendricks et al., 2016). Also, Florida put into effect new state laws in October 2010, limiting dispensation of opioids to a 72-hour supply and prohibiting the advertisement of narcotic analgesics (Kennedy-Hendricks et al., 2016). In 2009, the Florida Legislature created the Electronic-Florida Online Reporting of Controlled Substance Evaluation program (E-FORCSE) to reduce drug abuse and enhance safer drug prescribing. In July 2011, a new Florida state law prohibited physicians from dispensing narcotic analgesics such as opioids onsite and increased penalties to pain clinics and medical practitioners involved in medication diversion (Kennedy-Hendricks et al., 2016). These efforts at the state level have reduced opioid-related deaths and saved approximately 1,023 lives in the process (Kennedy-Hendricks et al., 2016).

The FLDE Medical Examiner Commission (2019) reported 2,773 ORDs in Florida in 2018; 1,841 of these deaths deemed opioids the cause of death, 312 fewer than in 2017 or a 10% decrease. A literature search revealed no multi-year investigation of the social determinants of the opioid-related mortality study, which focuses primarily on older adults in Florida, that have been conducted thus far. A need exists to investigate opioid-related mortality, specifically among older adults. Thus, this research on ORD among older adults is urgently needed.

This researcher aimed to describe the social determinants of ORD among older adults in Florida. This study examined the association of gender and race to opioid-related deaths, and examined the association of county characteristics such as population density (metropolitan or urban vs. nonmetropolitan or rural), median household income, education level, and percentage of people in poverty per Florida county to opioid death rate. The manner of death (accident, homicide, natural causes, i.e., disease or diagnosis, suicide, and from undetermined causes) of older adults with ORD in Florida were also examined. The long-term goal of this multi-year (2014-2018) analysis was to provide scientific evidence about the social determinants of health of opioid-related deaths in older adults that could provide direction for development of strategic interventions by government agencies and other stakeholders and for future opioid research.

The Importance of Conducting Research on Opioid-Related Deaths in Older Adults

The Office of Disease Prevention and Health Promotion (ODPHP, n.d.) reported that 46.3 million people in the United States are 65 years old and above. This number is projected to increase to 98 million by 2060 (ODPHP, n.d.). The growing number of older adults is a legitimate concern since aging adults have higher risks of chronic disease. Further, ODPHP (n.d.) reported that in 2012, 60% of older adults experienced having two or more chronic diseases such as diabetes, heart diseases, cancers, bronchitis, Alzheimer's disease, and strokes. Unfortunately, some of these diseases are associated with moderate to severe pain requiring opioid treatment.

Kochanek et al. (2019) reported that 2,813,503 people died in the United States in 2017 alone. The age-adjusted death rate in the United States was 731.9 deaths per 100,000 population in 2017, with a 0.4% increased rate from 2016 (Kochanek et al., 2019). The leading causes of death among people ≥ 65 years and over (older adults) were heart disease, cancer, and chronic lower respiratory disease (CDC, n.d.a); which were nearly the same as the leading causes of death in the total population in the United States in 2017—heart disease: 647,457; cancer: 599,108 deaths; accidents (unintentional injuries): 169,936, intentional self-harm including suicide: 47,173 (CDC, n.d.a; Xu et al., 2020). The national prescription opioid deaths increased from 3,442 in 1999 to 17,029 in 2017 (NIDA, 2020b). The exact figure for older adults in terms of opioid-related death nationwide varied among racial/ethnic groups (Lippold et al., 2019).

Although ORD was not on the list of the leading causes of death, opioids remained a significant driver of drug-related poisoning, which in turn was the leading cause of preventable death among people 23-67 years old (Injury Facts, n.d.). Among the list of preventable deaths in this age group (23-67) were heart disease, cancer, intentional injuries, chronic lower respiratory diseases, stroke, and Alzheimer’s. On the other hand, suicide remained at the bottom of the leading causes of death in the U.S. general population—14.2 deaths per 100,000 in 2018. This study included the manner of death in older adults with opioid-related deaths, in which suicide was one of them (another manner of death included accidents, homicide, natural cause, and undetermined cause).

While Gladden and colleagues (2019) highlighted an increase in illicitly manufactured fentanyl-related deaths by 11% in the United States from December 2017-January-June 2018, this report did not cover the prevalence of opioid or illicitly manufactured fentanyl overdoses among older adults. There was a government warning that exposure to fentanyl could kill people, where touching and inhaling fentanyl could result in disorientation, coughing, sedation, and even cardiac or respiratory arrest (U.S. Drug Enforcement Administration [DEA], 2016). The DEA (2016) reported that 13,002 exhibits of fentanyl were tested nationwide and found that fentanyl was 40-50 times more potent than heroin. The lack of longitudinal studies on the effects of opioids on the aging population, specifically the opioid mortality rate in older adults, was identified as a research gap. In this study, I highlighted the prevalence of opioid-related mortality in older adults, including synthetic fentanyl. This study also examined the relationship of the manner of deaths to the drugs involved among older adults.

The CDC (2019) reported that the overall rates of opioid prescriptions filled decreased in 2018 (i.e., a 30-day supply of opioid prescriptions dropped by 29.4% from 2006-2018). However, the rate of drug overdose mortality continues to increase and remained a public health challenge (CDC, 2019). Older adults posed a greater risk of opioid-related deaths due to prescription opioid misuse, resulting in accidents and mental functioning changes (Chang, 2017; Schepis et al., 2018). Weiss and colleagues (2018) reported that almost 125,000 hospitalizations of older adults in the United States were due to opioids. Besides, those 65 and older persons have the highest increase (25%) of at least one prescription fill for an opioid (CDC, 2019). Research on the consequences of opioid use among this age group is sparse. Jensen-Dahm et al. (2015) pointed out that more evidence was needed about the potential consequences of opioid use among the elderly population. They reported that more older adults (41%), particularly in nursing homes, received prescription opioids, which could be problematic given the FDA warning of increased adverse effects among this age group. Although the proportion of opioid-related deaths in people $\geq$ 65 years was less than that of younger age groups (i.e., 25-54 years old), the consistent increase of opioid-related deaths in older adults nevertheless warranted a careful investigation (AHRQ, 2019; Lippold et al., 2019).

Phenomenon of Interest

The phenomenon of interest in this study was the social determinants of opioid-related deaths in older adults. Social determinants of health are conditions or circumstances in places where people live (home and neighborhoods), work, play, worship, and age that have an impact on their health and quality of life including life expectancy (CDC, 2020f). Social determinants of health include the demographic characteristics of the places where people live such as access to healthcare resources or drugs, education, disposable income; for example, where people could afford to buy a house in a safe neighborhood, with better school and so on. The socioeconomic well-being of people may have a great effect in their health outcomes (Altekruse et al., 2020).

Understanding the social determinants of health of opioid-related deaths (particularly among people 65 years old and above) was vital in elucidating disparity and possible root causes of the opioid crisis (Dasgupta et al., 2018). Structural racism for instance, has been associated with increased risk for drug use and overdose (Minnesota Department of Health, n.d.). In a study conducted by Jinakiram et al. (2018), it was reported that non-Hispanic Whites and African Americans were more likely to receive an opioid prescription than were Hispanics, while Blacks who complained of back pain were less likely to receive an opioid prescription than whites (Dickason et al., 2015).

Problem Statement

Since 1999, opioid overdose deaths have been steadily increasing in the United States. Gomes and colleagues (2018a) reported a 345% increase in opioid-related deaths in the country from 2001-2016. From 2014-2018, more than 4,000 older decedents ($\geq$ 65 years old) in Florida had prescription opioids and non-prescription opioids in their system, i.e., heroin. The sunshine state was considered the epicenter of the opioid epidemic, where it recorded 8.1 drug related deaths per 100,000 population in 2001, then increased to 17 deaths per 100,000 population in 2010 (Lee et al., 2014).

The percentage of people 65 years old and above was higher in Florida than the U.S. percentage of older adults (20.9% vs 16.5%) based on the 2019 population estimates (U.S. Census Bureau, n.d.). Four counties in Florida were ranked in the top 10 U.S. counties with a higher number of older adults. Sumter, a small metropolitan county in Florida, registered the highest percentage of people 65 and above at 52.9%, followed by Charlotte at 37.7% (second), Citrus at 35.2% (tied with Lancaster, Virginia) at fourth place, and Sarasota county at 33.9% (tied with Llano, Texas) in 10th place (Kent, 2015). The percentage of older adults seeking treatment for opioid use disorder had increased by 53.5% from 2013-2015 (Huhn et al. 2018), while opioid-related deaths among rural older adults also increased (3.7% of the 4,578 deaths in U.S. rural areas in 2015). Although there was a reduction in the number of deaths from opioid overdoses in 2018 (FDLE, 2019), still 14.4 million of the 43.6 million Medicare Part D beneficiaries received opioids in 2017, 80% of which were opioids with the highest abuse potential (Office of Inspector General, 2018). In 2018, the Office of the Inspector General or OIG in the United States reported that 354,000 Medicare Part D beneficiaries were prescribed opioids or almost 3 out of 10, with nearly 50,000 of them facing serious overdose (OIG, 2019).

Meanwhile, the use of Naloxone (drug involved in reversing opioid overdose and used for Medication-Assisted Therapy or MAT) more than doubled from 2017 to 2018, which was a good sign that more Medicare part D beneficiaries were availing themselves of treatments (OIG, 2019). However, the outcome of opioid use/overdose among older adults remained uncertain.

There was a dearth of research about the outcomes of opioid use in older adults (Carew & Comiskey, 2018; Larney et al., 2015). A need existed to investigate the social determinants of the opioid-related deaths in this vulnerable population. Determining social determinants of health such as gender and race/ethnicity is critical in understanding disparities in opioid treatment and opioid deaths (Barocas et al., 2019; McClellan, 2019). This study aimed to provide evidence on the opioid-related deaths among this vulnerable population.

Significance of the Study

The results of this study will inform nursing practice, research, administration, and education. Findings from this study elucidated the use of opioid drugs that have high abuse potential, leading to drug overdoses in this vulnerable population. This study could help foster the provider's perception of clients taking opioids and identifying clients who are at risk for misusing opioids. Moreover, this study's findings add more evidence to the contemporary state of opioid research, particularly in older adults and can inform prevention strategies.

While research on the social determinants of opioid-related death is limited, this study focused on the sociodemographic factors such as population density (i.e., metropolitan or urban versus nonmetropolitan or rural counties), median household income, average education level, and percentage of people in poverty in Florida, and determined which of these factors were strong predictors of opioid death rate. Knowing these predictors of opioid death rate is important in identifying patterns of opioid overdoses and improving treatment targets in affected communities. Increased public awareness about the appropriate use of opioids and the negative consequences of opioids when misused or abused was another valuable contribution of this study.

Of paramount importance is a gap in research regarding the social determinants of opioid-related deaths in older adults. There was a minimal amount of literature published on this subject that focused on older adults. There is a critical need to better understand the social determinants of ORD in older adult, particularly the county characteristics where they died. Evidence suggested that a reduction in opioid prescription was not proportional to reducing opioid mortality (Dasgupta et al., 2017). Instead, Dasgupta and colleagues (2017) argued that knowing the root cause of drug-related deaths, particularly opioids, was necessary to address the opioid epidemic, including understanding the social and economic variables, i.e., race/ethnicity, income, education, poverty, and healthcare access. Rollston (2018) reported that while we have access to information about the social determinants of health, this area has not been fully explored in the opioid crisis. The National Institute of Health (NIH, 2018), through its Helping to End Addiction Long-term (HEAL) Initiative, acknowledged that more research is needed to better understand the higher rates of substance abuse, suicide, drug overdoses, particularly opioid use across the lifespan (NIH, 2018). Specifically, NIH (2018) identified areas of opportunity for research and target interventions through its HEAL Communities Study which aimed to integrate efforts from various stakeholders in state and local governments to address the opioid crisis in urban and rural communities. Also, NIH (2018) urged that any changes in social and economic policy should be based upon the current research on the social factors underlying the opioid epidemic, which has strongly influenced the opioid use disorder and opioid-related deaths. This study aligned with the NIH HEAL initiative to accelerate solutions to the opioid crisis using evidence-based research by exploring the social determinants of opioid-related deaths.

The information generated from this secondary data analysis would be beneficial to government agencies such as the Food and Drug Administration, Drug Enforcement Agency, the Department of Justice (Soelberg et al., 2017), as well as policymakers at the state level, including Florida, thus informing efforts to reverse the death epidemic from drug overdoses. This study underscored the Florida county characteristics where the older adults who died from an opioid overdose or those who had opioids in their system at the time of death, such as gender and race, population density, whether it is a metropolitan (urban) or nonmetropolitan (rural) county, also the median household income, average education level, and percentage of people in poverty.

For caring science, this study on opioid-related mortality was linked to patient outcome (i.e., improve care and outcomes), which could impact organizational structure and healthcare delivery (Priest & McCarty, 2019), thus making it relevant and valuable to the discipline of nursing. Olshansky (2017) posited that nurses played a critical role in improving health by linking the social determinants of health or SDH to health outcomes, in this instance, reducing harms from opioid use.

Purpose of the Study

This study has the following purposes: (a) Determine the association between gender and opioid-related deaths, as well as between race and opioid-related deaths in older adults in Florida. (b) Examine the county characteristics such population density, education level, median household income, percentage of people in poverty, and proportion of race to opioid death rate. The county characteristics mentioned above were part of the social determinants of opioid-related deaths in older adults. (c) Determine whether there was a relationship between the manner of death and the opioid drugs involved among older adults who died with opioid as a cause of death. (d) Analyze the trend of opioid death rate in Florida by county and through the study period using data from FDLE between 2014 and 2018.

Also, the purpose of this study aligned with the Drug Enforcement Agency priorities in addressing the opioid crisis through research (National Institute of Justice [NIJ], 2019). This study's long-term goal was to add evidence to the contemporary state of opioid research, particularly in older adults, where there is a dearth of research about the negative consequences of opioid use and misuse among this vulnerable age group.

Connection to Caring Science

The connection of opioid-related deaths to caring science is evident in the principle of primum non nocere or “first, do no harm.” Evans (2016) explained this principle of “first, do no harm” as a foundation for medical care grounded in the concept of beneficence or the duty not to harm others. This principle of “first, do no harm” also applies to other health-related disciplines, i.e., nursing. The duty to do good is at the heart of nursing science, where caring for others requires compassion, competence, confidence, commitment, conscience, and comportment, which in fact constitute the six Cs of caring by Roach (Chadwick, 2017). In other words, healthcare professionals, among other people, are duty-bound to do good deeds.

Opioid analgesics, prescribed for acute or chronic pain, are administered by nurses to ease the client’s pain and suffering. Opioids come with adverse effects such as respiratory depression, and when taken at a prolonged period, could cause addiction and harm, including death (Galicia-Castillo, 2016; Tilly et al., 2017). Dunn (2010) emphasized that as patient advocates, nurses must observe and put into practice the principle of nonmaleficence (not harm) and beneficence (do good) by providing safe care, which includes the right medication administration, monitoring for adverse drug effects, and proper reporting.

Rushton (2017) reiterated the nurse's ethical responsibility to social justice by addressing interests and keeping our patients’ health and well-being as a priority. Thornton and Persaud (2018) stressed that addressing the social determinants of health was nursing’s ethical obligation, which in turn played a pivotal role in reducing health inequity. Meanwhile, Olshansky (2017) posited that nurses had a critical role in improving health by linking the social determinants of health or SDH to health outcomes, in this instance, reducing harms from opioid use.

Nursing's caring philosophy was grounded in human caring and restoring human existence's wholeness, which defines the nursing profession (Boykin et al., 2010; Watson & Woodward, 2010). Part of this study's caring intention was to understand the social determinants of opioid-related deaths among older adults in Florida. The increasing mortality from opioid overdoses or toxicity was a significant health-related issue that affected our patients' holistic well-being and our society.

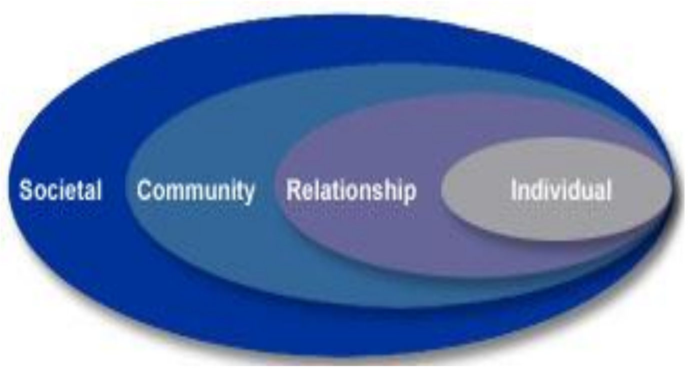
Theoretical Framework or Conceptual Model

This study utilized the Socio-Ecological Model in guiding our understanding of opioid-related deaths in older adults. Urie Bronfenbrenner first developed the socio-ecological model (SEM) in 1979 to understand the multiple factors or social influences that affect children and their development (Gilstrap & Zierten, 2020). Bronfenbrenner viewed children or individuals as dynamic entities that do not grow alone but within the context of relationships in the environment composed of families, friends, neighbors, community, and society, which influences the individual persons (Gilstrap and Zierten, 2020).

The SEM can also be used to examine the various levels of interactions in the physical and social environments that may contribute to health disparities in substance use (Minnesota Department of Health, n.d.). Additionally, SEM is useful in examining the root causes of complex health problems such as the opioid epidemic and elucidating the social determinants of opioid-related deaths (Healthy People 2020; CDC, 2020f). The CDC has used SEM as a framework for prevention by focusing on its four levels of interactions in the individual, relationship, community, and society areas to better understand a healthcare problem (CDC, 2020g). The Social-Ecological Model is seen as a feasible approach in measuring the interactions of the social determinants of health (Poux, 2017). To illustrate the levels of interaction in the SEM, see Figure 1.

Figure 1

Adapted Socio-Ecological Model Showing Levels of Interactions



Note. Source: CDC, 2020.

In this study, I also examined the social determinant variables at each level within the context of the socio-ecological model. For instance, at the individual level, gender, race, and age of deceased persons found in the FDLE reports from 2014-2018 were included in the analysis. Factors at the individual level could explain the difference in ORD among older adults based on their gender and race. Studies showed that more men died from opioid overdose than women (Benson et al., 2019), while more women had active opioid prescriptions at the time of death (Gomes et al., 2018b). Meanwhile, Altekruse and colleagues (2020) reported that whites accounted for the majority of opioid overdose deaths (80.7%) compared to other race/ethnic groups such as American Indian, Alaskan Natives, Asian and Pacific Islanders (1%), Blacks (8.2%), and Hispanics (7.3%) of opioid overdose deaths in the United States based on the American Community Survey from 2008-2015. Blacks suffered more deaths from opioid overdose in large central metro than whites (Lippold et al., 2019). The individual factors of gender and race were also reflected in Research Question 1, which asked whether there was an association between gender and race to ORD in older adults.

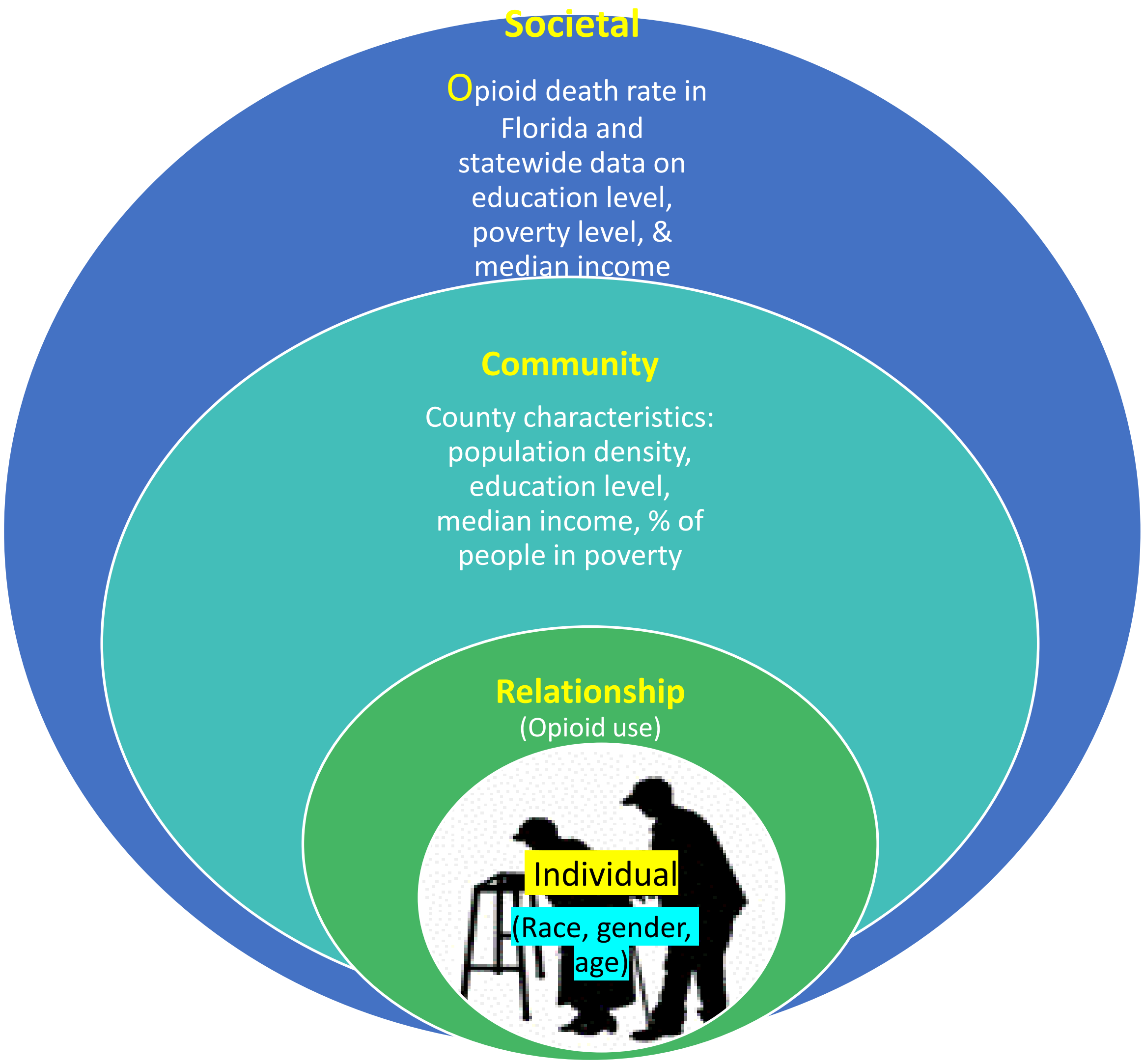
While other factors at the individual level, such as substance use and history of abuse (CDC, 2020g), could also contribute to opioid-related deaths, these factors were not included in the model since these data were not available in the FDLE reports. For the relationship that constituted the interpersonal level, access or use of opioids as evidenced by the presence of these substances in the decedent's system at their time of death, or as the cause of their death was included. However, the relationship of family history of a substance use disorder, for instance, was not included due to the unavailability of this information in the FDLE reports.

The county in this study represented the community level. The social determinants of ORD at the community level were population density or where the older adults live, either in the rural or urban county, average education level of the county (high school graduates or higher), percentage of people in poverty in a particular county, and median income level. One study showed that these factors in the community level such as low educational attainment and poverty could influence the propensity to drug abuse, including opioids; for instance, older adults who used opioids (as indicated by the drug being present at the time of death or as the cause of death), who also have lower education, may have a lower income, which could be attributed by lower economic opportunities in the rural area (population density) (Rollston, 2018). Thus, the research question on whether these social determinants of ORD (proportion of race, education, income, population density, percentage of people in poverty) predict opioid death rate was included in this study.

For the societal level, I utilized Florida-wide data such as the average percentage of people in poverty, average median household income, education level of high school graduates and higher, and proportion by race in Florida. These statewide data were obtained from the U.S. Census Bureau (n.d.). For instance, the proportion by race of White alone, not Hispanics or Latino in Florida, was 53.2%; the percentage of high school graduates or higher in Florida was 88.2%; the median household income (from 2015-2019) in Florida was $55,660.00; and the percentage of percentage of people in poverty was 12.7%. In this study, the data for the social determinant variables of race, income, education, and percentage of people in poverty by Florida counties were entered in the database as they appeared in the US Census Bureau (n.d.a). I also placed the opioid death rate in Florida (based upon the number of opioid-related deaths in older decedents (opioid as a cause of death) within study period (2014-2018) per population of older adults in the societal level of the socio-ecological model. I created a modified SEM using the social determinants variable used in the study. See Figure 2.

Figure 2

Modified Socio-Ecological Model for Opioid-Related Deaths in Older Decedents Based on the Study Variables



The Concept Tree

The applicability of the socio-ecological model to opioid-related deaths in older adults was further explained through a concept tree. Tappen (2016) emphasized the benefits of using a concept tree in articulating the theoretical framework. The theoretical framework (in this study, the socio-ecological model) was placed on top of a tree to guide our understanding of the interconnectedness between variables that might contribute to opioid-related deaths. The concept tree then branched out to proposition, to construct and dimensions, and to indicators. An illustration of this concept tree is found in Appendix A.

Proposition

The proposition used in the concept tree included older adults in communities with a high propensity to drug use such as counties with the above state average of people living in poverty, below state average education level of high school graduates and higher, in densely populated areas such as metropolitan counties, comprising people belonging to underserved racial/ethnic groups experience more opioid-related deaths. Opioid-related deaths were higher in economically disadvantaged areas (Pear et al., 2019). Structural racism was linked to increased substance use, such as opioids (Minnesota Department of Health, n.d.). Studies indicated that race was one factor in opioid-related deaths, where more whites died from opioid use than other racial or ethnic groups (Altekruse et al., 2020; Lippold et al., 2019). Opioid use puts older adults at greater risk for drug interactions and adverse drug effects (Barocas et al., 2019), including death (West & Dart, 2016).

Construct

The social determinants of opioid-related deaths comprised the construct of this concept tree. Studies showed that social determinants of health are conditions that lead to substance use, such as opioids. These conditions are found within the community where older decedents were found at a time of death with an opioid present in their system or with opioids as a cause of death.

Dimensions

The dimensions identified in the concept tree, which also corresponds to the socio-ecological model, are individual and interpersonal variables. Under individual dimensions are race and gender of older decedents, while interpersonal exposure was the opioid use resulting from either prescription from a healthcare provider or from someone from whom the older adults obtained the drugs found in their system.

Indicators

The indicators of social determinants of health under community are county characteristics such as population density (metropolitan or urban and nonmetropolitan or rural), average education level high school and higher, median household income, and percentage of people in poverty. These indicators were also reported as socioeconomic factors by Altekruse et al. (2020) and Hedegaard et al. (2018). Clinton et al. (2019) also reported these socioeconomic factors that were associated with opioid-related deaths. For instance, Altekruse et al. (2020) and Hedegaard et al. (2018) reported that younger adults (18-24) abused more opioids than older adults; males (74.7%) are more affected than females in terms of opioid overdose (Clinton et al., 2019); and non-Hispanic whites (78.8%) were more likely to die from opioid-related deaths than any other ethnicities (Clinton et al., 2019). In this study, older adults are defined as people 65 years and above with opioid-related deaths in Florida from 2014-2018.

The negative outcome of opioid use was opioid-related deaths, which was also manifested in the manner of death, such as accident, homicide, natural cause, suicide, and the undetermined cause, which consequently affect society at large. These outcomes (opioid death rate or the manner of death from opioid drugs resulting in the accident, homicide, natural cause, suicide, and undetermined cause) affect society and affect the person (in this study, the older adults).

Chapter Summary

Historically, opioids are prescribed for acute and chronic pain. There are approximately 50 million Americans with chronic pain (Dahlhamer et al., 2018). Understandably, patients expect that medical providers treat this disabling symptom. In the early 1990s, pharmaceutical companies assured medical providers that opioids are safe with no addictive properties. Actually, opioids come with adverse effects, addictive and deadly (CDC, 2017). The rising mortality rate from opioid overdoses is truly alarming with 70,237 recorded deaths in the United States in 2017 alone (Strickler et al., 2020). This deadly epidemic from opioid overdoses will continue to create havoc, not only in the economy in terms of socioeconomic cost ($179.4 billion total opioid costs in 2018 alone) (Simmons-Duffin, 2019), but its negative effects to the individual persons, families, and communities around the country, and in other parts of the world is truly profound.

The findings of this study will add evidence to the existing body of research on opioid use in older adults, particularly on the social determinants of ORD. This study on the social determinants of opioid-related deaths was linked to caring science as nurses took care of patients with pain, and pain medication often involves opioid medications included in this study. Understanding the social determinants of health, particularly in opioid-related deaths is akin to understanding health inequity, which is also a nursing social mandate (Thornton & Persaud, 2018).

Death from drug overdoses is clearly not a desirable patient outcome. So, understanding this deadly epidemic from opioids is paramount in providing pain-related care and patient education. It is hoped that it will provide additional knowledge to caring science and future opioid research and increase awareness about the devastating effects of opioids for appropriate surveillance, interventions, and treatment.

CHAPTER 2: LITERATURE REVIEW

The importance of the social determinants of opioid-related deaths in older adults was examined in this chapter. Social determinants of health include factors such as age, gender, race, county characteristics (based on household median income, average education level, population density [metropolitan or urban and nonmetropolitan or rural]), proportion of race, and the percentage of people in poverty to opioid-related deaths among the elderly population are explored. This chapter begins with a review of the related literature on the social determinants of health and its role in opioid-related deaths, followed by a review of the contemporary state of research on opioid deaths in older adults, and ends with a chapter summary.

The Role of Social Determinants of Health in Opioid-Related Deaths

Healthy People 2020 defined the social determinants of health as conditions found in the environment where people live, work, play, and age, including the socioeconomic factors such as education, income, and poverty level; as well as places or settings including neighborhood and workplace (Office of Disease Prevention and Health Promotion, 2020). Understanding the social determinants of health was a key factor in addressing health inequities. Health inequities could be translated as the preventable differences in health outcomes (Minnesota Department of Health, n.d.).

Rollston (2018) reported that living in poor communities or areas with lower socioeconomic status could pose risk factors for drug use and addiction, including opioids. Reduced healthcare access in rural areas or exposure to poorer communities with high crime rates and drug activities could predispose an individual to illicit drug use such as heroin or even misuse or abuse of prescribed opioids (Rollston, 2018). Also, education, the nature of the job, and income level could play a critical role in adapting social norms conducive to crime and drug use, while poor housing and lack of better job opportunities could lead to depression (Rollston, 2018).

Further, the AHRQ (2019) reported that older adults were more prone to develop adverse effects from opioids due to altered drug metabolism, cognitive decline, and dementia, which could compound the problem of unintentional opioid poisoning or overdosing.

Several studies on the social determinants of health were examined for their relevance to opioid-related deaths. Each of these social determinants or factors such as age, race, gender, median household income, education level, population density, and percentage of people in poverty in this paper was reviewed in light of the currently available studies. Few studies addressed opioid overdose deaths in older adults; one of them utilized the National Violent Death Reporting System in 2016 (Clinton et al., 2019); one study reported the sociodemographic predictors of prescription opioid use among older adults using wealth and education as contributors to opioid use (Grol-Prokopczyk, 2019). However, more research is needed to investigate the social determinants of opioid-related deaths in older adults, including county characteristics, especially at the state level.

The DEA, through the NIJ, a research arm of the U.S. Department of Justice, acknowledged the need for more research in combatting the opioid crisis (NIJ, 2019). One strategy identified in the DEA’s three-pronged approach was empowering the communities to take charge through community outreach in reducing opioid-related deaths. One critical step in this approach was identifying the most vulnerable population at risk for opioid-related deaths (Nechuta et al., 2018).

In a broader sense, there were several studies done on opioid-related mortality in general, meaning all age groups, but these studies did not focus on opioid-related deaths specifically among older adults, nor were they focused on the social determinants of opioid-related deaths in the older population (Hedegaard et al., 2018; Hser et al., 2017; King et al., 2014; McClellan, 2019; Nechuta et al., 2018; Veldhuizen & Callaghan, 2014). Indeed, opioid-related deaths or drug overdoses among the older population have received little attention (Carew & Comiskey, 2018; Larney et al., 2015). This study addressed that gap in research by examining the social determinants of opioid-related deaths in the elderly population. In this study, I examined the social determinants of health included age, gender, race, community, or county characteristics such as population density, whether it was an urban or rural county, education level (high school graduates or higher), median household income, and percentage of people in poverty in that county that could predict opioid death rates in Florida.

Age

Age was one factor unique to this study, given the target population of older adults. Clausen et al. (2009) investigated the age of opioid users in Norway from 1997-2003 and found that older opioid users were at greater risk of opioid-related deaths after leaving opioid maintenance treatment, while younger adults had a higher risk of death upon entering opioid maintenance treatment due to risk of overdose. While this study was not focused on analyzing opioid treatment effectiveness, comparing the age group in terms of opioid-related deaths was useful for this study.

Meanwhile, age had been implicated as a factor in opioid-related deaths. While older adults were vulnerable to drug adverse effects due to the aging process that slowed down drug metabolism and excretion, leading to increased toxicity (Covington & Higgins, 2016), a recent study by Santosa and colleagues (2020) reported that older adults who used opioids before a minor outpatient surgery had a 68% greater risk of dying within 90 days of surgery. Also, older adults who were considered opioid naïve and were newly prescribed with opioids within 30 days have a 15% increased mortality rate (Allen et al., 2015). On the other hand, Melix and colleagues (2020) reported that analysis of the social determinants of health among Florida neighborhoods revealed that being Hispanic (*B*: 0.06, $p < .001$) was a significant factor in life expectancy related to percentage of age dependent population such as < 5 years old and older adult (≥ 65 years old) (*B*: 0.13, $p < .001$); whereas percentage of household with no automobile (B: -0.05, p <.0001), and percentage of mobile homes (*B*: - 0.02, $p <.001$), and percentage of female as heads of household (*B*: - 0.02, $p <.001$) showed negative associations to life expectancy.

A recent study conducted by Altekruse et al. (2020) included the sociodemographic factors of age, gender, ethnicity, income, and dwelling location, i.e., urban vs. rural areas. Altekruse et al. (2020) reported that opioid-related deaths were more prevalent in people age 10-59 years old, while people 60-79 years old accounted for only 5.4% out of 13,620 people who died from opioid overdoses between 2008-2015 in the United States. Using the Mortality Disparities in American Communities (MDAC) study, Altekruse and colleagues (2020) reported that more males suffered from opioid-related deaths than females (60.5% vs. 39.5%); the majority of those were whites (80.7%). People with low socioeconomic status (SES) and those living in urban areas were more at risks for opioid-related deaths than those living in rural areas.

The differences of this study from that of Altekruse et al. (2020) are as follows: (a) Target population - Altekruse et al. (2020) included all age groups, while this study focused on decedents, 65 years old and above; (b) Altekruse et al. (2020) focused on opioid-related deaths nationwide, while this study encompassed opioid-related deaths in Florida. Thus, sociodemographic characteristics might vary; (c) Altekruse and colleagues (2020) utilized sociodemographic data such as age, gender, ethnicity, and rural vs. nonrural areas, useful for comparison purposes. This study expanded the variables to include county education levels, average median income, population density, and percentage of people in poverty to describe the county characteristics with the highest number of opioid-related deaths in older adults.

Meanwhile, Hedegaard et al. (2018) retrospectively analyzed drug overdose deaths in the United States from 1999 to 2017. Using the National Vital Statistics System, Hedegaard and colleagues (2018) reported that drug overdose deaths were lower in people 65 years old and above (6.9/100,000) as compared to other age groups, i.e., 25-34 years old (38.4/100,000), 35-44 years old (39.0/100,000), and 45-64 (37.7/100,000). Hedegaard and colleagues (2018) reported a similar result in drug overdose deaths that were higher in males (29.1%) than in females (14.4%) and lower in older people in 2017. Interestingly, this study by Hedegaard and colleagues (2018) focused on the age-adjusted rate comparison, useful in the study where older adults were the target population.

However, Hedegaard and colleagues (2018) did not examine the association of age, gender, and other social determinants of opioid overdose deaths nor the county opioid death rate per state.

Gender

Examining gender as a covariate in ORD was essential in determining whether disparity occurred in opioid use, misuse, or opioid-related death between men and women. Health experts from Yale argued that women were more likely to misuse opioids than men due to their higher pain sensitivity, and women who used addictive medications such as opioids were more likely to develop opioid use disorder than men (YaleNews, 2018). The report added that 28% of pregnant women who entered addiction treatment misused opioids in 2012 (YaleNews, 2018).

Choo et al. (2014) studied gender in opioid misuse in the emergency department. Using the 2011 data from the Drug Abuse Warning Network (DAWN), a nationally representative sample in the United States (N = 1,096,741), the researchers stated that the result revealed no difference in opioid-involved emergency room visits between men and women. However, there was a difference in outcome when other substances were involved. For instance, men who had opioid-involved emergency visits with alcohol and heroin were more likely to be hospitalized than those with opioids alone; while women who had opioid-involved emergency room visits with antidepressants or with illicit drug use were more likely to be hospitalized than those with opioids alone. For both genders, opioids, when taken alone, had a lower risk for hospital admissions—aOR = 0.65; 95% CI: 0.54-0.77 for females and aOR = 0.62; 95% CI: 0.46-0.83 for males. Also, death was rarely an outcome for both genders (Choo et al., 2014), which was quite the opposite of this study, where opioid-related death was the outcome variable.

In a different study where gender was one of the factors in opioid prescriptions, Benson et al. (2019) reported that women were more likely to receive opioid prescriptions for chronic long-term pain than were men (which was quite different from the findings of Altekruse et al., 2020; Clinton et al., 2019; Hedegaard et al., 2018). On the other hand, Beauchamp and colleagues (2018) conducted a study on sex differences in drug poisoning among older adults. This study by Beauchamp and colleagues (2018) did not indicate whether the drugs involved were prescriptions or not. They utilized data from the Toxicology Investigators Consortium (ToxIC) registry from January 2010 to December 2016. The data were entered by participating toxicologists at 79 facilities in the United States and Israel. Total cases (N = 51,441) included inpatient and outpatient settings, and 52.3% of the 2,930 older adults included in the study were females. Chi-square tests were used to analyze differences in the distribution of variables. Beauchamp and colleagues (2018) reported that female decedents had more drug adverse reactions than males (9.6% vs. 6.4%; $p < .001$). Females more likely to be evaluated for analgesics/opioids and cardiovascular medications than males by medical toxicologists (17.6% vs. 11.8%, $p < .001$), while males were evaluated for ethanol or alcohol intoxication (7.4% vs. 1%) than females (Beauchamp et al., 2018). No significant differences in death rates for drug-related poisoning such as benzodiazepines, stimulants, or illicit opioids between men and women ($p = .14$). Beauchamp and colleagues (2018) focused only on gender differences, while this study included other social determinants of

ORD such as race, population density, education level, median household income and percentage of people in poverty.

Race

Race was another factor to consider in opioid-related mortality. The U.S. population is becoming increasingly diverse. Knowing the patterns of opioid-related deaths among different racial/ethnic groups is important in creating culturally tailored interventions to curb the deaths from opioid overdoses in the communities (Lippold et al., 2019). It was reported that blacks $\geq$ 65 years old had the highest rate in drug overdose deaths in the United States at 123% from 5.2 to 11.6 per 100,000 from 2015 to 2017, and this involved any opioids; while synthetic opioids registered the highest increase at 533%, from 1.2 to 7.6/100,000 in large central metropolitan areas among this ethnic group (Lippold et al., 2019). Meanwhile, whites posted a 29% increase in opioid-involved overdose dose deaths from 2015 to 2017 in large central metropolitan areas in the United States among people 65 years and older (Lippold et al., 2019). There was no available number for the Hispanic group; Asians were not included in the study. The reasons cited for this difference in opioid-involved overdose deaths among these ethnic groups were the difference in opioid prescribing rates by the providers, underlying opioids and other substance use disorders, and the increase in illicitly manufactured fentanyl that scattered in the communities around the country (Lippold et al., 2019). This study by Lippold and colleagues (2019) focused only on race and age group and urban or metropolitan areas in the United States using the National Vital Statistics System from 2015 to 2017.

In contrast, the current study investigated other social determinants of ORD such as gender, population density (rural vs. urban counties), median income in Florida from 2014-2018, aside from age and ethnicity. In another study, researchers found that non-Hispanic whites and African Americans were more likely to receive opioid prescriptions than the Hispanic group, at least among those Medicaid patients undergoing dental procedures in the United States from 2013-2015 (Janakiram et al., 2018).

Meanwhile, Kashef (2018) reported that blacks who received opioid prescriptions long-term were more likely to be tested for illicit drugs than whites, and once they tested positive; their opioid prescriptions were discontinued, while approximately 90% of those patients who were tested positive, i.e., marijuana and cocaine, continued with their opioid prescriptions. Dickason et al. (2015) reported that African American patients who complained of back pain during the emergency visit were less likely to receive an opiate than whites (50% vs. 72%, $p < 0.001$). This retrospective study ($N = 2{,}461$) of chart reviews occurred between January 2007-December 2011, in an urban academic hospital in the Midwestern area in the United States. No significant difference in opioid prescribing among racial/ethnic groups with other diagnoses presented in the emergency department such as migraine and fractures (Dickason et al., 2015).

Population Density

Another key variable in describing the difference in opioid-related deaths among older adults was geographic location, particularly the county characteristics. Examining the county characteristics as to location, whether rural or urban county in terms of opioid-related death, was vital in explaining the differences in ORD and why people in the rural areas were turning to opioid use. Monnat and Rigg (2018) reported that the prescription opioid death rate was 16 times higher in the rural Midwest in 2016 than in 1999 (approximately 1,600% increase), while the rural Northeast of the country reported rates 11.1 times higher during the same year period (or approximately 1,141% increase). Monnat and Rigg (2018) attributed this increase in opioid death rate to social factors such as stigma, family ties (where a family member might share prescription opioids with other family members), and fewer high-paying job opportunities in the rural areas.

Benson et al. (2019) reported that more older adults turned to opioids in rural areas than in urban areas. Among the reasons why older adults in the rural areas used more opioids were low income, high unemployment, lack of access to healthcare or travel distance, and the nature of rural jobs that predisposed them to physical pain (Benson et al., 2019). It was important to investigate whether this finding was true in Florida, where more than half of its counties (37 of 67 counties) are categorized as rural counties (Rural Health Information Hub, n.d.). The database included differences in opioid-related deaths among Florida counties from 2014-2018.

Median Household Income

One county characteristic that could explain why people used more opioids was the household median income and the type of job most people had in that county. For instance, if more people worked on the farm that demands hard, manual labor or in rural areas requiring skilled labor, this kind of work might contribute to musculoskeletal pain. And this could explain the increased opioid prescription rate in that county. This reasoning aligned with the findings of Galicia-Castillo (2016), who reported that one of the common conditions that could cause pain in older adults was musculoskeletal pain and low back pain.

Monnat et al. (2019) conducted a county-level difference in overall drug mortality and opioid-related deaths in the United States using the U.S. census data from 2014-2016. Results revealed that drug-mortality was higher in counties with more economic disadvantages, with more blue-collar or service-oriented jobs, and higher opioid prescription rates. It was reported that counties with higher opioid-related deaths also have higher drug mortality rates. Rates of opioid overdoses, both prescription and illicit opioids, could also be found among counties with low socioeconomic status with a large concentration of service industry workers, congruent with prior studies (Monnat et al., 2019). On the other hand, heroin and all types of opioid-related mortality were more prevalent in urban counties with high proportions of professional workers and considered less economically disadvantaged (Monnat et al., 2019). The reason for this high heroin use in the urban county remained unclear.

This finding implied that efforts to curb opioid-related deaths should be locally or regionally tailored. Monnat et al. (2019) did not focus on older adults but county-level differences across the country. This study investigated Florida counties' characteristics with a high or low percentage of opioid-related deaths among older adults in terms of sociodemographic variables such as population density (metropolitan and nonmetropolitan counties), median household income, percentage of people in poverty and education level.

Education Level

The Helping to End Addiction Long-term Initiative (HEAL) of the NIH (2018) reported that death rates from drug overdoses, particularly opioids, were disproportionately higher among whites without a college degree. In March 2018, the

National Institute of Health (NIH) convened a panel of experts to discuss the socio-cultural and socioeconomic underpinnings of the opioid epidemic that plague the country. Those without a college degree were more likely to be affected due to decreased economic opportunities, which led to social despair, suicide, alcohol, and drug abuse (NIH, 2018). Additionally, Dosa et al. (2009) reported that people with low educational levels, such as below high school, had high rates of opioid use (55%).

In a study conducted by Chang (2017), which aimed to examine the prevalence of opioid misuse in people 50 years old and above in New York, education level was a significant factor in predicting opioid misuse. The odds of opioid misuse were 2.5 times higher in people with some college or above education level, which was significant (p = .046), than those who did not have a college education. This study did not explain the possible association of education to opioid misuse but indicated a need for further research. Using a convenience sample (N = 130), Chang (2017) reported that nearly 35% of the participants misused their prescription opioids. Besides education, other predictors of opioid misuse were illicit drug use, depression, and pain affecting participants' jobs. This study by Chang (2017) recommended a larger sample to increase ability to classify opioid misuse among this age group. While this study by Chang (2017) helped describe factors of opioid misuse among people $\geq$ 50 years old, this study focused on the opioid-related deaths in people $\geq$ 65 years old with a larger sample (N = 4,241).

Percentage of People in Poverty

Approximately 38.1 million Americans lived in poverty in 2018 (or 11.8% of the 327.876 million in that same year) (Poverty USA, n.d.). The U.S. government's poverty thresholds are as follows: A family of three making $19,985; four people = $25,701; five people = \$30,459; six people = \$34,533; seven = \$39,194; eight people = \$43,602, and a family of nine or more = \$51,393 (Poverty USA, n.d.). The poverty rate among older adults in the United States accounts for 14.1% when rising healthcare costs are included in the calculation. In Florida, the percentage of people in poverty is 13.6% (U.S. Census Bureau, n.d.).

Reinberg (2018) reported that poverty was an important socioeconomic factor where most of the 515 million Americans who died from opioid overdoses since 2006 lived in poor neighborhoods with fewer job opportunities in the country. Reinberg (2018) quoted John Auerbach, president and chief executive officer of the Trust for America's Health, in arguing that there was a strong correlation between drug use, overdose, and social determinants of health, such as poverty. However, the strength of correlation was not specified in the Reinberg (2018) report. Also, Mercola (2020) reported that poverty and pain might have played a critical role in the opioid crisis. Rollston (2018) reported that people living in poor neighborhoods might have different social norms due to increased exposure to crime and drug use. Altekruse and colleagues (2020) reported that people living in poverty had a higher risk of dying from opioid overdose than those who were not (with a hazard ratio of HR 1:36; 95% CI:1:20-1.54). A hazard ratio is the ratio of the rate between two groups (in other words, it is the probability of an event in a treatment group versus the probability of an event in the control group) (Barrington, n.d.).

Research on Opioid-Related Mortality Among Older Adults

Opioid-related deaths in older adults warrant careful investigation. Older adults faced greater risks of opioid misuse due to increasing persistent pain (Galicia-Castillo, 2016); opioid misuse could be a gateway to heroin use or the nonmedical use of opioid analgesics (SAMHSA, 2017). Even at a dose considered therapeutic for an opioid in older adults, research showed that risks remained high among this age group as evidenced by an increased rate of falls, fractures; increased emergency department visits, and hospitalizations with opioid use in older adults (AHRQ, 2019; Tilly et al., 2017).

Larney et al. (2015) conducted a retrospective study on mortality in older adults with opioid use disorders (*N* = 6,754) in the Veterans Health Administration from 2000-2011. Using the VA's National Patient Care Database, Larney et al. (2015) reported that older adults were more likely to die from any cause than younger adults with opioid use disorder. Specifically, older decedents were more likely to die from chronic illness (cardiovascular disease, liver-related illnesses, and cancer) than from drug-related causes (OR = 2.2; 95% CI: 2.2, 2.3). Moreover, Larney et al. (2015) reported that older adults with opioid use disorder presented with more complex healthcare needs than adults ($\geq$50 years old) without opioid use disorder and, more importantly, than younger adults (< 50 years old) with opioid use disorder. Older adults with opioid use disorder often died with the same comorbidities as older adults without opioid use disorder, such as a history of cigarette smoking and poor nutrition. Findings from this study expanded knowledge about older adults with opioid-related mortality and identified risks of comorbidities involved.

On the other hand, Carter et al. (2019) investigated the increasing rates of opioid misuse in older adults with emergency department visits in the United States in 2006, 2009, 2011, and 2014. Using the Nationwide Emergency Department Sample (*N* = 126,931), the researchers reported the results revealed that from 2006 to 2014, there was an almost 220% increase in older adults' opioid misuse-related visits to the emergency department. Further, Carter et al. (2019) reported that the emergency department visits by older adults with opioid misuse-related cases resulting in hospital admissions were almost 50% higher than those without opioid misuse. Among the factors associated with this rise in emergency department visits were increased chronic conditions (i.e., essential hypertension, 16.8%, other nervous system disorder 16.1%, COPD 16.0%, and nutritional deficiencies at 1.5%); greater injury risk (i.e., falls 6.3%); increased alcohol dependence (9.7%); and mental health diagnosis (i.e., anxiety at 14%). To reiterate, this study by Carter et al. (2019) only focused on emergency department visits by older adults. The current study focused on all older adults who died with opioids as the cause of death and were present in the decedent's body at the time of death. It should also be noted that Carter et al. (2019) utilized the data intermittently from 2006 to 2014, while this study utilized FDLE data from 2014 to 2018, with no gap in yearly data analysis.

Identification of Knowledge Gap

The literature review identified a consistent knowledge gap, which was a lack of research done on the consequences of opioid overdoses among older adults. Another research gap was the sparse research conducted on death from an opioid overdose, particularly among people 65 years old and above. Another gap in the literature was insufficient research on the social determinants of opioid-related mortality among older adults as well as the manner of death from opioid use in older adults such as accidents and suicides.

Chapter Summary

Several studies related to opioid-related mortality were reviewed to examine science's current state regarding this issue. The prevalence of opioid-related deaths was evident in several studies, and results in the rising opioid-death rates were congruent in most studies reviewed. People were more likely to die from polysubstance toxicity or a combination of illicit opioids and prescription medications such as benzodiazepines and stimulants than opioids alone.

A review of the literature identified some patterns of opioid-related deaths such as follows: several studies pointed out that opioid use was more prevalent in males than females (Altekruse et al., 2020; Bech et al., 2019; Hedegaard et al., 2018), while more females suffered from opioid adverse effects than males and more women were prescribed opioids than were men (Beauchamp et al., 2018; Benson et al., 2019). On the other hand, more older adults in rural counties turned to opioid use (Benson et al., 2019). Opioids were used for various reasons, including chronic pain (Schiller & Mechanic, 2019; Tilly et al., 2017). Opioids came with adverse effects such as euphoria, sedation, respiratory depression, and death (West & Dart, 2016). Older adults were at higher risks for opioid adverse effects due to physiologic changes that led to slow metabolism and drug excretion (Tilly et al., 2017).

The convergence of articles selected in the literature review was based on their relevance, either providing evidence on the prevalence of opioid-related deaths, studying the factors associated with opioid mortality, or other demographic information believed to have associations with opioid-related deaths. The dearth of research about opioid-related deaths among older adults supported the need to conduct an in-depth investigation of the social determinants of opioid-related mortality among this vulnerable population in Florida.

CHAPTER 3: RESEARCH METHODS

This chapter describes the research methods and procedures employed in this study beginning with the research design, followed by the research questions and data analysis. The target population was presented, along with the samples and setting. Also included were inclusion and exclusion criteria, study variables and their definition, validity and reliability, ethical considerations, including the protection of human subjects, data sources, data cleaning protocol, strengths and limitation of the study, and the data management plan. A chapter summary was also included.

Research Design

This was a quantitative, retrospective study. The research design was a secondary analysis. A statewide analysis of raw data from the FDLE agency titled *Drugs Identified in Deceased Persons by Florida Medical Examiners Commission* from 2014-2018 was conducted (2017). Social determinants of ORD in older decedents including gender, race, population density, percentage of people in poverty, education level (high school graduates or higher), median household income were examined. The relationship between the manner of death and the type of opioid drugs involved in older adults who died with opioid as a cause of death was also examined.

Research Questions

For this study, the following research questions were examined:

1. Are gender, race associated with opioid-related deaths in older adults?

2A. Do county characteristics (proportion by race, median household income, high school education, population density, and proportion at or percentage of people in poverty) predict the opioid death rate among older adults in Florida?

2B. What is the trend by county of opioid death rate in older adults and over the years between 2014-2018 in Florida?

3. Is there a relationship between the manner of death and the type of opioid drugs involved in the older adult population who died with opioid as a cause of death?

Sample, Setting, and Population

The sample of participants in this study was older adult decedents found in the FDLE Medical Examiners Commission annual drug reports from 2014-2018 who either had an opioid as a cause of death or opioid present in their system at the time of death, or both (2015, 2016). Older adult was operationally defined as a person 65 years old and above. Thus, the sample population were decedents 65 years old and above (N = 4,241) between 2014-2018 FDLE drug reports who had opioids in their system at the time of death and/or had opioids as the cause of death. Altogether, 1,007 older adults died from opioids as a cause of death.

Since this was secondary data analysis, the recruitment process was not applicable. Tappen (2016) stated that using secondary data for research makes sense since it is hard to gather “high quality data” from many people who might be difficult to find, in this case, older adults who overdosed or misused opioids and other drugs. With high quality data, a researcher can perform multiple analyses from the data set (Tappen, 2016). Aside from saving time and money in conducting a study requiring a large sample, another advantage of using secondary data for research with high quality data is that it comes with greater external validity. On the other hand, one disadvantage of secondary data analysis is that the researcher is limited to the data already obtained. For instance, the FDLE data did not contain individual sociodemographic information on income and education level. To mitigate this concern, the author used the 2014-2018 data from the U.S. Census Bureau (n.d.) regarding the Florida county median household income and education for comparative purposes.

The setting of this study was the State of Florida, including all Florida counties. Florida counties were classified as metropolitan or urban and nonmetropolitan or rural counties using the 2013 NCHS Rural-Urban Classification Schema (Ingram & Franco, 2014). For the list of metropolitan and nonmetropolitan counties, see the study variable definitions later in this chapter.

Inclusion and Exclusion Criteria

After a preliminary examination of the FDLE Medical Examiners Commission drug reports from 2014-2018, the following inclusion and exclusion criteria were developed:

Inclusion

1. Decedents should have at least one opioid in their system as the cause of death or opioid present at the time of death.

2. Decedents are found on the FDLE Commission Drug Report from 2014-2018 with raw data that includes age, gender, race, and the manner of death.

3. Decedents should be at least 65 years old with opioid-related deaths.

Exclusion

1. Those decedents who had drugs—solely cocaine, cannabinoids and synthetic cannabinoids, ethanol, benzodiazepines, stimulants, hallucinogenic agents such as Phenylcyclidine, PCP analogs, tryptamine, gamma-hydroxybutyrate, inhalants, and ketamine present in their body at the time of death or listed as the cause of death were excluded from the data analysis (*N* = 54,796).

2. Those decedents with missing data such as age, gender, race/ethnicity, and the manner of death were also excluded.

3. Older decedents ($\geq$ 65 years old) listed under nonopioid drugs (*N* = 6,622) were not included in the study.

Study Variables

Table 1 lists the study variables and their source.

Table 1

Study Variables and Source

Study Variables	
Decedent characteristics: Gender Race	Source: FDLE Annual reports from 2014-2018
County characteristics: Population density Metropolitan (urban) Large central metro Large Fringe Metro Medium Metro Small Metro Nonmetropolitan (Rural) Micropolitan Noncore	Note: County was included in the FDLE reports. They were classified based on the 2013 NCHS urban-rural classification scheme for counties (Ingram & Franco, 2014).
Median household income	Source: U.S. Census Bureau Quick Facts Florida.
Education level (high school graduates and higher)	
Percentage of people in poverty	
Proportion by Race	
Opioid Drugs:	Source: FDLE reports (2014-2018) Opioid-related death (ORD) Opioid as present in the system at a time of death or as a cause of death

(table continues)

Table 1 *(continued)*

Study Variables	
Morphine Fentanyl Fentanyl analogs Codeine Oxycodone Oxymorphone Hydrocodone Hydromorphone Meperidine Tramadol Buprenorphine Methadone Heroin	Source: The opioid drugs listed here were also included in the FDLE reports from 2014-2018.
Manner of Death (MOD) Accident Homicide Natural cause Suicide Undetermined cause	MOD were also included in the FDLE reports

The sociodemographic variables (also classified as the independent variables) used in this study were gender, race, county median household income, average county education (high school graduates and higher), population density, and percentage of people in poverty by Florida county. The dependent variable was the opioid death rate. The manner of death was also operationally defined later in this chapter.

Definition of the Study Variables

Gender was coded as male or female.

Race was categorized as non-Hispanic white, black, Hispanic, Asian, and other in the FDLE reports. Another reason for the use of race in this study was to fit the U.S. Census Bureau coding of race, which adheres to the 1997 Office of Management and Budget classification (U.S. Census, Bureau, n.d.b).

Proportion by race. This was coded as the percentage of whites alone, non-Hispanic nor Latino in the population by county in Florida as found in the U.S. Census Bureau (n.d.a). Non-Hispanic white was selected for this variable since the preliminary findings showed that majority of older adults with opioid as a cause of death were primarily non-Hispanic white (93%). Statewide, Florida includes 53.2% non-Hispanic white, 26.4% Hispanic, 16.9% black or African American, 3.0% Asian and others (i.e., American Indian and Alaskan Native, Native Hawaiian), which constituted the remaining percentage (U.S. Census Bureau, n.d.a).

Median household income was the median income by Florida county recorded in the U.S. Census Bureau from 2014-2018. The Florida median income for 2014-2018 was $53,267 statewide (U.S. Census Bureau, 2018).

Education level refers to the percentage of population by county with high school graduates or higher in Florida from 2014-2018, as found in the U.S. Census Bureau. The Florida statewide education level for high school graduates or higher was 88% for 2014-2018.

The percentage of people in poverty. This was coded as the percentage of people in poverty by county in Florida as it appeared in the U.S. Census Bureau (n.d.). The percentage of people in poverty in Florida statewide is 13.6% (U.S. Census Bureau, n.d.).

Population density refers to classification as a metropolitan or urban area versus nonmetropolitan or rural area. This researcher intended to include the suburban counties. However, Groves (2011) reported that the Office of Management and Budget has the regulatory mandate according to federal law to facilitate uniformity in definition, be transparent, and promote a single definition for various statistical entities. Thus, the term suburban or suburban county as a Florida county classification was not adopted. Instead, this researcher adopted the 2013 National Center for Health Statistics urban-rural classification scheme for counties (Ingram & Franco, 2014). The following are the county classifications based on population density and the list of Florida counties under them:

Metropolitan county, also known as an urban county, is an area with a population of at least 50,000 that comprises an urban center or nucleus with a population density of 1,000 persons per square miles and adjoining territories with at least 500 persons square mile. It is further classified into four categories as large central metro, large fringe metro, medium metro, and small metro.

Large central metro counties comprise Metropolitan Statistical Areas (MSAs) of 1 million or more population that contains the entire population of the largest city of the MSA, or have their entire population contained in the largest principal city of the MSA or contain at least 250,000 inhabitants of any principal city of the MSA. The Florida counties included in the large central metro are Duval, Hillsborough, Miami-Dade, Orange, and Pinellas county.

Large fringe metro counties comprise MSAs of 1 million or more in population that did not qualify as large central metro counties. The Florida counties included in the large fringe metro are Baker, Broward, Clay, Hernando, Lake, Nassau, Osceola, Palm Beach, Pasco, St. Johns, and Seminole county.

Medium metro counties comprise MSAs of population of 250,000-999,999. The Florida counties included in medium metro counties are Alachua, Brevard, Collier, Escambia, Flagler, Gadsden, Gilchrist, Jefferson, Lee, Leon, Manatee, Marion, Martin, Polk, St. Lucie, Santa Rosa, Sarasota, Volusia, and Wakulla county.

Small metro counties comprise MSAs with a population of less than 250,000. The Florida counties included in the small metro counties are Bay, Charlotte, Citrus, Gulf, Highlands, Indian River, Okaloosa, Sumter, and Walton county.

Nonmetropolitan counties are outside the boundaries of metro areas, also known as rural counties, are subdivided into the micropolitan and noncore counties.

Micropolitan are nonmetro labor market areas centered on urban clusters of 10,000-49,999 persons and defined with the same criteria as a metro area. The Florida counties included in the micropolitan counties are Columbia, DeSoto, Hardee, Hendry, Monroe, Okeechobee, and Putnam county.

Noncore counties are nonmetro counties not included in micropolitan areas. The Florida counties included in noncore counties are Bradford, Calhoun, Dixie, Franklin, Glades, Hamilton, Holmes, Jackson, Lafayette, Levy, Liberty, Madison, Suwannee, Taylor, Union, and Washington county.

Manner of death, as used in this study, refers to accident, homicide, natural cause (i.e., disease condition/diagnosis), suicide, or from an undetermined cause. Accident was operationally defined as an unintentional, preventable injury such as drowning, motor vehicle accident, fall, poisoning, including drug overdose or choking (National Safety Council, 2018). The NIDA also defined accidental death as unintentional death (NIDA, 2017). According to NIDA (2017), unintentional drug poisoning deaths, as in the case of opioid-related deaths are cases where "a drug was taken accidentally, too much of a drug was taken accidentally, the wrong drug was administered or taken in error, and an accident occurred in the use of a drug/s in a medical and surgical procedures." The FDLE reports did not include definitions for the manner of death.

The definitions for the other classifications were obtained from the Bureau of Justice Statistics (n.d.): Homicide is defined as the killing of a human being by another human being, the natural cause is death from natural agents such as illness (i.e., heart complications and other complications from long-term or chronic illnesses); suicide is the intentional killing of oneself such as hanging oneself; while the undetermined cause is the unknown cause of death not classified as an accident, homicide, suicide or from a natural cause.

Opioid death rate refers to the total number of deaths from opioids (as a cause of death) by county in Florida divided by the total number of people 65 years old and above for each Florida county x 1000. This investigator used the age-specific death rate (ASDR) formula as follows (Divisha, n.d.; Florida Department of Health, n.d.a):

$$ASDR = \frac{\text{Number of deaths in a particular age group}}{\text{The mid-year population of the age group}} \times 100{,}000$$

Opioid-related deaths are defined as any loss of life from misuse or overdose of opioids. In this study, opioid-related death is operationally defined as any death recorded in the FDLE Medical Examiners Commission annual drug report with an opioid present in the system at the time of death or an opioid deemed the cause of death.

In defining an opioid drug as a cause of death (COD) or present at the time of death (PTD), this researcher utilized the FDLE Medical Examiners' definition as follows: A drug such as an opioid was indicated as the cause of death (COD) "only when, after examining all evidence, the autopsy, and toxicology results, the medical examiner determines the drug played a causal role in the death" (FDLE, 2015). Meanwhile, a drug was indicated as present at the time of death (coded in this study as PTD) only when it was present in the decedent's body in toxicology results, "these were drug occurrences and were not equivalent to deaths" (FDLE, 2015). The medical examiners are medical doctors that determine the drug as the cause of death or merely present or detected in the body at the time of death and submit this report to the FDLE Medical Examiners Commission (FDLE, 2015). FDLE (2015) further reported that it was not unusual that a decedent could have multiple drugs as the cause of death or multiple drugs as present at the time of death but did they not play a causal role in one's death.

Opioids is a broad term that refers to either natural or human-made substance (meaning synthetic) (Fookes, 2019), are a class of drugs naturally found in the opium plants that include heroin (street drug or Illicit opioid-schedule 1 drug), or drugs prescribed for severe pain known as painkillers, also known as prescription opioids, classified as schedule II drugs, meaning they have potential for addiction and dependence. For this study, opioids include morphine, fentanyl and fentanyl analogs, codeine, oxycodone, oxymorphone, hydrocodone, hydromorphone, methadone, buprenorphine, meperidine, and tramadol. These drugs bind to the opioid receptors, such as mu receptors, and produce effects such as pain relief and sedation.

Social determinants of health are conditions in the environment where people are born, live, work, play and worship that have an impact or effect on people's health including their quality of life (Office of Disease Prevention and Health Promotion, 2020). In this study, the social determinants of opioid-related deaths include gender, the race of decedents, county characteristics such as population density (i.e., metropolitan or urban vs. nonmetropolitan or rural), median household income, education level (high school graduates or higher), and percentage of people in poverty by Florida county between 2014-2018.

Reliability and Validity

Validity is the extent to which an instrument is true to what it intends to measure, while reliability refers to consistency that when a phenomenon is measured, the instrument used to measure it will yield the same or a consistent result (Tappen, 2016). In this study, publicly held data from the FDLE's annual drug reports (2014-2018) were used to examine the opioid-related deaths and the association of gender, race to opioid-related deaths, and the county characteristics in predicting the opioid death rate in older adults in Florida.

The relationship of the manner of deaths to the drugs involved was explored. It came with an assumption that government data were reliable and trustworthy, and the measures that these medical examiners used, for instance, in conducting toxicology reports were consistent over time. Another way to test reliability and validity for secondary data analysis is if findings are consistent with other research work on a similar topic or subject. This researcher conducted repeated testing in SPSS such as the frequency distributions of the sociodemographic variables for consistency of results. Each part of the statistical tests in SPSS was analyzed multiple times to verify result accuracy. Further, coding of the variables, i.e., assigning names or labels to the variables, was also verified with the statistician before this investigator proceeded to ensure accuracy in all phases of data coding and analysis. A code book listing the coding for all the variables used in this study was created to maintain consistency. No new measures were employed to test anything other than what was stated in this study's research design.

This study followed the guidance on using secondary data for research by the Division of Research at Florida Atlantic University. Since this study utilized secondary data, no data collection protocol was required. According to Florida Statute, Chapter 406, the Florida Medical Examiners are medical doctors mandated by law to perform death investigations and toxicology and laboratory tests, review results, and determine the manner and cause of death (FDLE, 2019). Government-source data are considered reliable and useful for research purposes (Bhasin, 2019; Yan & Weber, 2018). The FDLE's annual drug report is a government-source data based on state-mandated reporting on the drugs that cause death (Quast, 2020).

Quast (2020) reported variations in the reporting of drug overdose deaths between the Medical Examiners Commission and Multiple Cause of Death or MCOD used by the CDC. MCOD appeared to undercount those fatal drug deaths with no apparent cause or pattern reported as reasons for this difference. However, Quast (2020) reported that the Medical Examiners Commission reports appeared to be more complete than MCOD since medical examiners must identify the cause of death and those drugs present at the time of death.

Ethical Considerations Including Protection of Human Subjects

The data used in this research study came from the FDLE Medical Examiners Commission's annual drug reports. The FDLE annual drug reports contained de-identified raw data such as age, sex, and race of the decedents. Request for raw data to be used solely for this research was made and obtained through the proper channels. Raw data were initially reviewed and found to be useful with de-identifiable information of the decedents. No personal information such as date of birth or social security number of the decedents was included. Raw data in the FDLE reports included an identification number and case number for each case or occurrence. A drug was coded as either cause of deaths (COD) and drugs present at the time of death (PTD). Data were handled properly following the FAU Internal Review Board protocol for the protection of human subjects. As secondary data analysis, no consent was needed from the participants.

Data Cleaning Process

The raw data from the FDLE agency were examined for usefulness and appropriateness of research purpose and any missing information such as age, gender, and race. Data were checked for entry errors and outliers. SPSS was used as a data cleaning tool using the frequency technique, enabling the detection of missing data that may have happened during the data entry. Essentially, the raw data from FDLE between 2014-2018 appeared clean, with very minimal missing information (0- 0.004%).

After applying the inclusion and exclusion criteria, nonopioid drugs such as benzodiazepines, stimulants, hallucinogenics (i.e., Phenylcyclidine, PCP analogs, Piperazine, tryptamine), gamma-hydroxybutyrate, inhalants such as halogenated, helium, hydrocarbon and nitrous oxide, and other substances such as Carisoprodol Meprobamate, cathinones, cocaine, cannabinoids, synthetic cannabinoids, chlordiazepoxide, alcohol, and ketamine were removed from the database. Total decedents across age groups with nonopioid drugs (N = 54,796) were removed from the database. Decedents below 65 years old listed under opioid drugs (N = 48,172) and those decedents with missing data (between 0–0.004%) per exclusion criteria were not included in the analysis.

Strengths and Limitation of the Study

One of this study's strengths was the large sample of older adults with opioids in their system at time of death and opioid as a cause of death (*N* = 4, 241) between 2014 to 2018 in the FDLE reports. It was assumed that this total number of older adults' ORD reflected Florida's statewide population. For instance, in 2018, there were 866 older adults out of 8,020 total decedents with opioid-related deaths in the raw data. Another strength was the presumed validity of the data since the data came from government sources. One government data source came from the FDLE Medical Examiners Commission drug reports from 2014-2018, done by medical doctors for state-mandated reporting of causal drugs to overdose deaths. Another government data source came from the U.S. Census Bureau for the Florida county characteristics, such as median household income, average education level, and percentage of people in poverty. Yan and Weber (2018) reported that government source data are reliable and valuable for scientific research. Simmons (2019) reported that the primary goal of government source data was for public information, thus government data are generally considered a reliable source.

A limitation was the absence of decedent's demographic information from FDLE Medical Examiners Commission annual drug reports such as educational level, income, psychiatric illness as coded in the International Statistical Classification of Diseases and Related Health Problems, 10th Revision or ICD 10 or pain level. This limited the researcher's ability to analyze data comprehensively. To mitigate this limitation on existing data, data from the U.S. Census Bureau (n.d.a) were used to examine Florida county characteristics such as county's median income, education level, and percentage of people in poverty per county.

This study was also limited to determining the proportions of ORD among older adults in Florida from 2014-2018. Also, this study was limited to evaluating if the proportion of race, median household income, average education level, population density, and percentage of people in poverty predicted opioid-related death rate among older adults, and determining whether there was a relationship between the manners of death and the types of opioid drugs involved in older adults, and whether gender and race were associated with ORD in older adults. Further, this study focused on older adults found in the FDLE annual drug report from 2014-2018. Another limitation of this study was the indication for opioid use by older decedents, which was not recorded in the raw data. There was no classification in the FDLE reports whether the opioid drugs included in the raw data were prescription opioids or illicit opioids, thus a limitation of this study.

This researcher selected a 5-year lookback period for data analysis (2014-2018) to track trends of ORD in older adults in Florida and for a pragmatic completion of this study. No data were available for the 2019 FDLE drug report at the time of this study, as verified with the FDLE through email correspondence. The raw data from the FDLE between 2014-2018 did not include place or type of dwelling place for these decedents, whether they were institutionalized or not, i.e., from nursing homes or assisted living, nor they were hospice patients at the time of their death or not, which was an additional limitation of this study.

Data Analysis Plan

The Statistical Package for the Social Sciences (SPSS) 26 was used to analyze the data. SPSS also works well when exporting Excel data, which is a good fit for this study since raw data from FDLE were displayed in an Excel format. Data screening was performed manually and electronically before the SPSS analysis. After applying the inclusion and exclusion criteria, data not pertinent to this study were removed. All data were de-identified, meaning no personal identifiers such as date of birth and social security number are entered in SPSS. The listwise deletion of these cases was expected to have minimal effect on the results' bias since so few missing data values existed (Tappen, 2016).

On preliminary analysis, missing data were identified, and they accounted for a very small percentage (between 0–0.004%) for opioid drugs included in this study. Tappen (2016) gave possible reasons for missing data such as an item was inadvertently missed, or an item was missed during data entry, or a participant withdrew from the study, and so on. However, for this study, the samples were decedents, so missing data were understandably not directly participant related. FDLE reports did not give any rationale for a few missing items. Data of decedents $\geq$ 65 years of age with ORD were extracted from the FDLE reports for analysis. Several statistical measures were employed based on the research questions.

Research Question 1

Are the sociodemographic variables of gender and race associated with opioid-related deaths in older adults in Florida?

Descriptive statistics were used to describe the variables (Plichta & Kelvin, 2013). The frequencies and percentages of gender and race were reported. Gender, race, and opioid-related deaths are categorical variables. For instance, gender was identified as male or female; race was identified as non-Hispanic white, black, Hispanic, Asian, and others; ORD was coded either an older adult had an opioid present in the body system at time of death (PTD) or as a cause of death (COD). The values for gender (male or female) were cross-tabulated in SPSS with the values of ORD (values for both PTD and COD were included in the analysis), as well as the values for race and again, ORD. To determine the association between the categorical variables, i.e., between gender and ORD, and between race and ORD, chi-square analyses were conducted. To show the strength of association between two categorical variables in a chi square test, the effect size using a phi value or a Cramer's V was reported. An effect size of $\leq$ 0.2 was considered to have a weak association, 0.2 - $\leq$ 0.6 was considered to have a moderate association, and an effect size of > 0.6 was considered to have a strong association (IBM, n.d.). The level of significance was also reported with a *p*-value of <. 05 considered as significant. A frequency table was presented, as well as a histogram to show the frequency distributions.

Research Question 2A

Do county characteristics (proportion by race, median household income, high school education, population density, and percentage of people in poverty) predict the opioid death rate among older adults in Florida?

The independent variables in Research Question 2A were race, county median household income, county average high school graduates and higher, population density, and proportion at or below poverty level. The dependent variable was the opioid death rate. Opioid death rate was calculated using the age specific death rate as the number of deaths from opioids per Florida county divided by the total population of older adults in that county x 100,000 (Divisha, n.d., Florida Department of Health, n.d.a). The data for the total population of older adults for each Florida county were obtained from the Florida Department of Health, Division of Public Health Statistics and Performance Management for comparative purposes. The mean for opioid death rate was obtained using SPSS.

Race (coded as non-Hispanic white, black, Hispanic, Asian, and other) and population density (coded as metropolitan [urban] and nonmetropolitan [rural]) were categorical variables. Population density was further categorized into the large central metro, large fringe metro, medium metro, and small metro, while the nonmetropolitan was divided into micropolitan and noncore. The county data such as education level (high school graduates or higher), proportion by race, median household income, and percentage of people in poverty were coded as they appeared in the U.S. Census Bureau (n.d.). The generalized linear model (GZLM) was the most appropriate technique to analyze this research question since it allowed models to fit to the data, and the response or outcome variable followed any probability in the exponential family of distribution.

Generalized Linear Model

A general linear model (GLM) usually refers to conventional linear regression models where the response variable is continuous with continuous or nominal/categorical predictor variables (Agresti, 2015). The GZLM extends the general linear model where the response variable is assumed to follow an exponential family distribution such as normal distribution, Poisson or binomial distribution (yes/no), gamma distribution (skewed towards larger positive values), and multinomial (could be numeric or string and must have at least two valid responses) (Agresti, 2015). The GZLM encompasses a broad class of models or most statistical methods such as analysis of variance or ANOVA, analysis of covariance (ANCOVA), logistic regression analysis, the multinomial response including factor and discriminant function analysis, with crossed and nested factors (Agresti, 2015).

For Research Question 2, a GZLM with a normal probability distribution with identity link function and robust covariance matrix estimation helped account for robust standard errors, which was particularly useful in case the family of distribution was mis-specified (Hosseinian, 2009; Plichta & Kelvin, 2013). The normal probability distribution with identity link function was selected because the dependent variable, opioid death rate, is a numeric or scale variable, and the identity link function can be used with any distribution (IBM, n.d.). The GZLM assumptions were not violated in the study, such as (a) additivity and linearity; in this study, it is assumed that opioid death rate has a linear relationship with any predictors such as median household income, race/ethnicity. And as we added more predictors such as average education level and percentage of people in poverty, the combined effects were added together; (b) independent errors, meaning the residual terms or error terms were uncorrelated; (c) homoscedasticity/homogeneity of variance or that the variance of the outcome variable remained stable. No case of a heterogeneous variance (that would create bias) was encountered in the analysis. This study had a large sample size (N = 4,241). Field (2013) argued that the assumption of normality was not a significant concern since the sample was large enough.

The dependent variable, the opioid death rate, was placed on the response tab of the generalized linear model in SPSS. The opioid death rate by county was calculated in SPSS (for all counties from 2014-2018) using the formula for age adjusted death rate (Divisha, n.d.) as explained earlier in this chapter. The independent variable with more than 1 level, such as population density (2 levels, metropolitan and nonmetropolitan counties), also classified as categorical variables, was placed under factors in the predictors tab; while the proportion of race (continuous variable, 1 level) education level (1 level), median household income (1 level), percentage of people in poverty (1 level), was placed under covariate in the predictors tab in SPSS to accomplish the modeling process. All the predictor variables were entered at the same time under the model tab of the GZLM in SPSS to examine the main effects. After determining which independent variable was statistically significant in predicting opioid death rate ($p > .05$), I also examined the possible interactions of these predictor variables under the model type of the generalized linear model.

The omnibus test of likelihood ratio chi-square was reported to indicate that the model containing the predictors represented the goodness of fit over a null model with no predictors. To determine which independent variables or covariates were strong predictors of opioid death rate, the level of significance for each predictor variables was examined in the parameter estimates. The level of significance was set at ($p < .05$). The result of this level of significance for all predictor variables was reported, as well as the standard errors (*SE*), odds ratio (*OR*) as presented by Exp (*B*) in the parameter estimates were reported along with the 95% confidence interval (CI). The value of R^2 (coefficients) as indicated by (*B*) was also reported. The tables for the test for model effects, parameter estimates for the predictor variables to opioid death rate, as well as the tables showing interactions or no interactions of these variables were also presented.

On Research Question 2B (sub-question), which asked, “What is the trend of opioid death rate in older adults who died with opioid as a cause of death by county, and over the years 2014-2018?” a general linear model, with repeated measures (ANOVA or analysis of variance) was used to analyze the data for the trend analysis. The independent variable also known as the repeated factor was the data years or time (2014-2018), and the dependent variable or repeated measures was the county. To determine the trend over time, I included the test within-subject contrast. Time was presented here as a data period between 2014 to 2018. The number of ORD, in this case, the opioid drugs as a cause of death (COD), was examined. All opioid-related deaths (COD) were tallied for each Florida county for each year 2014, 2015, 2016, 2017 and 2018. Again, the opioid death rate was then calculated using the age adjusted death rate formula (Divisha, n.d.) as follows: number of opioid-related deaths (COD) in older adults divided by the total population of older adults in that county times 100,000.

The trend by county, and the trend by county over time, were also examined. Again, the Florida counties (n = 67) were classified by population density such as metropolitan (urban) and nonmetropolitan (rural). The assumptions of the GZLM were not violated such as additivity and linearity in such a way that the dependent variable was linearly related to the independent or predictor variable; the variables were normally distributed; each case was an independent observation, the variance of the residual was constant across predictive value or homoscedastic; independence of errors and no collinearity of prediction (Field, 2013).

The variances of the mean scores, result for the Mauchly's test of sphericity, and the Greenhouse-Geisser test result were reported, along with the outcome of the measures and the outcome of within subject contrasts, as well as the *F* value were also reported. Again, the level of significance was set at $p < .05$. A plot indicating whether there is a linear or quadratic trend or not was also presented.

Research Question 3

Is there a relationship between the manner of death and the type of opioid drugs involved in older adults who died with opioid as a cause of death?

For this question, a chi-square test was used. Chi-square test is used to make inferences that there is a relationship or association between variables (Plichta & Kelvin, 2013; Polit, 2010), when both variables are nominal or categorical (Tappen, 2016). The variables manner of death (coded as an accident, homicide, natural cause, suicide, and undetermined cause) and the type of opioid drugs involved, in this case, opioid as a cause of death by opioid type such as morphine, codeine, and so on, are categorical variables. Each case, meaning an older adult who died with an opioid as a cause of death (COD) (i.e., morphine, codeine, fentanyl, fentanyl analog, oxycodone, hydrocodone, hydromorphone, buprenorphine, methadone, meperidine, tramadol, and heroin) was cross-tabulated with the manner of death, which is also a categorical variable. The chi-square test's assumptions were not violated in this calculation since the sample size is adequate (more than five cells), the data are frequency data, and the observations are independent of each other (Plichta & Kelvin, 2013).

A frequency statistics table for all variables is presented. The chi square test results, including the Pearson chi-square value, degrees of freedom, and significance value are reported. The strength of the association (or effect size) between variables is reported using Cramer's V. Cramer's V is a measure of association between nominal or categorical variables which fits in this research question since the manner of death, and the type of opioid drugs involved or ORD are both categorical variables. The results of Cramer's V are interpreted as follows: ranges from 0-1 with higher values indicating a stronger association between variables (Polit, 2010). For instance, a level of < 0.2 is weakly associated, 0.2 < 0.6 is moderately associated, and > 0.6 is strongly associated (IBM, n.d.). Again, the alpha level of significance is set at $p < .05$; $p < .05$ is considered significant.

Data Management and Safety Plan

Data used for this study were kept in a computer assigned for research purposes to maintain confidentiality, accessible only by the principal investigator and this researcher with a newly assigned password and user ID provided. The dissertation chair or designee acted as the principal investigator of the study. The decedents' information was assigned a new code identification for secondary data analysis. No personal information traceable to a decedent such as social security number and date of birth was included in the data analysis to maintain confidentiality. Progress of the study and the data monitoring and safety plan were reviewed periodically. The researchers/investigators followed the FDLE protocol regarding the proper management of data shared for this study and follow the recommendations from the IT Department of the Christine E. Lynn College of Nursing at Florida Atlantic University regarding data management plan for security and privacy.

Chapter Summary

The research methodology was discussed including the data and data analysis plan sources based on the research questions. The rationale for the use of statistical measures was also provided. A GZLM using a normal probability distribution with identity link function was used to examine whether race, median household income, population density, education level (high school graduates and higher), and percentage of people in poverty predicted opioid death rates in older adults in Florida. Chi square tests were utilized to determine the association between race, gender and opioid-related deaths in older adults, as well as the relationship between the manner of death and the opioid drugs involved. To examine trends of opioid death rate by Florida county and through the years, a 5-year study period between 2014-2018 was selected. In addition, this study also examined the characteristics of counties with highest and least count of ORD.

CHAPTER 4: RESULTS

Introduction

This quantitative, retrospective study had a four-fold purpose: (a) Determine the association of the sociodemographic variables of gender and race/ethnicity to opioid-related deaths (ORD) among older adults in Florida; (b) Examine which county characteristics such as proportion by race/ethnicity, median household income, education level, and percentage of people in poverty are strong predictors of the opioid death rate among older adults in Florida; (c) Determine whether a relationship existed between the manner of death and the opioid drug involved in older adults with who died with opioid as a cause of death; and (d) Analyze the trend of opioid death rate in Florida by county and through the study years 2014-2018.

The research design was a secondary analysis of data from the FDLE agency from 2014-2018. The research questions were analyzed using descriptive statistics, chi-square tests, and generalized linear models. Results for each research question are presented, including related tables and figures from the data analyses, followed by a summary of Chapter 4.

Data Sources and Description

After applying the inclusion and exclusion criteria, data for the older adults or decedents ≥ 65 years old with opioid-related deaths were extracted from the FDLE reports (N = 4,241) from 2014-2018. The total number of older adults with opioids present in their system at the time of death (PTD) was 3,234, while the total number of older adults who died with opioids as a cause of death was 1,007. See the diagram for the study participant selection in Appendix B. The opioid drugs included in this study (*n* = 13) were morphine, codeine, fentanyl, fentanyl analog, oxycodone, oxymorphone, hydrocodone, hydromorphone, methadone, buprenorphine, meperidine, tramadol, and heroin.

Sociodemographic Characteristics of Older Decedents With ORD

From 2014 to 2018, there were a total of 4,241 older adults with opioid-related deaths who died with an opioid as a cause of death (COD) (*n* = 1,007) and/or an opioid was present in their system at the time of death in Florida (PTD) (*n* = 3,234). This researcher extracted the data for older decedents (≥ 65 years old) with opioids as a COD to elucidate the sociodemographic characteristics of older decedents who died with an opioid as a cause of death. The result is as follows: The majority of these older decedents with opioids as a cause of death were non-Hispanic white (*n* = 937 or 93.04%), 56.50% were male (*n* = 569). More than 50% (56.01%) of these older decedents with an opioid as a COD died from an accident (*n* = 564), followed by 402 decedents who died from suicide (39.92%). None of these older decedents with an opioid as a COD died from a natural cause.

The majority of these ORDs in older adults with an opioid as a COD (*n* = 975) or 96.83% resided in urban or metropolitan counties, while rural or nonmetropolitan counties accounted for only 32 deaths (3.17%). The Florida counties with the highest number of opioid as a cause of death in older adults occurred in Palm Beach county with 110 deaths, followed by Broward county with 94 deaths, Duval county with 77 deaths, Miami Dade county with 72 deaths, Pinellas with 56 deaths, and Hillsborough county with 55 deaths during the study years (2014-2018). The age range of older decedents is from 65-101 years old, with a mean age of 73.45. The top opioid drugs (as a COD) that accounted for the highest number of deaths in older adults were oxycodone with 236 deaths, followed by morphine with 197 deaths, hydrocodone with 144 deaths, fentanyl with 92 deaths, and tramadol with 74 deaths. A summary of the sociodemographic characteristics of older adults with ORD (which included opioid as a PTD and as a COD) is presented in Table 2.

Table 2

Characteristics of Older Adults With Opioid-Related Deaths (N = 4,241)

Opioid Present at Time of Death (PTD) *n* = 3,234; Opioid as Cause of Death (COD) *n* = 1,007

Characteristics	PTD		COD	
	n	%	n	%
Gender				
Male	2,203	68.12	569	56.50
Female	1.031	31.88	438	43.50
Total	3,234	100.0	1,007	100.0
Race/Ethnicity				
Non-Hispanic				
White	3,019	93.35	937	93.04
Black	159	4.92	62	6.16
Hispanic	24	0.74	5	0.50
Asian	18	0.56	0	0.0
Others	14	0.43	3	0.30
Total	3,234	100.0	1,007	100.0

(table continues)

Table 2 *(continued)*

Characteristics	PTD n	PTD %	COD n	COD %
Manner of Death				
Accident	21,071	33.12	564	56.01
Homicide	83	2.57	0	0.0
Natural cause	835	25.82	0	0.0
Suicide	1,210	37.41	402	39.92
Undetermined	35	1.08	41	4.07
Total	3,234	100.0	1,007	100.0
Population Density				
Large Central Metro (Urban)	1,055	32.62	307	30.49
Large Fringe Metro (Urban)	663	20.50	286	28.40
Medium Metro (Urban)	977	30.21	308	30.59
Small Metro (Urban)	361	11.16	74	7.35
Micropolitan (Rural)	87	2.69	12	1.19
Noncore Counties (Rural)	91	2.81	20	1.98
Total	3,234	100.0	1,007	100.0

For the list of opioid frequencies and percentages included in the data analysis, see Table 3:

Table 3

Opioid-Related Deaths (ORD) Distribution (PTD n = 3,234; COD n = 1,007) in Older Adults by Opioid Drugs in Florida From 2014-2018.

Characteristics	PTD		COD	
	n	%	n	%
Buprenorphine	13	0.40	1	0.09
Codeine	130	4.02	21	2.09
Fentanyl	205	6.34	92	9.14
Fentanyl Analog	5	0.15	42	4.17
Heroin	4	0.12	44	4.37
Hydrocodone	575	17.78	144	14.30
Hydromorphone	283	8.75	52	5.16
Meperidine	4	0.12	2	0.20
Methadone	79	2.44	52	5.16
Morphine	618	19.11	197	19.56
Oxycodone	541	16.73	236	23.44
Oxymorphone	242	7.48	50	4.97
Tramadol	535	16.54	74	7.35
Total	3,234	100.0	1,007	100.0

Note. PTD = opioid present at time of death; COD = opioid as a cause of death

The following figures show the frequency distribution of oxycodone (an opioid drug with the highest number of deaths among older adults (n = 236) by gender, race, population density, Florida county, and the manner of death.

Figure 3

Distribution of Oxycodone-Related Deaths in Older Adults by Gender in Florida

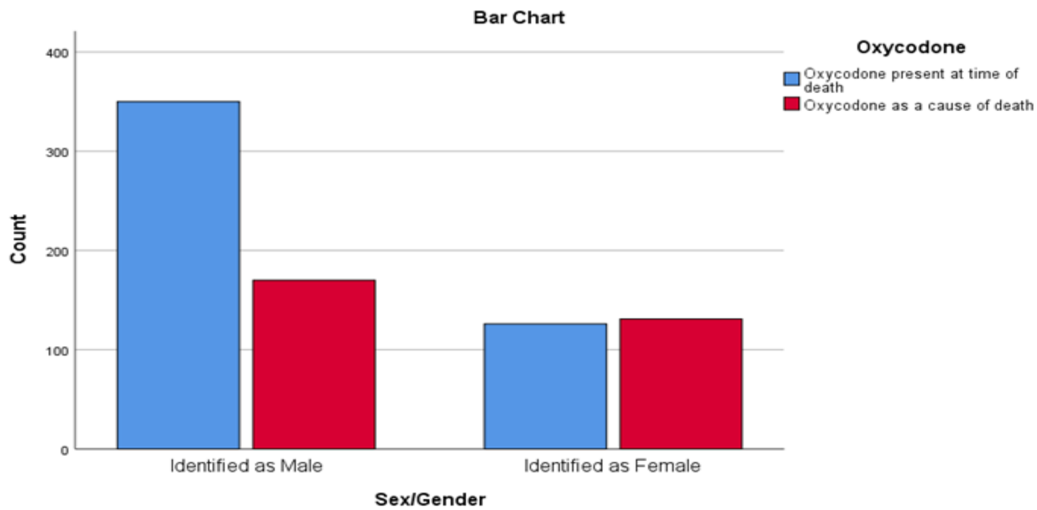


Figure 4

Distribution of Oxycodone-Related Deaths in Older Adults by Race in Florida

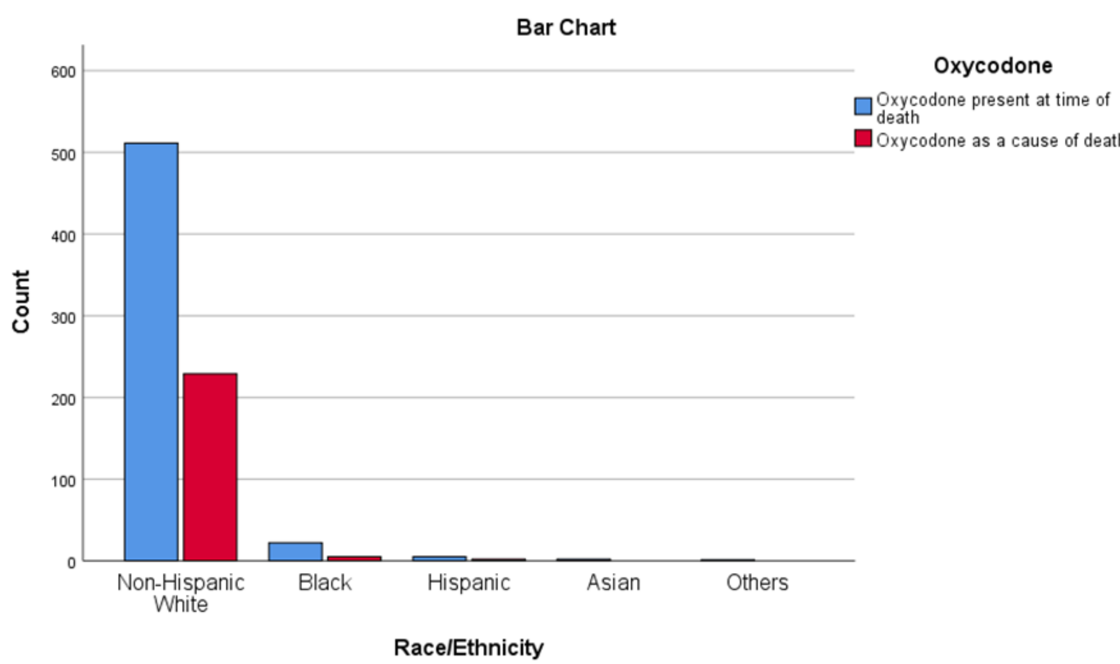


Figure 5

Oxycodone-Related Deaths Among Older Adults by Population Density in Florida

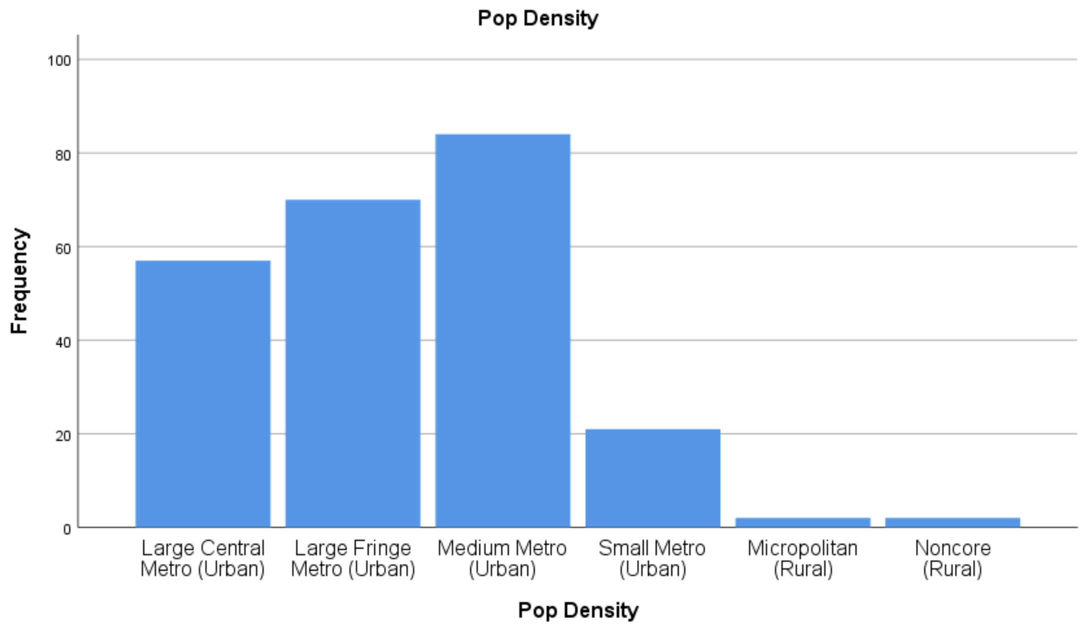


Figure 6

Florida Counties With Oxycodone-Related Deaths in Older Adults

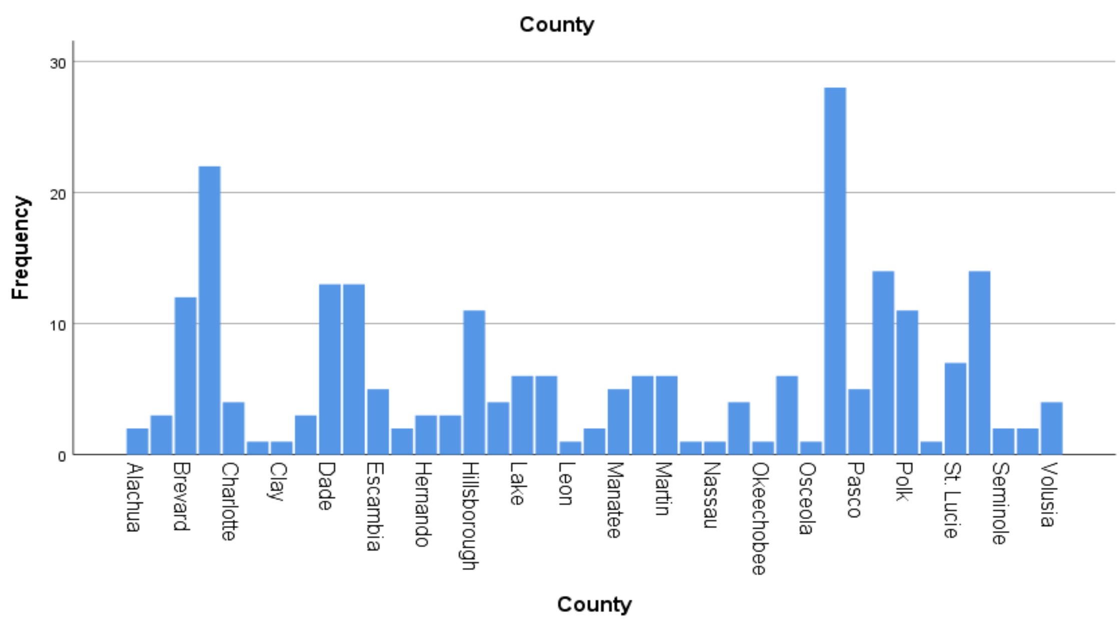
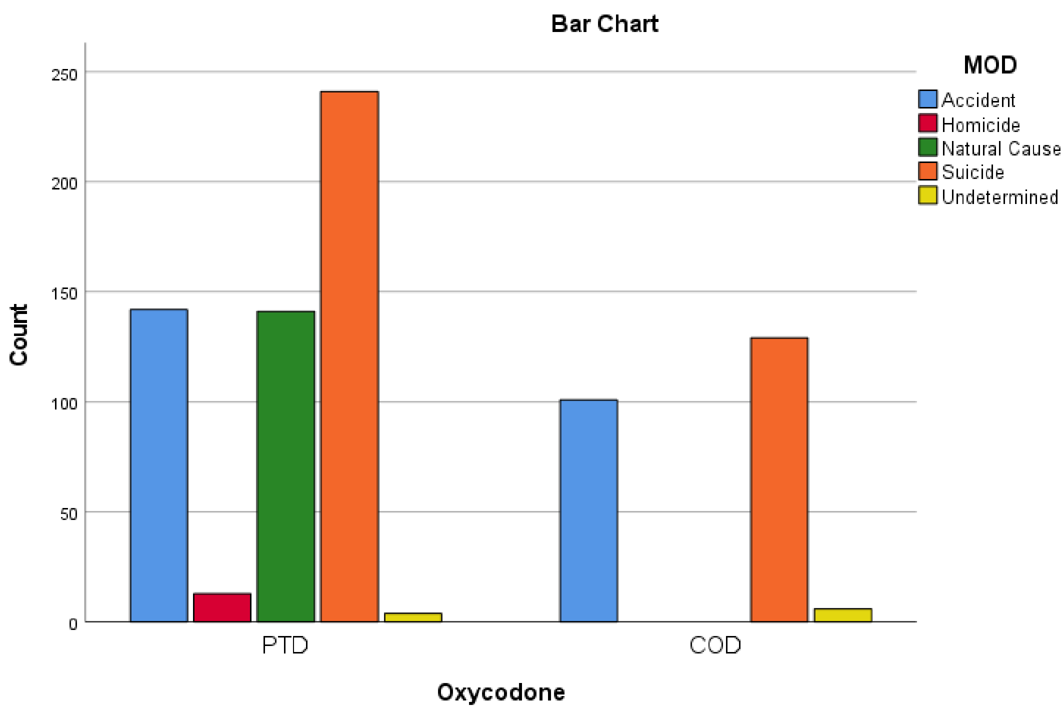


Figure 7

Manner of Death From Oxycodone in Older Adults in Florida



Research Questions and Results

The following are the results of the data analysis by research question:

Research Question 1

Are the sociodemographic variables of gender and race associated with opioid-related deaths in older adults in Florida?

Results: Association of Gender to ORD

A chi square test of independence was conducted to determine the association between gender and opioid-related deaths, and between race and opioid-related deaths. There was a significant association between gender and opioid-related deaths, $X^2(1, n = 151)$, $p < .001$. More older male decedents ($n = 569$) died from opioids as a cause of death than older female adults (n = 438) or (56.50% vs. 43.50%). The opioids with significant association with gender were codeine ($X^2(1) = 7.694$, $p = .006$) (males were more affected than females, 64.9% vs. 35.1%), hydrocodone ($X^2(1) = 55.482$, $p < .001$), (males were more affected than females, 66.5% vs. 33.5%), and oxycodone ($X^2(1) = 43.858$, $p < .001$), (males were more affected than female, 66.9% vs 33.1%). All of them indicated moderate strength of association with a Cramer's V value of .226, .278, and .238, respectively. Gender also showed significant association with hydromorphone-related death ($X^2(1) = 7.068$, $p = .008$) (males more affected than females, 67.8% vs. 32.2%) and tramadol ($X^2(1) = 13.932$, $p < .001$) (males more affected than females, 64.3% vs. 37.1%), both showing a small effect with a Cramer's V value of .107 and .151, respectively. Buprenorphine and meperidine did not meet the chi-square test's assumptions because cells showed 75% had an expected count less than 5. A Fisher exact test was used for small sample sizes, such as buprenorphine and meperidine-related deaths, and it showed no significance with $p > .05$. See Table 4.

Table 4

Association Between Gender and Opioid-Related Deaths (ORD) in Decedents ≥ 65 years Old

Opioid-Related Deaths (Opioid Drugs)	Male n	%	Female n	%	$X^2(1)$	*p*
Codeine	98	64.9	53	35.1	7.694	.006
Hydrocodone	478	66.5	241	33.5	55.482	.001
Hydromorphone	227	67.8	108	32.2	7.068	.008
Oxycodone	520	66.9	257	33.1	43.858	.001
Tramadol	383	64.3	226	37.1	13.932	.001
Fentanyl	212	71.38	85	28.6	2.190	.13
Fentanyl Analog	40	85.1	7	14.9	.115	.73
Heroin	37	75.5	11	22.4	.011	.91
Methadone	85	64.89	46	35.11	.424	.51
Morphine	485	59.5	330	40.5	.924	.33
Oxymorphone	193	66.1	99	33.9	2.744	.90

Note. Buprenorphine and Meperidine are not included in the table since they did not meet assumptions for Chi-square test.

Results: Association of Race to ORD

Results of a chi-square test of independence indicated that there was no significant association between race and opioid-related deaths (all opioid drugs), $X^2(1, 4)$ = .326-9.172, *p* > .05. Despite that majority of the opioid-related deaths (COD) affected 937 non-Hispanic whites (93%), this result was not statistically significant. Only hydrocodone showed almost significant result (*p* = .057) with 689 non-Hispanic whites affected. Buprenorphine and meperidine had a small sample size and did not meet chi-square assumptions since cells had an expected count of less than 5. For the buprenorphine and meperidine, Fischer's exact test was used, and the result was not statistically significant ($p > .05$). For the association between race and the specific opioid drug-related deaths, see Table 5.

Table 5

Association Between Race and Opioid-Related Deaths in Older Adults (Non-Hispanic White [NHW], Black [B], Hispanic [H], Asian [A] and Others [O])

ORD by Opioid Type		Race *n*	%	$X^2(4)$	*p*
Codeine	NHW	143	94.7	.326	.83
	B	6	4.0		
	H	2	1.3		
	A	0	0.0		
	O	0	0.0		
Fentanyl	NHW	256	86.2	6.027	.19
	B	6	4.0		
	H	2	1.3		
	A	2	.7		
	O	2	.7		
Fentanyl Analog	NHW	37	78.7	1.171	.27
	B	10	21.35		
	H	0	0.0		
	A	0	0.0		
	O	0	0.0		
Heroin	NHW	39	79.6	1.007	.31
	B	9	18.4		
	H	0	0.0		
	A	0	0.0		
	O	0	0.0		

(table continues

Table 5 *(continued)*

ORD by Opioid Type		Race *n*	%	$X^2(4)$	*p*
Hydrocodone	NHW	689	95.8	9.172	.057
	B	23	3.2		
	H	3	.4		
	A	3	.4		
	O	1	.1		
Hydromorphone	NHW	314	93.7	6.730	.15
	B	14	4.2		
	H	3	.9		
	A	2	.6		
	O	1	.3		
Methadone	NHW	127	96.9	.372	.54
	B	4	3.1		
	H	0	0.0		
	A	4	3.1		
	O	0	0.0		
Morphine	NHW	753	92.4	3.278	.65
	B	45	5.5		
	H	3	.4		
	A	2	.7		
	O	2	.7		
Oxycodone	NHW	740	95.2	3.228	.52
	B	27	3.5		
	H	7	.9		
	A	2	.3		
	O	1	.1		

(table continues)

Table 5 *(continued)*

ORD by Opioid Type		Race *n*	%	$X^2(4)$	*p*
Oxymorphone	NHW	282	96.6	.546	.76
	B	8	2.7		
	H	2	.7		
	A	0	0.0		
	O	0	0.0		
Tramadol	NHW	560	92.0	1.275	.86
	B	36	5.9		
	H	7	1.1		
	A	2	.3		
	O	3	.5		

Research Question 2A

Do county characteristics (proportion by race, median household income, high school graduates or higher, population density, and proportion or percentage of poverty level) predict the opioid-related death rate among older adults in Florida?

The data for the county characteristics such as proportion by race, median household income, education level (high school graduates or higher), percentage of people in poverty were coded by Florida county as they appeared in the U.S. Census Bureau (n.d.). The education level of high school graduates or higher in Florida is 88% for 2014-2018 (U.S. Census Bureau, n.d.). There were 36 out of 67 counties in Florida with the education level of high school graduates and higher below state average, while 30 counties with above state average education of high school or higher. The percentage of people in poverty in Florida (statewide) is 12.7% (U.S. Census Bureau, n.d.). The number of counties in Florida with below the state average in terms of percentage of people in poverty is 28; while 39 counties with above the state average of percentage of people in poverty. The median household income in Florida (statewide) was $53, 267 during the study period. There were 23 counties in Florida at above the state average median income, while 44 counties have below the state average median income. In terms of population density, 5 counties were classified as large central metro (urban), 11 as large fringe metro (urban), 19 as medium metro (urban), and 9 counties were classified as small metro (urban). Twenty-three counties were classified as rural or nonmetropolitan, 7 of them were micropolitan (rural counties), and 16 counties were classified as noncore (rural). For the frequencies and percentages of these counties by population density, see Table 6.

Table 6

Frequency Distribution of Opioid-Related Deaths (COD) by Florida County (N = 67) in Terms of Population Density

Population Density	*n*	%
Large Central Metro	5	7.5
Large Fringe Metro	11	16.4
Medium Metro	19	28.4
Small Metro	9	13.4
Micropolitan	7	10.4
Noncore	16	23.9

The predictor variables were also examined for multicollinearity using the collinearity statistics in SPSS. The results were as follows: Median income, Tolerance = .273, VIF (variance inflation factor) = 3.668; percent of people in poverty, Tolerance = .182, VIF = 5.501; population density, Tolerance = .290, VIF = 3.452; proportion by race, Tolerance = .532, VIF = 1.881, and education level (high school graduates or higher), Tolerance = .246, VIF = 4.061. VIF > 5 is problematic, which makes it difficult to assess the contribution of a predictor variable to the model (Witten et al., 2017). The result showed that the predictor variable percentage of people in poverty has a VIF = 5.501. In addition, the predictor variables of median household income and percentage of people in poverty were also examined to discover whether they are highly correlated using bivariate correlations in SPSS. Both predictor variables of median income and percentage of people in poverty showed high collinearity ($r = -.840$). Field (2016) explained that correlation above .80 and .90 are highly correlated which could be problematic (limiting the size of the coefficient and making it difficult to examine the importance of the variables in predicting the outcome, for instance, opioid death rate). Therefore, the percentage of people in poverty was removed from the equation. For the result of the collinearity statistics, see Table 7.

Table 7

Test for Multicollinearity Among Predictor Variables of Opioid Death Rate Using Linear Regression

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	*p*	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-1.842	1.951		-.944	.34	-5.744	2.060		
	Proportion by Race/Ethnicity Ref: Non-Hispanic White	-.005	.005	-.143	-.887	.37	-.015	.006	.532	1.881
	Education Level (High School Graduates or Higher)	.042	.019	.516	2.185	.003	.004	.081	.246	4.061
	Percent of Poverty	-.020	.026	-.216	-.784	.43	-.073	.032	.182	5.501
	Population Density	.037	.067	.121	.553	.58	-.098	.172	.290	3.452
	Median Income by County	-1.522E-5	.000	-.296	-1.319	.19	.000	.000	.273	3.668

Note. a. Dependent Variable: Outcome Variable Opioid Death Rate 2014-2018

In addition, further classifying the population density in Research Question 2A into six levels (large central metro, large fringe metro, medium metro, and small metro [for the urban counties] and micropolitan and noncore [for the rural counties]) posed a problem of sample size being distributed thinly in Research Question 2A. Therefore, the Florida counties were classified back to metropolitan (urban) and nonmetropolitan (rural) counties only in Research Question 2A. The omnibus test likelihood chi square ratio indicated that the model with the predictor variables (median income, education level, population density, and proportion by race) showed goodness of fit over the null model, $X^2(4) = 11.422$, $p = .02$. See Table 8.

Table 8

Omnibus Test

Likelihood Ratio Chi-Square	df	*p*
11.422	4	.022

Note.
Dependent Variable: Outcome Variable ODR 2014-2018
Model: (Intercept), Metropolitan or nonmetropolitan, Proportion by Race/Ethnicity Ref: Non-Hispanic White, Education Level (High School Graduates or Higher), Median Income by County
a. Compares the fitted model against the intercept-only model.

Results for Research Question 2A

A GZLM with normal probability distribution and identity link function was used to analyze whether county characteristics such as proportion by race, median household income, education level (high school graduates and higher), and population density could predict opioid death rate in older adults in Florida.

The predictor variables—proportion by race, education level (high school graduates or higher), median household income, and population density (metropolitan or nonmetropolitan)—were entered together and examined for their main effects. Results indicated that education level (high school graduates or higher) came out as a significant predictor of opioid death rate in older adults ($p = .003$). Other county characteristics were not significant predictors of opioid death rate such as proportion by race ($p = .43$), population density (metropolitan or nonmetropolitan ($p = .45$), and county median income (p = .24), thus they did not contribute to the model. For the summary of predictor variables of the opioid death rate, see Table 9.

Table 9

Predictor Variables of Opioid Death Rate

Tests of Model Effects			
	Type III		
Source	Wald Chi-Square	df	*p*
(Intercept)	7.856	1	.005
Proportion by Race Ref: Non- Hispanic White	0.608	1	.43
Education Level (high school graduates or higher)	8.952	1	.003
Population Density (Metropolitan Or nonmetropolitan)	5.423	5	.45
Average Median Income	0.191	1	.24

Note.
Dependent Variable: Mean Death Rate
Model: (Intercept), Proportion by Race Ref: White NHW, Education Level (high school graduates or higher), Poverty Level, Population Density, Median Income

In Table 10 under parameter estimates, the predictor variable, education level (high school graduates or higher), showed a positive and significant contribution to the model: $\beta = .052$, $p < .003$, OR= 1.053, (95% CI: 1.018, 1.090). This result suggested that in a county population with low education level (lower than high school), the odds of opioid death rate increased by a factor of 1.053, which was statistically significant (p = .003). Metropolitan counties (n = 44) have higher mean scores for education level (high school graduates or higher) than the nonmetropolitan counties (*n* = 23), 88.773 vs. 78.843 respectively. Again, the Florida statewide education level of high school graduates or higher was 88% (U.S. Census Bureau, n.d.a).

Other predictor variables indicated the following results: proportion by race: β = -.003, *p* = .43, OR= .997 (95% CI: .988, 1.005); which suggested that a decrease in the proportion of race (non-Hispanic White), increased the odds of opioid death rate by a factor of .997, which was not statistically significant (*p* = .43). The predictor variable median household income had this result: β = -1.054E-5, *p* = .24, OR = 1.000 (95% CI: 1.000, 1.000) which suggested no effect or change as indicated by OR = 1.000, not statistically significant (*p* = .24). Meanwhile, for the predictor variable of population density (metropolitan), the result was: β = -.135, *p* = .45, OR = .873 (95% CI: .611, 1.248), which indicated that opioid death rate was not influenced by metropolitan counties nor it was a significant predictor of opioid death rate (*p* = .45).

For a summary of the predictor variable parameter estimates, see Table 10.

Table 10

Parameter Estimates for the Predictor Variables of Opioid Death Rate Using Generalized Linear Model With Normal Probability Distribution Identity Link Function

Variables	β	*SE*	*p*	OR	95% *CI*
(Intercept)	-3.093	1.0660	.004	.045	[.006, .366]
Population Density					
Metropolitan	-.135	.1822	.45	.873	[.611, 1.248]
Nonmetropolitan	0[a]	.	.	1	. .
Median Household Income	-1.054E-5	9.0290E-6	.24	1.000	[1.000, 1.000]
Proportion by Race (Ref: Non-Hispanic White)	-.003	.0043	.43	.997	[.988, 1.005]
Median Income by County	7.494E-5	5.4763E-5	.17	1.000	[1.000, 1.000]
Education Level (High School Graduates or Higher)	.052	.0174	.003	1.053	[1.018, 1.090]
(Scale)	.211[b]	.0364			

The predictor variables such as county median income, education level, proportion of race, and population density were also examined for their interactions using a generalized linear model with normal probability distribution and identity link functions. Results indicated that there was no statistically significant interactions among predicting variables in metropolitan counties ($p = .63$) and nonmetropolitan counties ($p = .77$). See Table 11.

Table 11

Interactions Between Predicting Variables to Opioid Death Rate Using Generalized Linear Model With Normal Probability Distribution and Identity Link Function

Parameter Estimates						
					95% *CI*	
Parameter	β	*SE*	*p*	*OR*	Lower	Upper
(Intercept)	0.163	0.0642	.01	1.177	1.038	1.335
Metropolitan * Proportion by Race Ref: Non-Hispanic White * Education Level (high school graduates or higher * Median Income by County	8.60E-11	1.81E-10	.63	1	1	1
Nonmetropolitan * Proportion by Race/Ethnicity Ref: White Alone * Edu Level HS * Median Income by County	9.65E-11	3.39E-10	.77	1	1	1
(Scale)	.032a	0.0056				

Note. Dependent Variable: Opioid Death rate Total 2014-2018
Model: (Intercept), Metropolitan or nonmetropolitan * Proportion by Race/Ethnicity Ref: White Alone * Edu Level HS * Median Income by County
a Maximum likelihood estimate.

Research Question 2B

What is the trend of opioid death rates in older adults by county and between 2014 and 2018?

For Research Question 2B, a general linear model with repeated measures was used to analyze the data. To determine the trend over time, I included the test within-subject contrast. Time was presented here as a study period between 2014 and 2018. The opioid death rate in older adults who died with opioid as a cause of death was examined for each Florida county (n = 67). Again, the opioid death rate was obtained by calculating the number of deaths from opioid as a cause of death (COD) in older adults, divided by the population of older adults per Florida county multiplied by 100,000 (Divisha, n.d.; Florida Department of Health, n.d.a). For trend by county, I simply classified the Florida county by population density such as metropolitan (urban) and nonmetropolitan (rural). An attempt to examine the population density using six levels such as for metropolitan or urban counties: large central metro, large fringe metro, medium metro, small metro; and for nonmetropolitan or rural counties: micropolitan and noncore counties was done. However, this method thinned out sample size, which in turn did not yield clear results. To better illustrate where these counties are situated, I included a map of Florida counties and a Florida map showing the population density distribution- see Appendix C and D.

The average mean scores of opioid death rates (opioid as a cause of death) across Florida counties between 2014-2018 are shown in Table 12. The mean score of opioid death rate was highest in 2017 (*M* = 5.947), followed by 2015 (*M* = 4.874), then by 2014 (*M* = 3.259), 2016 (*M* = 2.884), and least by 2018 (*M* = 2.657). See Table 12.

Table 12.

Differences in the Mean in Opioid Death Rates in Older Adults by Study Period (Time)

Time	Mean (μ)	*SE*
2014	3.259	0.668
2015	4.874	1.321
2016	2.884	0.522
2017	5.947	1.553
2018	2.657	0.549

In terms of population density, nonmetropolitan counties had the highest mean scores of opioid death rate in 2017 (*M* = 7.276, *SE* = 2.517), followed by 2015 (*M* = 5.839, SE = 2.142), and lowest in 2016 (*M* = 0.849, *SE* = 0.846). For metropolitan counties, the highest mean scores for opioid death rate occurred in 2016 (*M* = 4.918, *SE* = 0.612), followed by 2017 (*M* = 4.619, *SE* = 1.82), and lowest in 2014 (*M* = 3.109, *SE* =

0.783). The opioid death rate was higher in nonmetropolitan counties versus metropolitan counties in 2014 (3.408 vs. 3.109), in 2015 (5.839 vs 3.909), and in 2017 (7.276 vs. 4.619). Meanwhile, the metropolitan or urban counties had higher opioid death rate in 2016 than the nonmetropolitan counties (4.918 vs. 0.849) and in 2018 (4.362 vs. 0.953).

See Table 13 for the mean score differences in opioid death rate by population density (metropolitan and nonmetropolitan counties) in Florida between 2014 and 2018. In addition, a plot showing this mean score difference in opioid death rate was also included. See Figure 8.

Table 13

Differences in the Mean Scores of Opioid Death Rate (Opioid as a Cause of Death) in Older Adults by Population Density From 2014 to 2018

Population Density * Time					
Measure: Opioid Death Rate by County (Population Density)					
				95% *CI*	
Population Density	Time	*M*	*SE*	Lower Bound	Upper Bound
Metropolitan (Urban County)	2014	3.109	0.783	1.545	4.672
	2015	3.909	1.549	0.817	7.002
	2016	4.918	0.612	3.697	6.14
	2017	4.619	1.82	0.985	8.253
	2018	4.362	0.643	3.077	5.646
Nonmetropolitan (Rural County)	2014	3.408	1.083	1.246	5.571
	2015	5.839	2.142	1.562	10.117
	2016	0.849	0.846	-0.84	2.538
	2017	7.276	2.517	2.249	12.302
	2018	0.953	0.89	-0.824	2.73

Results of Research Question 2B

A general linear model with repeated measures was used to examine the trend of opioid death rate in older adults by Florida county (metropolitan and nonmetropolitan) and by study years (between 2014 and 2018). Mauchly's test indicated that the assumption of sphericity was violated, X^2 (9) = 108.008, $p < .001$; therefore, Greenhouse-Geisser corrected tests are reported ($\varepsilon = .538$). Result indicated that there was no trend in opioid death rate over time, $F(2.153, 131.319) = .717$, $p = .50$, $\eta^2 = .012$. Tables 14 and 15 show Mauchly's test of sphericity and the tests of within-subjects effect, respectively.

Table 14

Mauchly's Test of Sphericity[a]

Measure: Opioid Death Rate Trend by Time and County

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	*p*	Epsilon b		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	0.162	108.008	9	.001	0.538	0.604	0.25

Table 15

Test Within-Subjects Effects Using General Linear Model With Repeated Measures

Tests of Within-Subjects Effects							
Measure: Opioid Death Rate Trend by Time (2014-2018) and by County (Population Density)							
Source		Type III Sum of Squares	df	Mean Square	*F*	*p*	Partial Eta Squared
Time	Sphericity Assumed	176.686	4	44.171	0.717	.58	0.012
	Greenhouse-Geisser	176.686	2.153	82.074	0.717	.50	0.012
	Huynh-Feldt	176.686	2.417	73.1	0.717	.51	0.012
	Lower-bound	176.686	1	176.686	0.717	.4	0.012
Time * Population Density	Sphericity Assumed	1007.574	20	50.379	0.818	.69	0.063
	Greenhouse-Geisser	1007.574	10.764	93.607	0.818	.62	0.063
	Huynh-Feldt	1007.574	12.085	83.373	0.818	.63	0.063
	Lower-bound	1007.574	5	201.515	0.818	.54	0.063
Error (Time)	Sphericity Assumed	15024.329	244	61.575			
	Greenhouse-Geisser	15024.329	131.319	114.411			
	Huynh-Feldt	15024.329	147.439	101.902			
	Lower-bound	15024.329	61	246.3			

Specifically, there was no linear trend in the opioid death rate in older adults in Florida, $F(1, 65) = .002$, $p = .96$, MSe = 48.544. Also, no substantial evidence of significant quadratic trend in opioid death rate was detected in the study, $F(1, 61) = 3.209$, $p = .07$, MSe = 27.64. There was no cubic trend in opioid death rate: $F(1, 61) = 0.205$, $p = .65$, MSe = 112.048. Table 16 shows the trend analysis of tests of within-subject contrasts using the general linear model with repeated measures.

Table 16

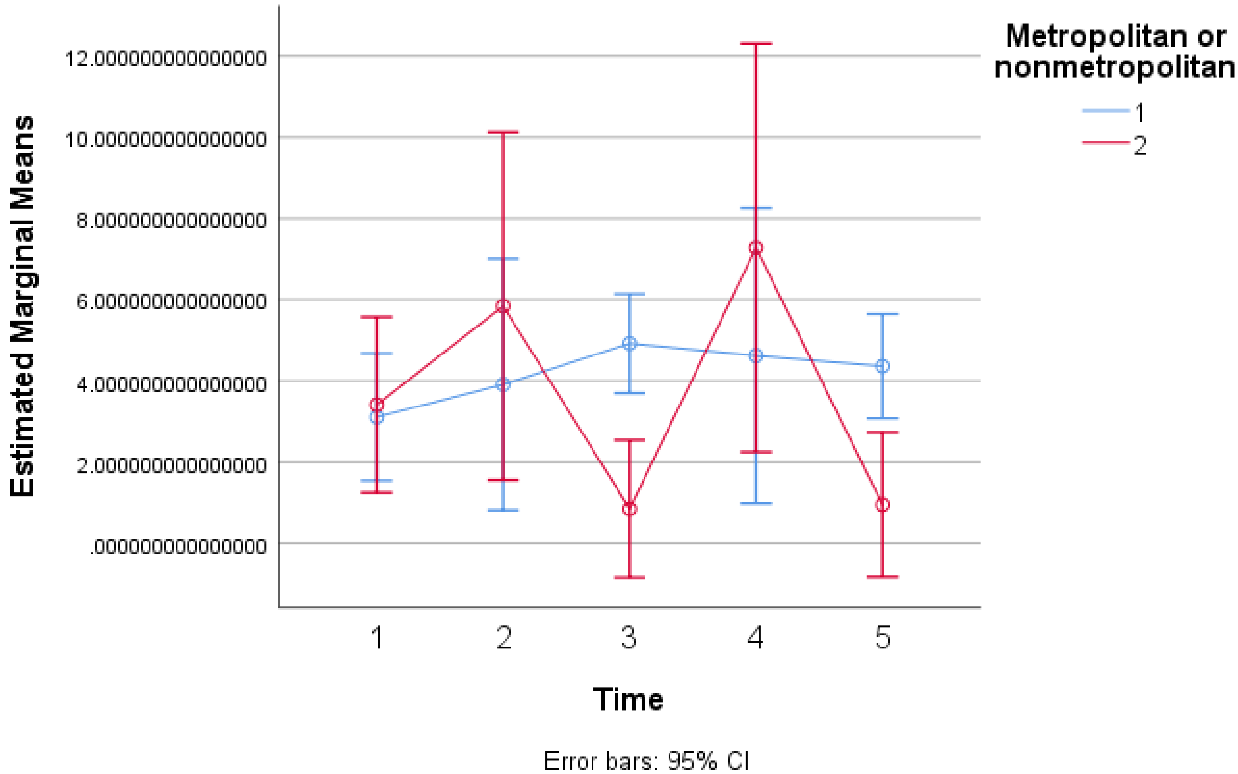
Tests of Within-Subjects Contrasts Using General Linear Model With Repeated Measures

Tests of Within-Subjects Contrasts							
Measure: Opioid Death Rate Trend by Time (2014-2018) and County (Population Density)							
Source	Time	Type III Sum of Squares	df	Mean Square	*F*	*p*	Partial Eta Squared
Time	Linear	20.92	1	20.92	0.408	.52	0.007
	Quadratic	88.708	1	88.708	3.209	.07	0.05
	Cubic	23.026	1	23.026	0.205	.65	0.003
Time * Population Density	Linear	98.863	5	19.773	0.386	.85	0.031
	Quadratic	76.085	5	15.217	0.551	.73	0.043
	Cubic	46.455	5	9.291	0.083	.99	0.007
Error(Time)	Linear	3124.15	61	51.216			
	Quadratic	1686.033	61	27.64			
	Cubic	6834.922	61	112.048			

Again, to further visualize the trend analysis, a plot showing the marginal means by population density (metropolitan and nonmetropolitan) is provided in Figure 8.

Figure 8

Temporal Trend of Opioid Death Rate by Florida County in Terms of Population Density Between 2014-2018



The difference in the mean of opioid death rate across time was also examined for its statistical significance by analyzing the pairwise comparison in SPSS. Results indicated that there was no statistical significance in opioid death rate across time. It should be noted, however, that there was almost a statistically significant difference in opioid death rate from 2017 to 2018 (p = .051). Examination of the pairwise comparison between metropolitan and nonmetropolitan counties revealed no statistical difference in the mean of opioid death rate by county or by population density (p = .60). Tables 17 and 18 show these results.

Table 17

Pairwise Comparison of Opioid Death Rate by Time Using General Linear Model With Repeated Measures by Time

Pairwise Comparisons						
Measure: Opioid Death Rate by Time (2014-2018)						
					95% *CI*	
(I) Time	(J) Time	Mean Difference (I-J)	*SE*	*p*	Lower Bound	Upper Bound
2014	2015	-1.616	1.163	.17	-3.939	0.708
	2016	0.375	0.787	.63	-1.196	1.946
	2017	-2.689	1.728	.12	-6.14	0.762
	2018	0.601	0.748	.42	-0.892	2.094
2015	2014	1.616	1.163	.17	-0.708	3.939
	2016	1.991	1.431	.16	-0.867	4.848
	2017	-1.073	2.129	.61	-5.325	3.179
	2018	2.217	1.321	.09	-0.421	4.855
2016	2014	-0.375	0.787	.63	-1.946	1.196
	2015	-1.991	1.431	.16	-4.848	0.867
	2017	-3.064	1.603	.06	-6.266	0.138
	2018	0.226	0.729	.75	-1.23	1.683
2017	2014	2.689	1.728	.12	-0.762	6.14
	2015	1.073	2.129	.61	-3.179	5.325
	2016	3.064	1.603	.06	-0.138	6.266
	2018	3.29	1.656	.051	-0.018	6.598
2018	2014	-0.601	0.748	.42	-2.094	0.892
	2015	-2.217	1.321	.09	-4.855	0.421
	2016	-0.226	0.729	.75	-1.683	1.23
	2017	-3.29	1.656	.051	-6.598	0.018

Table 18

Pairwise Comparison of Opioid Death Rate by County Using General Linear Model

Pairwise Comparisons						
Measure: Opioid Death Rate Trend by County						
					95% *CI*	
(I) Metropolitan or nonmetropolitan	(J) Metropolitan or nonmetropolitan	Mean Difference (I-J)	SE	*p*	Lower Bound	Upper Bound
Metropolitan (Urban Counties)	Nonmetropolitan (Rural Counties)	0.518	0.996	.60	-1.471	2.508
Nonmetropolitan (Rural Counties)	Metropolitan (Urban Counties)	-0.518	0.996	.60	-2.508	1.471

Note. Based on estimated marginal means
a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Results for Research Question 3

Is there a relationship between the manner of death of older adults with opioid as a cause of death and the type of opioid drugs involved?

A chi-square test of independence showed that there was a statistically significant relationship between the manner of death (MOD) of older adults who died with opioid as a cause of death and the type of opioid drugs involved, $X^2(4, n = 47\text{-}815) = 13.669$ - 107.895, $p < .05$. Opioid drugs such as codeine, fentanyl, fentanyl analog, heroin, hydrocodone, hydromorphone, methadone, morphine, oxycodone, oxymorphone, and tramadol showed a statistically significant relationship or association to the manner of death, $p < .001$. Meperidine as a cause of death ($n = 2$) and buprenorphine as a cause of death ($n = 1$) do not meet the assumptions of chi-square since > 20% of cells have an expected count less than 5. The result for the association between the manner of death and meperidine as a cause of death was not statistically significant: $X^2(2) = 3.750$, *p* = .15, and also for buprenorphine, not statistically significant: $X^2(3) = 1.436$, $p = .69$, which had moderately large effect (with Cramer's V value = .305).

More older decedents (with opioid as a COD) died from accidents (*n* = 564), followed by suicide (*n* = 402), and undetermined cause (*n* = 41). No older adults with opioid as a cause of death died from homicide and natural cause. The opioid drugs that caused the most accident in older adults were morphine (*n* = 119), oxycodone (*n* = 101), followed by fentanyl (*n* = 80), hydrocodone (*n* = 50), methadone (*n* = 44), fentanyl analog (*n* = 42), and heroin (*n* = 41). All older decedents with fentanyl analog as a cause of death died from an accident (100%), while 93% (*n* = 41) of older decedents with heroin as a cause of death died from an accident. More than half of older decedents with tramadol as a cause of death died from suicide (63.5%), while 64.53% or 91 of 144 of older decedents with hydrocodone (COD) died from suicide. Suicide also accounted for 54.66% or 94 of 144 of older decedents with oxycodone as a cause of death.

For the effect size, I chose to report Cramer's V value since the manner of death has more than two categories. Polit (2010) reported that Cramer's V could be used for contingency tables of any size. The following are the strength of the relationship between the manner of death and the type of opioid drug involved: those with large effect are codeine (Cramer's V value = .464), methadone (.571), fentanyl (.377), fentanyl analog (.611), heroin (.693), morphine (.364), and oxycodone (.339). The opioid drugs with a medium effect size are hydrocodone (Cramer's V value = .258), hydromorphone (.284), oxymorphone (.276), and tramadol (.244). For the relationship between the manner of death and the opioid drugs involved, see Table 19.

Table 19

Relationship Between Manner of Death and the Opioid Drugs Involved in Opioid as a Cause of Death in Older Adults

Opioid Drug	Manner of Death n	%	X2	p	Cramer's V
Codeine	A = 8	38.1	32.541	< .001	.464
	NC = 0	0.0			
	S = 9	42.9			
	U = 4	19.0			
Fentanyl	A = 80	87.0	42.233	< .001	.377
	H = 0	0.0			
	NC = 0	0.0			
	S = 12	13.0			
	U = 0	0.0			
Fentanyl Analog	A = 42	100.0	17.547	< .001	.611
	U = 0	0.0			
Heroin	A = 41	93.2	23.036	< .001	.693
	H = 0	0.0			
	NC = 0	0.0			
	S = 1	2.3			
	U = 2	4.5			
Hydrocodone	A – 50	34.7	47.674	< .001	.258
	H = 0	0.0			
	NC = 0	0.0			
	S = 91	63.2			
	U = 3	2.1			
Hydromorphone	A = 29	55.8	26.949	< .001	.284
	H = 0	0.0			
	NC = 0	0.0			
	S = 19	36.5			
	U = 4	7.7			

(table continues)

Table 19 *(continued)*

Opioid Drug	Manner of Death n	%	X2	p	Cramer's V
Methadone	A = 40	67.8	13.669	< .008	.323
	H = 0	0.0			
	NC = 7	11.9			
	S = 10	16.9			
	U =2	3.4			
Morphine	A = 119	60.4	107.895	< .001	.364
	H = 0	0.0			
	NC = 0	0.0			
	S = 63	32.0			
	U = 15	7.6			
Oxycodone	A = 101	42.8	89.249	< .001	.339
	H = 0	0.0			
	NC = 0	0.0			
	S = 129	54.7			
	U = 6	2.5			
Oxymorphone	A = 25	50.0	22.289	< .001	.276
	H = 0	0.0			
	NC = 0	0.0			
	S = 24	48.0			
	U = 1	2.0			
Tramadol	A = 24	32.4	36.179	< .001	.244
	H = 0	0.0			
	NC = 0	0.0			
	S = 47	63.5			
	U = 3	4.1			

Note. Accident (A), Homicide (H), Natural Cause (NC), Suicide (S), Undetermined (U).

Chapter Summary

This chapter presented the results of the study which aimed to investigate the social determinants of ORD in older adults in Florida from 2014-2018. A total of 4,241 cases of older decedents ($\geq$ 65 years old) with opioids found in their system at time of death (*n* = 3,234), or opioid/s as a cause of death (*n* = 1,007) were analyzed. Thirteen opioid drugs were included in the analysis: buprenorphine, codeine, fentanyl, fentanyl analog, heroin, hydrocodone, hydromorphone, meperidine, methadone, morphine, oxycodone, oxymorphone, and tramadol.

Results of chi square tests of independence indicated a significant association between gender and ORD ($p < .001$). Older males were more affected than the older females (56.5% vs. 43.5%). Opioid drugs that had significant association with gender were codeine ($p = .006$), hydrocodone ($p < .001$), hydromorphone ($p = .008$), oxycodone ($p < .001$), and tramadol ($p < .001$). Race had no significant association with ORD ($p > .05$). There was a statistical significance about the relationship between the manner of death in older adults with opioid as a cause of death and the type of opioid drugs involved ($p < .05$). Fifty-six percent of older adults with opioid as a cause of death died in accidents, while nearly 40% of older adults with opioid as a cause of death died in suicide. The opioid drugs that showed significant relationship with the manner of death were codeine, fentanyl, fentanyl analog, heroin, hydrocodone, hydromorphone, methadone, morphine, oxycodone, oxymorphone, and tramadol.

County education level (high school graduates or higher) came out as a significant predictor of opioid death rate using a generalized linear model with normal probability distribution and identity link functions in SPSS ($\beta = .52$, $p = .003$, OR= 1.053, (95% CI: 1.018, 1.090) among the predictor variables used in the study. This result suggested that in the county with low education level (high school graduates or higher), the odds of opioid death rate increased by a factor of 1.053. There was a substantial difference in the mean in the education level (high school graduates or higher) between metropolitan counties ($M = 88.773$, $SD = 3.3389$) and nonmetropolitan counties ($M = 78.843$, $SD =$

4.9916). There was no statistically significant trend in opioid death rate by Florida county (metropolitan vs. nonmetropolitan) and data years (2014-2018) ($p > .05$). Chapter 5 discusses the results of this study in the context of the socio-ecological model for the social determinants of ORD in older adults and uses of the results of this study for future research, practice, and policy recommendations.

CHAPTER 5: DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

Introduction

This secondary analysis was conducted to investigate the social determinants of ORD in older adults in Florida using raw data from the FDLE agency from 2014-2018. A gap in research concerned the negative consequences of opioid use in older adults was identified during the literature review. This study examined the association between gender and race to ORD in decedents $\geq$ 65 years and above. This study sought to determine whether county characteristics such as proportion by race, median household income, education level (high school graduates or higher), and percentage of people in poverty predicted the opioid death rate in older adults. Further, this study analyzed the trend of opioid death rates in older adults by Florida county and through the data years 2014 to 2018. The relationship between the manner of death and the opioid drugs involved in older adults who died with an opioid as a cause of death was also examined.

A total of 4,241 cases of ORD in older adults in Florida from 2014-2018 were analyzed. Of these 4,241 ORD in older adults, 1,007 identified opioids as the cause of death (COD) as determined by the medical examiners through urine and toxicology reports. The results of this study were summarized as follows:

1. There was a significant association between gender and ORD where older male decedents were more affected than older female decedents ($p < .001$);

race was not associated with ORD ($p > .05$).

2. The manner of death, particularly accidents and suicides, showed a significant relationship with most of the opioid drugs such as morphine ($p < .001$), oxycodone ($p < .001$), oxymorphone ($p < .001$), codeine ($p < .001$), fentanyl, fentanyl analogs ($p < .001$), heroin ($p < .001$), hydrocodone ($p < .001$), hydromorphone ($p < .001$), methadone ($p < .001$), and tramadol ($p < .02$). Fifty-six percent of older decedents with an opioid as a cause of death died from an accident, nearly 40% died from suicides, and 4% died from an undetermined cause. Again, in this study, an accident was defined as an opioid drug taken accidentally, too much opioid was taken accidentally or unintentionally, the wrong drug was administered or taken by mistake, or an accident occurred in the use of the opioid drug during a medical or surgical procedure (NIDA, 2017). No older decedents with an opioid as a COD died from homicide nor natural causes.

3. Education level (high school graduates or higher) showed as a significant predictor of opioid death rate in older adults ($p = .003$). There was a substantial mean score difference in education level between metropolitan counties and nonmetropolitan counties in Florida ($M = 88.773$ vs. $M = 78.843$, respectively).

4. There was no significant linear and quadratic trend in opioid death rate in terms of time or from 2014 to 2018 and population density (metropolitan vs. nonmetropolitan).

Discussion

Opioids continue to be a major contributor to drug overdose deaths. People’s lives have been lost unnecessarily from ORD, affecting life expectancy, individual and family relationships, and quality of life. The death epidemic from opioids also affected our vulnerable population, the older adults, where it created an undue financial strain on our economy and continued to impact communities, particularly in the United States.

Of paramount significance was this study's result, where it addressed the social determinants of ORD in older adults, where a dearth of research was conducted. In contrast, most opioid research studies focused on the younger population; this study aimed to examine the sociodemographic predictors of opioid death rate in older adults. This is critically important since older adults posed a higher risk of opioid overdose and deaths than the younger population (AHRQ, 2019). The purpose of this study aligned with the National Institute of Health HEAL (Helping to End Addiction Long-Term) initiatives by focusing on the social determinants of opioid-related deaths at a county or local level (NIH, 2018). Identifying the most vulnerable among the vulnerable population of older adults statewide by knowing "where they are" is critical in formulating target interventions that are responsive and culturally tailored to the needs of the affected communities or counties, particularly that of the older adults (CDC, 2020f; Nechuta et al., 2018).

This study's results added evidence to the negative consequences of opioid use in this segment of our population. The number of older decedents who died with an opioid as a cause of death that resulted in accidents (n = 564 or 56%) and suicides (n = 402 or 39.92%) warrants careful attention.

The Study Findings Within the Context of the Theoretical Framework

The socio-ecological model was selected as a theoretical framework of this study to understand better the interactions of factors in the physical and social environments that influenced health and health outcomes (Kilanowski, 2017). Those factors in the environment where people live, work, play, and age are referred to as the social determinants of health (CDC, 2020f). This researcher adapted the CDC's four-level socio-ecological model to include individual, interpersonal, community, and societal levels (CDC, 2020g). While no data on the interpersonal or relationship level of the socio-ecological model were available from the FDLE reports, the use of an opioid (being present in the older decedent's system at a time of death or was a cause of death) suggested an opioid source. Studies showed that older adults were 2.6 times more likely to receive opioid prescriptions than those people 20-24 years old (CDCg, 2020); and 354,00 Medicare Part D beneficiaries received prescription opioids in 2018, which was problematic since approximately 50,000 of them faced serious overdose (OIG, 2019). It should be noted this study did not focus on the opioid source; rather, it focused on the social determinants of opioid-related deaths in older adults.

Let's examine the results of this study at each level of the socio-ecological model. The result of this study indicated that gender had a significant association with ORD, while race had no significant association with ORD. These two sociodemographic variables—gender and race, found in the socio-ecological model individual level provided descriptions of the ORD prevalence in older adults. This result showed a similar pattern with other studies indicating that more men were affected with ORD than women (Altekruse, et al., 2020; Hedegaard et al., 2018). Hedegaard and colleagues (2018) reported the highest drug overdose rate increase in younger people 25-34 years old (38.4 per 100,000) and 35-44 years old (39 per 100,000) from 1999 to 2017, compared to people 65 years old and above at 6.9 per 100,000 of the same years. However, in this study, it indicated that the number of older adults who died with an opioid as a cause of death in Florida between 2014 and 2018 was consistently high: 134 deaths in 2014, 177 deaths in 2015, 254 deaths in 2016, 242 deaths in 2017, and 200 deaths in 2018. This translated to 22.43 deaths per 100,000, which was higher than what Hedegaard and colleagues reported at 6.9 deaths per 100,000. Florida had a population of 21,477,737 in 2019, of which 20.9% are people > 65 years old (U.S. Census Bureau, n.d.). Out of this 1,007 total number of deaths in older adults (opioid as a cause of death), more older males (*n* = 569) died from opioids than females (*n* = 438 deaths) or 56.5% versus 43.5%. This study found that oxycodone, hydrocodone, morphine, fentanyl, and tramadol were among the opioid drugs with a statistically significant relationship with the manner of death where older adults died from an accident (56%) and suicide (39.92%). This result was comparable with Hedegaard and colleagues' (2018) findings, who reported a significant increase (45%) in synthetic opioid-related deaths in the United States from 2016 to 2017, such as fentanyl analogs and tramadol.

While the majority of older adults who died from opioids as a cause of death (*n* = 937 or 93 %) were non-Hispanic whites in this study, the result indicated that race was not a factor in ORD in older adults (p > .05). Lippold et al. (2019) reported that blacks > 65 years old had the largest increase of drug overdose deaths (123% involving any opioid) from 5.2 to 11.6 per 100,000 in large metro areas in the United States between 2015 and 2017 and a 533% increase in synthetic opioid deaths from 1.2 to 7.6 deaths per 100,000 of the same years. In another study, DeLaquil and colleagues (2020) reported that African Americans were two times more likely to die of a drug overdose in Minnesota in 2019 than whites. In contrast, this study showed that only 62 black older adults died from opioid as a cause of death in Florida from 2014 to 2018, and most of these deaths occurred in metropolitan areas. However, one study showed that blacks who complained of back pain during emergency room visits were less likely to receive an opioid prescription than whites (Dickanson et al., 2015); while Hispanics were less likely to receive opioid prescriptions after a dental diagnosis than African Americans and whites (Janakiram et al., 2019). This result might explain why blacks or other ethnicities received fewer opioid prescriptions than whites, resulting in fewer opioid-related deaths among blacks, Hispanics, and Asian decedents, as reflected in this study's results.

In the context of opioid-related deaths, which was placed in the interpersonal or relationship level of the socio-ecological model (representing opioid use), previous studies showed that a significant number of older adults received opioids; for instance, the U.S. Office of Inspector General (2019) reported that 354,000 Medicare Part D beneficiaries were prescribed opioids in 2018, with approximately 50,000 of these beneficiaries facing serious overdose. Huhn et al. (2018) reported that the percentage of older adults in the United States who sought treatment for opioid use disorder increased 53.5% from 2013 to 2015. Also, Le Roux et al. (2016) reported that the percentage of older adults who complain of pain was higher than the general population (40% vs. 30%), and chronic pain was a significant health issue in older adults (Dahlhamer et al., 2018; Domenichiello & Ramsden, 2019). This could explain why a significant number of older decedents had opioids in their system at a time of death (n = 3,234) or as a cause of their death (n = 1,007), as reported in this study results. The older adults' vulnerability to adverse effects from opioid use due to the aging process and comorbidities could increase their risks for unintentional drug poisoning or overdose (AHRQ, 2019). This becomes problematic as the number of older adults with emergency room visits due to opioid misuse increased by 220% in the United States from 2006 to 2014 (Carter et al., 2019). At the community level of the socio-ecological model, the results of this study indicated that county education level (high school graduates or higher) was a significant predictor of opioid death rate ($p = .003$). It is noteworthy to mention that among the top five Florida counties with the highest opioid death rate from 2014 to 2018 (Levy, Hamilton, Bradford, Duval, and Holmes counties), these counties have an education level below the state average of 88%, except for Duval with slightly above the state average education level (high school graduates or higher) at 89.8%. For instance, Levy county, with an opioid death rate of 89/100,000 (where opioid was a cause of death), the education level was 84.9%; Hamilton county with an opioid death rate of 77/100,000 had an educational level of 73%; Bradford county with an opioid death rate of 60/00,000 had an education level of 79.6%, and Holmes county with an opioid death rate of 50/100,000 had an education level of 78%, which again was below the statewide average of 88%.

These counties (Levy, Hamilton, Bradford, and Holmes) are classified as nonmetropolitan counties, while Duval county is classified as metropolitan, large central metro, to be exact. Meanwhile, aside from Duval county, other metropolitan counties with a higher opioid death rates, were Highland county with an opioid death rate of 36/100,000 had an education level of 85.7%, Miami-Dade, a large central metro with an opioid death rate of 16 per 100,000, had an education level of 81.4%. On the other hand, Palm Beach county, classified as a large fringe metropolitan county, had an opioid death rate of a 32 per 100,000 and had an education level of 88.5%, which was slightly above the state average of 88% (U.S. Census Bureau, n.d.); while Broward county, also a large fringe metropolitan county with an opioid death rate of a 30 per 100,000 had an education level of 89%. Manatee county, a medium metropolitan county in Florida, had an opioid death rate of 26 per 100,000, had an education level of 89.7%, which was slightly higher than the state average.

An independent sample *t* test was conducted to examine the mean difference in education level between metropolitan and nonmetropolitan counties. Results indicated that there was a substantial difference in the mean scores of the education level (high school graduates or higher) between the metropolitan counties ($M = 88.773$, $SD = 3.3389$) and the nonmetropolitan counties, which was statistically significant: ($M = 78.843$, $SD = 4.9916$); $t(65) = 9.706$, $p < .001$. After controlling for other variables, education was a significant predictor of opioid death rate in older adults, which elucidates a need for harm reduction strategy geared towards educating our vulnerable population about opioids.

Nevertheless, it was surprising to find that population density was not a significant predictor of the opioid death rate ($p = .45$). This was in contrast to what Monnat and Riggs (2018) reported that opioid deaths were 16x higher in rural counties than urban counties, and more older adults were turning to opioid use in rural areas than in urban areas (Benson et al., 2019). Also, median household income was not a significant predictor of opioid death rate in Florida ($p = .24$), which again, was not congruent to what Monnat and colleagues (2019) reported that counties with low socioeconomic status (represented by low income) had a higher incidence of opioid-related deaths.

At the socio-ecological model's societal level, the opioid death rate per Florida county indicated no statistical significance in terms of a linear or cubic trend in older adults. A decrease in opioid death rate in the metropolitan counties from 2016 to 2018, as reflected in the trend results for Research Question 2B, could be explained by the statewide implementation of opioid overdose prevention programs in Florida, such as the naloxone distribution and prescription drug monitoring program, i.e., Electronic- Florida Online Reporting of Controlled Substances Evaluation (E-FORCSE; Florida Department of Health, n.d.b) in 2016 (Florida Department of Children and Families, 2018). Further, according to the Florida Department of Children and Families (2018), there was a significant increase in prescriber enrollment to E-FORCSE resulting in a 4% reduction in the number of days' supply of opioids to clients, as well as a 76.1% reduction in people having multiple opioid prescribers.

The multidirectional nature of the socio-ecological model wherein a factor in one level, i.e., individual-level such as gender and race, could have also influenced other factors in the different levels of the model, i.e., community level, thus demonstrating an interaction. This investigator also examined the interactions within the predictor variables in SPSS, again using a generalized linear model with normal probability distribution and identity link function. Results revealed no significant interactions among education level, median household income, and race proportion to the opioid death rate.

Gender as a Sociodemographic Variable in ORD

A chi-square test of association indicated that there was a statistical significance between gender and ORD. The alpha value was $p < .001$. This study showed that older male decedents have higher ORD than older female decedents (58.44% vs. 41.56%). The association of gender to opioid-related deaths indicated a small to moderate effect, as reflected in the phi value of .107-.278.

While there was no study conducted in older adults about opioid as a cause of death to my knowledge, that can be used for comparative analysis with the findings of this study, the work of Beauchamp and colleagues (2018) on sex differences in poisonings among older adults revealed that older female adults were more exposed to opioid poisoning than older male adults (117 vs. 85) from 2010 to 2016. Besides, older female adults were more likely to be screened for opioid poisoning than older male adults, while male patients were more likely to be evaluated for alcohol toxicity (Beauchamp et al., 2018). The Kaiser Family Foundation (KFF) (2018) reported that more males died from opioid overdose in Florida than females, similar to this study's findings. However, the KFF report included all age groups, while this study focused solely on older adults. Besides, no inferential statistics were reported in the KFF report used to associate gender with ORD.

Choo et al. (2014) examined gender in opioid misuse in U.S. emergency departments and concluded that death was a rare outcome from opioid misuse between genders. While no clinical indication was included in the FDLE reports on drugs identified in deceased persons, this study did not infer opioid misuse as a reason for ORD. The result of this study where ORD occurred more in older adult males than older adult females also corresponds to the findings of Wilson et al. (2020), where males had a 79.9 rate of opioid overdose deaths compared to females with a 36.6 rate. However, the Wilson study's age range for these decedents was 15-64 years old and not older adults.

Further, this study on the association between gender and ORD conformed to the historically familiar pattern of gender-based differences in ORD.

Race as a Sociodemographic Variable in Opioid-Related Deaths

Again, a chi-square test of association showed no significant association between race and ORD ($p > .05$). This result was quite different from a study conducted by Lippold et al. (2019), where they reported increases in the opioid-involved and synthetic opioid-involved overdose death rate among > 18 years old between 2015 to 2017 in U.S. large central metropolitan areas. Lippold and colleagues (2019) reported that almost all racial/ethnic groups showed significant increases in opioid-involved death rate, particularly among blacks 55-64 years old from 21.8 to 42.7 between 2015-2017. However, Lippold and colleagues (2019) study's age groups were different from this study, which focused on older adults.

While the county proportion of race, using non-Hispanic white as a reference, did not yield a significant association with opioid death rate ($p = .43$), it was interesting to find that in the Florida counties with at least a 30 per 100,000 opioid death rate, a majority of them had a higher proportion of non-Hispanic whites than the statewide average of 53.2% non-Hispanic white (NHW) (U.S. Census Bureau, n.d.a). For instance, Levy county with an 89 per 100,000 opioid death rate, the proportion of non-Hispanic white was 79.2%, while Hamilton county, with a 77 per 100,000 opioid death rate, the proportion of non-Hispanic white was 54.7%, Bradford with a 60 per 100,000 opioid death rate had a proportion of non-Hispanic white at 72.2%, in Holmes with a 50 per 100,000 opioid death rate, the proportion of NHW was 86.4%. Only Duval county, with a

59 per 100,000 opioid death rate, had a proportion of NHW at 52%, and Broward county, with a 30 per 100,000 opioid death rate, had a proportion of NHW at 34.8%.

Johnson (2016) reported that over prescriptions of opioids occurred more often among whites and led to more risks of opioid overdoses and deaths. Johnson (2016) cited providers' reluctance to prescribe opioids to black or Hispanic patients because they were concerned that drugs might be diverted or sold in the streets as the reason why fewer black or Hispanic patients died from opioid overdoses than white.

The Association of the Manner of Death and the Opioid Drugs Involved

The result indicated that the relationship between the manner of death (accidents, homicide, natural cause, suicide, and from undetermined cause) and the opioid drugs involved (as a cause of death) was statistically significant ($p < .001$). More than 50% (56%) of older decedents with an opioid as a cause of death died from accidents, while 39.9% died from suicide, and only .41% died from an undetermined cause. Oquendo and Volkow (2018) reported suicide as a silent contributor to opioid-overdose mortality. This study revealed that there were ORD in older adults that resulted in suicide, such as oxycodone with 129 cases, hydrocodone with 91 cases of suicide, morphine with 63 cases of suicides, and tramadol with 47 cases of suicide.

Abiragi et al. (2020) reported that the majority of ORD were accidental. Abiragi and colleagues (2020) reported that fentanyl and heroin were the significant contributors to drug-related deaths, where heroin was observed to have a five-fold increase in heroin-related deaths from 2010 to 2016 among males 25-44 years old. While fentanyl is classified as a Schedule 2 prescription opioid, heroin is classified as a Schedule 1 opioid with no medical use. Thus, it is an illicit or illegal opioid (U.S. Drug Enforcement

Administration, n.d.). The result of this study revealed that there were 41 of 42 (97.6%) cases of older decedents with heroin as a cause of death died from accidents, and only 1 case or 2.4% died from suicide. This piece of information is significant since interventions for drug-related accidents and drug-related suicides could be different in terms of approaches and medical management.

Moreover, in this study, oxycodone accounted for 129 deaths in older decedents due to suicide, 101 deaths that resulted in accidents, and only 6 deaths with an undetermined cause. This result was quite alarming, given that oxycodone was not specifically included in the 2019 Beers criteria for a list of medications that may harm older adults. The Beers criteria reported opioids among the drugs inappropriate for long-term care residents, particularly in patients with a history of falls or fractures (Fixen, 2019; Therapeutic Research Center, 2019). However, it did not specify oxycodone in the list, nor that some opioids such as oxycodone or tramadol could lead to suicidal deaths. In this study, tramadol (which is included in the Beers list) recorded 24 deaths resulting from accident, 47 deaths resulting from suicide, and only 3 deaths with an undetermined cause. In this study, morphine also contributed to a significant number of ORD: 119 deaths resulting from accidents, 63 deaths resulting from suicide, and 15 deaths with an undetermined cause.

On the other hand, this study result indicated that 80 older adults with fentanyl as a cause of death died from accidents, while 12 died from suicide. All 42 older adults with fentanyl analog as a cause of death died from accidents. This result was similar to what the CDC (2021c) reported about fentanyl-related deaths driving an increase in synthetic opioid-involved deaths. One implication of this result about the manner of death of older decedents with opioid-related deaths was that a healthcare provider should pay extra attention when prescribing these specific opioids such as oxycodone, morphine, fentanyl, and even tramadol to older adults. Florida passed the law in 2018 requiring prescribers and dispensers of controlled substances, including opioids, to consult the database, referring to the prescription drug monitoring program or the E-FORCSE before prescribing and dispensing these opioids (Scott, 2018). The risk of accidents and suicide should be considered when prescribing these opioid drugs. Likewise, older adults should be cautioned about these risks when taking these drugs. Only one older adult died from buprenorphine as a cause of death, and this death resulted from an accident in this study, while only two older adults died from meperidine as a cause of death—one of these deaths resulted from suicide and the other one from an undetermined cause from 2014-2018.

Education Level as a Predictor Variable in Opioid Death Rate

The result of this study indicated that the county education level (high school graduates or higher) showed statistical significance in predicting opioid death rate (ODR) (p = .003), suggesting that the odds of opioid death rate increased by a factor of 1.053 % in a county with low education level. Again, there was substantial evidence that education level was higher in the metropolitan counties (n = 44) than nonmetropolitan counties (n = 23), with a mean difference of 88.773 versus 78.843. This might help explain why several nonmetropolitan counties in Florida, such as Levy (89 per 100,000 ODR), Hamilton (77 per 100,000 ODR), Bradford (60 per 100,000 ODR, and Holmes 50 per 100,000 ODR), had higher opioid death rates compared to the metropolitan counties such as Palm Beach county (32 per 100,000), Brevard County (33 per 100,000 ODR), and Broward (30 per 100,000 ODR). All these metropolitan counties mentioned have at least a higher education level (above the state average). This result was comparable to what Dosa et al. (2009) reported that people with low education levels, such as those without high school degrees, had a higher rate of opioid use (55%).

In 2018, the NIH convened a panel and discussed the socioeconomic underpinnings of the opioid epidemic. In that panel discussion, NIH (2018) reported that the death rates from opioid use disorder were higher among whites without a college degree than those with a college degree. The NIH (2018) also reported that people without a college education were economically disadvantaged, leading to despair, suicide, and drug abuse.

Results revealed that only Miami-Dade County, which is classified as a large central metropolitan county, has below the state average education level (high school graduates or higher) at 81% (state average was 88 %), and it had 72 opioid deaths (COD) recorded between 2014-2018 or 16 per 100,000 ODR. Miami-Dade has a population of 2,716,940 (U.S. Census Bureau, n.d.). Of this Miami-Dade population, only 16.7% or 434,710 people are older adults or 65 years old and above (U.S. Census Bureau, n.d.). Using the age-specific death rate, the opioid death rate of Miami-Dade was 16 per 100,000, which was lower compared to Duval county. However, Miami-Dade County has a lower proportion of non-Hispanic white at only 12.9 % compared to the state average of 53.2%. Duval county is also classified as a large central metropolitan county in Florida, with 77 opioid deaths (COD) in older adults between 2014-2018. Duval’s education level (high school graduates or higher) was 89.8%, just slightly above the state average of 88%, with a proportion of non-Hispanic white at 52%, close to the state average 53.2%

(U.S. Census Bureau, n.d.). Duval's opioid death rate was 59 per 100,000. Duval has a population of 957,755; 14.5% of this population is older adults. On the other hand, Pinellas county, a large central metropolitan county in Florida, recorded 56 opioid deaths (COD) in older adults from 2014-2018. Pinellas has a total population of 974,996 with at least 25.4% or 247,648 older adults. Pinellas has an education level (high school graduates or higher) of 91.3%, above the state average. Pinellas' opioid death rate was 24 per 100,000, slightly higher than Miami-Dade county, but with a 73.6% proportion of non-Hispanic white. Hillsborough county, another large central metropolitan county in Florida, had a total number of opioid deaths (CODs) in older adults of 55 deaths. Hillsborough's education level (high school graduates or higher) was 88.7% (slightly higher than the state average). Hillsborough has a total population of 1,471,968. 14.5% of this population is older adults or 213,435. Hillsborough county's opioid death rate was 28 per 100,000, also higher than Miami-Dade. However, Hillsborough has a proportion of non-Hispanic white at 47.7%, higher than Miami-Dade. Moreover, Broward county, a large fringe metropolitan county, has an older adult population of 17.1% or 333,925. Broward County has an education level of 89 %, just slightly above the state average, but with a proportion of non-Hispanic white at 34.8% (higher than Miami-Dade). Broward County has a 30 per 100,000 opioid death rate.

In light of this result about education as a significant predictor of opioid death rate in older adults, it appeared that proportion of race might have played a role, although not statistically significant (p = .43). More study is needed to elucidate this assumption. The interaction of the predicting variable of education level high school graduates and higher with other predicting variables in this study was also examined. Results revealed that there were no significant interactions between education level and population density (p = .93), percentage of people in poverty (p = .63), median household income (p = .99), and proportion by race (p = .29).

Trends in Opioid Death Rates by County and Through Study Years (2014-2018)

The results of this study indicated that there was no linear or quadratic trend in opioid death rate in older adults in Florida, either by county or by study years 2014-2018. Despite that a substantial number of older adults who died with an opioid as a cause of death (n = 975) resided in metropolitan counties compared to nonmetropolitan counties (n = 32), the result showed no statistically significant trend in opioid death rate when it comes to population density. However, four nonmetropolitan counties in Florida (Levy, Hamilton, Bradford, and Holmes county) have the highest opioid death rate rates from 2014-2018, ranging from 50-89 per 100,000. While it could be argued that the population of older adults in these rural counties was lower than that of the metropolitan counties, this result was reflective of Monnat and Rigg's (2018) findings of a 1,600% increase in prescription opioid death rate in the rural Midwest and rural Northeast of the country from 2011 to 2012. Monnat and Rigg (2018) used the 2011 and 2012 data from the National Survey on Drug Use and Health in the United States, while this study focused on a statewide analysis using FDLE data from 2014-2018. Thus, a regional difference in ORD results could exist. Meanwhile, Monnat et al. (2020) reported high heroin cases in urban counties, which was comparatively similar to this study's result: heroin as a cause of death accounted for 44 deaths in older adults in Florida from 2014-2018. No inferential analysis related to the increase in heroin-related deaths in older adults is made whether there was a diversion to illicit opioids in this age group because of the 2018

Florida regulations limiting opioid prescriptions for 3- to 7-day supply to patients with acute pain (Scott, 2018). Further study on the consistent increase in heroin-related deaths in the older adult is recommended.

Implications

This study's implications are divided into four sections: practice, research, policy, and educational implications.

Practice Implications

This study provided evidence of the types of opioid drugs that cause more accidents and suicides in older adults. Let's examine the opioid drugs that the older adults died (as a cause of death) that resulted from accidents: codeine (38.1%), fentanyl (87%), fentanyl analog (100%), hydrocodone (34.7%), hydromorphone (55.8%), methadone (67.8%), morphine (60.4%), oxycodone (42.9%), oxymorphone (50%), and tramadol (31.7%). For the opioid drugs that resulted from suicide in older adults, hydrocodone topped the list at 63.2%, followed by oxymorphone at 48%, tramadol at 47.9%, then by codeine and oxycodone, both at 42.9%, hydromorphone at 36.5%, morphine at 32%, methadone at 16.9% and fentanyl at 13%. Besides verifying the database (i.e., E-FORCSE) when prescribing opioids to older adults, a healthcare provider needs to consider the adverse effects of these opioids, particularly those that cause the most accidents and suicides to older adults. Older adults and their caregivers may need to discuss with their provider the type of opioid drugs that they would prefer to take for their pain symptoms and the type of activities that they need to select or avoid when taking these opioids, such as those requiring heightened mental alertness, i.e., driving, or operating a piece of machinery.

For nursing practice, nurses administer pain analgesia, including opioids. Nurses act as a patient advocate and conduct health teaching, including medication's adverse effects. Nurses could leverage this study's results in discussing with providers and patients alike which opioid drugs could cause more accidents or suicides in this age group. Meanwhile, nurses working in long-term care facilities may also encounter older adults who use opioids. Hunnicutt and colleagues (2019) reported that a significant proportion of nursing home residents in the United States were prescribed opioids (N = 182,735), with 2.2% of these older adults (n = 3,977) being started with long-acting opioids such as transdermal fentanyl, morphine extended-release, oxycodone, methadone, and tramadol from 2011-2013. This practice of prescribing long-acting opioids to older adults could be problematic since this could affect older adults at higher risks for opioid misuse and adverse health outcomes, including increased hospitalizations and death (West & Dart, 2015; Dosa et al., 2009). In light of this, nurses are better positioned to identify and monitor older adults who have higher risks for opioid adverse effects and overdoses.

Policy Implications

One of the issues that emerged from the study result was the manner of death of older adults who had opioids as a cause of death. In particular, was the number of older adults who died from opioid-related accidents and suicides. For instance, 53 older adults with tramadol-related deaths died from accidents, while 80 older adults with tramadol-related death died from suicide during the study period 2014-2018. While the CDC updated the guidelines for prescribing opioids for chronic pain (CDC, 2016), tramadol was not included in the list of opioid drugs under MME (Morphine Milligram Equivalents) for the commonly prescribed opioids.

Also, examining the characteristics of counties with a higher number of opioid-related deaths and those with no opioid-related deaths in older adults could indicate strengthening the social programs that have worked well in these counties in addressing the opioid crisis and those programs that may require modifications. Monnat and colleagues (2020) reported that knowing the prevalence of drug-related deaths at the county level was meaningful enough since counties absorbed the drug crises' cost and powerful enough to deliver the health services and social programs to address these drug-related issues. The NIH (2018), during their panel discussion, recommended that any social and economic policy changes should be based on current research on the social determinants of health affecting opioid overdoses and death. It is hoped that this study's results be used to inform efforts in addressing the opioid crisis, particularly among older adults.

Research Implications

More research is needed to explore the interactions of opioids with other substances such as ethanol, cannabinoids, stimulants, and psychotropic medications, i.e., benzodiazepines that primarily focused on older adults. Studies that focus on the polysubstance use in older adults, including opioids, may need to consider integrating other social determinants of health such as living arrangement (whether living alone or not), healthcare insurance, transportation access in rural vs. urban setting that may affect access to opioid medications or follow up with a healthcare provider as variables in the research design. A larger sample size study involving a national registry or database could be useful for secondary analysis of opioid-related deaths in this age group to enhance contribution to generalizable knowledge.

Future research should be undertaken to explore opioid-related accidents and suicides and the underlying factors such as comorbidities, especially in older adults.

Educational Implications

One important implication of this result is to examine these counties' needs with the higher opioid death rate in older adults, whether these counties could benefit from tailored educational programs, i.e., opioid harm reduction specific for the older adults. In a study conducted by the National Council on Aging or NCOA (2019), respondents were asked about the reasons why an opioid crisis happened in their communities. The respondents' two most cited rationales were lack of awareness of alternative pain management for chronic pain other than opioids and lack of information provided by the healthcare providers to clients regarding the risks and harms of opioid use, misuse, and addiction (NCOA, 2019). This could explain why counties with an education level below state average could experience increase odds of opioid deaths.

Caregivers' education should also be included in the opioid education dissemination project since some older adults may rely on them for assistance in medication preparation and administration. For nursing education, incorporating the results of this study in substance abuse literature, identifying the high-risk older adults for opioid misuse could help promote patient-centered care and safety. For future direction, and collaborative study involving opioid harm reduction initiatives for older adults in the community or county level is highly recommended.

Limitations

This study has some limitations. Since this was secondary data analysis, the study's findings are limited to the data contained on the FDLE reports about drugs found in deceased persons, including opioids. While the study's focus was on the sociodemographic variables of opioid-related deaths in older decedents, data on educational attainment, nature of job or employment, individual income level were not part of the raw data provided by the FDLE. Instead, the investigator employed county data on the sociodemographic characteristics such as median household income by county, county education level of high school graduates or higher, and proportion by a race that comprised the predicting variables for the social determinant of ORD. These are government-source data that are publicly accessible such as the U.S. Census Bureau data and the Florida Department of Health and Statistics, deemed useful and reliable for scientific research. Again, these are county-level data and not individual information from the older decedents included in the study.

The indications for opioid use were not known in this study, so no inferential implication of the cause and effect of opioid use, thus serving as a limitation. Also, the FDLE reports did not specify opioid drugs like prescription opioids. Hence, no reference to prescription opioid drugs except for the illegal opioid (heroin) was made in this study. The distribution of opioid-related deaths among older adults was limited to county locations within the state of Florida. Due to the limited nature of secondary data in the study, no information was included whether these older decedents found in the FDLE reports were community-dwelling older adults, nor were they resided in long-term care facilities they hospice patients at the time of death. This study focused on determining the association between gender, race, opioid-related deaths, and the relationship between the manner of death and the opioid drugs involved. This study was also limited to finding which county characteristics, such as proportion by race, education level of high school graduates and higher, median household income, and population density, predict the opioid death rate in older adults. This study did not examine the interactions of opioids with other drugs that could synergistically potentiate the drugs' adverse effects. Future research should examine such drug interactions to determine variations in drug-related deaths. The manner of death reported in this study was based solely on the medical examiners' report, as reflected in the FDLE reports.

Recommendations

Based on this study's findings, this author recommends that similar studies be conducted on the specific opioid drug that causes more deaths in older adults and links it with emerging substances such as cannabinoids and synthetic cannabinoids to determine the interactions of these drugs or substances in drug-related deaths.

Another recommendation for future research is to investigate the role of opioids in opioid-involved suicide, not only among older adults but also across age groups. As this study suggested, 402 or 37.45% of older decedents with an opioid as a cause of death died from suicide. For instance, out of 236 older adults with oxycodone-related deaths, 129 died from suicide, while more than half of older adults with tramadol-related deaths, 47 out of 74 or 63.5%, died from suicide. This is an important issue for future research. More studies are needed on the possible interactions of opioids such as oxycodone, hydrocodone, and tramadol with other substances such as alcohol, marijuana, or cannabinoid in triggering events conducive to suicidal thoughts such as induced hallucinations, delirium, or confusion.

This study's findings have provided useful insight into the need to create harm reduction initiatives geared towards reducing opioid-related deaths in older adults. For future research, this investigator proposes to create a research project that targets educating older adults, family, or their caregivers about the risks of using opioids and offer alternative pain management to reducing reliance on opioid medications, particularly in a patient with chronic pain. A future direction is to apply for grants to support the research project/s geared towards reducing risks or creating opioid harm reduction education initiatives tailored for older adults. One recommendation is to evaluate existing programs on harm reduction by county and identify areas that work and potential areas for improvement that could benefit the older adults.

It is recommended that the findings of this study also be shared among long-term care facilities in the region and the country. The Institute of Aging (n.d.) reported that at least 1.3 million older adults lived in nursing homes in 2012. Hunnicutt and colleagues (2017) reported that approximately 2.2% of the U.S. nursing home residents (n = 3,977) were started with long-acting opioids from 2011-2013, such as transdermal fentanyl, morphine extended-release, and oxycodone extended release that could cause adverse effects to this age group given FDA warning about these drugs. Additionally, healthcare providers working with older adults who are experiencing acute or chronic pain to consider the types of opioid drugs that have a high incidence of accidents and suicide before even prescribing them to this vulnerable population. The need to carefully assess older adults' history in terms of the history of falls, fractures, and suicide is paramount even before prescribing oxycodone, morphine, fentanyl, and synthetic opioids or analogs tramadol to older adults. Health teaching that highlights opioid risks could not be underestimated in terms of its benefits in reducing harms associated with opioid use by an older adult. It is also recommended that nurses and other healthcare team members, including caregivers, support efforts in preventing the initiation of opioid prescriptions that were found to have a higher prevalence of accidents and suicides among older adults while complementing treatments with nonpharmacologic pain treatment alternatives.

Conclusion

Opioid-related deaths remain a significant and urgent public health issue that continues to plague our society, counties, and communities. This study was important in filling a gap in research about insufficient data on the sociodemographic factors of opioid-related deaths, specifically in older adults. This study aligned with the National Institute of Health HEAL Initiative (2018) in addressing the opioid epidemic thorough research of the social determinants of opioid-related deaths that may help inform efforts for opioid harm reduction strategies in the affected communities.

This secondary data analysis achieved its four-fold purpose:

1. Determining the association between gender, race/ethnicity, and opioid-related deaths;

2. Examining the relationship of the manner of death to the opioid drugs involved;

3. Examining which county characteristics such as proportion by race/ethnicity, median household income, education level, and population density could predict opioid death rate; and

4. Analyzing trends of opioid-related deaths in Florida counties and through the years 2014-2018.

The results of this study added evidence to the contemporary state of opioid research in older adults. Chi-square tests were conducted in SPSS to examine the association of gender, race to opioid-related deaths, and the relationship of the manner of death to the type of opioid drugs involved. Older decedents with opioids as the cause of their deaths were primarily non-Hispanic whites (93.04%); older male adults were more affected than females (56.50% vs. 43.50%), which was statistically significant ($p < .001$). However, race indicated no significant association with opioid-related deaths ($p > .05$). The majority of the opioid as a cause of death in older adults occurred in metropolitan or urban counties (96.82%). However, no significant linear or quadratic trend was identified in this study, either by county or by data years (2014-2018). The manner of death showed a statistically significant relationship with the opioid drugs involved ($p <.001$). A substantial number of older adults with an opioid as a cause of death died from accidents and suicide (56% and 39.92%, respectively). This result has an important implication for patient safety. Most opioid drugs are included in the study (codeine, fentanyl, fentanyl analog, hydrocodone, hydromorphone, methadone, morphine, oxycodone, and oxymorphone and tramadol were implicated with opioid-related accidents and suicides. While this study's results conformed with previous research findings, i.e., social demographics, more research is needed to elucidate the role of specific opioids in the increasing rate of opioid-related accidents and suicide among older adults.

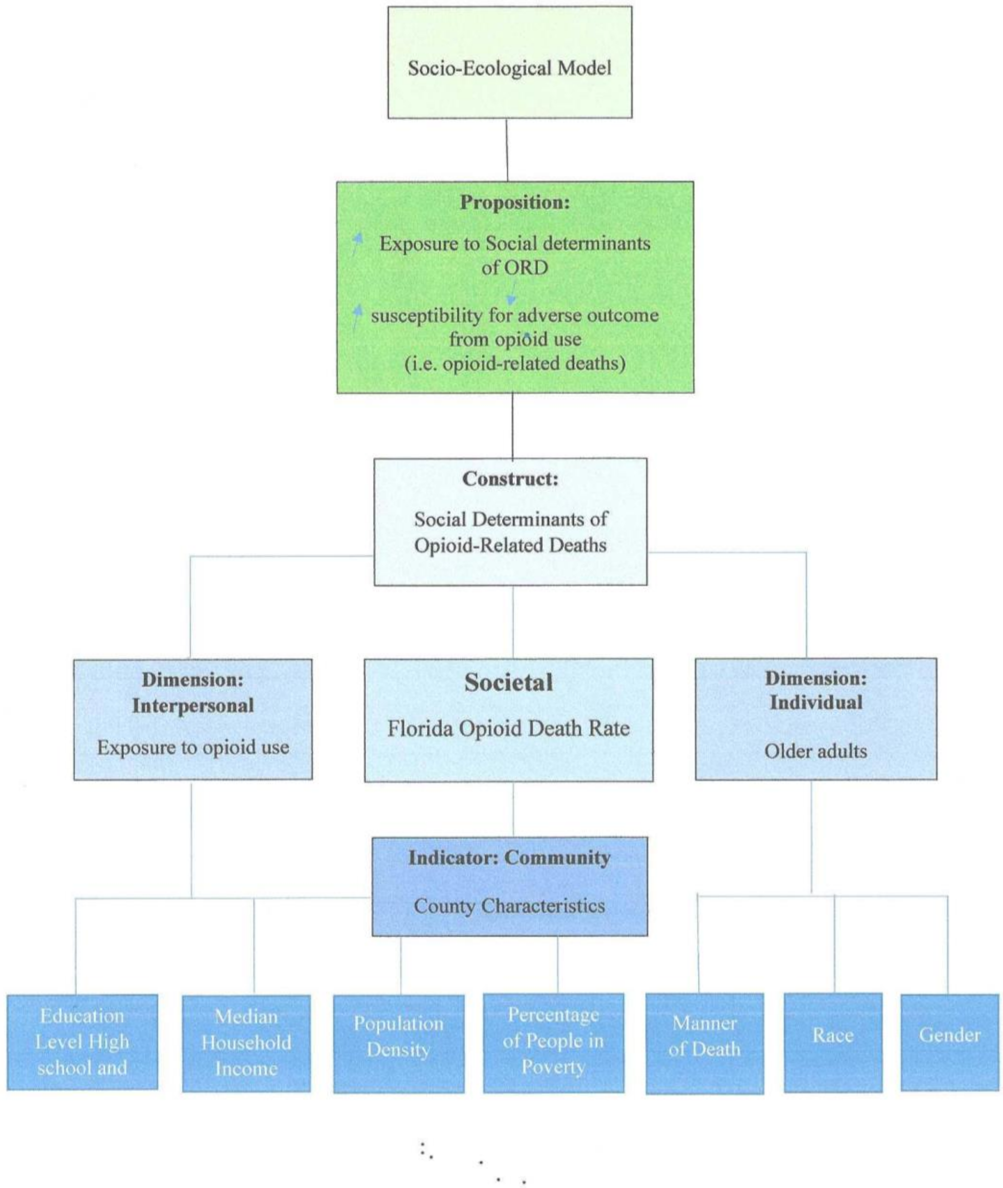
A generalized linear model with a normal probability distribution and identity link function was used to examine which county characteristics predicted the opioid death rate in older adults. One compelling result of this study was that county education level (high school graduates or higher) emerged as a significant predictor of opioid death rate (p = .003), after controlling for other social determinant factors such as median household income, population density, the proportion by race and education level by county, and education level. There was a substantial difference in the mean education scores between metropolitan counties and nonmetropolitan counties. Even though population density was not a significant predictor of opioid death rate, there were nonmetropolitan counties with the highest opioid death rate identified in the study, such as Levy county, Hamilton, Bradford, and Holmes County, warrants further investigation.

This study's theoretical framework was grounded in the socio-ecological model, which proved useful in explaining the variables used in each level of the model. It was surprising to learn that there were no significant interactions among the predictor variables of median household income, population density, the proportion by race, and education level. Nevertheless, the socio-ecological model elucidated the need for opioid harm reduction strategies specific to older adults, as education level emerged as a significant predictor of the opioid death rate. It is worth investing or allocating resources to increasing public awareness about the harms and dangers of opioid drugs, particularly in older adults. Studies have shown that older adults were two times more likely to suffer from opioid overdoses than the younger population.

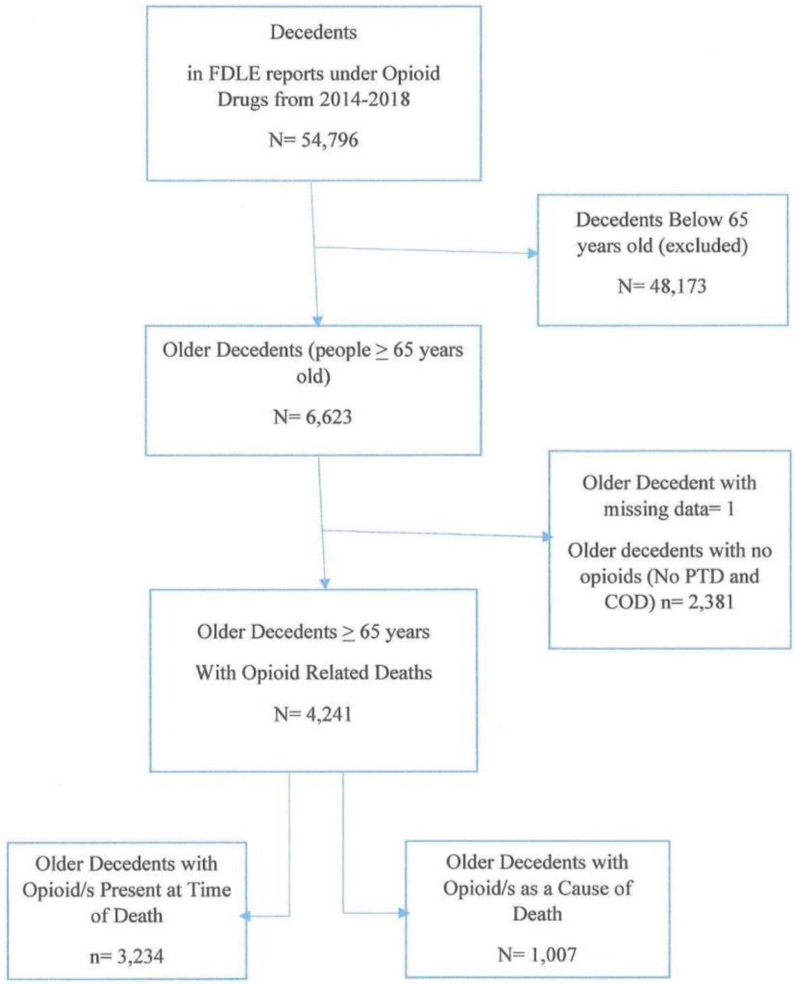
Policymakers, government agencies such as the Drug Enforcement Administration, Food Drug Administration, state or local government, and other stakeholders could leverage the results of this study in considering actionable plans to protect our older adults from opioid misuse and overdoses and to reduce the opioid death rate in our society, particularly in older adults.

APPENDICES

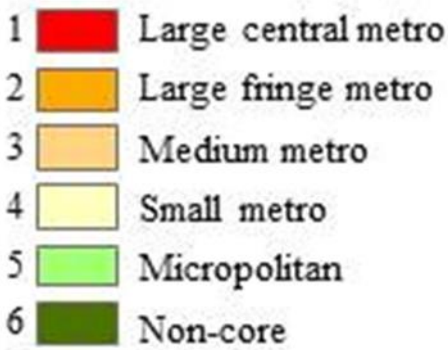
Appendix A: Concept Tree: The Social Determinants of Opioid-Related Deaths in Older Adults

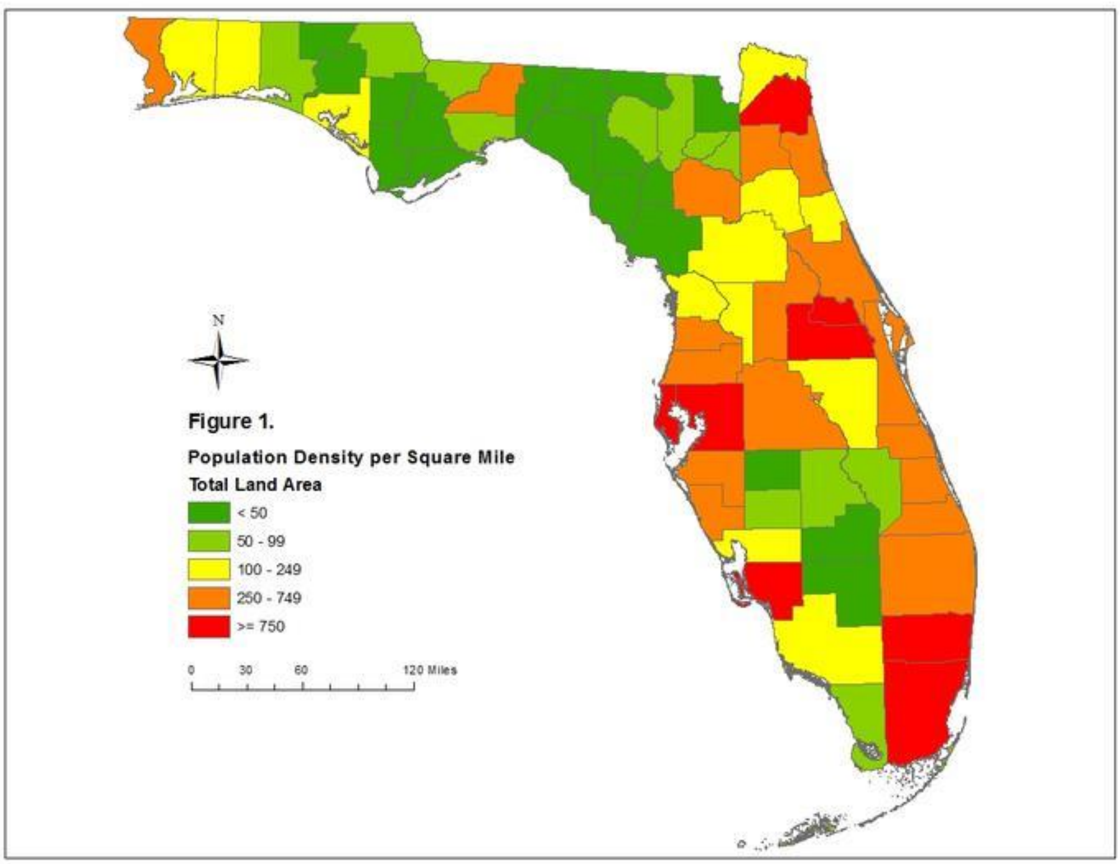


Appendix B. Diagram Showing Selection of Study Participants



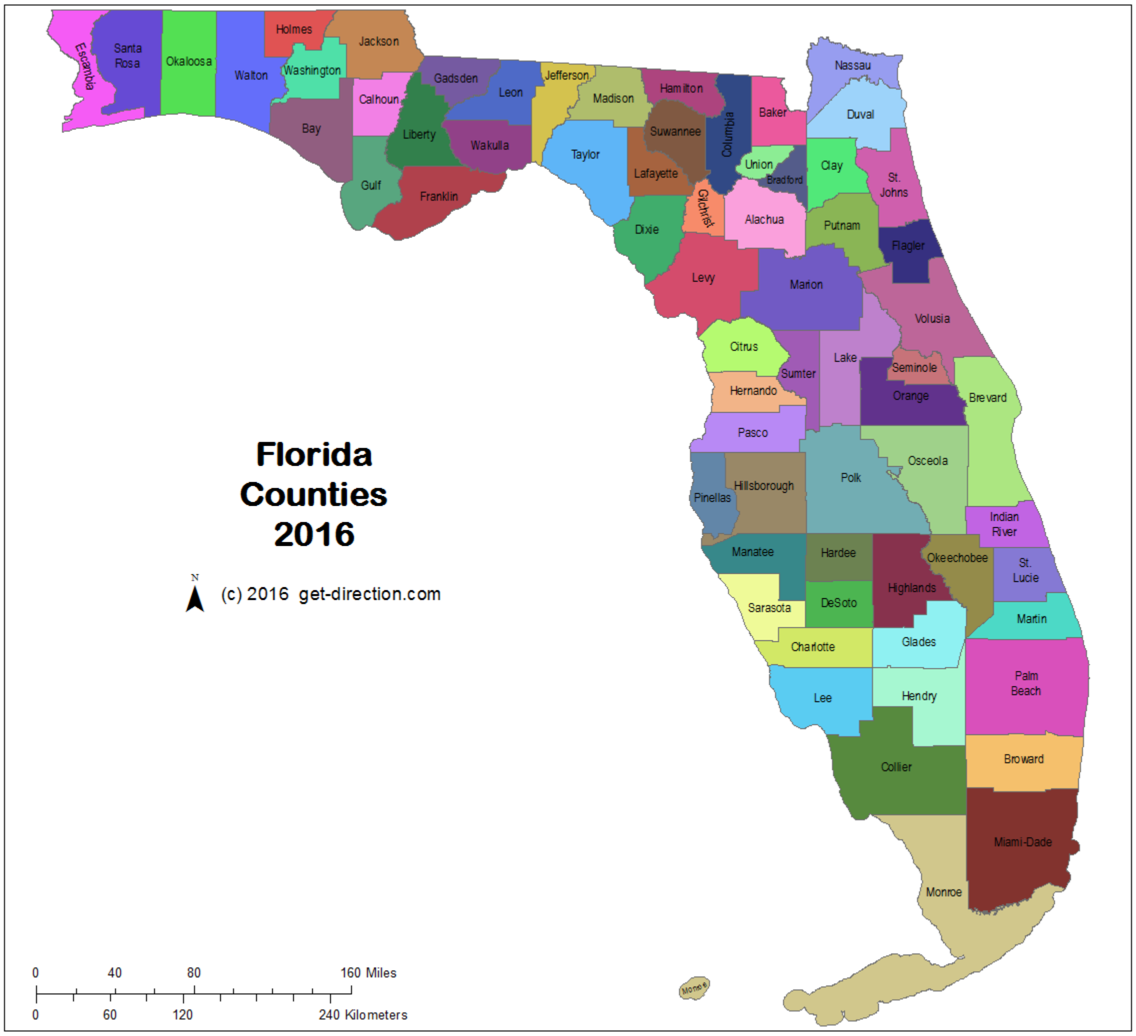
Appendix C Florida Map Showing Population Density





Rayer, S. & Wang, Y. (2014). Measuring population density for counties in Florida. Bureau of Economic and Business Research. Retrieved from https://www.bebr.ufl.edu/population/website-article/measuring-population-density-counties-Florida

Appendix D. Map of Florida Counties



Source: www.get-direction.com

REFERENCES

Abiragi, M., Bauler, L. D., & Brown, T. (2020). Importance and approach to manner of death opinions in opioid-related deaths. *Journal of Forensic Sciences, 65*(3), 1009-1011.

Agency for Healthcare Research and Quality. (2019). Prevention, diagnosis, and management of opioid misuse and opioid use disorder in older adults. *Evidence-based Practice Center Technical Brief Protocol*. https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/opioids-oa-protocol.pdf

Agresti, A. (2015). *Wiley series in probability and statistics: Foundations of linear and generalized linear models*. John Wiley and Sons, Inc.

Allen, C., Meeraus, W., & Donegan, K. (2015). The comparative risk of all-cause mortality in older patients prescribed opioids for non-malignant pain: A retrospective observational cohort study. *Drug Safety*, *38*, 962-963.

Almodovar, A. S., & Nahata, M.C. (2019). Potentially unsafe chronic medication use among older adult chronic opioid users. *Pharmacotherapy, 39*(2), 140-147. https://doi.org/10.1002/pharm.2218

Altekruse, S. F., Cosgrove C. M., Altekruse, W. C., Jenkins, R. A., & Blanco, C. (2020). Socioeconomic risk factors for fatal opioid overdoses in the United States: Findings from the Mortality Disparities in American Communities Study (MDAC). *PLoS ONE 15*(1), e0227966. https://doi.org/10.1371/journal.pone.0227966

Andersson, L., Håkansson, A., Krantz, P., & Johnson, B. (2020). Investigating opioid-related fatalities in southern Sweden: Contact with care-providing authorities and comparison of substances. *Harm Reduct J. 17*(1), 5. https://doi.org/10.1186/s12954-019-0354-y

Barocas, J. A., Wang, J., Marshall, B., LaRochelle, M. R., Bettano, A., Bernson, D., Beckwith, C. G., Linas, B. P., & Walley, A. Y. (2019). Sociodemographic factors and social determinants associated with toxicology confirmed polysubstance opioid-related deaths. *Drug and alcohol dependence*, *200*, 59–63. https://doi.org/10.1016/j.drugalcdep.2019.03.014

Barrington, R. (n.d.). Hazard and hazard ratio in statistics. *The Nutrition Blog*. https://www.robertbarrington.net/statistics/the-hazard-ratio/

Beauchamp, G. A., Carey, J.L., Adams, T., Wier, A., Colon, M. F., Cook, M., Cannon, R., Katz, K. D., & Greenberg, M.R. (2018). Sex differences in poisonings among older adults: An analysis of the toxicology investigators consortium (ToxIC) registry, 2010 to 2016. *Clinical Therapeutics*, *40*(8), 1366-1374, e8.

Bech, A. B., Clausen, T., Waal, H., Saltyte Benth, J., & Skeie, I. (2019). Mortality and causes of death among patients with opioid use disorder receiving opioid agonist treatment: A national register study. *BMC Health services research, 19*(440), 1-10.

Benson, W., Kuehn, K., & Weirich, M. (2019). Why are rural older adults turning to opioids? *Aging in Rural America, 43*(2), 55-61.

Bhasin, H. (2019). Sources of secondary data and its advantages and disadvantages. https://www.marketing91.com/sources-of-secondary-data

Boykin, A., Schoenhofer, S.O, & Linden, D. (2010). Anne Boykin and Savina O. Schoenhofer's nursing as caring theory. In M.E. Parker & M. C. Smith, *Nursing theories and nursing practice* (3rd ed.). F.A. Davis Company.

Bureau of Justice Statistics. (n.d.). Arrest-related deaths. https://www.bjs.gov/index.cfm?ty=tp&tid=82

Carew, A. M., & Comiskey, C. (2018). Treatment for opioid use and outcomes in older adults: A systematic literature review. *Drug and Alcohol Dependence, 182*, 48-57.

Carter, M., Yang, B., Davenport, M., & Kabel, A. (2019). The impact of the opioid crisis on older adults: Insights from the emergency department. *Innovation in Aging, 2*(1), 437. https://doi.org/10.1093/geroni/igy023.1638

Centers for Disease Control and Prevention. (2016). CDC guideline for prescribing opioids for chronic pain-United States, 2016.

Centers for Disease Control and Prevention. (2017). Opioid overdose: When the prescription becomes the problem. https://www.cdc.gov/drugoverdose/opioids/prescribed.html

Centers for Disease Control and Prevention. (2019). Prescribing practices: Changes in opioid prescribing practices. https://www.cdc.gov/drugoverdose/data/prescribing/prescribing-practices.html

Centers for Disease Control and Prevention. (2020a). *Fatal injury reports, national, regional and state, 1981-2019.* https://webappa.cdc.gov/sasweb/ncipc/mortrate.htmla

Centers for Disease Control and Prevention. (2020b). *New data show significant changes in drug overdose deaths*. https://www.cdc.gov/media/releases/2020/p0318-data-show-changes-overdose-deaths.html

Centers for Disease Control and Prevention. (2020c*)*. Opioid overdose: Commonly used terms. https://www.cdc.gov/drugoverdose/opioids/terms.html

Centers for Disease Control and Prevention. (2020e). Overdose deaths and the involvement of illicit drugs: Urgent need for overdose prevention interventions. https://www.cdc.gov/drugoverdose/pubs/featured-topics/VS-overdose-deaths-illicit-drugs.html

Centers for Disease Control and Prevention. (2020f). Social determinants of health: Know what affects health. https://www.cdc.gov/socialdeterminants/about.html

Centers for Disease Control and Prevention. (2020g). The social-ecological model: A framework for prevention. https://www.cdc.gov/violenceprevention/publichealthissue/social-ecologicalmodel.html

Centers for Disease Control and Prevention. (2021a). America’s drug overdose epidemic: Putting data to action. https://www.cdc.gov/injury/features/prescription-drug-overdose/index.html

Centers for Disease Control and Prevention. (2021b). Opioid overdose: Understanding the epidemic. https://www.cdc.gov/drugoverdose/epidemic/index.html

Centers for Disease Control and Prevention. (2021c). Opioid overdose: Fentanyl. https://www.cdc.gov/drugoverdose/opioids/fentanyl.html https://www.cdc.gov/mmwr/volume/65

Centers for Disease Control and Prevention. (n.d.a). Leading causes of death. *National Center for Health Statistics* https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm

Centers for Disease Control and Prevention. (n.d.b). Guideline for prescribing opioids for chronic pain: Improving practice through recommendation. https://cdc.gov/drugoverdose/prescribing/guideline.html

Centers for Disease Control and Prevention. (n.d.c). *Module 5: Assessing and addressing opioid use disorder (OUD).* https://www.cdc.gov/drugoverdose/training/oud/accessible/index.html

Centers for Disease Control and Prevention. (n.d.d). Older person's health. *National Center for Health Statistics*. https://www.cdc.gov/nchs/fastats/older-american-health.htm

Center for Medicare and Medicaid Services. (2017). Centers for Medicare and Medicaid Services (CMS) Opioid Misuse Strategy. https://www.cms.gov

Chadwick, D. (2017). Care, compassion, courage, commitment, communication and competence: The 6 Cs. *Journal of Perioperative Practice*. https://doi.org/10.1177/175045891702701001

Chang, Y. P. (2017). Factors associated with prescription opioid misuse in adults aged 50 or older. *Nursing Outlook*, *66*, 112-120.

Choo, E. K., Douriez, C., & Green, T. (2014). Gender and prescription opioid misuse in the emergency department. *Academy Emergency Medicine*, *21*(12), 1493-1498. https://doi.org/10.1111/acem.12547

Clausen, T., Waal, H. Thoresen, M., & Gossop, M. (2009). Mortality among opiate users: Opioid maintenance therapy, age and causes of death. *Addiction, 104*, 1356-1362.

Clinton, H. A., et al. (2019). Evaluating opioid overdose using the national violent death reporting system, 2016. *Drug and Alcohol Dependence, 194*, 371-376.

Covington, T. M., & Higgins, D. A. (2016). Opioid use in the elderly. *Journal of Nurse Life Care Planning, 56*(1), 28-32.

Dahlhamer, J. L.,Lucas, J., Zelaya, C., Nahin, R., Mackey, S., DeBar, L., Kerns, R., VonKorff, M., Porter, L., & Helmick, C. (2018). Prevalence of chronic pain and high-impact chronic pain among adults - United States, 2016. *Morbidity and Mortality Weekly Report, 67*, 1001-1006. https://doi.org/10.15585/mmmwr.mm6736a2

Daoust, R., Paquet, J., Moore, L., Émond, M., Gosselin, S., Lavigne, G., Choinière, M., Boulanger, A., Mac-Thiong, J. M., & Chauny, J. M. (2018). Recent opioid use and fall-related injury among older patients with trauma. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*, *190*(16), E500–E506. https://doi.org/10.1503/cmaj.171286

Dasgupta, N., Beletsky, L., & Ciccarone, D. (2018). Opioid crisis: No easy fix to its social and economic determinants. *American Journal of Public Health*, *108*(2), 182–186. https://doi.org/10.2105/AJPH.2017.304187

DeLaquil, M., Giesel, S., & Wright, N. (2020). *Drug overdose deaths among Minnesota residents, 2000-2018*. Saint Paul: Minnesota Department of Health. Report. https://www.health.state.mn.us/communities/opioids/documents/2018overdosedeathreport.pdf

Dickason, R. M., Chauhan, V., Mor, A., Ibler, E., Kuehnle, S., Mahoney, D., Armbrecht, E., & Dalawari, P. (2015). Racial differences in opiate administration for pain relief at an academic emergency department. *The Western Journal of Emergency Medicine*, *16*(3), 372–380. https://doi.org/10.5811/westjem.2015.3.23893

Divisha, S. (n.d.). Measuring death rate: Top 5 methods. https://www.sociologydiscussion.com/demography/population-growth/measuring-death-rate-top-5-methods/3027

Domenichiello, A. F., & Ramsden, C. E. (2019). The silent epidemic of chronic pain in older adults. *Progress in Neuropsychopharmacology & Biological Psychiatry*, *93*, 284-290.

Dosa, D. M., Dore, D. D., Mor, V., & Teno, J. M. (2009). Frequency of long-acting opioid analgesic initiation in opioid-naïve nursing home residents. *Journal of Pain and Symptom Management*, *38*(4),515-521.

Dunn, D. (2010). Do no harm: Our duty to report. *Nursing Management,* 38-43.

Evans, J. M. (2016). Medical ethics: Do no harm…Whatever that means. *Caring for the Ages*. https://www.caringfortheages.com

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.).SAGE Publication, Inc.

Fixen, D. R. (2019). 2019 AGS Beer criteria for older adults. *Pharmacy Today*, 44-54. https://www.pharmacytoday.org/article/S1042-0991(19)31235-6/pdf

Florida Department of Children and Families. (2018). Patterns and trends of opioid epidemic in Florida. http://www.floridahealth.gov/statistics-and-data/e-forcse/fl-seow-annual-report-2018.pdf

Florida Department of Health. (n.d.a). All causes of death. *Division of Public Health Statistics and Performance Management.* http://www.flhealthcharts.com/ charts/DataViewer/DeathViewer/DeathViewer.aspx

Florida Department of Health. (n.d.b) E-FORCSE home page. http://www.floridahealth.gov/statistics-and-data/e-forcse/index.html

Florida Department of Health. (n.d.c). Life expectancy report. http://www.flhealthcharts.com/ChartsReports/rdPage.aspx?rdReport=ChartsProfiles.LifExpectancyProfile

Florida Drug and Law Enforcement (2015). Drugs identified in deceased persons by Florida medical examiners commission 2014 Annual Report. https://www.fdle.state.fl.us/MEC/Publications-and-Forms/Documents/Drugs-in-Deceased-Persons/2014-Annual-Drug-Report.aspx

Florida Drug and Law Enforcement (2016). Drugs identified in deceased persons by Florida medical examiners commission 2015 Annual Report. https://www.fdle.state.fl.us/MEC/Publications-and-Forms/Documents/Drugs-in-Deceased-Persons/2015-Annual-Drug-Report.aspx

Florida Drug and Law Enforcement. (2017). Drugs identified in deceased persons by Florida medical examiners commission 2016 Annual Report. https://www.fdle.state.fl.us/MEC/Publications-and-Forms/Documents/Drugs-in-Deceased-Persons/2016-Annual-Drug-Report.aspx

Florida Drug and Law Enforcement. (2018). Drugs identified in deceased persons by Florida medical examiners commission 2017 Annual Report. https://www.fdle.state.fl.us/MEC/Publications-and-Forms/Documents/Drugs-in-Deceased-Persons/2017-Annual-Drug-Report.aspx

Florida Drug and Law Enforcement. (2019). Drugs identified in deceased persons by Florida medical examiners commission 2018 Annual Report. https://www.fdle.state.fl.us/MEC/Publications-and-Forms/Documents/Drugs-in-Deceased-Persons/2018-Annual-Drug-Report.aspx

Fookes, C. (2019). Opioid vs. opiate- What's the difference between them? https://www.drugs.com/medical-answers/difference-between-opioid-opiate-3504802/

Fugelstad, A., Thiblin, I., Johansson, L.A., Agren, G., & Sidorchuk, A. (2019). Opioid-related deaths and previous care of drug use and pain relief in Sweden. *Drug and Alcohol Dependence, 201*, 253-259.

Galicia-Castillo, M. (2016). Opioids for persistent pain in older adults. *Cleveland Clinic Journal of Medicine, 83*(6), 443-451.

Gilstrap, L.L. & Zierten, E.A. (September 21, 2020). Urie Bronfenbrenner. *Encyclopedia Britannica.* https://www.britannica.com/biography/Urie-Bronfenbrenner

Gladden, R. M., O'Donnell, J., Mattson, C. L., & Seth, P. (2019). Changes in opioid-involved overdose deaths by opioid type and presence of benzodiazepines, cocaine, and methamphetamine-25 states, July-December 2017 to January-June 2018. Centers for Disease Control and Prevention. *MMWR, 68*(34), 737-744.

Gomes, T., Tadrous, M., Mamdani,M.M., Paterson, M., & Juurlink, D.N. (2018a). The burden of opioid-related mortality in the United States. *JAMA Network Open, 1*(2), e180217. https://doi.org/10.1001/jamanetworkopen.2018.0217

Gomes, T., Khuu, W., Martins, D., Tadrous, M., Mamdani, M.M., Paterson, M., & Juurlink, D.N. (2018b). Contributions of prescribed and non-prescribed opioids to opioid-related deaths: Population based cohort study in Ontario, Canada. *BMJ, 362*, 1-7. https://www.bmj.com/content/362/bmj.k3207

Grol-Prokopczyk, H. (2019). Use and opinions of prescription opioids among older American adults: Sociodemographic predictors. *Journal of Gerontological Social Sciences, 74*(6), 1009-1019.

Groves, R. (2011). *Rural and suburban America: When one definition is not enough*. https://www.census.gov/newsroom/blogs/director/08

Guy, G. P., Zhang, K., Bohm, M., Losby, J., Lewis, B., Young, R., Murphy, L. B., & Dowell, D. (2017). Vital signs: Changes in opioid prescribing in the United States, 2006-2015. Centers for Disease Control and Prevention. *MMWR*, *66*(26), 697-704.

Health Resources and Services Administration. (2020). *Opioid crisis*. https://www.hrsa.gov/opioids

Hedegaard, H., Minino, A. M., Warner, M. (2018). Drug overdose deaths in the United States, 1999-2017. *National Center for Health Statistics. Centers for Disease Control and Prevention.* https://www.cdc.gov/nchs/products/databriefs/db329.htm

Himes, C. L, & Kilduff, L. (2019). *Which U.S. states have the oldest population?* https://www.prb.org/which-us-states-are-the-oldest/

Hosseinian, S. (2009). *Robust inference for generalized linear models*. Thesis No. 4386. EPFL. https://doi.org/10.5075/epfl-thesis-4386

Howard, J., Cimineri, L., Evans, T., Chosewood, L. C., & Afanuh, S. (2019). *Medication-assisted treatment for opioid use disorder*. National Institute for Occupational Safety and Health. U.S. Department of health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2019-133, https://doi.org/10.266.16/NIOSHPUB2019133

Hser, Y. I., Mooney, L., Saxon, A., Miotto, K., Bell, D., Zhu, Y., Liang, D., & Huang, D. (2017). High mortality among patients with opioid use disorder in a large healthcare system. *Journal for Addiction Medicine, 11*(4), 315-319. https://doi.org/10.1097/ADM.0000000000000312.

Huhn, A. S., Strain, E. C., Tompkins, D. A., & Dunn, K. E. (2018). A hidden aspect of the U.S. opioid crisis: Rise in first-time treatment admissions for older adults with opioid use disorder. *Drug and Alcohol Dependence*, *193*, 142-147.

Hunnicutt, J. N., Hume, A. L., Ulbricht, C. M., Tija, J., & Lapane, K. L. (2019). Long-acting opioid initiation in US nursing homes. *Pharmacoepidemiology Drug Safety, 28*, 31-38.

IBM Knowledge Center. (n.d.). *Cramer's V*. https://www.ibm.com/support/knowledgecenter/

Ingram, D. D., & Franco, S. J. (2014). 2013 NCHS urban-rural classification scheme for counties. National Center for Health Statistics. *Vital Statistics 2*(166), 1-81. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf

Injury facts. (n.d.). Deaths by demographics. Age and cause. https://injuryfacts.nsc.org/

Institute on Aging. (n.d.). Living in institution. https://www.ioaging.org/aging-in-America

Janakiram, C., Chalmers, N. I., Fontelo, P., Iafolla, T. J., Brow, A. R., & Dye, B. A. (2018). Sex and race or ethnicity disparities in opioid prescriptions for dental diagnoses among patients with Medicaid. *Journal of Medical Dental Association*, *149*(4), 246-255. https://doi.org/10.1016/j.adaj.2018.02.010

Jensen-Dahm, C., Gasse, C., Astrup, A., Bo Mortensen, & P. Waldemar, G. (2015). Frequent use of opioids in patients with dementia and nursing home residents: A study of the entire elderly population of Denmark. *Alzheimer's & Dementia, 11*, 691-699.

Johnson, S.R. (2016). The racial divide in the opioid epidemic. *Modern Healthcare*. https://www.modernhealthcare.com/article/220160227/MAGAZINE/302279871/the-racial-divide-in-the-opioid-epidemic

Kaiser Family Foundation. (2018a). Opioid overdose deaths by age group. https://www.kff.org/other/state-indicator/opioid-overdose-deaths-by-age-group

Kaiser Family Foundation. (2018b). Opioids overdose death rates and all drugs overdose death Rates per 100,000 population (age-adjusted).

https://www.kff.org/other/state-indicator/opioid-overdose-death-rates

Kashef, Z. (2018). Study finds racial disparities in prescribing opioids for chronic pain. *YaleNews*. https://news.yale.edu/2018/08/20/study-finds-racial-disparities-prescribing-opioids-chronic-pain

Kennedy-Hendricks, A., Richey, M., McGinty, E. E., Stuart, E. A., Barry, C. L., & Webster, D. W. (2016). Opioid overdose deaths and Florida's crackdown on pill mills. *American Journal of Public Health*, *106*(2), 291–297. https://doi.org/10.2105/AJPH.2015.302953

Kent, L. (2015). Where do the oldest Americans live? *Pew Research Center*. https://www.pewresearch.org/fact-tank/2015/07/09/where-do-the-oldest-americans-live/

Kiang, M. V., Basu, S., Chen, J., & Alexander, M. J. (2019). Assessment of changes in the geographical distribution of opioid-related mortality across the United States by opioid type, *JAMA Network Open*, 1-10. https://doi.org/10.1001/jamanetworkopen.2019.0040

Kilanowski, J. F. (2017). Breadth of the socio-ecological model. *Journal of Agromedicine*, *22*(4), 295-297. https://doi.org/10.1080/1059924x2017.1358971

Kimber, J., Hickman,M., Strang, J., Thomas, K., & Hutchinson, S. (2019). Rising opioid-related deaths in England and Scotland must be recognized as a public health crisis. *The Lancet Psychiatry*, *6*(8), 639-640.

King, N.B., Fraser, V., Boikos, C., Richardson, R., & Harper, S. (2014). Determinants of increased opioid-related mortality in the United States and Canada, 1990-2013: A systematic review. *American Journal of Public Health*, *104*(8), e32-e42.

Kochanek, K.D., Murphy, S.L., Xu, J., & Arias, E. (2019). Deaths: Final data in 2017. *National Vital Statistics Report*, *68*(9), 1-77. https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_09-508.pdf

Lam, F. L. (2019). Polypharmacy in elderly opioid users. *The Brown University Psychopharmacology Update, 30*(5), 2-3.

Larney, S., Bohnert, A. S., Ganoczy, D., Ilgen, M. A., Hickman, M., Blow, F. C., & Degenhardt, L. (2015). Mortality among older adults with opioid use disorders in the Veterans Health Administration, 2000-2011. *Drug and Alcohol Dependence*, *147*, 32–37. https://doi.org/10.1016/j.drugalcdep.2014.12.019

Lee, D., Delcher, C., Maldonado-Molina, M. M., Bazydlo, L. A. L., Thogmartin, J. R., & Goldberger, B. A. (2014). Trends in licit and illicit drug-related deaths in Florida from 2001-2012. *Forensic Science International, 245*, 178-186.

Le Roux, C., Tang, Y., & Drexler, K. (2016). Alcohol and opioid use disorder in older adults: Neglected and treatable illnesses. *Current Psychiatry Reports, 18*(9), 87.

Lippold, K. M., Jones, C. M., Olsen, E. O., & Giroir, B. P. (2019). Racial/ethnic and age group differences in opioid and synthetic opioid-involved overdose deaths among adults aged ≥18 years in metropolitan areas-United States, 2015-2017. *MMWR Morbidity and Mortality Weekly Report*, *68*(43), 967-973.

Masnoon, N., Shakib, S., Kalisch-Ellett, L., & Caughey, G. E. (2017). What is polypharmacy? A systematic review of definitions. *BMC Geriatrics, 17*(1), 230. https://doi.org/10.1186/s12877-017-0621-2

McClellan, C. B. (2019). Disparities in opioid related mortality between United States counties from 2000 to 2014. *Drug and Alcohol Dependence, 199*, 151-158.

Mercadante, S., Arcuri, E., & Santoni, A. (2019). Opioid-induced tolerance and hyperalgesia. CNS Drugs, 33, 943-955. https://doi.org/10.1007/s40263-019-00660-0

Melix, B. L., Uejio, C. K., & Kintziger, K. W. (2020). Florida neighborhood analysis of social determinants and their relationship to life expectancy. (2020). *BMC Public Health 20*(632). https://doi.org/10.1186/s12889-020-08754-x

Mercola, J. (2020). Opioid crisis- A result of poverty, availability and pain. https://www.lewrockwell.com/2020/01/joseph-mercola/opioid-crisis-a-result-of-poverty-availability-and-pain/

Minnesota Department of Health. (n.d.). Opioids: Social determinants of substance use and overdose prevention. http://www.health.state.mn.us/index.html

Monnat, S. M., Peters, D. J., Berg, M. T., & Hochstetler, A. (2019). Using census data to understand county-level differences in overall drug mortality and opioid-related mortality by opioid type. *AJPH, 109*(8), 1084-1091.

Monnat, S. M., & Rigg, K. K. (2018). The opioid crisis in rural and small-town America. *The Carsey School of Public Policy at the Scholars' Repository, 343*, 1-6.

Morone, N. E., & Weiner, D. K. (2013). Pain as the fifth vital sign: Exposing the vital need for pain education. *Clin Ther*. *35*(11):1728-1732. https://doi.org/10.1016/j.clinthera.2013.10.001

National Center on Aging. (2019). The impact of the opioid epidemic on the aging services network and the older adults they serve. *Issue Brief.* https://www.ncoa.org/resources/the-impact-of-the-opioid-epidemic-on-the-aging-services-network-and-the-older-adults-they-serve/

National Institute on Drug Abuse. (2017). Intentional vs. unintentional overdose deaths. https://www.drugabuse.gov/drug-topics/treatment/intentional-vs-unintentional-overdose-deaths

National Institute on Drug Abuse. (2019). Florida opioid summary. https://www.drugabuse.gov

National Institute on Drug Abuse. (2020a). Prescription opioids drug facts. https://www.drugabuse.gov/publications/drugfacts/prescription-opioids

National Institute on Drug Abuse. (2020b). Overdose death rates. https://www.drugabuse.gov/drug-topics/trends-statistics/overdose-death-rates

National Institute of Health. (2018). Full-summary- contributions of social and behavioral research in addressing the opioid crisis. https://heal.nih.gov/news/ executive-summary-2018-03-06National Institute of Health. (2018b). The helping to end addiction long-term initiative: Supporting science-based solution to the opioid crisis. https://heal.nih.gov/

National Institute of Justice. (2019). Law enforcement looks to research to help fight the opioid crisis. https://nij.ojp.gov/topics/articles/law-enforcement-looks-research-help-fight-opioid-crisis

National Institute on Neurological Disorders and Stroke. (n.d.). Chronic pain information page: What research is being done? https://www.ninds.nih.gov/Disorders/ All-Disorders/Chronic-Pain-Information-Page

National Records of Scotland. (2020). Drug-related deaths increase. https://www.nrscotland.gov.uk/news/2020/drug-related-deaths-increase

National Safety Council. (2018). Accidental deaths hit highest number in record US history. https://www.nsc.org/in-the-newsroom/nsc-statement-on-new-cdc-data-showing-a-rise-in-accidental-death

Nechuta, S. L., Tyndall, B. D., Mukhopadhyay, & McPheeters, M. L. (2018). Sociodemographic factors, prescription history and opioid overdose deaths: A statewide analysis linked PDMP and mortality data. *Drug and Alcohol Dependence, 190*, 62-71.

Office of Disease Prevention and Health Promotion. (n.d.). Older adults. https://www.healthypeople.gov/2020/topics-objectives/topic/older-adults

Office of Disease Prevention and Health Promotion. (2020). Social determinants of health. https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health

Office of Inspector General. U.S. Department of Health and Human Services. (2018). Opioid use in Medicare Part D remains concerning. HHS OIG Data Brief. (OEI-02-18-00220). https://oig.hhs.gov/oei/reports/oei-02-18-00220.pdf

Office of Inspector General. U.S. Department of Health and Human Services. (2019). Opioid use decreased in Medicare Part D, while medication-assisted therapy (MAT) increased. HHS OIG Data Brief. (OEI- 09-19-00390). https://oig.hhs.gov/oei/reports/oei-02-19-00390.pdf

Olshansky, E. F. (2017). Social determinants of health: The role of nursing. *American Journal of Nursing, 117* (12), 11.

Oquendo, M. A., & Volkow, N. D. (2018). Suicide: A silent contributor to opioid-overdose deaths. *New England Journal of Medicine, 378*(17), 1567-1569.

Owens, P. L., Barrett, M. L., Weiss, A. J., Washington, R. E., & Kronick, R. (2014). Hospital inpatient utilization related to opioid overuse among adults, 1993–2012: Statistical Brief #177. *Healthcare Cost and Utilization Project (HCUP) Statistical Briefs*. Agency for Healthcare Research and Quality (US). https://www.hcup-us.ahrq.gov

Pear, V. A., Ponicki, W. R., Gaidus, A., Keyes, K. M., Martins, S. S., Fink, D. S., Rivera-Aguirre, A., Gruenewald, P. J., & Cerdá, M. (2019). Urban-rural variation in the socioeconomic determinants of opioid overdose. *Drug Alcohol Depend*, 1(195), 66-73. doi:10.1016/j.drugalcdep.2018.11.024

Plichta, S. B., & Kelvin, E. (2013). *Munro's statistical methods for health care research* (6th ed.). Lippincott Williams & Wilkins.

Polit, D. F. (2010). *Statistics and data analysis for nursing research* (2nd ed.). Pearson Education Inc.

Poux, S. (2017). *Social-ecological model offers new approach to public health.* The Borgen Project. https://borgenproject.org/social-ecological-model

Poverty USA. (n.d.). The population of poverty USA. https://www.povertyusa.org/facts

Priest, K. C., & McCarty, D. (2019). Role of the hospital in the 21st century opioid overdose epidemic: The addiction medicine consult service. *Journal of Addiction Medicine*, *13*(2), 104–112. https://doi.org/10.1097/ADM.0000000000000496

Public Health Agency of Canada. (2019). Updated numbers of opioid-related overdose deaths in Canada. https://www.canada.ca/en/public-health/news/2019/04/updated-numbers-on-opioid-related-overdose-deaths-in-canada.html

Quast, T. C. (2020). Potential undercounting of overdose deaths caused by specific drugs in vital statistics data: An analysis of Florida. *Drug and Alcohol Dependence, 207*(107807).

Rasu, R. S., Vouthy, K., Crowl, A. N., Stegeman, A. E., Fikru, B., Bawa, W. A., & Knell, M. E. (2014). Cost of pain medication to treat adult patients with nonmalignant chronic pain in the United States. *Journal of Managed Care & Specialty Pharmacy, 20*(9), 921–928. https://doi.org/10.18553/jmcp.2014.20.9.921

Reinberg, S. (2018). U.S. opioid ODs cluster in centers of poverty. *WebMD*. https://www.webmd.com/mental-health/addiction/news/20180326/us-opioid-ods-cluster-in-centers-of-poverty#1

Reinecke, H., Weber, C., Lange, K., Simon, M., Stein, C., & Sorgatz, H. (2015). Analgesic efficacy of opioids in chronic pain: recent meta-analyses. *British Journal of Pharmacology, 172*(2), 324–333. https://doi.org/10.1111/bph.12634

Rochon, P. A. (2019). Drug prescribing for older adults. *UpToDate.* https://www.uptodate.com

Rollston, R. (2018). The social determinants of addiction. *The Medical Care Blog.* https://www.themedicalcareblog.com/the-social-determinants-of-addiction/

Roxburgh, A., Hall, W. D., Dobbins, T., Gisev, N., Burns, L., Pearson, S., & Degenhardt, L. (2017). Trends in heroin and pharmaceutical opioid overdose deaths in Australia. *Drug and Alcohol Dependence, 179*, 291–298. https://doi.org/10.1016/j.drugalcdep.2017.07.018

Rudd, R. A., Aleshire, N., Zibbell, J. E., & Gladden, R. M. (2016). Increases in Drug and Opioid Overdose Deaths--United States, 2000-2014. *MMWR. Morbidity and*

Mortality Weekly Report, *64*(50-51), 1378–1382. https://doi.org/10.15585/mmwr.mm6450a3

Rural Health Information Hub. (n.d.). Florida. https://www.ruralhealthinfo.org/states/florida

Rushton, C. H. (2017). Our ethical obligation to social justice. *Johns Hopkins Nursing*. https://www.magazine.nursing.jhu.edu

Santosa, K.B., Lai, Y., Oliver, J.D., Hu, H.M., Brummett, C.M., Englesbe, M.J., & Waljee, J.F. (2020). Preoperative opioid use and mortality after minor outpatient surgery. *JAMA Surgery*,*155*(12), 1169–1171. doi:10.1001/jamasurg.2020.3623

Saunders, K. W., Dunn, K. M., Merrill, J. O., Sullivan, M., Weisner, C., Braden, J. B., Psaty, B. M., & Von Korff, M. (2010). Relationship of opioid use and dosage levels to fractures in older chronic pain patients. *Journal of General Internal Medicine*, *25*(4), 310–315. https://doi.org/10.1007/s11606-009-1218-z

Schepis, T. S., McCabe, S. E., & Teter, C.J. (2018). Sources of opioid medication for misuse in older adults: Results from a nationally representative survey. *PAIN,159* (8), 1543-1549.

Schieber, L.Z., Guy, G.P. Jr., Seth, P., & Losby, J.L. (2020). Variation in adult outpatient opioid prescription dispensing by age and sex- United States, 2008-2018. *MMWR Morbidity and Mortality Weekly Report*, *69*, 298-302.

Schiller, E. Y., & Mechanic, O. J. (2019). Opioid overdose. *StatPearls Publishing*, *LLC*. https://creativecommons.org/licenses/by/4.0

Scott, J. (2018). Florida new law on controlled substance prescribing. *Florida Medical Magazine.* https://www.flmedical.org/Florida/Florida_Public/Docs/FMA-Opioid-HB21.pdf

Simmons, A. (2019). The 3 best sources for reliable data online and how to use them. https://populationeducation.org/the-3-best-sources-for-reliable-data-online-and-how-to-use-them

Simmons-Duffin, S. (2019). The real cost of the opioid epidemic: An estimated $179 billion in just 1 year. https://health.wusf.usf.edu/post/real-cost-opioid-epidemic-estimated-179-billion-just-one-year#stream/0

Soelberg, C. D., Brown, R. E., Jr, Du Vivier, D., Meyer, J. E., & Ramachandran, B. K. (2017). The US opioid crisis: Current federal and state legal issues. *Anesthesia and Analgesia*, *125*(5), 1675–1681. https://doi.org/10.1213/ANE.0000000000002403

Stannard, C. (2018). Where now for opioids in chronic pain? *Drug and Therapeutics Bulletin*, *56*(10), 118-122. https://www.dtb.bmj.com

Stein, R. (2017). *Life expectancy drops again as opioid deaths surge in U.S*. https://www.npr.org/sections/health-shots/2017/12/21/572080314/life-expectancy-drops-again-as-opioid-deaths-surge-in-u-s

Strickler, G. K., Kreiner, P. W., Halpin, J. F., Doyle, E., & Paulozzi, L. J. (2020). Opioid prescribing behaviors - Prescription behavior surveillance system, 11 States, 2010-2016. *Morbidity and Mortality Weekly Report. Surveillance Summaries (Washington, D.C. : 2002), 69*(1), 1–14. https://doi.org/10.15585/mmwr.ss6901a1

Substance Abuse and Mental Health Services Administration. (2017). Opioid misuse increases among older adults. *The CBHSQ Report*. https://www.samhsa.gov/data/sites/default/files/report_3186/Spotlight-3186.html

Substance Abuse and Mental Health Services Administration (SAMHSA). (2020). *Suicide prevention*. https://www.samhsa.gov/find-help/suicide-prevention

Suriaga, A., & Tappen, R. (2020). A systematic review of opioid use in long-term care. *Annals of Long-Term Care, 1-5, s1-s4.* https://doi.org/ 1025270/altc.2020.03.00002

Tappen, R. (2016). *Advanced nursing research: From theory to practice* (2nd ed.). Jones & Bartlett Learning.

Therapeutic Research Center. (2019). Potentially harmful drugs in the elderly: Beers list. *Clinical Resource # 350301*.

Thornton, M., & Persaud, S. (2018). Preparing today's nurses: Social determinants of health and nursing education. *OJIN: The Online Journal of Issues in Nursing, 23*(3), manuscript 5. doi: 10.3912/OJIN.Vol23No03Man05

Tilly, J., Skowronski, S., & Ruiz, S. (2017). The opioid public health emergency and older adults. https://www.nasuad.org.

United Nations Office of Drugs and Crime. (2019). Two-thirds of global drug deaths now from opioids: UN drugs report. https://news.un.org

U.S. Census Bureau. (n.d.a). Quick facts Florida. https://www.census.gov/quickfacts/FL

U.S. Census Bureau (n.d.b). About what is race? https://www.census.gov/topics/population/race/about.html

U.S. Drug Enforcement Administration. (n.d.). Drug scheduling.

https://www.dea.gov/drug-scheduling

U.S. Drug Enforcement Administration. (2016). *DEA warning to police and public: Fentanyl exposure kills.* https://www.dea.org/press-releases/2016/06/10/dea-warning-police

U.S. Department of Health and Human Services. (n.d.). HHS awards over $1 billion to combat the opioid crisis. https://hhs.gov

U.S. Department of Health and Human Services (HHS), Office of the Surgeon General. (2018). *Facing addiction in America: The surgeon general's spotlight on opioids*. DC: HHS.

Veldhuizen, S., & Callaghan, R.C. (2014). Cause-specific mortality among people previously hospitalized with opioid-related conditions: A retrospective study. *Annals of Epidemiology, 24,* 620-624.

Watson, J., & Woodward, T. K. (2010). Jean Watson's theory of human caring. In M. E. Parker, & M. C. Smith, *Nursing theories and nursing practice* (3rd ed.). F.A. Davis Company.

Weiss, A., Heslin, K. C., Barrett, M. L., Izar, R, & Bierman, A. S. (2018). Opioid-related inpatient stays and emergency department visits among patients aged 65 years and older, 2010 and 2015: Statistical brief #244. https://pubmed.ncbi.nlm.nih.gov/30475561/

West, N. A., & Dart, R. C. (2016). Prescription opioid exposures and adverse outcomes among older adults. *Pharmacoepidemiology and Drug Safety, 25*, 539-544.

Wilson, N., Kariisa, M., Seth, P., Smith, H., & Davis, N. I. (2020). Drug and opioid-involved overdose deaths-United States, 2017-2018. Centers for Disease Control and Prevention. *Morbidity and Mortality Weekly Report, 69*(11), 290-297.

Witten, J. G., Hastie, T., & Tibshirani, R. (2017). *Introduction to statistical learning: with applications in R*. (7th ed.). Springer.

World Health Organization. (2018). Management of substance abuse: Information sheet on opioid overdose. https://www.who.int/substance_abuse/information-sheet/en/

Xu, J., Murphy, S.L., Kochanek, K.D., & Arias, E. (2020). Mortality in the United States, 2018. *NCHS Data Brief, 355*.

YaleNews. (2018). Opioid epidemic responses overlook gender. https://news.yale.edu/2018/07/05/opioid-epidemic-responses-overlook-gender

Yan, A., & Weber, N. (2018). In G. Chowdhury, J. McLeod, V. Gillet, & P. Willett, *Mining open government data used in scientific research,* Transforming Digital Worlds.iConference. Lecture Notes in Computer Science, 10766. Springer.