

Examining Prescription Opioid Use, Misuse and Use Disorders for Association with Socio-demographic Predictors, BMI, Suicidal Behavior and Health Services Use in the US Adult Population

By

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1 Abstract

1.1 Problem

The prescription opioid epidemic in the United States is associated with negative health and social outcomes. Examining the association of socio-demographic predictors, BMI, suicidal behavior and health services use in prescription opioid use without misuse (POU), prescription opioid misuse without use disorders (POMU) and prescription opioid use disorder (POUD) samples is important to make necessary intervention in each sample to prevent the expansion of epidemic.

1.2 Method

A cross-sectional secondary data analysis using the 2016-2017 National Survey on Drug Use and Health (NSDUH) data was conducted. The sample size for the past year POU was 24,400; POMU was 3,771; POUD was 721 and the reference sample who did not have any use of prescription opioid in the past year was 55,304.

1.3 Result

The prevalence of the past year POU is 32.4 %, POMU is 5.2 % and POUD is 1.0 %. Age ≥ 50 and age 30-49 years have a higher risk of POU [OR 1.37; OR 1.44] and age ≥ 50 has a lower risk of POMU [0.54] than age 18-29 years. Males have a lower risk of POU [0.92] and a higher risk of POMU [1.31] and POUD [1.66] than females. Non-Hispanic Whites have a higher risk of POU [1.33], POMU [1.42] and POUD [3.68] than Hispanics. Single people have a higher risk of POMU [OR 1.27] than married individuals. 'Medicaid only' insurance coverage has a higher risk of POU, POMU, POUD than almost all other insurance types. Obesity [OR 1.45] and overweight

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[OR 1.18] have a higher risk of POU than normal BMI. Suicidal behaviour has a higher risk of POU [1.25] < POMU [2.58] < POUD [3.37]. More than 1 emergency department visit has a higher risk of POMU [2.10] < POU [2.22] < POUD [3.74]; more than 1 overnight hospital stay has a higher risk of POMU [1.40] < POUD [1.70] < POU [2.03] ; more than 1 outpatient department visit has a higher risk of POMU [1.29] < POUD [1.43] < POU [2.38] and mental health services use has a higher association with POU [1.49] < POMU [1.90] < POUD [4.34] when compared with no use of those facilities.

1.4 Conclusion

This research has identified significant risk factors of POU, POMU, and POUD in the US adult population, and recommended intervention measures to reduce the burden of prescription opioid epidemic in the US.

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Dedication

3 Dedication

I am dedicating this work to the memory of my father Ahsan Ullah Chowdhury

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4 Introduction

The United States (US) is the main consumer of prescription opioids around the world (G. C. Alexander, America, & Zealand, 2015). In 2017, prescription opioids were the second most commonly used and misused substances following marijuana in the US (Bose, Hedden, Lipari, Park-Lee, & Tice, 2018). Prescription opioid misuse and dependence are associated with multiple complications involving the respiratory system, gastrointestinal system, central nervous system, cardiovascular system and even overdose-related premature mortality (Blanco et al., 2013). Death from opioids including prescription opioid overdose constitutes 68 percent of all drug overdose deaths in 2017 (CDC, 2018a) and it is 6 times higher than in 1999 (CDC, 2018b). In addition to these complications, non-medical use of a prescription opioid is associated with other illicit substance use, specifically transition to heroin use (Jones, 2013; Pisano et al., 2017; Smith, Kuramoto-Crawford, & Lynch, 2016). This epidemic involving prescription opioid can be explained by the over-prescription of opioid with an estimated 1 prescription for every 5 patients with chronic pain (non-cancer) in a hospital setting (Lin, Wang, Boyd, Simoni-Wastila, & Buu, 2018). People who are using opioids are at risk of starting misuse and therefore use disorders if not properly monitored or if associated with socio-demographic and other risk factors (Hooten et al., 2017; Hooten, St Sauver, McGree, Jacobson, & Warner, 2015; Schuchat, 2017). Based on current literature review, there was no extensive research that examined the differences in socio-demographic risk factors among the prescription opioid use without misuse (POU), misuse without use disorder (POMU) and use disorder (POUD) samples in the US adult population. Identifying the pattern of association of socio-demographic risk factors in POU, POMU and POUD samples using nationally representative data is important to understand the population characteristics in these samples to develop targeted prevention and intervention strategies. Self-

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poisoning by prescription drug specifically opioids is the second common medium of suicidal attempt after firearm in the US (Xiang, Zhao, Xiang, & Smith, 2012). Prescription opioids are responsible for over 5000 suicide deaths per year (Ashrafioun, Bishop, Conner, & Pigeon, 2017). Very few studies have explored the Suicidal Behavior in POU, POMU and POUD samples in the US considering probable confounders (Xiang et al., 2012). Similarly, the association of BMI (Body Mass Index) with POU, POMU, and POUD in the US is less explored. But it is important as research found that obesity is highly associated with chronic health conditions (Okifuji & Hare, 2015; A. A. Stone & Broderick, 2012) which in turn associated with prescription opioid use and misuse (Raghupathi & Raghupathi, 2018). Prescription opioid misuse and overdose are also linked with increased health service utilization such as a higher rate of emergency department (ED) visits and hospitalizations (R. N. Hansen, Oster, Edelsberg, Woody, & Sullivan, 2011) in this population which comprises significant amount of US healthcare cost (Aroke et al., 2018; Chang, Kharrazi, Bodycombe, Weiner, & Alexander, 2018; Ghate, Haroutiunian, Winslow, & McAdam-Marx, 2010; Riaz, Wolden, Gelblum, & Eric, 2016). Increased health services use may be due to prevalence of chronic diseases (Raghupathi & Raghupathi, 2018) or other co-existing risk factors such as psychiatric illness (Hooten et al., 2017) or even for complications resulting from overdose (Blanco et al., 2013) or for addiction treatment (Romo, Ulbricht, Clark, & Lapane, 2018). Therefore, the pattern of health services use including mental health services use in POU, POMU, and POUD population is necessary to understand the severity of the problem in three groups of populations. Understanding the risk factors by policymakers, health care providers and patients will assist to prevent transition to misuse and addiction.

Introduction

The purpose of the study is to examine the association of socio-demographic predictors, BMI, suicidal behavior, general health services use, and mental health services use in prescription opioid using, misusing and use disorder US adult population in 2016-2017.

5 Chapter 2: Literature Review

5.1 Prescription Opioids (POs)

POs are a class of semi-synthetic medications originated from the opium poppy plant. POs are prescribed to relieve pain intensity with a similar mechanism of action as heroin (Brande, 2017; “National Institute on Drug Abuse,” 2018).

5.2 Sources of opioids

Serturmer isolated crude opium morphine from opium poppy: *Papaver somniferum* and *P album* in 1803 which is pure alkaloid. Later on, other natural, semi-synthetic, synthetic opioid-like drugs were produced for analgesic use (Katzung, Masters, & Trevor, 2012).

5.3 Classification of PO

PO can be classified as a) Strong Opioid Agonists: Morphine, Methadone, Fentanyl, Hydromorphone, Meperidine, Oxycodone, Sufentanil, Alfentanil, Remifentanil; b) Partial Opioid Agonists: Codeine, Hydrocodone; and c) Mixed Opioid Agonists-Antagonists: Buprenorphine, Nalbuphine (Katzung et al., 2012). Natural opioid (e.g., codeine or morphine). PO can also be classified as a) Semisynthetic opioid (e.g., hydrocodone, hydromorphone, or oxycodone); and b) Synthetic opioid (e.g., fentanyl, methadone, or tramadol) (Katzung et al., 2012)

5.4 Route of Administration

Oral, parenteral, intramuscular, subcutaneous, nasal insufflation, transdermal and oral mucosa via lozenges. The most common route of administration is oral prescription opioids (Katzung et al., 2012). Addicted people take crush pills or open capsules or dissolved opioids or even

injection to get a higher effect which can result in even coma or death (National Institute of Drug Abuse, 2016; “National Institute on Drug Abuse,” 2018).

5.5 Distribution and Excretion

After absorption, opioids bind with plasma protein in the blood. Then it is distributed to tissues. Brain, lungs, liver, kidneys, spleen, skeletal muscles and fatty tissues act as the main reservoirs of opioids. The principal metabolite of opioids is glucuronide that is excreted through urine. Some can also be excreted through bile. A little proportion of absorbed opioids remain unchanged in blood and excreted through urine (Katzung et al., 2012).

5.6 Clinical Effects of PO

Short term effects of opioid use are analgesia, euphoria, sedation, confusion, respiratory depression, cough suppression, constipation, miosis, truncal rigidity, nausea and vomiting (“National Institute on Drug Abuse,” 2018). Other rare effects include bradycardia, hypotension, biliary colic, decreased renal plasma flow, prolonged labor in women, flushed skin, pruritis, urticaria, etc. (DrugFacts: Prescription Opioids, NIDA, 2019; “National Institute on Drug Abuse,” 2018; Katzung et al., 2012).

5.7 PO Misuse, Dependence and Abuse

PO misuse is defined as *“The use of prescription opioid in any way without the doctor’s instruction. It may be using other’s prescription, using larger or frequent dose or for longer duration against the prescription of own, or any other way than doctor instructed”* (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

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‘Dependence or Abuse’ definition in NSDUH (National Survey on Drug Use and Health): *“The dependence or abuse is defined on the basis of the 11 diagnostic criteria specified in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), which includes withdrawal; tolerance; use in dangerous situations; trouble with the law; and interference with major obligations at work, school, or home”* (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

Definition of ‘Dependence’ in NSDUH: Respondents were identified as having PO dependence with at least three or more prescription pain reliever dependence criteria:

“(a) Spent a great deal of time over a period of a month or more getting, using, or getting over the effects of pain relievers, (b) Used pain relievers more often than intended or was unable to keep set limits on pain reliever use, (c) Needed to use pain relievers more than before to get desired effects or noticed that same amount of pain reliever use had less effect than before, (d) Inability to cut down or stop using pain relievers every time tried or wanted to, (e) Continued to use pain relievers even though they were causing problems with emotions, nerves, mental health, or physical problems, (f) Pain reliever use reduced or eliminated involvement or participation in important activities, (g) Reported experiencing three or more pain reliever withdrawal symptoms at the same time that lasted longer than a day after pain reliever use was cut back or stopped. Symptoms include (i) feeling kind of blue or down; (ii) vomiting or feeling nauseous; (iii) having cramps or muscle aches; (iv) having teary eyes or a runny nose; (v) feeling sweaty, having enlarged pupils, or having body hair standing up on skin; (vi) having diarrhea; (vii) yawning; (viii) having a fever; and (ix) having trouble sleeping.” (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

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Definition of ‘Abuse’ in NSDUH: Respondents were identified as having prescription pain reliever abuse with one or more pain reliever abuse criteria: “(a) *Serious problems at home, work, or school caused by using pain relievers, such as (i) neglecting their children, (ii) missing work or school, (iii) doing a poor job at work or school, (iv) losing a job or dropping out of school. (b) Used pain relievers regularly and then did something that might have put you in physical danger. (c) Use of pain relievers caused you to do things that repeatedly got you in trouble with the law. (d) Problems with family or friends probably caused by using pain relievers and continued to use pain relievers even though you thought using pain relievers caused these problems*” (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

Katzung (2012) describes ‘physical dependence’ on opioid as ‘opioid dependence’ and ‘psychological dependence’ on opioid as ‘opioid addiction’.

5.8 Neuronal Mechanism of Opioid Misuse, Dependence and Abuse

PO bind with inhibitory G protein-coupled receptors: μ , κ and δ to exert various effects (Katzung et al., 2012). When opioids bind with these receptors in the brain, spinal cord and other organs, pain signals from the brain are inhibited and pleasure hormone dopamine is released (Murthy et al., 2016; National Institute of Drug Abuse, 2016; “National Institute on Drug Abuse,” 2018). Release of pleasure hormone dopamine is so rewarding that it may instigate further intake of opioids in a group of users which is the first step of emerging misuse and dependence (Brandt, 2017; DrugFacts: Prescription Opioids, NIDA, 2019; “Opioid Crisis Fast Facts-CNN,” 2018).

Literature Review

The Dopamine hypothesis of addiction or the 'Hijacked Brain Theory' explains the neuronal development of PO dependence. This theory described how the normal neuronal networks of the brain are disrupted and the addiction cycle is produced.

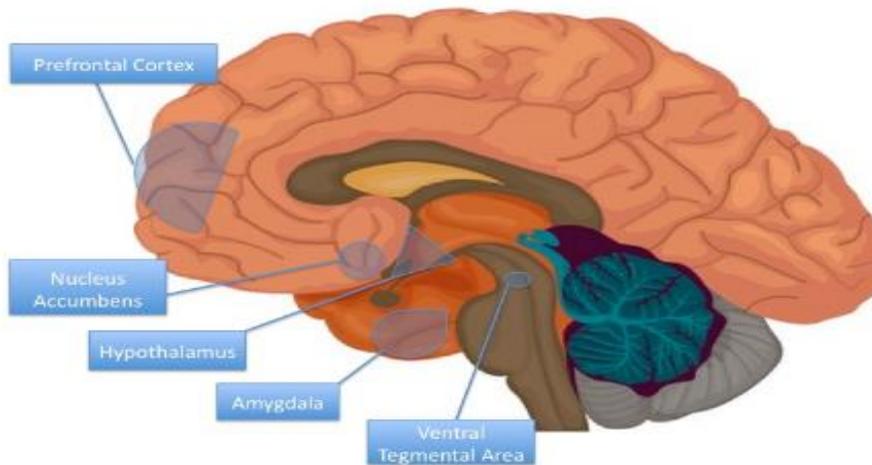
Four major behavior in addiction cycle are:

Impulsivity: It is when a person takes PO for the first time for analgesia or misused PO from curiosity, Positive reinforcement: Rewarding effect of the PO with or without other socio-demographic or co-existing risk factors positively reinforce to take it again, Negative reinforcement: Rewarding effect after misuse along with or without other socio-demographic or co-existing risk factors reinforce to take it again, and Compulsivity: The person will repeatedly search for opioids to get rewarding effects (Murthy et al., 2016).

These four major behavior are linked with three main regions in the brain: the basal ganglia, the extended amygdala, and the prefrontal cortex (Figure 1.1) (Murthy et al., 2016).

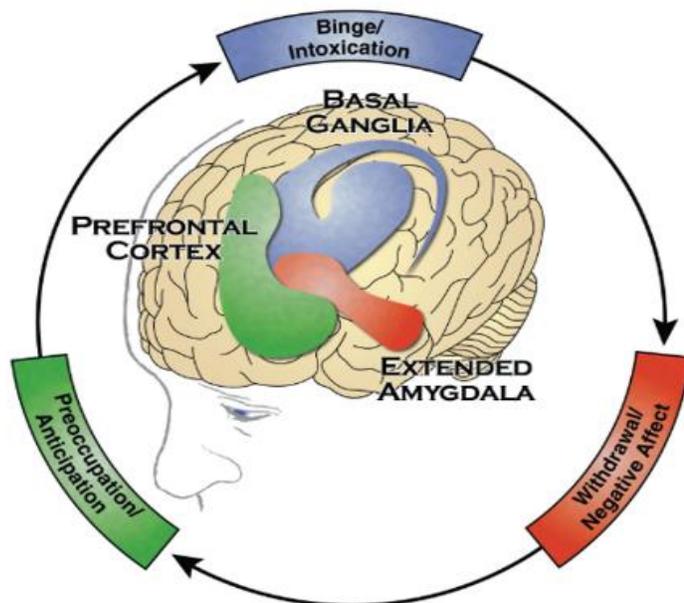
Nucleus accumbens (NAc) and the dorsal striatum are two sub-regions of basal ganglia that are involved in the addiction cycle (Kalivas & Volkow, 2005; Murthy et al., 2016). The extended amygdala is situated underneath the basal ganglia (Davis, Walker, Miles, & Grillon, 2010; Murthy et al., 2016). The prefrontal cortex is located at the very front of the brain. Other sub-regions regions involved are hypothalamus and ventral tegmental area (VTA) (Ball et al., 2011; Murthy et al., 2016).

Figure 1. 1 Brain Regions Involved in PO Addiction Cycle (Horvath, Misra, Epner, & Cooper, 2019).



The following three stages of addiction take place in the concerned brain regions when their usual functions are hijacked by opioids: a) Intoxication in Basal Ganglia: Impulsivity takes place at this stage when a person consumes opioids and experiences its rewarding effects, b) Withdrawal/Negative Affect in Extended Amygdala: Positive or negative reinforcement take place in this stage when a person experiences a negative emotional state in the absence of opioids, and c) Preoccupation/Anticipation in Prefrontal Cortex: Compulsivity takes place in this stage when a person hunt for opioids again to fix the emotional disturbance (Katzung et al., 2012; Murthy et al., 2016). Three stages are shown in Figure 1.2.

Figure 1. 2 Three Stages of Addiction Cycle in Brain (Murthy et al., 2016)



In Binge/Intoxication Stage, dopamine is produced from the VTA of the basal ganglia due to direct stimulation by opioids. Then dopamine moves towards NAc. Dopamine act on NAc to give the person a rewarding effect (Figure 1.1, Figure 1.2) (Murthy et al., 2016; Nestler, 2005).

In Withdrawal/Negative Affect Stage, once opioid intake is stopped there is no more dopamine. Due to the absence of dopamine for a certain period, reward circuitry in NAc stops working and withdrawal symptoms are produced. To cope with this situation, the stress system in the extended amygdala is activated which release CRH (Corticotropin-releasing hormone) and dynorphin (Figure 1.1, Figure 1.2) (Koob & Volkow, 2010; Murthy et al., 2016).

In Preoccupation/Anticipation Stage, in response to CRH, glutamate secretion increases which compromise the executive function of the prefrontal cortex, and the patient takes opioids again. Therefore, the regular neuronal mechanism in the three regions are hijacked by opioids and a

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vicious cycle of opioid addiction develops (Murthy et al., 2016; National Institute of Drug Abuse, 2016).

5.9 Development of PO Epidemic in the US

In the 1990s, the US faced ‘untreated pain’ epidemic. At that time, the American Pain Society declared pain as a fifth vital sign. Concurrently, oxycontin sales representatives implemented marketing strategies and particular activities to influence the increased prescription of oxycontin by physicians especially by primary care physicians (“HHS.gov,” 2017; Maxwell, 2011; Van Zee, 2009). From 1996 to 2012, global prescription rate and sales of PO such as oxycontin, morphine, and codeine sale rate increased (G. C. Alexander et al., 2015; Dhalla et al., 2009; Van Zee, 2009).

Since then, the US is the main consumer of PO. For instance, in 2009, the US consumed 99% hydrocodone, 60% hydromorphone, and 81% oxycodone of overall consumption in the world (G. C. Alexander et al., 2015). Lack of strategies in opioid prescription for use, increased demand from patients (Boscarino et al., 2011; CDC, 2014-07-Vital signs, 2014), alluring offers and massive advertisement by pharmaceuticals, illicit supply of PO are responsible for today’s epidemic situation (G. C. Alexander et al., 2015; G. C. Alexander, Kruszewski, & Webster, 2014; Manley, 2013).

5.10 Statistical Review on PO

PO misuse is the second most common illicit substance use after marijuana in the US (Currie, Jin, & Schnell, 2018; “National Institute on Drug Abuse,” 2015). In 2017, 4.1 percent of people aged 12 and older had PO misuse and 0.6 percent of people aged 12 and older had PO use

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disorder (Bose, Hedden, Lipari, Park-Lee, & Tice, 2018; “Statistics on Drug Addiction Quick Facts on Drug Addiction,” 2019). In 2015, the prevalence of PO use in the US adult population was 37.8 percent, misuse was 4.7 percent and use disorder was 0.8 percent (Han et al., 2017). The change in prevalence from 2015 to 2017 is consistent with the drop in the prevalence of prescription dispensed by 10.2 percent from 2016 to 2017 (“Opioid Crisis Fast Facts-CNN,” 2018). In 2016, health care providers wrote 66.5 prescriptions per 100 patients in the US (“CDC,” 2018). Yet if we compare with 1999, the amount of per capita opioid prescription in MME (millimole equivalent) is 3 time higher in 2015 (Currie et al., 2018; Dowell, Noonan, & Houry, 2017; Riaz, Wolden, Gelblum, & Eric, 2016) and between 2000 to 2010, the clinical use of PO increased by 300 percent in the US (G. C. Alexander et al., 2015; Axeen, Seabury, & Menchine, 2018; Currie et al., 2018; Daubresse et al., 2013). Though there were fluctuation and plateau in the prescription rate for decades, in general, the rate increased (Kahn, 2015; Riaz et al., 2016; Schuchat, 2019). Similar fluctuation but overall increasing trend was noticed in the average duration of opioid prescription (Schuchat, 2017) and its abuse (Chary et al., 2017; Kahn, 2015; Martins et al., 2017). Of all opioid-involved overdose deaths in 2015, approximately half are linked with PO overdose and the death rate increased in line with increased prescription rate between 1999 to 2013 (G. Alexander, Frattaroli, & Gielen, 2015; Lindsay Liu, Diana N. Pei, 2018; National Institute of Drug Abuse, 2016; Riaz et al., 2016). In recent years, between 2016-2017, PO overdose death rate is almost stable (Scholl, Seth, Kariisa, Wilson, & Baldwin, 2017) following an increase between 2014 to 2015 (Rudd, Seth, David, & Scholl, 2010). Till now, PO is a significant proportion of overdose-related death in the US (Mattson et al., 2018; Von Korff & Franklin, 2016). It encompasses 68 percent of all drug overdose deaths in 2017 (“CDC,” 2017). Individuals with inappropriate PO use are at high risk of misuse, use disorders, overdose

deaths and even shift to other illicit substance use (Boscarino et al., 2011; Compton, Boyle, & Wargo, 2015; Muhuri, Gfroerer, & Davies, 2013).

5.11 Socio-Demographic Factors and PO

The impact of socio-demographic factors on PO use, misuse and use disorder described in the literature are not consistent. In 2017, the prevalence of PO use disorder was 1 percent in age between 18 to 25 years and 0.6 percent in 26 years or older (Bose et al., 2018). At the same time, the prevalence of PO misuse was 7.3 percent in age between 18 to 25 years and 3.8 percent in 26 years or older (Bose et al., 2018). PO use and misuse were highest between the ages of 18 to 25 years (Belt, 2018; Hughes et al., 2016) but the overdose rate was highest between age 45 to 54 years (Belt, 2018). On the other hand, Brande (2017) stated in his research that from 2003 to 2010, among all ages, the highest increase in PO misuse occurred in those 50 years or older. Similarly, Davidson (2018) mentioned that between 2002 and 2014, the opioid abuse has been showing downwards trend in younger ages but it has doubled among 50 years or older people in the US (Campbell et al., 2010; Davidson, 2018). Davidson (2018) also mentioned that the prevalence of PO misuse among 60 years or older women is 11 percent which is higher than the average national rate in 12 years or older people. Likewise, P Coolen, A Lima, J Sabel (2009) conducted a study based on 1668 lower-income people who died from PO abuse found that the highest proportion (34.4 percent) of those people belongs to 45 to 54 years of age. These findings are also supported by School's (2017) research which states that from 2016 to 2017, of all PO overdose deaths, the largest relative change in death rate occurred in persons aged ≥ 65 years (17.2%) (Blanco et al., 2013). Similarly, among those who visited the ED from 2005 to 2011, the highest proportion of 35 percent were 65 years or older (Bush, 2013). The median age of death

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from PO abuse is 47 years (Mattson et al., 2018). Therefore, some reports indicate that the misuse and use disorder are higher in younger people aged 25 or less while most evidence indicates the abuse or use disorder and their related death rates are higher in 50 years or older.

Prevalence of lifetime and past-year PO use is higher in man than women (15.9% vs. 11.2%; 5.9% vs. 4.2%) (Back, Payne, Simpson, & Brady, 2010; Blanco et al., 2013). On the contrary, from 1997 to 2005, Campbell (2010) found that women had higher opioid use than men. Past year PO misuse was higher in men than women in a study using NSDUH data (Hughes et al., 2016; Martins et al., 2017). Opioid overdose death risk is also higher in man than women (Huang, Keyes, & Li, 2018). P Coolen, A Lima, J Sabel (2009) also found that 58.9% of those who died from PO overdose are male. Both sexes have equal rates of emergency department visit following abuse of opioid medications. Though the abuse rate is higher in men, the gap between men and women for opioid medication abuse is reducing. It is stated that there is a 400 percent increase in opioid overdose death in women than men from 1999 to 2013 (Brande, 2017). In contrary, Bush (2013) found that from 2005 to 2011, among those who visited ED from opioid Tramadol-related adverse reactions, 75 percent were females.

One clinic-based experiment found that black patients tend to develop abuse (Dasgupta, Beletsky, & Ciccarone, 2018) which is contradictory to most findings illustrating that PO use, misuse, use disorder, and related complications are higher in White than Black people (Blanco et al., 2013; Brande, 2017; Friedman et al., 2019; Hansen & Netherland, 2016; Martins et al., 2017). Some researches have found that the gap in opioid overdose deaths between black and white is decreasing (Belt, 2018; Scholl et al., 2017).

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A lower level of education, unemployment, low socioeconomic status, chronic health conditions are correlated with each other and can contribute to the risk of opioid use, misuse and use disorders (Belt, 2018; Brande, 2017; Dasgupta et al., 2018; Grol-Prokopczyk, 2018; Han et al., 2017). In contrary Currie (2018) mentioned that there is no simple causal association between socio-economic status and PO abuse.

In US adult population, substance use problems including opioid misuse and use, disorders are common in uninsured people when compared with those who have private insurance coverage only (Han et al., 2017; Wu, Kouzis, & Schlenger, 2003). Another study found that the opioid prescription rate is twice in Medicaid enrollees when compared with private insurance or higher when compared with non-Medicaid insurances (P Coolen, A Lima, J Sabel, 2009). The death rate from PO overdose in Medicaid enrollees is also higher than others. Of those who died from a PO overdose, 45.4 percent are Medicaid enrollees (P Coolen, A Lima, J Sabel, 2009).

In 2014-2017, the rate of PO was significantly higher in nonmetropolitan counties than in metropolitan counties. It can be explained by the higher proportion of older people in non-metropolitan counties (García et al., 2019; Newman, 2019). Following the release of CDC guidelines in 2016, opioid prescription is declining in both urban and rural counties. The overdose rate is also higher in counties with lower socio-economic conditions (Dasgupta et al., 2018).

5.12 BMI and PO

Association between BMI and PO use, misuse, and use disorders have not been adequately explored. Manley (2017) found that the association of BMI with various substance use disorder is not consistent and differ by gender. When Hu (2018) compared obesity in opioid-dependent

participants with other stimulant-dependent participants, found that obesity is least prevalent in opioid-dependent participants.

5.13 Suicidal Behavior and PO

Suicide is the 10th leading cause of death in the US (Rockett et al., 2014; Xu, Murphy, Kochanek, Bastian, & Arias, 2018). US adult population is showing an overall increase in suicidal thoughts, plans and attempts from 2008 to 2017 (Bose et al., 2018; D. M. Stone et al., 2018). For every 31 attempts during this period, at least 1 attempt resulted in death (Bose et al., 2018). Opioid-related suicides have doubled in the last 15 years (Esang & Ahmed, 2018). ED visits involving substance abuse-related suicidal attempts have also increased by 41 percent from 2004 to 2011 (Crane, 2016). When the toxicology results of people who died from suicide with chronic pain were compared with those who died from suicide without chronic pain, it showed that association of opioids is 51.9 percent vs 18.8 percent respectively (Ann. Intern. Med., 2018). Inappropriate dosing can be a risk factor to drive suicide in PO users (Mccarthy & Blow, 2017). Ashrafioun (2017) also found that suicidal thoughts, plans, and attempts are significantly associated with PO use, misuse and use disorders (Ford & Perna, 2015; Wood, 2018). From 2000 to 2017, overall 40 percent of all suicidal and unintentional drug overdose deaths are associated with opioids and use of opioid as a form of suicidal death has increased over 20 years and the association is different per socio-demographic characteristics or co-existing mental health condition (A. S. B. Bohnert & Ilgen, 2019; Braden, Edlund, & Sullivan, 2017; Collins, 2018; Haskins, 2019; Piscopo, Lipari, Rti, Cooney, & Glasheen, 2016). Opioid-related suicidal death is more in White and at the age range of 40 to 65. Gender difference in opioid-related overdose death is not comparable between studies (A. S. B. Bohnert & Ilgen, 2019; Braden et al., 2017;

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Wood, 2018). On the contrary, Kuramoto (2012) found that not always PO use, misuse or use disorder are associated with suicidal thoughts or plans or attempts.

5.14 Health Service Use and PO

Initial prescription use commonly starts in the hospital setting (Kim, Nolan, & Ti, 2017). Over 75 percent of misusers mentioned prescriber as a source of PO for misuse in 2017 (Currie et al., 2018). Physicians who overprescribe opioids have patients who have 1.3 times the long term use of PO than other physician's patients (Barnett, Olenski, & Jena, 2017). The prescription rate has been increasing over the years (Axeen et al., 2018; Daubresse et al., 2013).

The prescriber's setting is also an important factor as the PO user's contact with health services differ between emergency department (ED) or outpatient department or inpatient hospital (CDC, 2010; Currie et al., 2018; Mental Health Law, Weekly, 2018, n.d.). From 1996 to 2012, overall prescription rate by health care providers has increased by 471 percent with the highest increase in prescription in doctor's office from 71 percent to 83 percent but decrease in ED doctor's prescription from 7.4 percent to 4.4 percent (Marra, Mazer-Amirshahi, Mullins, & Pines, 2018; Mental Health Law, Weekly, 2018, n.d.). During this period, on average, 44 percent of patients received a prescription from a doctor's office, 26 percent from an outpatient visit and dental offices, 16 percent from ED visit and 14 percent from the indoor hospital (Mental Health Law, Weekly, 2018, n.d.). Similarly, among the high-risk users, 87.8 percent received a prescription from doctor's office and among all high dose prescriptions, 80 percent from doctor's office (Axeen et al., 2018; Mental Health Law, Weekly, 2018, n.d.).

Some studies over discrete years mentioned fluctuating or stable trend in PO-related ED visits (CDC, 2010; Crane, 2013; Faryar, Ems, Bhandari, & Huecker, 2018; Jones & McAninch, 2015;

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Kahn, 2015; “National Center for Health Statistics,” 2018; Vivolo-Kantor et al., 2018) but the overall trend is decreased since 1996 (Mental Health Law, Weekly, 2018, n.d.). Another study mentioned opioid overdose including PO-related hospitalization raised by 181 percent between 2008 to 2016 (Kahn, 2015; Warfield, Pollini, Stokes, & Bossarte, 2019). In recent years, from 2016 to 2017, opioid overdose-related ED visits among those aged 11 years or older has increased by 29.7% (Vivolo-Kantor et al., 2018). More interesting is that 53.50 percent of all PO poisoning related ED visits were unintentional (2006-2011) (Tadros, Layman, Davis, Davidov, & Cimino, 2015). Around half of the PO abuse-related cost includes ED care and indoor poisoning care cost (HHS, 2016).

Nearly 1 in 5 ED discharges includes an opioid prescription (Barrett & Bellew, 2018; Daoust et al., 2018). This is also higher in hospitalized patients. Opioids are also overprescribed after surgery as well as after dental surgery (Baker, Avorn, Levin, Bateman, & Author, 2016; Bates, Laciak, Southwick, & Bishoff, 2011; Harris et al., 2013; Kim et al., 2017). The refill rate is also higher after discharge from hospital (Morris, 2019; Mundkur et al., 2019).

Mental health services utilization rate is 49.6 percent in 2017 in US adults who had any kind of past-year mental health issues or substance use disorder issues. This study was conducted based on NSDUH data (Bose et al., 2018). No study examined the mental health services use by POU, POMU and POUD population in the US.

5.15 Summary

Current research findings describing the association of socio-demographic factors with PO use, misuse, and use disorders are not consistent. No study has explored the association of BMI and mental health services use with PO use, misuse and use disorder in the US. Findings on the

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relationship between suicidal plans, thoughts, and attempts with our population of interest are also inadequate. Health services utilization pattern in three groups is examined in some studies but still needs follow up. This is critical to examine all three samples: PO use without misuse, PO misuse without use disorder and PO use disorder to understand the difference in socio-demographic characteristics, BMI, suicidal behavior and health services utilization in the US. Understanding the differences and identifying specific risk factors in each sample will help in developing high-risk group-based interventions to prevent the onset of misuse or use disorder in high-risk groups and to stop the transition from use to addiction. Comparing the odds ratios in the three samples will help in understanding the severity of the problem in each sample and scopes to compare our findings with current data to monitor progress in overcoming the opioid epidemic. The CDC estimates the total economic burden of only PO misuse in the US is \$78.5 billion a year including the costs of health care, lost productivity, addiction treatment, and criminal justice involvement (“CDC,” 2018). This is a considerable proportion when compared with annual overall drug use related cost of \$740 billion (“Statistics on Drug Addiction Quick Facts on Drug Addiction,” 2019). To curb the health care cost of PO-related complications it is important to understand the pattern of health services utilization in POU, POMU, and POUD.

5.16 Purpose of the Study

The purpose of the study is to describe the association of socio-demographic factors, Body Mass Index (BMI), suicidal behavior and health services utilization with the POs Use, Misuse and Use Disorders in the US adult population in 2016-2017.

6 Chapter 3: Research Design

6.1 Objectives and Hypothesis

6.1.1 Objective 1

To describe the socio-demographic factors associated with past year POU, POMU and POUD in the US adult population in 2016-2017. Socio-demographic factors considered for our research are age, sex, ethnicity, employment, family income, insurance coverage, marital status, education, and county.

6.1.2 Hypothesis 1

Being elderly, male, non-Hispanic White, unemployed, lower-income, Medicaid insurance coverage, lower level of education, being single and living in non-metropolitan areas have statistically significant higher likelihood of past year POU, POMU and POUD in the US adult population in 2016-2017 as compared to younger, females, Hispanics, full-time employment, higher income, any other insurance coverage, higher level of education, married and large metropolitan areas respectively.

6.1.3 Objective 2

To examine the association of BMI with past year POU, POMU and POUD in the US adult population in 2016-2017.

6.1.4 Hypothesis 2

Obesity has a statistically significant higher association with the past year POU, POMU and POUD in the US adult population in 2016-2017 as compared to individuals with normal BMI.

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6.1.5 Objective 3

To examine the association of past year Suicidal Behaviour with past year POU, POMU and POUD in the US adult population in 2016-2017. Suicidal Behaviour includes suicidal plans, suicidal thoughts, and suicidal attempts.

6.1.6 Hypothesis 3

Past year suicidal behavior has a statistically significant higher association with past year POU, POMU and POUD in the US adult population in 2016-2017 as compared to those who did not have any suicidal behavior in the past year.

6.1.7 Objective 4

To examine the association of past year General Health Service Utilization with past year POU, POMU and POUD in the US adult population in 2016-2017. General Health Services include emergency department visit, overnight hospital stays and outpatient department visit.

6.1.8 Hypothesis 4

General health service utilization in the past year have a statistically significant higher association with past year POU, POMU and POUD in the US adult population in 2016-2017 as compared to those who did not use general health services in the past year.

6.1.9 Objective 5

To examine the association of past year Mental Health Service Utilization with past year POU, POMU and POUD in the US adult population in 2016-2017. Mental Health Services include overnight hospital stay, outpatient department visit, and doctor's prescription for reasons of mental health problems.

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6.1.10 Hypothesis 5

Mental health service utilization in the past year have a statistically significant higher association with past year POU, POMU and POUD in the US adult population in 2016-2017 as compared to those who did not use any types of mental health services in the past year.

6.2 Data Source and Population

6.2.1 Data Source

We conducted a secondary data analysis of the cross-sectional combined data of 2016 and 2017 National Survey on Drug Use and Health (NSDUH) public use file. NSDUH is a probability sampled, cross-sectional survey conducted in each year in the US. It is conducted by RTI International, Research Triangle Park, North Carolina and sponsored by the Center for Behavioral Health Statistics and Quality (CBHSQ) within the Substance Abuse and Mental Health Services Administration (SAMHSA) (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). This survey sample is representative of the US adult population.

6.2.2 Target Population Definition

The target population has the same definition since 1991. The target population includes inhabitants of households and non-institutional quarters such as college dorms, group homes, civilians dwelling on military settings, and persons with no permanent residence such as homeless people in shelters and inhabitants of single rooms in hotels from 50 states and the District of Columbia in the US. The active military persons, institutionalized citizens in prisons, nursing homes, mental institutes, long-term hospital stays and homeless persons not living in a shelter were excluded from this survey which constitutes 2% of the US population. In 2016 and

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2017 respectively 67,942 and 68,032 respondents were interviewed (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

6.2.3 Sample Allocation

Since 2014, the respondents are allocated in a way to maintain enough sample size in smaller states and age distribution in each year sample is also similar throughout this period.

The sample size in different states are: 4,560 in California; 3,300 in each of Florida, New York, and Texas; 2,400 in each of Illinois, Michigan, Ohio, and Pennsylvania; 1,500 in each of Georgia, New Jersey, North Carolina, and Virginia; 967 in Hawaii; 960 in District of Columbia.; and 960 in each of the other 37 states (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

The age distribution of each state's sample is: youths aged 12 to 17 are 25 percent, young adults aged 18 to 25 are 25 percent, adults aged 26 to 34 are 15 percent, adults aged 35 to 49 are 20 percent, and adults aged 50 or older are 15 percent (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

6.3 NSDUH Survey Method

6.3.1 Selection of Dwelling Unit

The NSDUH survey is an independent, stratified, multistage area probability sampling of dwelling units within each state and the District of Columbia in the US (Figure 1.3).

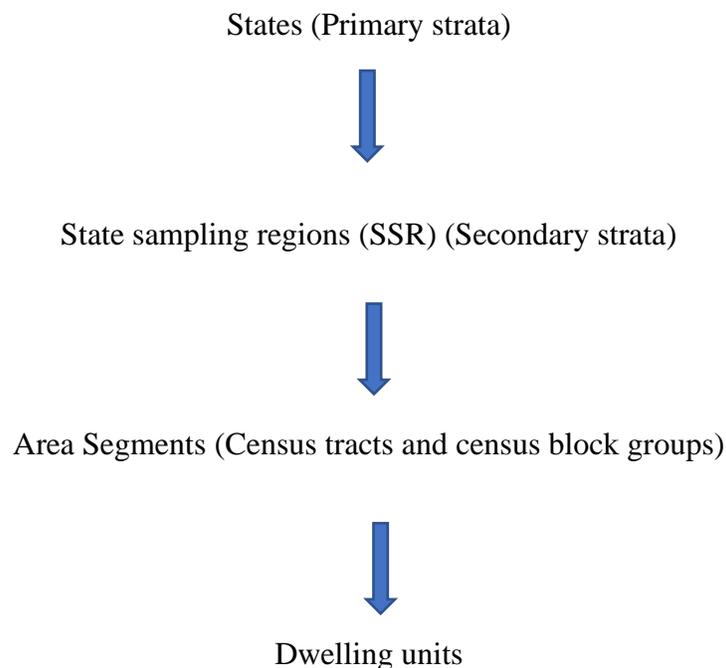


Figure 1. 3 Selection of Dwelling Units (National Survey on Drug Use and Health, 2017)

6.3.2 Interview Technique

The field interviews were conducted by approximately 650 Field Interviewers (FIs) directed by RTI staff members. After selection of dwelling units, FIs visited selected dwelling units and obtained informed written consent from respondents for interviews. From each dwelling unit, 0 to 2 respondents were selected based on roster information collected from the dwelling unit members (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

The survey was completed using computer-assisted interviewing techniques which combines computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) methods. CAPI method was used to collect non-sensitive information such as socio-demographic information and ACASI was used to collect sensitive information such as substance use and mental health-related information. ACASI method was used to maintain confidentiality,

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increased survey response rate and the accuracy of sensitive information. Each interview lasted for an hour and each respondent was offered an incentive of \$30 (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

The interviewers were properly trained, and the interview techniques were closely monitored. Data editing and statistical adjustments were made for non-response and automatic skip-outs. Consistency checks and imputation were employed to increase the accuracy of survey estimates.

6.4 Sensitivity, specificity and Response Rate of the Survey

Sensitivity values of the NSDUH survey substance use questions range from 0.8 to 0.97 and specificity values range from 0.7 to 0.95. The sensitivity and specificity were measured by a clinical validation study using the DSM-VI criteria of substance use (Jordan, Karg, Batts, Epstein, & Wiesen, 2008).

A weighted screening response rate was 77.88 percent and a weighted CAI response rate was 68.44 percent in 2016. In 2017, a weighted screening response rate was 75.08 percent and a weighted CAI response rate was 67.12 percent (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

6.5 Ethical Consideration

We have used public access data. Therefore, no cost is associated to get access into the data and no approval required from the Research Ethics Board (REB) at the University of Manitoba. Institutional Review Board at RTI International approved the data collection protocol of NSDUH. Every respondent gave free, informed, written consent. ACASI was used for the more sensitive section in which respondents read questions on a computer screen or listen to questions

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on computerized headphones to submit their answers. Therefore, the interviewer remained blind about the responses entered by respondents (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

To guard NSDUH data confidentiality, the full analytic files were treated with a statistical disclosure limitation method called MASSC, which stands for four major steps: a) Micro Agglomeration, b) Optimal Probabilistic Substitution, c) Optimal Probabilistic Sub-sampling, and d) Optimal Sampling Weight Calibration. Personal and geographic identification information such as name, phone number, address, census region, state, etc. was removed from the data. The household links for more than one respondent from a single household were eliminated from the public use files (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

Standard techniques of categorization, top-and-bottom coding, substitution, and sub-sampling were used to treat variables with a higher chance of personal identification and high value for analysis. In substitution, a sample of record was randomly selected and then its variables were replaced by a comparable donor record. In sub-sampling, randomly selected record proportions were removed from the file. For further confidentiality, the stratum and the cluster variable were treated by coarsening, substitution, and scrambling. As an additional measure to protect the confidentiality, certain variables were recoded, collapsed or locally suppressed to make composite variables. Some variables were re-examined and compared with original variables to check for bias and precision following application of the mentioned techniques (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

6.6 Methods

6.6.1 Study Sample

The NSDUH 2016 public use data file contains 56,897 un-weighted observations and 2017 public use file contains 56,276 un-weighted observations (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

In the combined data, the un-weighted population sample size for past year PO use without any kind of misuse (POU) is 24,400; population sample size for past year PO misuse without any kind of use disorder (POMU) is 3,771 and past year PO use disorder (POUD) sample size is 721.

6.6.2 Study Variables

We used pooled data from the 2016 and 2017 NSDUH surveys. For each variable, the NSDUH codebook provides variable name, description of the variable with categories, and value codes for each category.

We checked our variables of interest for similarities in the variable name, definition, and categories across 2016 and 2017 data. Our variables of interest are comparable between 2106 and 2017. All variables of interest are described in appendix A.

6.6.2.1 Outcome variables

6.6.2.1.1 PO Use without Misuse (POU)

POU is defined as any use of PO without any kind of misuse in the past year. We created this variable from ‘past year prescription pain reliever use’ and ‘past year prescription pain reliever misuse’ variables in the data (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

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Past year prescription pain reliever uses the variable in data: A screening question about past year use of prescription pain reliever was asked to respondents. If they mentioned ‘yes’ then past year prescription pain reliever use was noted as ‘yes’. To guide respondents, they were shown name and picture of following prescription pain relievers which comprises both generic and brand names of opioid medications: Vicodin, Lortab, Norco, Hydrocodone (generic), OxyContin, Percocet, Percodan, Roxycodone, Oxycodone (generic), Ultram, Ultram ER, Ultracet, Tramadol (generic), Extended-release tramadol (generic), Tylenol with codeine 3 or 4 (NOT over-the-counter Tylenol), Codeine pills (generic), Kadian, MS Contin, Morphine (generic), Extended-release morphine (generic), Duragesic, Fentora, Fentanyl (generic), Suboxone, Buprenorphine (generic), Buprenorphine plus naloxone (generic), Opana, Opana ER, Oxymorphone (generic), Demerol, Dilaudid or hydromorphone, Exalgo or extended-release hydromorphone, Methadone and others. Non-prescription pain reliever such as Aspirin, Tylenol, Advil, or Aleve was excluded while reporting (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). This past year PO use is a binary variable with the label ‘Yes and No’.

There was no missing data associated with POU variable. A total of 4492 PO users who had past year misuse or use disorders were excluded from this sample.

6.6.2.1.2 PO Misuse without Use Disorders (POMU)

‘PO misuse without use disorder’ comprises those who have misused PO in the past year but did not develop use disorders. We created this variable from ‘past year prescription pain reliever misuse’, ‘past year prescription pain reliever abuse’ and ‘past year prescription pain reliever dependence’ variables in the data (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

Research Design

Past year prescription pain reliever misuse variable in data: If the response to the ‘past year prescription pain reliever use’ screening question was ‘yes’, then a question about past year misuse of prescription pain reliever was asked to respondents. If the respondents said ‘yes’ then the ‘past year prescription pain reliever misuse’ was noted as ‘yes’. If respondents said ‘no’ to misuse but mentioned the name of a prescription pain reliever misuse to the ‘misuse of some other drugs’ section, then the response was noted as ‘logically assigned yes’ (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

To clarify the word ‘misuse’ to the respondents the question was asked as follows:

“Please think only about prescription pain reliever use in any way a doctor did not direct you to use it, including:

- *Using it without a prescription of your own, Using it in greater amounts, more often, or longer than you were told to take it, Using it in any other way a doctor did not direct you to use it.”*

(Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

Past year PO misuse is a binary variable with the label ‘Yes and No’.

There was no missing data associated with POU variable. A total of 25121 people who had past year PO use only or past year PO use disorder were excluded from this sample.

6.6.2.1.3 PO Use Disorders (POUD)

Past year POUD comprises those who experienced prescription pain reliever use disorder in the past year. It is defined as any kinds of dependence or abuse of prescription pain reliever in the past year (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

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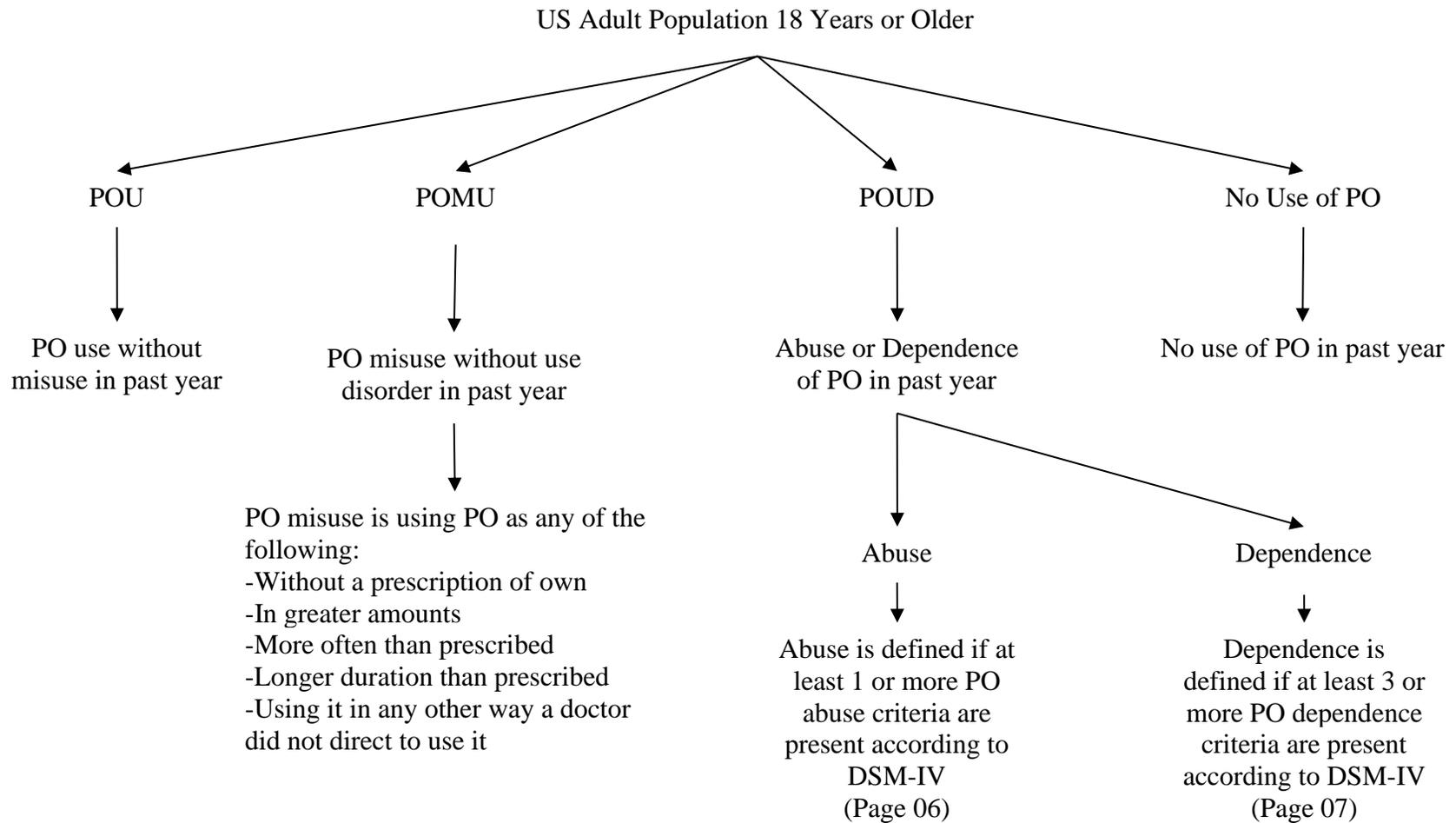
We created the PO use disorder variable from the ‘past year PO abuse’ and ‘past year PO dependence’ variables in the data. Past year PO abuse and dependence variables in the data are created based on 11 diagnostic criteria (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). The 11 diagnostic criteria are described in the literature review section.

Past year PO use disorder is a binary variable with the label ‘Yes and No’.

There was no missing data associated with POU variable. A total of 28171 people who had past year PO use only or past year PO misuse only were excluded from this sample.

The outcome variables are described in diagram 1.

Diagram 1 Summary of Outcome and Reference Samples



6.6.2.2 Socio-demographic Variables

6.6.2.2.1 Age

Respondents were asked to enter their date of birth at the beginning of the interview. Age can also be regenerated from some other questions in the survey.

We used the 'Age2' variable and created the 'Age' variable for our research with 3 categories: a) 18-29 Years, b) 30-49 Years and c) 50 Years or More. Our age categories are comparable to existing literature (Han et al., 2017). We also examined the frequency of age categories to ensure that the three categories have comparable frequencies. The age variable is not associated with any missing value.

6.6.2.2.2 Sex

The binary sex variable (female and male) based on the self-reported data was used for our research. The sex variable is not associated with any missing value.

6.6.2.2.3 Ethnicity

Information on ethnicity was collected as 7 categories in the survey. We recategorized it as a new variable 'ethnicity' into 4 categories: a) Hispanic, b) Non-Hispanic White, c) Non-Hispanic Black and d) Non-Hispanic Others. Ethnicity categories are comparable to existing literature (Han et al., 2017) and the frequency of each category are also comparable. Ethnicity is not associated with any missing values.

6.6.2.2.4 Marital Status

The marital status variable in the survey has 4 categories: married, widowed, divorced or separated, never been married and legitimate skip respondents who were less than 14 years old.

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Examining the frequency output of the marital status variable in data, we made 2 categories of marital status: a) Married and b) Never Married or Widowed or Divorced. This study includes only 18 years and older. So, the legitimate skip respondents were excluded from our study.

Marital status has no missing value.

6.6.2.2.5 Annual Family Income

The imputed annual family income variable and the recoded family income variables in the survey data have 7 categories and 4 categories respectively, frequencies of which are consistent. We used the recoded income variable with 4 categories: a) Less than \$ 20,000; b) \$ 20,000 to \$ 49,999; c) \$ 50,000 to \$ 74,999 and d) \$ 75,000 or more, and these are comparable to literature. The income variable has no missing value (Han et al., 2017). Annual family income has no missing value.

6.6.2.2.6 Education

To collect the education data, respondents were asked if they are currently enrolled in school or not? If the response was *'yes or in the break but will return to school'*, then it was noted as 'yes'.

Those with 'yes' response were asked about types of schools: elementary school, junior high or middle school, high school, or college education or university education or even homeschooling.

After the respondents mentioned about types of school, they were asked about grade or year:

"What grade or year of school are you now attending? or What grade or year of school will you be attending when your vacation is over?" (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

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The education variable in the data has 11 categories. After examining the frequencies we re-categorized education variable into 4 groups: a) 11 or 12 Grades Completed, no Diploma; b) High School Diploma; c) Some College Credit with or without Associated Degree; and d) College Graduate or Higher which is comparable to literature (Han et al., 2017). Education has no missing value.

6.6.2.2.7 Employment

NSDUH survey data reported employment status as 5 categories: a) Employed Full-Time, b) Employed Part-Time, c) Unemployed, d) Others and e) 12-14 years old (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

For our research, we made 3 categories: a) Employed Full-Time, b) Employed Part-Time, c) Unemployed and Others (living with a disability, retired, volunteer workers, homemaker, on lay-off and training). We excluded 12 to 14 years old as this age group is not our population of interest. Employment has no missing value.

6.6.2.2.8 Insurance

Insurance data were separately collected on Medicare, Medicaid, Champus, Private Insurance, and other health insurance.

‘Medicare’ variable in data: The question asked for Medicare is “*Medicare is a health insurance program for people aged 65 or older and for certain people with disabilities. Are you covered by Medicare?*” (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

‘Medicaid’ variable in data: The question asked for Medicaid is “*Medicaid is a public assistance program that pays for medical care for people with low income and people with disabilities. The*

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Medicaid program is also called Medifill or Medical Assistance. Are you covered by Medicaid?” (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

‘CHAMPUS’ variable in data: Question for CHAMPUS is *“There are certain programs that cover active duty and retired career military personnel and their dependents and survivors and disabled veterans and their dependents and survivors. Are you covered by TRICARE, or CHAMPUS, CHAMPVA, the VA, or military health care”?* (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

‘Private health insurance’ variable in data: Question for private insurance is *“Private health insurance can be obtained through work, such as through an employer, union, or professional association, by paying premiums directly to a health insurance company, or by purchasing a plan through the Health Insurance Marketplace. It includes coverage by a health maintenance organization or HMO, fee for service plans, and single service plans. Are you currently covered by private health insurance?”* (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

‘Other health insurance’ in data: Those who are covered by any other health insurance except abovementioned health insurances are defined as other health insurance users (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

After examining the literature findings and the frequency output of the insurance variables in data we created a new ‘insurance’ variable with 4 categories: a) Medicaid Only: Those who are only covered by Medicaid, b) Private Health Insurance Only: Those who are only covered by private health insurance, c) Others Only: Those who are covered by any other health insurance

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except Medicaid and Private Health Insurance, d) Uninsured: Those who do not have any kind of health insurance coverage (Han et al., 2017). Therefore, ‘Others Only’ category in this research also includes those who are covered by Medicare.

Insurance coverage variable in our data has 9,161 respondents who have more than one types of insurance coverage which are not included in our study.

6.6.2.2.9 County

For our research, we used the County variable provided in the data with 3 levels: a) Non-Metro, b) Small Metro and c) Large Metro Areas.

6.6.2.3 Body Mass Index

The data has a BMI variable created using the formula $BMI = [\text{weight (lbs)} \div \text{height (in)}^2] \times 703$ (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). We re-categorised BMI into 4 groups: a) Underweight: BMI < 18.5, b) Normal: 18.5 to 24.9, c) Overweight: BMI 25 to 29, and d) Obese: BMI 30 or more.

6.6.2.4 Suicidal Behaviour Variables

The mental health section of the survey collected information on suicidal thoughts, plans, and attempts. The questions asked to collect data on suicidal behavior are a) *“At any time in the past 12 months, including today, did you seriously think about trying to kill yourself?”* b) *“During the past 12 months, did you make any plans to kill yourself?”* c) *“During the past 12 months, did you try to kill yourself?”* (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

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We used these three questions to create ‘suicidal behavior’ variable with 2 response: a) Respondent does not have any suicidal plan or suicidal thoughts or suicidal attempt in the past year, b) Respondent had one of the criteria among suicidal plan, suicidal thoughts and suicidal attempts in the past year. We do not have any missing data for the suicidal behavior variable.

6.6.2.5 General Health Service Use Variables

The health section of the survey collected information on General Health Service Use by the respondents for any reason irrespective of drug use or mental health problems.

Questions asked about health service use are a) *“During the past 12 months, how many different times have you been treated in an emergency room for any reason”*? b) *“During the past 12 months, how many nights were you an inpatient in a hospital”*? c) *“During the past 12 months, how many times you visited the outpatient department”*? The responses to these questions are given in numbers (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). For our research, we recoded each type of health service utilization into 3 categories a) No Visit, b) 1 Visit, and c) More than 1 Visit.

The missing frequency of emergency department visit, overnight hospital stays, and outpatient department visit are respectively 1,349; 197 and 1,674. The missing frequencies are the responses which comprise don’t remember and don’t know. To take the missing values of general health services use into consideration, we examine the socio-demographic characteristics, PO use, misuse, and use disorders between the missing and non-missing group. We did not find any difference in the examined characteristics between the missing and non-missing group of general health services use. Therefore, no chance of misclassification for the missing sample.

6.6.2.6 Mental Health Services Use Variables

The adult mental health service utilization section in the survey has collected data on the use of mental health services. Treatment for alcohol or drug use was not included.

Questions asked about mental health service use are a) *“During the past 12 months, have you stayed overnight or longer in a hospital or other facility to receive treatment or counseling for any problem you were having with your emotions, nerves, or mental health? Please do not include treatment for alcohol or drug use”*. b) *“During the past 12 months, did you receive any outpatient treatment or counseling for any problem you were having with your emotions, nerves, or mental health at any of the places listed below? It includes an outpatient mental health clinic or center, the office of a private therapist, psychologist, psychiatrist, social worker, or counsellor that was not part of a clinic, a doctor's office that was not part of a clinic, an outpatient medical clinic or a partial day hospital or day treatment program, and some other places”*. c) *“During the past 12 months, did you take any prescription medication that was prescribed for you to treat a mental or emotional condition”*? (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). These variables have binary outcome ‘yes and no’ in the data.

We recreated a new ‘mental health service use’ variable with 2 outcomes: a) No use of mental health service by the respondents, b) Use of one of the 3 types of mental health services use from an overnight hospital stay, outpatient department visit, and doctor’s prescription. The mental health service utilization variable is categorized into two categories to get an appropriate sample size.

6.6.3 Data Manipulation`

6.6.3.1 Weight Variables

NSDUH 2016 and 2017 data provides three sets of analysis weights at the person level, questionnaire dwelling unit (QDU) level, and person pair level. These three weights share the same first 11 weight components. QDU-level and person pair-level analysis weights have several additional specific weight components. All weight components were used to produce the final weight variable. For the purpose of our research, we divided the weight variable in the combined two years of data by 2 as suggested in the public use file guideline (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). The master weights are inflation weights and so simply combining the weights over two years means the reference population is “double” what it actually is (i.e., the average population over 2 years is approximately half the sum of the two separate sets of weights).

6.6.3.2 Editing, Imputation, and Recoding of Variables

According to the codebook, invalid interview responses, bad data, don't know, and refused in the edited variables were replaced by valid interview responses and checked for consistency with the edited variable. For PO use in the past year, if a respondent skipped out of a question, it is noted as ‘not used in the relevant time period’ in the imputation-revised variables. For other variables, it is noted as ‘legitimate skip’ (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018). Statistical imputation was used to replace missing values with non-missing values. Modified predictive mean neighborhood (modPMN) method was used to replace missing values of demographic variables like employment status, immigrant status, income, insurance,

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and PO use, or dependence or abuse variables. Not all variables in the data needed edit or imputation (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

6.6.3.3 Variance Estimation of Totals in Data

The sampling error is reduced by selecting a large sample and/or by using efficient sample design and estimation strategies, such as stratification, optimal allocation, and ratio estimation. The use of probability sampling methods in NSDUH allows estimation of sampling error from the survey data (Center for Behavioral Health Statistics and Quality, 2018; RTI International, 2018).

6.6.3.4 Data Preparation to Conduct Our Analysis

For our analysis, we used public access data 2016 and 2017. At first, each year data set was sorted by age 18 years and elder. Then, two subset data were created from two sorted data including our variables of interest. Each subset was sorted and combined by the sample design variable ‘variance estimation stratum’ (VESTR) and ‘variance estimation replicates within stratum’ (VEREP). During analysis, we used the final person-level analysis weight and no separate mental health weight was needed for the suicidal behavior variable. We used the master weight variable to generalize the findings to the US general population. We used strata and cluster variables to consider the complex multistage stratified sampling design of the survey.

As suggested in the codebook, we used imputation-revised variables for our analysis. When imputation-revised format was not available, we used the recoded format, and when the recoded format was not available, then we used the edited format of that variable

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for our analysis. The imputation-revised variables selected for the analysis are sex, employment, family income, insurance, marital status, education, PO use, PO misuse, and PO use disorders.

The edited variables selected for the analysis are age, county, and general health service use variables. The recoded variables selected for the analysis include ethnicity, suicidal behavior, mental health service use, and BMI. Here the edited variables mean the original variables reported in the codebook. Imputed and recoded variables are derived from the edited variables and are also reported in the codebook. After selecting the appropriate variables, we recoded those variables again in SAS for the purpose of our analysis.

For ‘general health service use’ and ‘mental health service use’ variables, we have ‘missing values’ in our analysis which are derived from ‘don’t know or unknown response or bad data logically assigned’. To take the missing values into consideration, we compared the missing group with the non-missing group to examine socio-demographic characteristics, PO use, misuse, and use disorders between the missing and non-missing group. We did not find any difference for the examined characteristics between the missing and non-missing group, therefore no chance of misclassification for the missing sample.

6.6.4 Statistical Analysis

The statistical software SAS 9.4 was used to conduct analysis. All predictors and covariates were examined for multi-collinearity and no multicollinearity was detected. Statistical tests conducted to answer each objective are illustrated in appendix B. The population weight, strata and sampling unit were applied during descriptive and regression analysis.

6.6.4.1 Statistical Analysis: Objective 1: To Describe the Socio-Demographic Factors

Associated with POU, POMU, and POUD in the US Adult Population in 2016-2017

The prevalence of socio-demographic factors with a 95% confidence interval (CI) in the NSDUH survey adult population were examined (Table 1.1).

The prevalence of socio-demographic factors with 95% CI in the past year POU, past year POMU and past year POUD samples were examined (Table 1. 2).

The demographic characteristics of the three groups were compared to see how one group (i.e., PO users) differed from misusers and from those with use disorders (Table 1.3, appendix B).

Univariable and multivariable logistic regression models were estimated to examine the relationship between socio-demographic factors and a) Past-year POU, b) Past-year POMU, and c) Past-year POUD (Table 1.3, appendix B).

6.6.4.2 Statistical Analysis: Objective 2: To Examine the Association of BMI with POU, POMU, and POUD in the US Adult Population in 2016-2017.

The prevalence of BMI with 95% CI in the NSDUH survey adult population was examined (Table 1.1).

The prevalence of BMI with 95% CI in the past year POU, past year POMU and past year POUD samples were examined (Table 1. 2).

Past year POU, past year POMU and past year POUD were considered as three binary outcome variables and BMI was considered as a categorical independent variable. The socio-demographic factors were considered as covariates (appendix B).

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Model 1 describes the univariate association (Table 1.4, Table 1.6, Table 1.8) and multivariable association (Table 1.5, Table 1.7&Table 1.9) of BMI with past year POU, past year POMU and past year POUD in US adult population during 2016-2017 when controlled for socio-demographic factors (appendix B).

Model 7 describes the multivariable association (Table 1.5, Table 1.7&Table 1.9) of BMI with past year POU, past year POMU and past year POUD in US adult population during 2016-2017 when controlled for all predictors (appendix B).

6.6.4.3 Statistical Analysis: Objective 3: To Examine the Association of Suicidal Behaviour with POU, POMU, and POUD in US Adult Population in 2016-2017.

The prevalence of past year suicidal behavior with 95% CI in the NSDUH survey adult population was examined (Table 1.1).

The prevalence of past year suicidal behavior with 95% CI in the past year POU, past year POMU and past year POUD samples were examined (Table 1. 2).

Past year POU, past year POMU and past year POUD were considered as three binary outcome variables and suicidal behavior was considered as a binary independent variable. The socio-demographic factors were considered as covariates (appendix B).

Model 2 describes the univariate association (Table 1.4, Table 1.6, Table 1.8) and multivariable association (Table 1.5,Table 1.7, Table 1.9) of past year suicidal behaviour with past year POU, past year POMU and past year POUD in US adult population in 2016-2017, when controlled for socio-demographic factors (appendix B).

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Model 7 describes the multivariable association (Table 1.5, Table 1.7&Table 1.9) of past year suicidal behavior with past year POU, past year POMU and past year POUD in US adult population during 2016-2017 when controlled for all predictors (appendix B).

6.6.4.4 Statistical Analysis: Objective 4: To Examine the Association of General Health Services Use with POU, POMU, and POUD in the US Adult Population in 2016-2017.

The prevalence of past year general health services use with 95% CI in the NSDUH survey adult population were examined (Table 1.1).

The prevalence of past year general health services uses with 95% CI in the past year POU, past year POMU and past year POUD samples were examined (Table 1. 2).

Past year POU, past year POMU and past year POUD each was considered as three binary outcome variables and past year general health services utilization were considered as independent variables. Three types of general health services utilization: emergency department visit, overnight hospital stays, and outpatient department visit were included in the analysis. The socio-demographic factors were considered as covariates (appendix B).

Model 3, Model 4 and Model 5 describe the unadjusted association (Table 1.4, Table 1.6, Table 1.8) and adjusted association (Table 1.5, Table 1.7, Table 1.9) of past year general health services use with past year POU, past year POMU and past year POUD in US adult population in 2016-2017, when controlled for socio-demographic factors (appendix B).

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Model 7 describe the adjusted association (Table 1.5, Table 1.7, Table 1.9) of past year general health services use with past year POU, past year POMU and past year POUD in US adult population in 2016-2017 when controlled for all predictors (appendix B).

6.6.4.5 Statistical Analysis: Objective 4: To Examine the Association of Mental Health Service Use with POU, POMU and POUD in US Adult Population in 2016-2017.

The prevalence of past year mental health service use with 95%CI in the NSDUH survey adult population were examined (Table 1.1).

The prevalence of past year mental health service use with 95% CI in the past year POU, past year POMU and past year POUD samples were examined (Table 1. 2).

Past year POU, past year POMU and past year POUD each was considered as three binary outcome variable and mental health service utilization variables were considered as the independent variable. The socio-demographic factors are considered as covariates (appendix B).

Model 6 describes the unadjusted association (Table 1.4, Table 1.6, Table 1.8) and adjusted association (Table 1.5,Table 1.7, Table 1.9) of past year mental health services use with past year POU, past year POMU and past year POUD in US adult population in 2016-2017, when controlled for socio-demographic factors (appendix B).

Model 7describes the adjusted association of past year mental health services use with past year POU, past year POMU and past year POUD in US adult population during 2016-2017, when controlled for all predictors (appendix B).

6.7 Conceptual Framework

To understand the development of PO misuse, Hooten (2017) recommended a conceptual framework. Hooten (2017) mentioned three-level factors: patient, practice environment and prescriber level factors to explain unintended prolonged use of opioids. He described some patient-level factors such as socio-demographic factors, medical or mental health conditions, pain etiology and response to pain. He also described some practice environment and prescriber level factors like regulatory laws, prescriber training, attitudes, and beliefs.

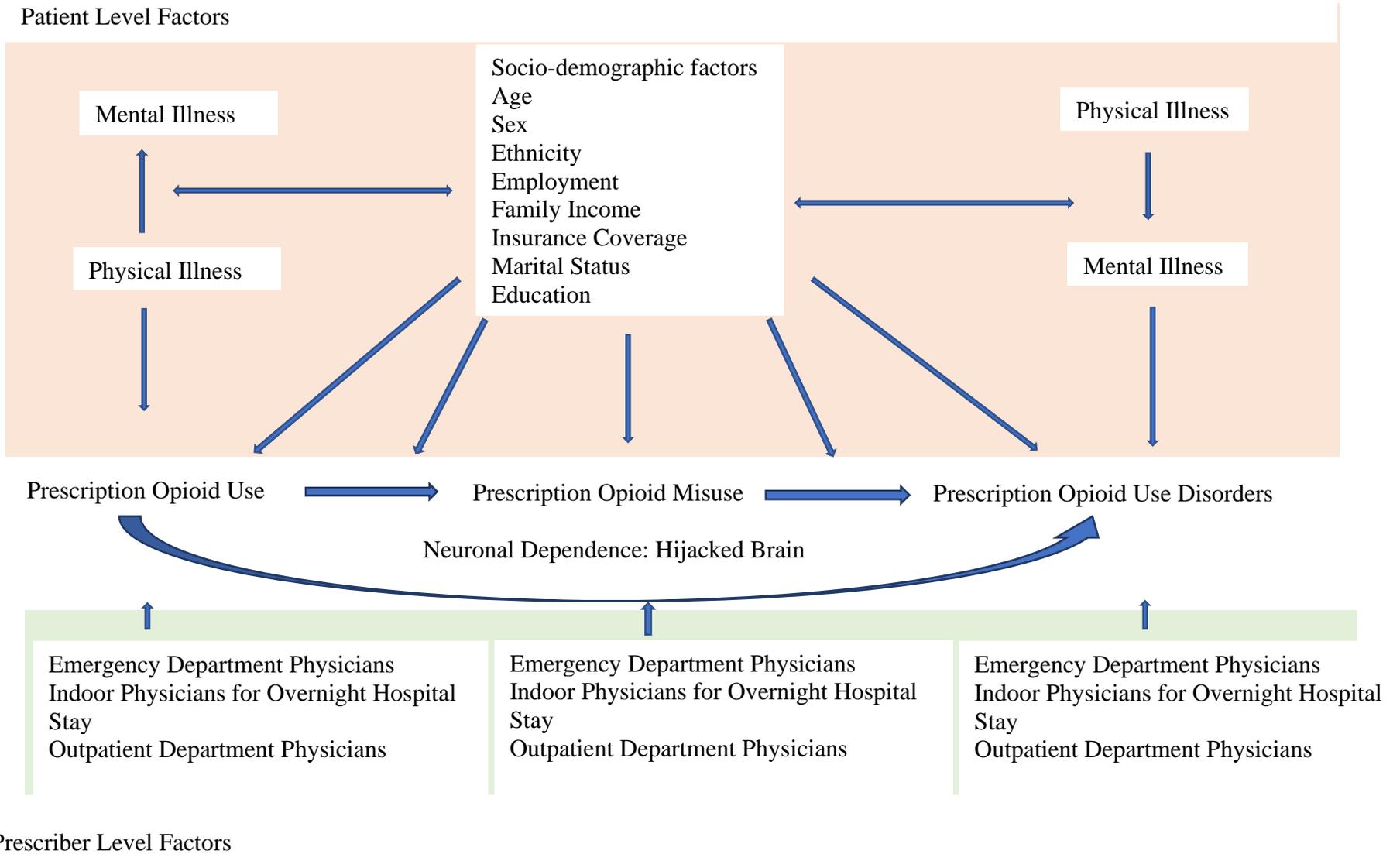
Health services utilization pattern that we examined can also be a practice environment factor as hospitals, doctors office, and emergency care prescription rate are different (*Mental Health Law, Weekly, 2018, n.d.*). Health services utilization is also linked with severe mental illness like suicidal behavior. All the predictors of PO use are interconnected and have complex interactions. Moreover, “Hijacked Brain Theory” of developing drug addiction can explain the transition from PO use to misuse and use disorder. Therefore, based on Hooten’s (2017) conceptual framework of misuse, we are proposing a framework in this research to explain how the patient-level factors, prescriber level factors and neuronal mechanism of addiction results in PO use, misuse, and use disorder or the transition from PO use to misuse or use disorder (Figure 1.4).

This framework shows that socio-demographic factors have an impact on PO use, misuse, and use disorders. Variation in age, sex, ethnicity, employment, family income, insurance coverage, marital status, and education can have a similar or dissimilar influence on PO use, misuse, and use disorders. Physical health condition (e.g. Obesity) can result in PO use due to associated painful illness (Blanco et al., 2016; Han et al., 2017; Okifuji & Hare, 2015; Shah, Hayes, & Martin, 2017; A. A. Stone & Broderick, 2012; Von Korff & Franklin, 2016). Long term physical

Research Design: Conceptual Framework

illness can also produce psychological upset which further instigates substance misuse for physical and psychological relief. Hijacked brain theory explains (details in the literature review section) development of use disorder from use which can be augmented by socio-demographic or health risk factors. Physicians at outpatient can prescribe opioid as regular pain management and in the emergency department for acute pain management, and to post-operative patients or chronic pain patients as indoor hospital management (Baker et al., 2016; Bates et al., 2011; Harris et al., 2013; Kim et al., 2017). If not properly monitored, the availability of opioids from prescription derived from symptomatic pain management can ultimately result in PO misuse and addiction (Compton & Volkow, 2006; Martins et al., 2017).

Figure 1.4 Conceptual Framework of PO Use, Misuse and Use Disorder



7 Chapter 4: Results

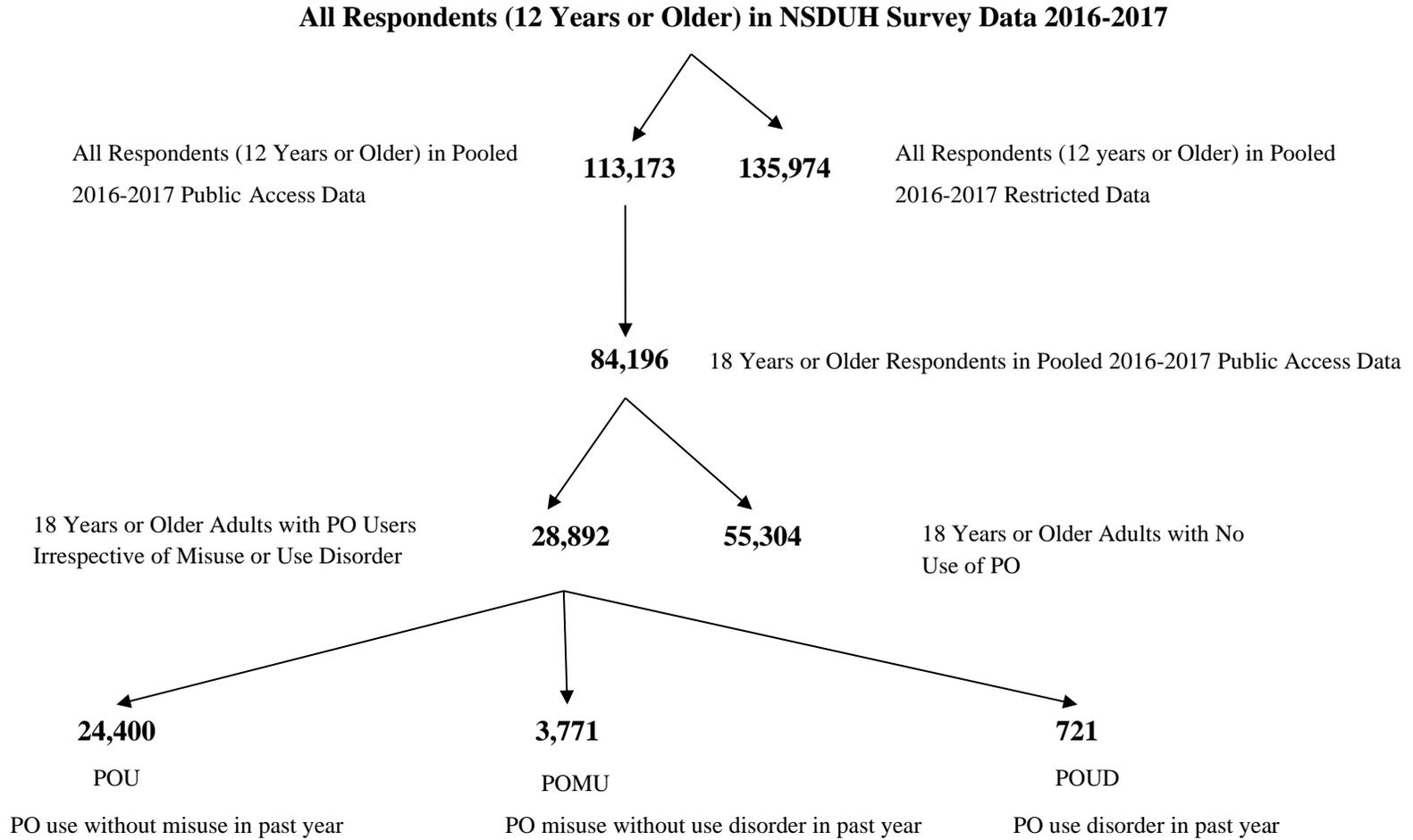
Total 135,974 people (unweighted) participated in the 2016 and 2017 NSDUH survey. Data of 113,173 respondents (unweighted) are available in public access files. Only those respondents who were 18 years or older (84,196) at the time of survey with a history of past year PO use were included in the analysis. The inclusion criteria were fulfilled by 28,892 respondents (weighted frequency: 85,676,888).

This past year PO using adult population sample was further divided into three separate samples:

- A. The PO user only without any kind of misuse (POU) in the past year (unweighted frequency: 24,400; weighted frequency: 75,462,724);
- B. The PO misuser only without any kind of use disorder (POMU) in the past year (unweighted frequency: 3,771; weighted frequency: 858,8375); and
- C. PO use disorder (POUD) in the past year (unweighted frequency: 721; weighted frequency: 162,5789).

In the individual analysis, each of the three samples was compared with those who were 18 years or older at the time of survey with no history of PO use in the past year irrespective of having a history of PO use prior to the last year. The reference group has 55,304 respondents (weighted frequency: 157,693,542) which are defined as no use of PO in the past year. In the three samples of POU, POMU, and POUD, the association BMI, Suicidal Behaviour, General Health Services Use and Mental Health Services Use with POU, POMU, and POUD in US adult population were examined. The selection of samples is shown in diagram 2.

Diagram 2 Description of samples



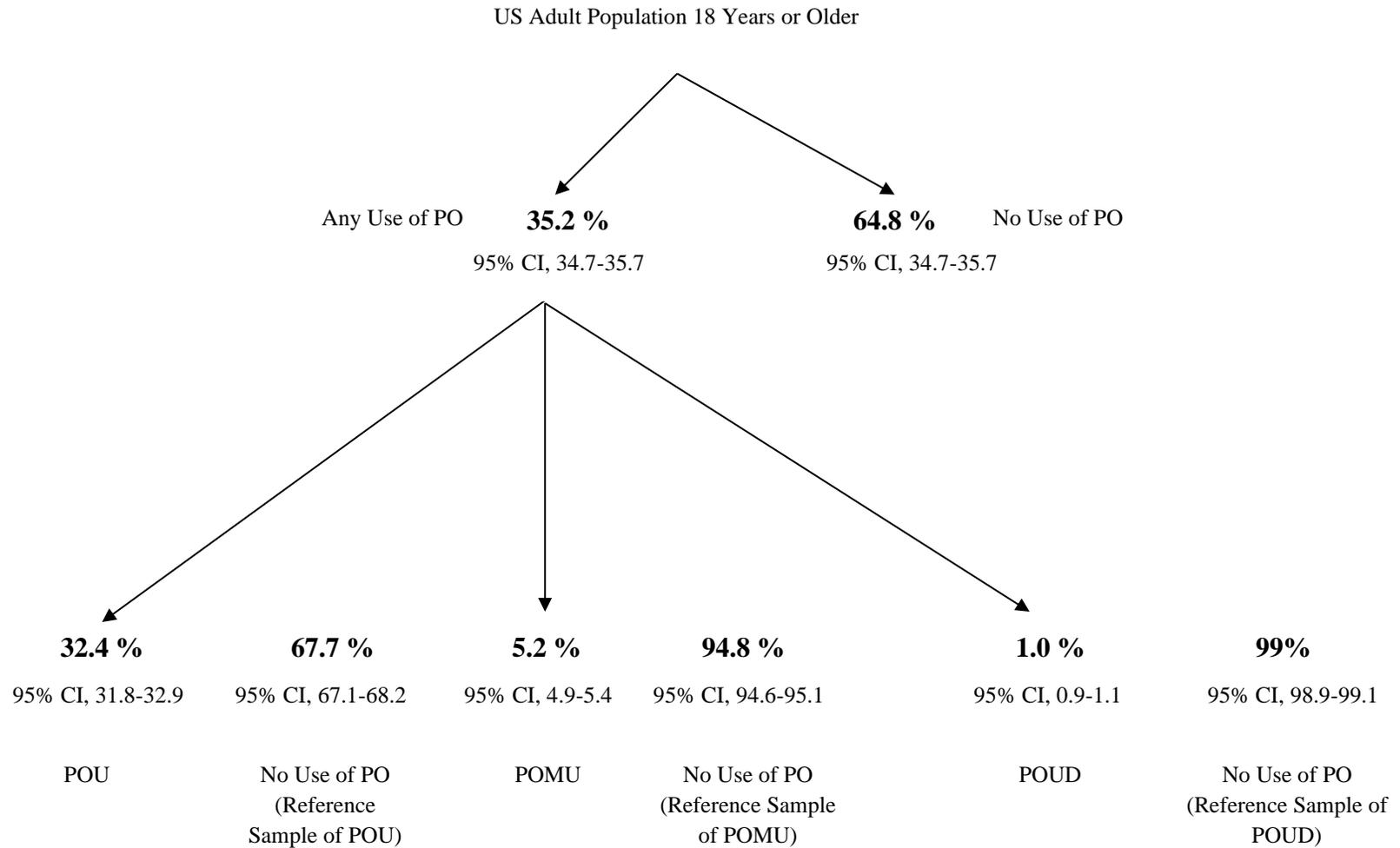
7.1 Descriptive Statistics: Description of the Variables of by NSDUH Survey US Adult Population

7.1.1 Outcome Variables: POU, POMU, and POUD of US Adult Population

Among the US adult population in 2016-2017, the prevalence of past year PO use irrespective of misuse was 35.2 percent (95% CI 34.7-35.7). The prevalence of past year POU was 32.4 percent (95% CI 31.8-32.9). The prevalence of past year POMU was 5.2 percent (95% CI 4.9-5.4) and the prevalence of past year POUD was 1.0 percent (95% CI 0.9-1.1) (Table 1.1).

The prevalence of POU, POMU, and POUD are shown in diagram 3.

Diagram 3 Prevalence of POU, POMU, and POUD



7.1.2 Socio-demographic Characteristics of US Adult Population

Most of the respondents are in the age group 50 or more with a percentage of 45.4 percent (95% CI 44.6-46.1). Females and males are almost equally distributed with a proportion of 51.8 percent (95% CI 51.3-52.2) vs 48.2 percent (95% CI 47.8-48.7) respectively. The ethnic majority are Non-Hispanic White who encompasses 64.2 percent (95% CI 63.5-64.9) of all ethnic diversity. Almost half of the respondents are full-time employee which is 49.7 percent (95% CI 49.1-50.3) of all US adults. The family income group 75,000 or more has the highest proportion of 38.0 percent (95% CI 37.1-38.8). More than half of the respondents have health expense covered by only private insurance which is 64.5 percent (95% CI 63.7-65.2). Around half of the respondents are married with a proportion of 51.9 percent (95% CI 51.2-52.6). An almost equal number of people had some college education and college degree: 31.1 percent (95% CI 30.5-31.7) vs 31.8 percent (95% CI 31-32.5). More than half of the respondents belong to large metropolitan areas which are 55.9 percent (95% CI 55.3-56.6) (Table1.1).

7.1.3 BMI of US Adult Population

An almost equal number of people have overweight and obesity: 32.9 percent (95% CI 32.4-33.3) vs 31.7 percent (95% CI 31.2-32.2), and these are higher than the proportion of people with normal weight (Table1.1).

7.1.4 Suicidal Behaviour in the US Adult Population

The prevalence of having one of the suicidal behavior criteria among suicidal thoughts, suicidal plans, and suicidal attempts is 4.2 percent (95% CI 4-4.4) (Table1.1).

Results: Descriptive Statistics

7.1.5 General Health Services Utilization in the US Adult Population

The prevalence of one emergency department visit in the past year is 14.5 percent (95% CI 14.1-14.9) and prevalence of more than one emergency department visit in the past year is 11.4 percent (95% CI 11.0-11.8). The prevalence of one overnight hospital stay in the past year is 2.5 percent (95% CI 2.4-2.7) and prevalence of more than one overnight hospital stay in the past year is 7.5 percent (95% CI 7.2-7.8). The prevalence of one outpatient department visit in the past year is 18.7 percent (95% CI 18.3-19.1) and prevalence of more than one outpatient department visit in the past year is 63.3 percent (95% CI 62.8-63.8) (Table 1.1).

7.1.5.1 Mental Health Services Use in the US Adult Population

The prevalence of one types of mental health service use in the past year is 14.5 percent (95% CI 14.2-14.8) (Table 1.1).

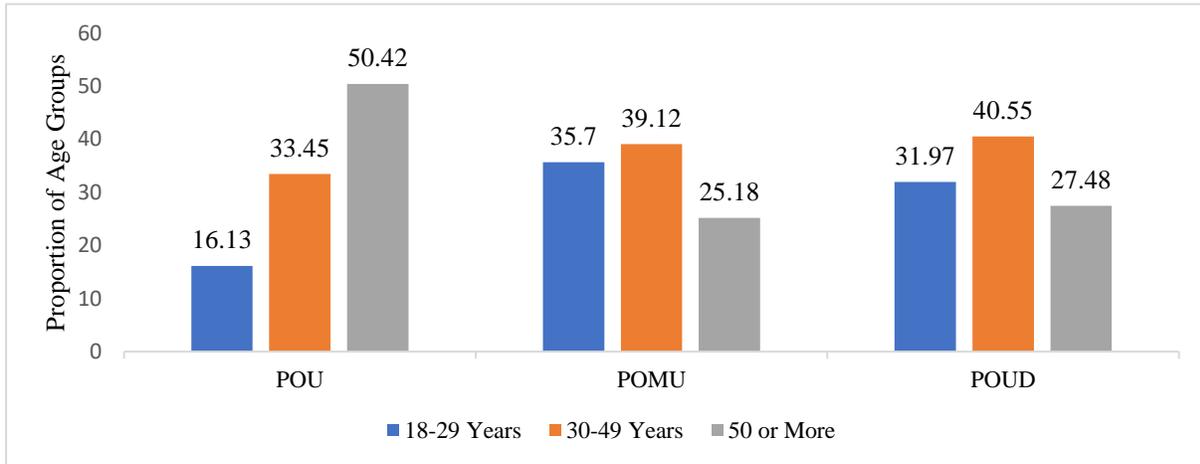
7.2 Descriptive Statistics: Description of Predictors by Three Outcome Variables: Past Year POU, Past Year POMU, and Past Year POUD

7.2.1 Socio-demographic Predictors by Three Outcome Variables: POU, POMU, and POUD

7.2.1.1 Age distribution in POU, POMU and POUD Samples

Half of the POU sample belongs to the age group 50 or more: 50.4 percent (95% CI 49.3-51.6). The biggest proportion of the POMU and POUD samples belong to age group 30-49 Years: 39.1 percent (95% CI 37-41.3) and 40.6 percent (95% CI 35.5-45.6) respectively (Table 1.2). Age distribution in 3 groups is shown in figure 1.5 (Table 1.2).

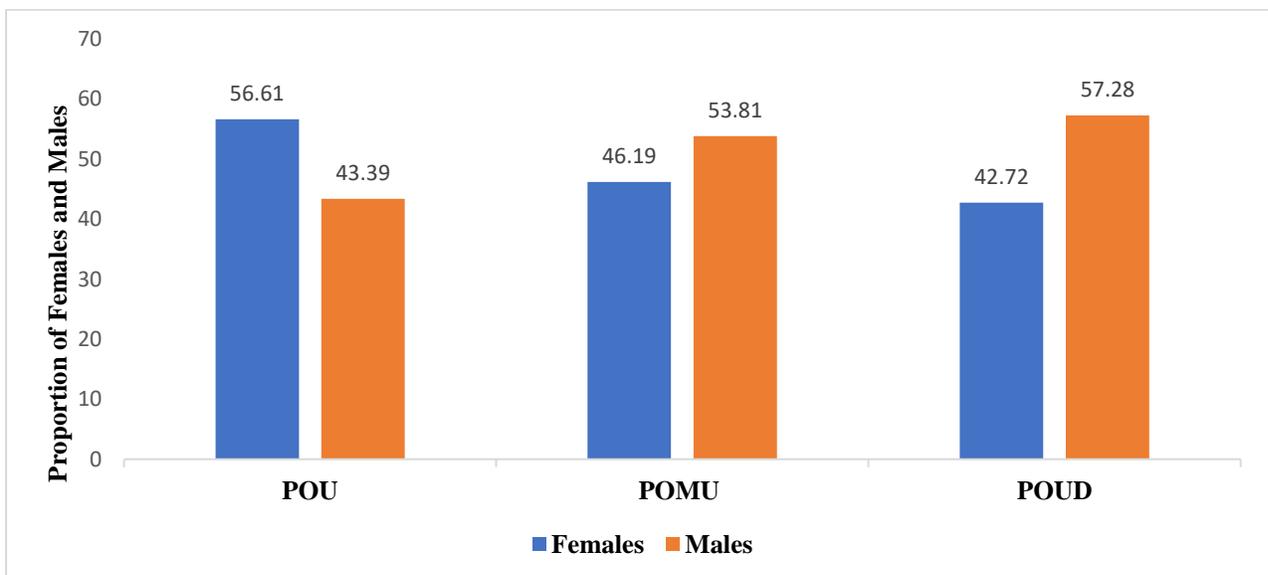
Figure 1. 5 Age Distribution in POU, POMU and POUD Samples



7.2.1.2 Sex distribution in POU, POMU and POUD Samples

Majority of the POU samples are females: 56.6 percent (95% CI 55.6-57.6). In POMU and POUD samples, majority respondents are males: 53.8 percent (95% CI 51.7-56) vs 57.3 percent (95% CI 51.3-63.3) (Table 1.2, Figure 1.6).

Figure 1. 6 Sex Distribution in POU, POMU and POUD Samples



7.2.1.3 The ethnic diversity in POU, POMU and POUD Samples

More than 67 percent of respondents in each sample (POU, POMU, and POUD) belongs to the non-Hispanic White group (Table 1.2).

7.2.1.4 Employment status in POU, POMU and POUD Samples

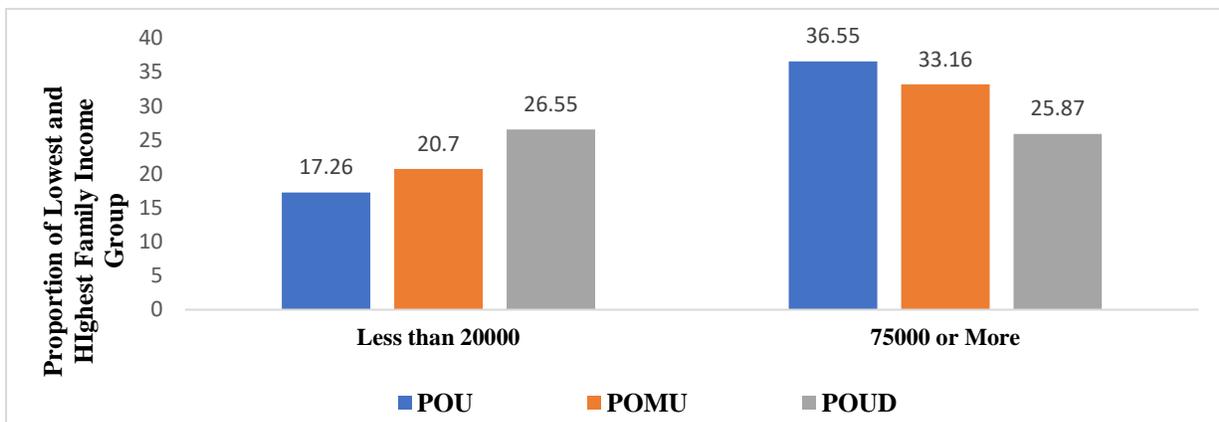
In the POU sample, an almost equal number of respondents belong to unemployed and full-time employment categories and these are more than 87% of that sample, and this is same in POUD sample too.

In the case of POMU, 54.6 percent (95% CI 52.5-56.6) belongs to full-time employment category and 30.6 percent (95% CI 28.4-32.8) belongs to the unemployed category (Table 1.2).

7.2.1.5 Family Income in POU, POMU and POUD Samples

Most of the POU, POMU, and POUD people have family income \$20,000 to 49,999 and \$75,000 or more (Table 1.2). The pattern in the prevalence of the lowest income and highest income in 3 groups are shown in figure 1.7 (Table 1.2). It shows that the prevalence of lowest income is highest in POUD sample and prevalence of highest income is highest in POU sample.

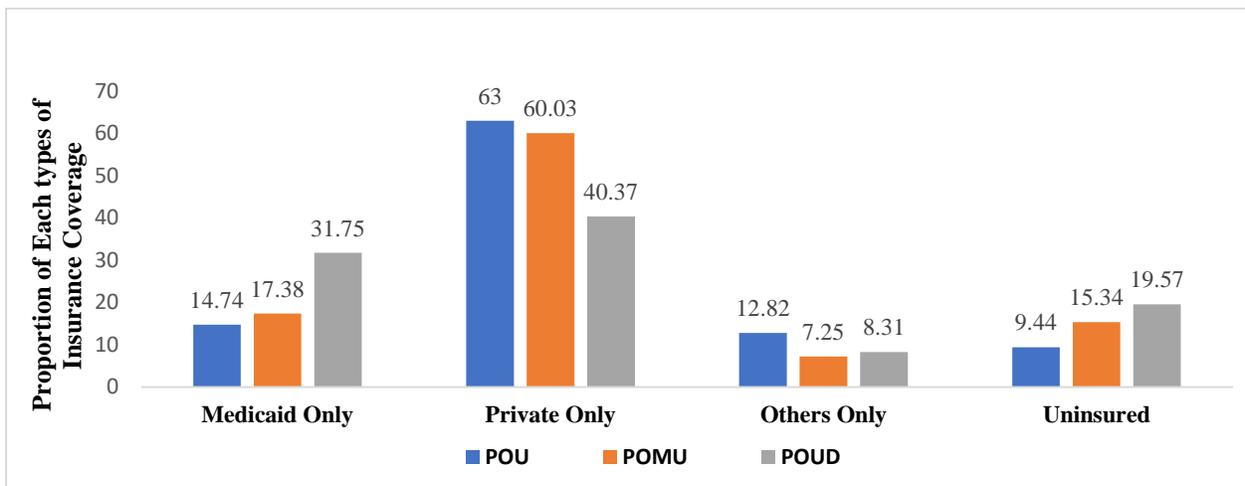
Figure 1. 7 Family Income in POU, POMU, and POUD Samples



7.2.1.6 Insurance Coverage of POU, POMU and POUD Samples

In POU and POMU samples, more than 60 percent are covered only by private insurance followed by only Medicaid coverage. In case of POUD, the proportion of only private insurance coverage and only Medicaid coverage are closer: 40.4 percent (95% CI 34.4-46.4) vs 31.8 percent (95% CI 26.5-37) (Table 1.2). The pattern of the prevalence of each type of insurance coverage in 3 groups is shown in figure 1.8 (Table 1.2).

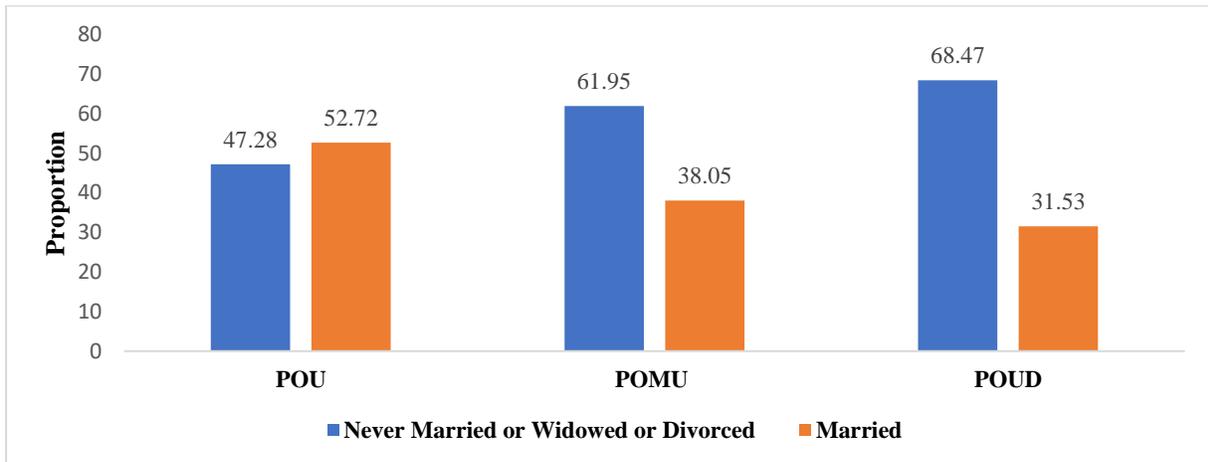
Figure 1. 8 Insurance Coverage in POU, POMU and POUD Samples



7.2.1.7 Marital Status in POU, POMU and POUD Samples

A greater percentage of people with POMU and POUD were not married compared with people with POU (Table 1.2, Figure 1.9).

Figure 1. 9 Marital Status in POU, POMU, and POUD Samples



7.2.1.8 Education status in POU, POMU and POUD Samples

In each of the three samples, around 35% has ‘some college’ education which is a higher proportion than other education categories (Table 1.2).

7.2.1.9 Metropolitan Statistical Areas distribution in POU, POMU and POUD Samples

In each of the three samples, more than 50% of people are from large metropolitan areas (Table 1.2).

7.2.2 BMI by Three Outcome Variables: POU, POMU, and POUD

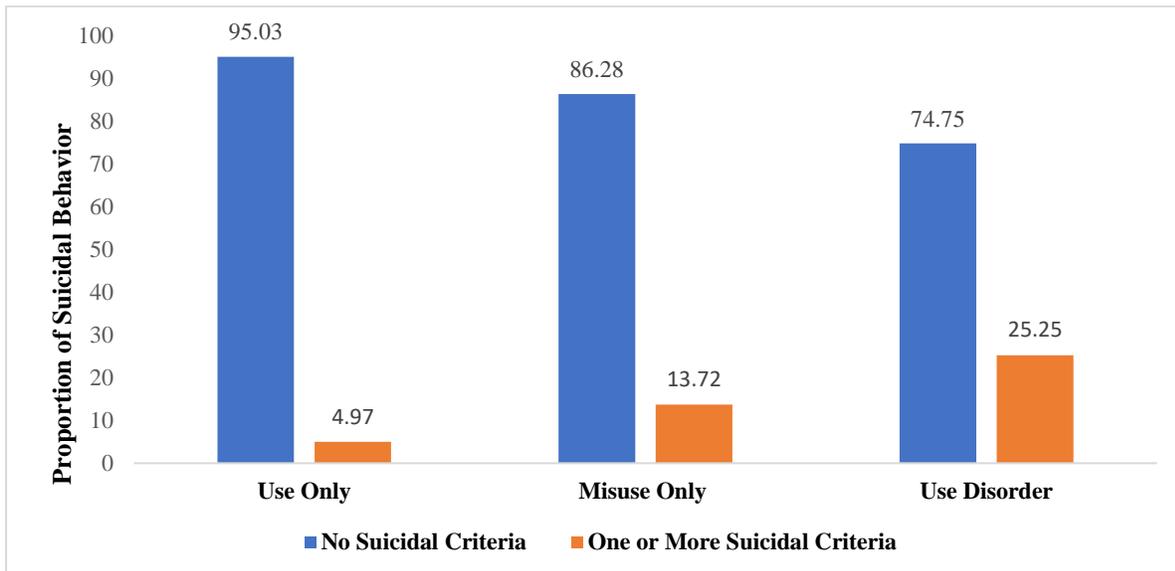
In the POU sample, the biggest proportion is obese category: 38.4 percent (95% CI 37.6-39.2). In POMU sample, equal proportion (around 32 percent) is normal BMI and overweight categories. Among those with POUD, the biggest proportion is normal BMI 36.3 percent (95% CI 30.3-42.2). Underweight is the least proportion (around 4 percent) in all three samples (Table 1.2).

7.2.3 Suicidal Behaviour by Three Outcome Variables: POU, POMU, and POUD

The prevalence of suicidal behaviour shows an increasing pattern from ‘POU’ < ‘POMU’ < ‘POUD’: 5.0 percent (95% CI 4.6-5.3) < 13.7 percent (95% CI 12.2-15.2) < 25.3 percent (95% CI 20.8-29.7) (Table 1.2, Figure 1.10).

The prevalence of suicidal behavior increased with the level of POU. It was lowest among people having POU (5.0%) and highest among those people having POUD.

Figure 1. 10 Suicidal Behaviour in POU, POMU and POUD Samples



7.2.4 General Health Services Use by Three Outcome Variables: POU, POMU, and POUD

7.2.4.1 Emergency Department Visit in POU, POMU and POUD Samples

The prevalence of ‘emergency department visit more than once’ is near double in POUD sample [33.4%, (CI 29.3-37.4)] than POU [18%, (CI 17.3-18.6)] and POMU [18%, (CI 16.3-19.5)] samples (Table 1.2, Figure 1.11).

7.2.4.2 Overnight Hospital Stay in POU, POMU and POUD Samples

The prevalence of overnight hospital stays more than once' is highest in POUD sample (18.5, 95% CI 14.5-22.5) and lowest in POMU sample (8.0, 95% CI 6.5-9.4) (Table 1.2, Figure 1.11).

7.2.4.3 Outpatient Department Visit in POU, POMU and POUD Samples

The prevalence of 'outpatient department visit more than once' is lower among people with POMU than those having POU and POUD (Table 1.2, Figure 1.11).

7.2.5 Mental Health Service Use by Three Outcome Variables: POU, POMU and POUD

The prevalence of Mental Health Service Utilization shows an increasing pattern from POU < POMU < POUD: 20.6 (95% CI 19.9-21.3) < 25.0 (95% CI 22.8-27.3) < 48.6 (95% CI 42.8-54.4) (Table 1.2, Figure 1.11).

Figure 1. 11 Health Services Utilization in POU, POMU and POUD samples

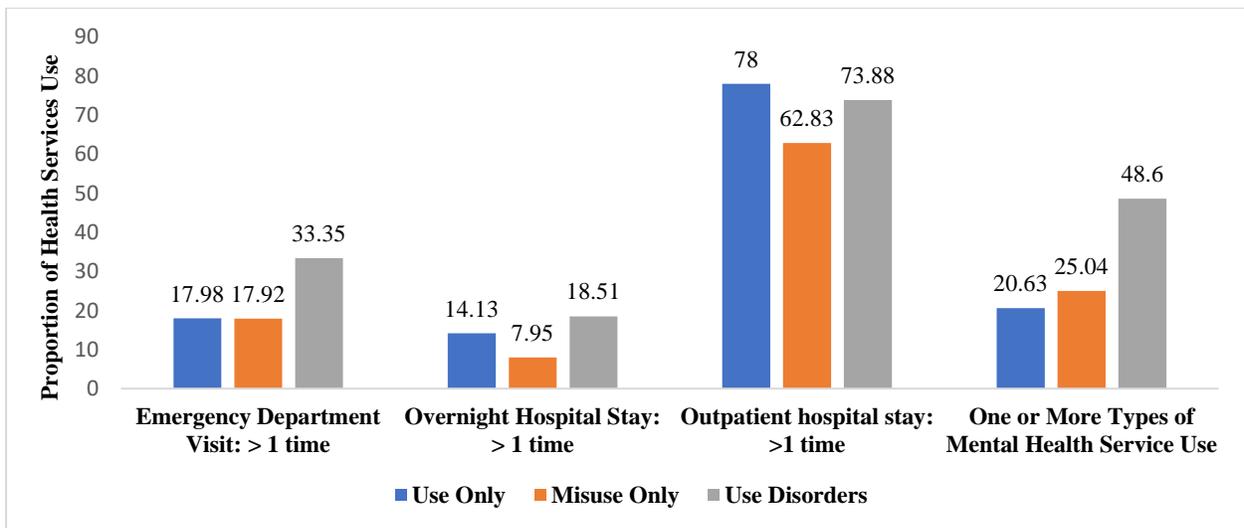


Table 1. 1 Descriptive Statistics: Description of the Variables of by NSDUH Survey US Adult Population

Variables	Percent (95% CI for Percent)
Study Sample	
PO Use without Misuse in the Past Year	32.4 (31.8-32.9)
PO Misuse without Use Disorder in the Past Year	5.2 (5.0-5.4)
PO Use Disorder in Past Year	1.0 (1.0-1.1)
Age	
18-29 Years	21.1 (20.7-21.6)
30-49 Years	33.5 (33.0-34.0)
50 or More	45.4 (44.6-46.1)
Sex	
Females	51.8 (51.3-52.2)
Males	48.2 (47.8-48.7)
Ethnicity	
Non-Hispanic White	64.2 (63.5-64.9)

Results: Descriptive Statistics

Non-Hispanic Black	11.8 (11.3-12.3)
Non-Hispanic Other	8.1 (7.8-8.4)
Hispanic	15.9 (15.3-16.4)
Employment	
Unemployed or Others	37.3 (36.7-37.9)
Part-Time	13.0 (12.7-13.4)
Full-Time	49.7 (49.1-50.3)
Annual Family Income	
Less than \$ 20,000	16.4 (15.9-17.0)
\$ 20,000 to \$ 49,999	29.7 (29.1-30.3)
\$ 50,000 to \$ 74,999	15.9 (15.5-16.4)
\$ 75,000 Or More	38 (37.1-38.8)
Insurance Coverage	
Medicaid Only	12.6 (12.2-13.0)
Private Only	64.5 (63.7-65.2)

Results: Descriptive Statistics

Others Only	11.2 (10.8-11.6)
Uninsured	11.7 (11.2-12.2)
Marital Status	
Never Married or Widowed or Divorced	48.1 (47.4-48.8)
Married	52 (51.2-52.6)
Education	
Less than high school	12.4 (11.9-12.9)
High School	24.8 (24.3-25.2)
Some College	31.1 (30.5-31.7)
College Graduate	31.8 (31.0-32.5)
Metropolitan Statistical Area	
Nonmetropolitan	14.5 (13.8-15.2)
Small	29.6 (28.9-30.3)
Large	55.9 (55.3-56.6)
BMI	

Results: Descriptive Statistics

Normal	30.6 (30.1-31.1)
Overweight	32.9 (32.4-33.3)
Underweight	4.9 (4.7-5.1)
Obese	31.7 (31.2-32.2)
Suicidal Behaviour	
No Suicidal Criteria	95.8 (95.6-96.0)
One or More Suicidal Criteria	4.2 (4.0-4.4)
General Health Services Use	
Emergency Department Visit	
No Visit	74.2 (73.6-74.7)
1 Visit	14.5 (14.1-14.9)
More than 1 Visit	11.4 (11.0-11.8)
Overnight Hospital Stay	
No Visit	89.9 (89.6-90.3)
1 Visit	2.5 (2.4-2.7)

Results: Descriptive Statistics

More than 1 Visit	7.5 (7.2-7.8)
Outpatient Department Visit	
No Visit	18.0 (17.6-18.4)
1 Visit	18.7 (18.3-19.1)
More than 1 Visit	63.3 (62.8-63.8)
Mental Health Services Use	
No Mental Health Service Use	85.5 (85.2-85.9)
One or More Types of Mental Health Service Use	14.5 (14.2-14.8)

Table 1. 2 Descriptive Statistics: Description of Predictors by POU, POMU, and POUD

	POU	POMU	POUD
Variables	Row Percent (95% CI)	Row Percent (95% CI)	Row Percent (95% CI)
Age			
18-29 Years	16.1 (15.6-16.7)	35.7 (33.8-37.6)	32.0 (27.5-36.4)
30-49 Years	33.5 (2.6-34.3)	39.1 (37.0-41.3)	40.6 (35.5-45.6)
50 or More	50.4 (49.26-51.59)	25.2 (22.7-27.7)	27.5 (21.3-33.6)
Sex			
Females	56.6 (55.62-57.60)	46.2 (44.1-48.3)	42.7 (36.7-48.7)
Males	43.4 (42.40-44.38)	53.8 (51.7-56.0)	57.3 (51.3-63.3)
Ethnicity			
Non-Hispanic White	68.3 (67.33-69.29)	67.2 (64.5-69.9)	76.3 (71.9-80.7)
Non-Hispanic Black	12.5 (11.7-13.3)	10.0 (8.8-11.2)	10.9 (7.4-14.5)
Non-Hispanic Other	6.5 (6.1-7.0)	6.1 (4.8-7.3)	5.2 (3.4-7.0)

Results: Descriptive Statistics

Hispanic	12.7 (12.1-13.3)	16.7 (14.8-18.7)	7.5 (5.0-10.1)
Employment			
Unemployed or Others	42.1 (41.0-43.1)	30.6 (28.4-32.8)	45.0 (39.8-50.3)
Part-Time	12.0 (11.5-12.5)	14.9 (13.4-16.3)	11.2 (7.9-14.6)
Full-Time	45.9 (45.0-46.9)	54.6 (52.5-56.6)	43.7 (38.3-49.2)
Annual Family Income			
Less than \$ 20,000	17.3 (16.4-18.1)	20.7 (18.8-22.6)	26.6 (21.3-31.8)
\$ 20,000 to \$ 49,999	30.3 (29.5-31.2)	29.6 (27.4-31.8)	32.4 (28.1-36.7)
\$ 50,000 to \$ 74,999	15.9 (15.2-16.5)	16.6 (14.6-18.5)	15.2 (11.4-119.0)
\$ 75,000 or More	36.6 (35.4-37.7)	33.2 (31.0-35.3)	25.9 (20.3-31.5)
Insurance Coverage			
Medicaid Only	14.7 (14.1-15.4)	17.4 (15.7-19.1)	31.8 (26.5-37.0)
Private Only	63.0 (61.9-64.1)	60.0 (57.5-62.6)	40.4 (34.4-46.4)
Others Only	12.8 (12.1-13.5)	7.3 (5.9-8.6)	8.3 (5.4-11.2)
Uninsured	9.4 (8.9-10.0)	15.3 (13.4-17.2)	19.6 (14.9-24.3)

Results: Descriptive Statistics

Marital Status			
Never Married or Widowed or Divorced	47.3 (46.2-48.3)	62 (59.4-64.5)	68.5 (62.4-74.6)
Married	52.7 (51.7-53.8)	38.1 (35.5-40.6)	31.5 (25.5-37.6)
Education			
Less than high school	11.3 (10.8-11.9)	12.0 (10.1-13.9)	16.6 (12.8-20.4)
High School	25.1 (24.3-26.0)	25.2 (23.2-27.2)	28.8 (23.9-33.7)
Some College	34.5 (33.5-35.4)	36.6 (34.7-38.4)	37.2 (31.9-42.5)
College Graduate	29.1 (28.0-30.1)	26.2 (23.5-28.9)	17.4 (13.2-21.6)
Metropolitan Statistical Area			
Nonmetropolitan	15.8 (14.9-16.6)	13.2 (11.8-14.6)	17.0 (13.6-20.4)
Small	31.3 (30.2-32.4)	30.4 (28.6-32.3)	31.5 (26.6-36.4)
Large	52.9 (51.9-53.9)	56.4 (54.2-58.5)	51.5 (46.0-56.9)
BMI			
Normal	25.5 (24.7-26.4)	32.6 (30.2-35.1)	36.3 (30.3-42.2)
Overweight	32.1 (31.1-33.0)	32.1 (29.9-34.3)	27.2 (22.6-31.9)

Results: Descriptive Statistics

Underweight	4.1 (3.7-4.5)	4.5 (3.3-5.7)	3.8 (1.9-5.7)
Obese	38.4 (37.6-39.2)	30.8 (28.8-32.8)	32.7 (28.3-37.2)
Suicidal Behaviour			
No Suicidal Criteria	95.0 (94.7-95.4)	86.3 (84.8-87.8)	74.8 (70.3-79.2)
One or More Suicidal Criteria	5.0 (4.6-5.3)	13.7 (12.2-15.2)	25.3 (20.8-29.7)
General Health Services Utilization			
Emergency Department Visit			
No Visit	60.6 (59.6-61.7)	65.7 (63.6-67.8)	46.5 (41.6-51.3)
1 Visit	21.4 (20.5-22.3)	16.4 (14.7-18.1)	20.2 (15.7-24.6)
More than 1 Visit	18.0 (17.3-18.6)	17.9 (16.3-19.5)	33.4 (29.3-37.4)
Overnight Hospital Stay			
No Visit	81.8 (81.1-82.4)	88.9 (87.2-90.6)	77.7 (73.5-81.9)
1 Visit	4.1 (3.8-4.5)	3.1 (2.2-4.0)	3.8 (2.2-5.4)
More than 1 Visit	14.1 (13.4-14.8)	8.0 (6.5-9.4)	18.5 (14.5-22.5)
Outpatient Department Visit			

Results: Descriptive Statistics

No Visit	8.7 (8.3-9.2)	19.5 (17.5-21.4)	16.0 (12.7-19.3)
1 Visit	13.3 (12.7-13.9)	17.7 (15.9-19.5)	10.1 (7.1-13.1)
More than 1 Visit	78.0 (77.2-78.8)	62.8 (60.5-65.2)	73.9 (69.7-78.1)
Mental Health Services Use			
No Mental Health Service Use	79.4 (78.7-80.1)	75.0 (72.7-77.2)	51.4 (45.7-57.2)
One or More Types of Mental Health Service Use	20.6 (19.9-21.3)	25.0 (22.8-27.3)	48.6 (42.8-54.4)

Results: Regression Analysis

7.3 Regression Analysis

The regression analysis has 10 steps as follows:

Step 1: Univariate regression analysis of all predictors with outcome variable past year POU.

Step 2: Multivariable regression analysis considering socio-demographic predictors and outcome variable past year POU.

Step 3: Variables of step 2 as before and BMI added as a predictor, which is Model 1.

Step 4: Variables of step 2 as before and suicidal behavior added as a predictor, which is Model 2.

Step 5: Variable of step 2 as before and emergency department visit added as a predictor, which is Model 3.

Step 6: Variables of step 2 as before and an overnight hospital stay added as a predictor, which is Model 4.

Step 7: Variables of step 2 as before and outpatient department visit added as a predictor, which is Model 5.

Step 8: Variables of step 2 as before and mental health services use added as a predictor, which is Model 6.

Step 9: All variables from step 2 to step 8 in one model with past year POU as an outcome variable, which is Model 7.

Results: Regression Analysis

Step 10: Step 1 to step 9 are repeated considering past year POMU as an outcome variable. Then again step 1 to step 9 are repeated considering past year POUD as an outcome variable.

ORs of the multivariable regression analysis models were examined. The ORs > 1 indicates a higher likelihood of association of predictors with the outcome variable and ORs < 1 indicates a lower likelihood of association of predictors with the outcome variable. If OR contains 1, it indicates that the finding is not significant.

7.3.1 Objective 1: Association of Socio-demographic Factors with Past Year POU, Past Year POMU and Past Year POUD in US Adult Population: Regression Analysis

7.3.1.1 Association of socio-demographic factors with POU

7.3.1.1.1 Association of Age with POU

In univariate analysis, age group '50 or more' and 30 to 49 years have higher odds of POU [OR 1.60, CI (1.51-1.70); OR 1.42, CI (1.35-1.49)] as compared to age group '18 to 29 years'. When adjusted for other socio-demographic factors, the OR's are still significant [OR 1.50, CI (1.39-1.62); OR 1.50, CI (1.43-1.57)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the OR's are still significant [OR 1.37, CI (1.26-1.49); OR 1.44, CI (1.37-1.52)] (Table 1.5, Model 7).

7.3.1.1.2 Association of sex with POU

In univariate analysis, males have lower odds of POU [OR 0.76, CI (0.73-0.80)] than females. When adjusted for other socio-demographic factors, the OR is still significant [OR 0.77, CI (0.73-0.82)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic

Results: Regression Analysis

variables, BMI, suicidal behavior, general health services use and mental health services use), the OR is still significant [OR 0.92, CI (0.87-0.98)] (Table 1.5, Model 7).

7.3.1.1.3 Association of Ethnicity with POU

In univariate analysis, Non-Hispanic Whites and Non-Hispanic Blacks have higher odds of POU [OR 1.51, CI (1.42-1.61); OR 1.48, CI (1.34-1.63)] as compared to Hispanics. When adjusted for other socio-demographic factors, the OR's are still significant [OR 1.48, CI (1.39-1.58); OR 1.38, CI (1.26-1.52)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the OR's are still significant [OR 1.33, CI (1.25-1.42); OR 1.21, CI (1.09-1.33)] (Table 1.5, Model 7).

7.3.1.1.4 Association of Employment with POU

In univariate analysis, Unemployed people have higher odds of POU [OR 1.33, CI (1.27-1.40)] as compared to full-time employment. When adjusted for other socio-demographic factors, this OR is still significant [OR 1.16, CI (1.09-1.24)] and the part-time employment holders have lower odds of POU [OR 0.91, CI (0.85-0.97)] when compared with full-time employment (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), only the part-time employment having lower odds of POU remains significant [OR 0.90, CI (0.84-0.97)] as compared to full-time employment (Table 1.5, Model 7).

7.3.1.1.5 Association of Annual Family Income with POU

In univariate analysis, people with family income less than \$ 20,000 and family income \$ 20,000 to \$ 49,999 have higher odds of POU [OR 1.18, CI (1.1-1.26); OR 1.10, CI (1.05-1.16)] as

Results: Regression Analysis

compared to people with a family income of \$ 75,000 or more. But when adjusted for other socio-demographic factors the odds ratios are no longer significant (Table 1.3). Again when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the OR's are still not significant (Table 1.5, Model 7).

7.3.1.1.6 Association of Insurance Coverage with POU

In univariate analysis, people who are uninsured, have only private insurance coverage and have any other types of health insurance coverage had lower odds of POU [OR 0.58, CI (0.53-0.64); OR 0.73, CI (0.69-0.77); OR 0.90, CI (0.82-0.99)] as compared to those who have only Medicaid Insurance coverage. When adjusted for other socio-demographic factors, the OR's are still significant [OR 0.62, CI (0.57-0.68); OR 0.73, CI (0.68-0.78); OR 0.80, CI (0.73-0.87)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the OR's are still significant [OR 0.88, CI (0.79-0.98); OR 0.87, CI (0.80-0.94); OR 0.83, CI (0.75-0.92)] (Table 1.5, Model 7).

7.3.1.1.7 Association of Marital Status with POU

In univariate analysis, marital status has no association with POU. When adjusted for other socio-demographic factors, it still has no association with POU (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), it is still not associated with POU (Table 1.5, Model 7).

Results: Regression Analysis

7.3.1.1.8 Association of Education with POU

In univariate analysis, some college education and high school education have higher odds of POU [OR 1.35, CI (1.24-1.47); OR 1.17, CI (1.07-1.27)] as compared to those who have less than high school education. When adjusted for other socio-demographic factors, the OR's are still significant [OR 1.46, CI (1.34-1.58); OR 1.21, CI (1.10-1.33)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the OR's are still significant [OR 1.41, CI (1.28-1.54); OR 1.23, CI (1.12-1.35)] (Table 1.5, Model 7).

7.3.1.1.9 Association of Metropolitan Statistical Area with POU

In univariate analysis, people living in small metropolitan areas and non-metropolitan areas have higher odds of POU [OR 1.18, CI (1.11-1.25); OR 1.23, CI (1.17-1.3)] than people living large metropolitan areas. But when adjusted for other socio-demographic factors, only the people living in small metropolitan areas have higher odds of POU [OR 1.08, CI (1.02-1.14)] as compared to large metropolitan areas (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the metropolitan statistical area has no association with POU (Table 1.5, Model 7).

7.3.1.2 Association of socio-demographic factors with POMU

7.3.1.2.1 Association of Age with POMU

In univariate analysis, age group '50 or more' and 30 to 49 years have lower odds of POMU [OR 0.36, CI (0.32-0.42); OR 0.75, CI (0.69-0.82)] as compared to age group '18 to 29 years'. When adjusted for other socio-demographic factors, the OR's are still significant [OR 0.52, CI (0.44-

Results: Regression Analysis

0.61); OR 0.90, CI (0.82-0.99)] (Table 1.3). But, when adjusted for all other variables, (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), only the people with 50 years or older have lower odds of the POMU [OR 0.54, CI (0.45-0.64)] (Table 1.7, Model 7) as compared to those with 18 to 29 years.

7.3.1.2.2 Association of sex with POMU

In univariate analysis, males have higher odds of POMU [OR 1.16, CI (1.06-1.27)] than females. When adjusted for other socio-demographic factors, the OR is still the same [OR 1.16, CI (1.06-1.27)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the OR is still significant [OR 1.31, CI (1.19-1.46)] (Table 1.7, Model 7).

7.3.1.2.3 Association of Ethnicity with POMU

In univariate analysis, only the Non-Hispanic Others have lower odds of POMU [OR 0.70, CI (0.57-0.87)] as compared to Hispanics. When adjusted for other socio-demographic factors, non-Hispanic others still have lower odds of POMU [OR 0.76, CI (0.61-0.95) and Non-Hispanic Whites have higher odds of POMU [OR 1.62, CI (1.37-1.93) than Hispanics (Table 1.3) which are still significant [OR 0.75, CI (0.60-0.95); OR 1.42, CI (1.19-1.68)] when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use) (Table 1.7, Model 7).

7.3.1.2.4 Association of Employment with POMU

In univariate analysis, unemployed people have lower odds of POMU [OR 0.82, CI (0.73-0.91)] as compared to full-time employment. When adjusted for other socio-demographic factors, employment status is no longer associated with POMU (Table 1.3). Similarly, when adjusted for

Results: Regression Analysis

all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), employment status is not associated with POMU (Table 1.7, Model 7).

7.3.1.2.5 Association of Annual Family Income with POMU

In univariate analysis, people with annual family income less than 20,000; 20,000 to 49,999 and 50,000 to 74,999 have higher odds of POMU [OR 1.55, CI (1.37-1.76); OR 1.19, CI (1.05-1.34); OR 1.22, CI (1.03-1.44)] as compared to people with annual family income of 75,000 or more.

When adjusted for other socio-demographic factors the odds ratios are no longer significant (Table 1.3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use, and mental health services use), the OR's are still not significant (Table 1.7, Model 7).

7.3.1.2.6 Association of Insurance Coverage with POMU

In univariate analysis, people who are uninsured, have only private insurance coverage and have any other types of health insurance coverage had lower odds of POMU [OR 0.80, CI (0.68-0.94); OR 0.59, CI (0.52-0.67); OR 0.43, CI (0.34-0.55)] as compared to those who have only Medicaid Insurance coverage. When adjusted for other socio-demographic factors, the OR's are still significant [OR 0.80, CI (0.67-0.96); OR 0.64, CI (0.56-0.75); OR 0.56, CI (0.44-0.72)] (Table 1.3). But when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use, and mental health services use), those who are uninsured are no longer associated with POMU (Table 1.7, Model 7).

Results: Regression Analysis

7.3.1.2.7 Association of Marital Status with POMU

In univariate analysis, people who are never married or widowed or divorced have higher odds of POMU [OR 1.8, CI (1.61-2.01)] as compared to those who are married. When adjusted for other socio-demographic factors, it still significant [OR 1.40, CI (1.23-1.59)] (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), it is still significant [OR 1.27, CI (1.11-1.45)] (Table 1.7, Model 7).

7.3.1.2.8 Association of Education with POMU

In univariate analysis, some college education has higher odds of POMU [OR 1.35, CI (1.14-1.61)] as compared to those who have less than high school education. When adjusted for other socio-demographic factors, the OR's are still significant [OR 1.31, CI (1.06-1.62)] (Table 1.3). But when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), education is no longer associated with POMU (Table 1.7, Model 7).

7.3.1.2.9 Association of Metropolitan Statistical Area with POMU

In univariate analysis, metropolitan statistical areas have no association with POMU. But when adjusted for other socio-demographic factors, people living in non-metropolitan areas have lower odds of POMU [OR 0.86, CI (0.75-0.98)] as compared to large metropolitan areas (Table 1.3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the odds ratio is still significant [OR 0.86, CI (0.75-0.99)] (Table 1.7, Model 7).

7.3.1.3 Association of socio-demographic factors with POUD

7.3.1.3.1 Association of Age with POUD

In univariate analysis, age group '50 or more' has lower odds of POUD [OR 0.44, CI (0.32-0.61)] as compared to age group '18 to 29 years'. But when adjusted for other socio-demographic factors, age is no longer associated with POUD (Table 1.3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), age is still not associated with POUD (Table 1.7, Model 7).

7.3.1.3.2 Association of sex with POUD

In univariate analysis, males have higher odds of POUD [OR 1.34, CI (1.04-1.71)] than females. But when adjusted for other socio-demographic factors, sex is no longer associated with POUD (Table 1.3). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the findings are similar as univariate analysis [OR 1.66, CI (1.24-2.22)] (Table 1.7, Model 7).

7.3.1.3.3 Association of Ethnicity with POUD

In univariate analysis, only the Non-Hispanic Whites and Non-Hispanic Blacks have higher odds of POUD [OR 2.84, CI (1.97-4.09); OR 2.18, CI (1.35-3.53)] as compared to Hispanics. But when adjusted for other socio-demographic factors, all ethnic groups Non-Hispanic Whites, Non-Hispanic Blacks and non-Hispanic others have higher odds of POUD [OR 5.52, CI (3.60-8.47); OR 2.21, CI (1.27-3.87); OR 1.98, CI (1.13-3.44)] as compared to Hispanics (Table 1.3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), all ethnic groups Non-

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Hispanic Whites, Non-Hispanic Blacks and non-Hispanic others have higher odds of POUD [OR 3.68, CI (2.34-5.78); OR 1.88, CI (1.04-3.41); OR 1.85, CI (1.04-3.29)] as compared to Hispanics (Table 1.7, Model 7).

7.3.1.3.4 Association of Employment with POUD

In univariate analysis, Unemployed people have lower odds of POUD [OR 1.5, CI (1.2-1.88)] as compared to full-time employment. Similarly, when adjusted for other socio-demographic factors, the OR is still significant [OR 1.48, CI (1.16-1.89)] (Table 1.3). But when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), only who have part-time employment have lower odds of POUD as compared to full-time employment [OR 0.65, CI (0.43-0.99)] (Table 1.7, Model 7).

7.3.1.3.5 Association of Annual Family Income with POUD

In univariate analysis, people with annual family income less than \$ 20,000 has higher odds of POUD [OR 1.54, CI (1.17- 2.20)] and people with annual family income \$ 50,000 to \$ 74,999 have lower odds of POUD [OR 0.60, CI (0.44-0.82)] as compared to people with annual family income of 75,000 or more. But when adjusted for other socio-demographic factors, annual family income is no longer associated with POUD (Table 1.3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use, and mental health services use), annual family income is still not a significant predictor of POUD (Table 1.7, Model 7).

7.3.1.3.6 Association of Insurance Coverage with POUD

In univariate analysis, people who are uninsured, have only private insurance coverage and have any other types of health insurance coverage had lower odds of POUD [OR 0.56, CI (0.41-0.77);

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OR 0.22, CI (0.17-0.29); OR 0.27, CI (0.18-0.42)] as compared to those who have only Medicaid Insurance coverage. When adjusted for other socio-demographic factors, the OR's are still significant [OR 0.59, CI (0.43-0.81); OR 0.23, CI (0.18-0.30); OR 0.26, CI (0.17-0.41)] (Table 1.3). But when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use, and mental health services use), those who are uninsured are no longer associated with POUD (Table 1.7, Model 7).

7.3.1.3.7 Association of Marital Status with POUD

In univariate analysis, people who are never married or widowed or divorced have higher odds of POUD [OR 2.4, CI (1.82-3.17)] as compared to those who are married. Similarly, when adjusted for other socio-demographic factors, it still significant [OR 1.77, CI (1.29-1.42)] (Table 1.3). But when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), marital status is no longer associated with POUD (Table 1.7, Model 7).

7.3.1.3.8 Association of Education with POUD

In univariate analysis, those who are college graduate have lower odds of POUD [OR 0.41, CI (0.28-0.58)] as compared to those who have less than high school education. Similarly, when adjusted for other socio-demographic factors, the OR is still significant [OR 0.65, CI (0.44-0.97)] (Table 1.3). Again when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), the association of education with POUD is still significant [OR 0.64, (0.41-0.99)] (Table 1.7, Model 7).

Results: Regression Analysis

7.3.1.3.9 Association of Metropolitan Statistical Area with POUD

In univariate analysis, people living in non-metropolitan statistical areas have higher POUD [OR 1.37, CI (1.06-1.78)] as compared to large metropolitan areas. But when adjusted for other socio-demographic factors, the metropolitan area is no longer a significant predictor of POUD (Table 1.3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), metropolitan areas have no association with POUD (Table 1.7, Model 7).

7.3.1.4 Summary of findings of Objective 1

7.3.1.4.1 Association of age with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), age 50 or older and age 30-49 years have higher risk of POU [OR 1.37, 95% CI (1.26-1.49); OR 1.44, CI (1.37-1.52)] and age 50 or older has lower risk of POMU [OR 0.54, CI (0.45-0.64)] as compared to 18 to 29 years old individuals. Age has no association with POUD.

7.3.1.4.2 Association of sex with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), males have lower risk of POU [OR 0.92, CI (0.87 -0.98)] and higher risk of POMU [OR: 1.31, CI (1.19-1.46)] and POUD [OR 1.66, CI (1.24-2.22)] when compared with females.

7.3.1.4.3 Association of ethnicity with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), Non-Hispanic Whites have higher

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risk of POU [OR 1.33, CI (1.25-1.42)], POMU [OR 1.42, CI (1.19-1.68)] and POUD [OR 3.68, CI (2.34-5.78)]; Non-Hispanic Blacks higher risk of POU [OR 1.21, CI (1.09-1.33)] and POUD [OR 1.85, CI (1.04-3.29)]; and Non-Hispanic others have lower risk of POMU [OR 0.75, CI (0.60-0.95)] and higher risk of POUD [OR 1.88, CI (1.04-3.41)] when compared with Hispanics.

7.3.1.4.4 Association of employment with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), part-time employment has a lower risk of POU [OR 0.90, CI (0.84-0.97)] and POUD [OR 0.65, CI (0.43-0.99)] when compared with Full-time employment. There is no association of employment with POMU.

7.3.1.4.5 Association of annual family income with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), family income has no association with POU, POMU, and POUD.

7.3.1.4.6 Association of insurance with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), those who are uninsured, have only private insurance coverage and have any other types of insurance coverage have a lower risk of POU as compared to those who have only Medicaid coverage.

Those who have only private insurance coverage and have any other types of insurance coverage have a lower risk of POMU and POUD as compared to those who have only Medicaid coverage.

Results: Regression Analysis

7.3.1.4.7 Association of marital status with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), those who are unmarried or widowed or separated have a higher risk of POMU [OR 1.27, CI (1.11-1.45)] as compared to married individuals. Marital Status has no association with POU and POUD.

7.3.1.4.8 Association of education with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), some college graduate and High school education has higher association with POU [OR 1.41, CI (1.28-1.54); OR 1.23, CI (1.12-1.35)] as compared to less than high school. College graduates have a lower risk of POUD [OR 0.64, CI (0.41-0.99)] as compared to those with less than high school education. Education has no association with POMU.

7.3.1.4.9 Association of metropolitan statistical areas with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, general health services use and mental health services use), small metropolitan areas have a higher association with POU [OR 1.05, CI (1.00-1.12)] as compared to large metropolitan areas. Non-metropolitan areas have a lower risk of POMU [OR 0.86, CI (0.75-0.99)] when compared with large metropolitan areas. Metropolitan statistical areas have no association with POUD.

7.3.2 Objective 2: Association of BMI with POU, POMU, and POUD in US Adult

Population: Regression Analysis

7.3.2.1 Association of BMI with POU

In univariate analysis, people with obesity and overweight have higher odds of POU [OR 1.24, CI (1.17-1.31); OR 1.73, CI (1.64-1.83)] as compared to normal weight (Table 1.4, Model 1). Similarly, when adjusted for socio-demographic predictors the ORs are still significant [OR 1.22, CI (1.13-1.31); OR 1.63, CI (1.54-1.72)] (Table 1.5, Model 1). Similarly, when adjusted for all other variables (socio-demographic variables, suicidal behavior, general health services use and mental health services use), the ORs are still significant [OR 1.18, CI (1.10-1.27); OR 1.45, CI (1.37-1.53)] (Table 1.5, Model 7).

7.3.2.2 Association of BMI with POMU

There is no association of BMI with POMU in univariate analysis (Table 1.6, Model 1), in multivariable regression analysis adjusted for socio-demographic factors (Table 1.7, Model 1) and in multivariable regression analysis adjusted for all other variables (socio-demographic variables, suicidal behavior, general health services use and mental health services use) (Table 1.7, Model 7).

7.3.2.3 Association of BMI with POUD

There is no association of BMI with POUD in univariate analysis (Table 1.6, Model 1), in multivariable regression analysis adjusted for socio-demographic factors (Table 1.7, Model 1) and in multivariable regression analysis adjusted for all other variables (socio-demographic variables, suicidal behavior, general health services use and mental health services use) (Table 1.7, Model 7).

7.3.3 Summary Findings of Objective 2

When adjusted for all other variables (socio-demographic variables, suicidal behavior, general health services use and mental health services use), obesity and overweight are significantly associated with POU. There is no association between obesity and overweight with POMU and POUD.

7.3.4 Objective 3: Association of Suicidal Behaviour with POU, POMU, and POUD in US Adult Population: Regression Analysis

7.3.4.1 Association of Suicidal Behaviour with POU

In univariate analysis, people with one or more suicidal behavior have higher odds of POU [OR 1.63, CI (1.5-1.77)] as compared to those who did not have any suicidal behavior in the past year (Table 1.4, Model 2). Similarly, when adjusted for socio-demographic predictors the OR is still significant [OR 1.68, CI (1.54-1.83)] (Table 1.5, Model 2). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, general health services use and mental health services use), the OR is still significant [OR 1.25, CI (1.12-1.39)] (Table 1.5, Model 7).

7.3.4.2 Association of Suicidal Behaviour with POMU

In univariate analysis, people with one or more suicidal behavior have higher odds of POMU [OR 4.95, CI (4.25-5.77)] as compared to those who did not have any suicidal behavior in the past year (Table 1.6, Model 2). Similarly, when adjusted for socio-demographic predictors, the OR is still significant [OR 3.44, CI (3.00-3.94)] (Table 1.7, Model 2). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, general health services use and mental health services use), the OR is still significant [OR 2.58, CI (2.21-3.02)] (Table 1.7, Model 7).

Results: Regression Analysis

7.3.4.3 Association of Suicidal Behaviour with POU

In univariate analysis, people with one or more suicidal behavior have higher odds of POU [OR 10.52, CI (8.2-13.5)] as compared to those who did not have any suicidal behavior in the past year (Table 1.8, Model 2). Similarly, when adjusted for socio-demographic predictors, the OR is still significant [OR 6.61, CI (4.88-8.96)] (Table 1.9, Model 2). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, general health services use and mental health services use), the OR is still significant [OR 3.37, CI (2.39-4.75)] (Table 1.9, Model 7).

7.3.5 Summary of Findings of Objective 3

When adjusted for all other variables (socio-demographic variables, BMI, general health services use and mental health services use), suicidal behavior is significantly associated with POU, POMU, and POU.

7.3.6 Objective 4: Association of General Health Services Use with POU, POMU, and POU in US Adult Population: Regression Analysis

7.3.6.1 Association of Emergency Department Visit with POU, POMU, and POU

7.3.6.1.1 Association of Emergency Department Visit with POU

In univariate analysis, one emergency department visit and more than 1 emergency department visit have higher odds of POU [OR 2.62, CI (2.47-2.79); OR 3.15, CI (2.17-3.34)] as compared to those who did not visit an emergency department in the past year (Table 1.4, Model 3).

Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 2.79, CI (2.60-3.00); OR 3.24, CI (3.02-3.47)] (Table 1.5, Model 3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behaviour, overnight hospital

Results: Regression Analysis

stay, outpatient department visit and mental health services use), the ORs are still significant [OR 2.09, CI (1.94-2.24); OR 2.22, CI (2.06-2.38)] (Table 1.5, Model 7).

7.3.6.1.2 Association of Emergency Department Visit with POMU

In univariate analysis, one emergency department visit and more than 1 emergency department visit have higher odds of POMU [OR 1.85, CI (1.64-2.10); OR 2.90, CI (2.56-3.28)] as compared to those who did not visit the emergency department in the past year (Table 1.6, Model 3). Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 1.89, CI (1.65-2.16); OR 2.69, CI (2.40-3.01)] (Table 1.7, Model 3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behaviour, overnight hospital stay, outpatient department visit and mental health services use), the ORs are still significant [OR 1.53, CI (1.32-2.78); OR 2.10, CI (1.84-2.39)] (Table 1.7, Model 7).

7.3.6.1.3 Association of Emergency Department Visit with POUD

In univariate analysis, one emergency department visit and more than 1 emergency department visit have higher odds of POUD [OR 3.22, CI (2.38-4.36); OR 7.63, CI (6.37-9.13)] as compared to those who did not visit an emergency department in the past year (Table 1.8, Model 3).

Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 3.26, CI (2.32-4.58); OR 6.08, CI (4.90-7.56)] (Table 1.9, Model 3). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behaviour, overnight hospital stay, outpatient department visit and mental health services use), the ORs are still significant [OR 2.27, CI (1.54-3.35); OR 3.74, CI (2.76-5.76)] (Table 1.9, Model 7).

7.3.6.2 Association of Overnight Hospital Stay with POU, POMU, and POU D

7.3.6.2.1 Association of Overnight Hospital Stay with POU

In univariate analysis, one overnight hospital stay and more than 1 overnight hospital stay have higher odds of POU [OR 2.74, CI (2.38-3.14); OR 3.85, CI (3.54-4.18)] as compared to those who did not have any overnight hospital in the past year (Table 1.4, Model 4). Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 2.98, CI (2.55-3.49); OR 3.69, CI (3.34-4.08)] (Table 1.5, Model 4). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, outpatient department visit, and mental health services use), the ORs are still significant [OR 1.85, CI (1.56-2.20); OR 2.03, CI (1.83-2.24)] (Table 1.5, Model 7).

7.3.6.2.2 Association of Overnight Hospital Stay with POMU

In univariate analysis, one overnight hospital stay and more than 1 overnight hospital stay have higher odds of POMU [OR 1.91, CI (1.38-2.65); OR 1.99, CI (1.60-2.46)] as compared to those who did not have any overnight hospital in the past year (Table 1.6, Model 4). Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 2.47, CI (1.79-3.41); OR 2.48, CI (1.92-3.20)] (Table 1.7, Model 4). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behaviour, emergency department visit, outpatient department visit and mental health services use), the ORs are still significant [OR 1.64, CI (1.16-2.34); OR 1.40, CI (1.06-1.84)] (Table 1.7, Model 7).

7.3.6.2.3 Association of Overnight Hospital Stay with POU D

In univariate analysis, one overnight hospital stay and more than 1 overnight hospital stay have higher odds of POU D [OR 2.64, CI (1.71-4.08); OR 5.30, CI (4.08-6.88)] as compared to those

Results: Regression Analysis

who did not have an overnight hospital stay in the past year (Table 1.8, Model 3). Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 3.19, CI (1.80-5.65); OR 5.21, CI (3.70-7.33)] (Table 1.9, Model 3). But when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, outpatient department visit use and mental health services use), more than one overnight hospital stay is only significant [OR 1.70, CI (1.08-2.69)] as compared to no hospital stay at all (Table 1.9, Model 7).

7.3.6.3 Association of Outpatient Department Visit with POU, POMU, and POU

7.3.6.3.1 Association of Outpatient Department Visit with POU

In univariate analysis, people with one outpatient department visit and more than 1 outpatient department visit have higher odds of POU [OR 1.59, CI (1.48-1.71); OR 3.56, CI (3.35-3.77)] as compared to those who did not visit outpatient department in past year at all (Table 1.4, Model 5). Similarly, when adjusted for socio-demographic predictors, the ORs are still significant [OR 1.61, CI (1.50-1.72); OR 3.35, CI (3.14-3.58)] (Table 1.5, Model 5). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, overnight hospital stay, and mental health services use), the ORs are still significant [OR 1.38, CI (1.28-1.50); OR 2.38, CI (2.22-2.55)] (Table 1.5, Model 7).

7.3.6.3.2 Association of Outpatient Department Visit with POMU

In univariate analysis, more than 1 outpatient department visits have higher odds of POMU [OR 1.29, CI (1.13-1.46)] as compared to those who did not have any outpatient department visit in the past year (Table 1.6, Model 5). But when adjusted for socio-demographic predictors, both of one outpatient department visit and more than 1 outpatient department visit have higher odds of

Results: Regression Analysis

POMU [OR 1.21, CI (1.04-1.41); OR 1.80, CI (1.57-2.06)] as compared to those who did not visited outpatient department at all in past year (Table 1.7, Model 5). Again, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, overnight hospital stay, and mental health services use), the findings are similar as univariate analysis that is those who have more than 1 outpatient department visits have higher odds of POMU [OR 1.29, CI (1.11-1.51)] (Table 1.7, Model 7).

7.3.6.3 Association of Outpatient Department Visit with POU

In univariate analysis, people with one outpatient department visit have lower odds of POU [OR 0.66, CI (0.45-0.97)] and people with more than 1 outpatient department visit have higher odds of POU [OR 1.84, CI (1.45-2.33)] as compared to those who did not visit outpatient department in past year (Table 1.8, Model 5). But when adjusted for socio-demographic predictors, only those who had more than 1 outpatient department visit in the past year have higher odds of POU [OR 3.17, CI (2.45-4.11)] as compared to those who did not visit at all (Table 1.9, Model 5). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, overnight hospital stay, and mental health services use), only those who had more than 1 outpatient department visit in past year have higher odds of POU [OR 1.43, CI (1.06-1.93)] (Table 1.9, Model 7).

7.3.6.4 Summary of Findings of Objective 4

7.3.6.4.1 Association of Emergency Department Visit with POU, POMU, and POU

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, overnight hospital stays, outpatient department visit, and mental health services use), one

Results: Regression Analysis

emergency department visit and more than 1 emergency department visit in the past year are significantly associated with POU, POMU, and POUD.

7.3.6.4.2 Association of Overnight Hospital Stay with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, outpatient department visit, and mental health services use), one overnight hospital stay is significantly associated with POU and POMU. More than 1 overnight hospital stays in the past year are significantly associated with POU, POMU, and POUD.

7.3.6.4.3 Association of Outpatient Department Visit with POU, POMU, and POUD

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, emergency department visit, overnight hospital stays, and mental health services use), one outpatient department visit in the past year is significantly associated with POU. More than 1 outpatient department visit in the past year is significantly associated with POU, POMU, and POUD.

7.3.7 Objective 5: Association of Mental Health Services Use with POU, POMU, and POUD in US Adult Population: Regression Analysis

7.3.7.1 Association of Mental Health Services Use with POU

In univariate analysis, people with one types of mental health services use in the past year have higher odds of POU [OR 2.19, CI (2.09-2.39)] as compared to those who did not use mental health services in the past year (Table 1.4, Model 6). Similarly, when adjusted for socio-demographic predictors, the OR is still significant [OR 2.00, CI (1.88-2.13)] (Table 1.5, Model 6). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal

Results: Regression Analysis

behavior and general health services use), the OR is still significant [OR 1.49, CI (1.39-1.61)] (Table 1.5, Model 7).

7.3.7.2 Association of Mental Health Services Use with POMU

In univariate analysis, people with one types of mental health services use in the past year have higher odds of POMU [OR 2.82, CI (2.48-3.20)] as compared to those who did not use mental health services in the past year (Table 1.6, Model 6). Similarly, when adjusted for socio-demographic predictors, the OR is still significant [OR 2.62, CI (2.33-2.95)] (Table 1.7, Model 6). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior and general health services use), the OR is still significant [OR 1.90, CI (1.66-2.18)] (Table 1.7, Model 7).

7.3.7.3 Association of Mental Health Services Use with POU

In univariate analysis, people with one types of mental health services use in the past year have higher odds of POU [OR 7.97, CI (6.37-9.97)] as compared to those who did not use mental health services in the past year (Table 1.8, Model 6). Similarly, when adjusted for socio-demographic predictors, the OR is still significant [OR 7.28, CI (5.60-9.48)] (Table 1.9, Model 6). Similarly, when adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, and general health services use), the OR is still significant [OR 4.34, CI (3.17-5.96)] (Table 1.9, Model 7).

7.3.7.4 Summary of Findings of Objective 5

When adjusted for all other variables (socio-demographic variables, BMI, suicidal behavior, and general health services use), one types of mental health services use in the past year is significantly associated with POU, POMU, and POU.

Results: Regression Analysis

The summary of protective and risk factors is shown in Diagram 4.

Results: Regression Analysis

Table 1. 3 Association of Socio-demographic Factors on POU, POMU, and POUD in US Adult Population: Univariate and Multivariable Regression Analysis

List of Variables	POU		POMU		POUD	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age						
50 or More vs 18-29 Years	1.60 (1.51-1.70)	1.50 (1.39-1.62)	0.36 (0.32-0.42)	0.52 (0.44-0.61)	0.44 (0.32-0.61)	0.82 (0.56-1.21)
30-49 Years vs 18-29 Years	1.42 (1.35-1.49)	1.50 (1.43-1.57)	0.75 (0.69-0.82)	0.9 (0.82-0.99)	0.87 (0.71-1.07)	1.21 (0.95-1.54)
Sex						
Males vs Females	0.76 (0.73-0.80)	0.77 (0.73-0.82)	1.16 (1.06-1.27)	1.16 (1.06-1.27)	1.34 (1.04-1.71)	1.30 (1.00-1.68)
Ethnicity						

Results: Regression Analysis

Non-Hispanic White vs Hispanic	1.51 (1.42-1.61)	1.48 (1.39-1.58)	1.13 (0.97-1.32)	1.62 (1.37-1.93)	2.84 (1.97-4.09)	5.52 (3.60-8.47)
Non-Hispanic Others vs Hispanic	0.99 (0.90-1.1)	1.00 (0.89-1.13)	0.70 (0.57-0.87)	0.76 (0.61-0.95)	1.33 (0.81-2.19)	1.98 (1.13-3.44)
Non-Hispanic Black vs Hispanic	1.48 (1.34-1.63)	1.38 (1.26-1.52)	0.90 (0.76-1.07)	0.94 (0.78-1.14)	2.18 (1.35-3.53)	2.21 (1.27-3.87)
Employment						
Unemployed or Others vs Full-Time	1.33 (1.27-1.40)	1.16 (1.09-1.24)	0.82 (0.73-0.91)	0.97 (0.85-1.11)	1.5 (1.2-1.88)	1.48 (1.16-1.89)
Part-Time vs Full-Time	1.00 (1.00-1.05)	0.91 (0.85-0.97)	1.04 (0.92-1.18)	0.92 (0.80-1.05)	0.98 (0.68-1.41)	0.77 (0.52-1.15)
Annual Family Income						
Less than \$ 20,000 vs \$ 75,000 or More	1.18 (1.1-1.26)	1.01 (0.92-1.11)	1.55 (1.37-1.76)	1.14 (0.99-1.33)	1.54 (1.17-2.20)	0.97 (0.69-1.35)

Results: Regression Analysis

\$ 50,000 to \$ 74,999 vs	1.06	0.98	1.22	0.97	0.60	1.16
\$ 75,000 or More	(0.99-1.15)	(0.91-1.06)	(1.03-1.44)	(0.83-1.14)	(0.44-0.82)	(0.79-1.69)
\$ 20,000 to \$ 49,999 vs	1.10	1.02	1.19	1.12	0.87	1.01
\$ 75,000 or More	(1.05-1.16)	(0.96-1.09)	(1.05-1.34)	(0.94-1.34)	(0.63-1.19)	(0.74-1.38)
Insurance Coverage						
Uninsured vs Medicaid Only	0.58	0.62	0.80	0.80	0.56	0.59
	(0.53-0.64)	(0.57-0.68)	(0.68-0.94)	(0.67-0.96)	(0.41-0.77)	(0.43-0.81)
Private Only vs Medicaid Only	0.73	0.73	0.59	0.64	0.22	0.23
	(0.69-0.77)	(0.68-0.78)	(0.52-0.67)	(0.56-0.75)	(0.17-0.29)	(0.18-0.30)
Others Only vs Medicaid Only	0.90	0.80	0.43	0.56	0.27	0.26
	(0.82-0.99)	(0.73-0.87)	(0.34-0.55)	(0.44-0.72)	(0.18-0.42)	(0.17-0.41)
Marital Status						
Never Married or Widowed or Divorced vs Married	0.99	1.04	1.8	1.40	2.4	1.77
	(0.95-1.04)	(0.99-1.09)	(1.61-2.01)	(1.23-1.59)	(1.82-3.17)	(1.29-2.42)
Education						

Results: Regression Analysis

Some College vs Less than High School	1.35 (1.24-1.47)	1.46 (1.34-1.58)	1.35 (1.14-1.61)	1.31 (1.06-1.62)	1.00 (0.72-1.38)	1.13 (0.78-1.64)
High School vs Less than High School	1.17 (1.07-1.27)	1.21 (1.10-1.33)	1.11 (0.91-1.34)	1.14 (0.93-1.41)	0.92 (0.66-1.27)	0.90 (0.62-1.30)
College Graduate vs Less than High School	1.00 (0.93-1.06)	1.03 (0.95-1.11)	0.84 (0.68-1.04)	0.9 (0.69-1.19)	0.41 (0.28-0.58)	0.65 (0.44-0.97)
Metropolitan Statistical Area						
Small vs Large	1.18 (1.11-1.25)	1.08 (1.02-1.14)	1.08 (0.98-1.19)	0.97 (0.87-1.08)	1.22 (0.95-1.57)	1.00 (0.76-1.32)
Nonmetropolitan vs Large	1.23 (1.17-1.3)	1.06 (0.99-1.13)	0.97 (0.86-1.09)	0.86 (0.75-0.98)	1.37 (1.06-1.78)	0.94 (0.71-1.25)

Results: Regression Analysis

Table 1. 4 Association of BMI, Suicidal Behaviour, General Health Service Use and Mental Health Service Use on POU:

Univariate Regression Analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
List of Variables	Unadjusted OR (95% CI)					
BMI						
Underweight vs Normal	0.99 (0.88-1.11)					
Overweight vs Normal	1.24 (1.17-1.31)					
Obese vs Normal	1.73 (1.64-1.83)					
Suicidal Behaviour						
One or More Criteria vs No Criteria		1.63 (1.5-1.77)				

Results: Regression Analysis

General Health Services
Use

Emergency Department
Visit

More than 1 Visits vs
None 3.15
(2.97-3.34)

1 Visits vs None 2.62
(2.47-2.79)

Overnight Hospital Stay

More than 1 Visits vs
None 3.85
(3.54-4.18)

1 Visits vs None 2.74
(2.38-3.14)

Outpatient Department
Visit

More than 1 Visits vs
None 3.56
(3.35-3.77)

Results: Regression Analysis

1 Visits vs None	1.59	
	(1.48-1.71)	
Mental Health Services Use		
One or More Types of Mental Health Service Use vs No Use		2.19
		(2.09-2.31)

Results: Regression Analysis

Table 1. 5 Association of Socio-demographic predictors, BMI, Suicidal Behaviour, General Health Service Use and Mental Health Service Use on POU: Multivariable Regression Analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
List of Variables	Adjusted OR (95% CI)						
Age							
50 or More vs 18-29 Years	1.39 (1.29-1.51)	1.54 (1.42-1.66)	1.60 (1.48-1.73)	1.48 (1.36-1.61)	1.35 (1.25-1.45)	1.49 (1.38-1.61)	1.37 (1.26-1.49)
30-49 Years vs 18-29 Years	1.41 (1.34-1.47)	1.52 (1.45-1.60)	1.55 (1.48-1.63)	1.49 (1.42-1.56)	1.49 (1.42-1.56)	1.46 (1.39-1.53)	1.44 (1.37-1.52)
Sex							
Males vs Females	0.75 (0.71-0.80)	0.77 (0.73-0.82)	0.80 (0.76-0.85)	0.80 (0.76-0.85)	0.91 (0.85-0.96)	0.81 (0.77-0.86)	0.92 (0.87-0.98)
Ethnicity							
Non-Hispanic White vs Hispanic	1.51	1.46	1.43	1.46	1.39	1.39	1.33

Results: Regression Analysis

	(1.42-1.61)	(1.38-1.56)	(1.34-1.53)	(1.37-1.56)	(1.30-1.48)	(1.30-1.47)	(1.25-1.42)
Non-Hispanic Others vs Hispanic	1.07 (0.96-1.20)	0.99 (0.88-1.12)	1.02 (0.91-1.15)	1.01 (0.89-1.14)	1.03 (0.92-1.15)	1.02 (0.90-1.15)	1.09 (0.97-1.24)
Non-Hispanic Black vs Hispanic	1.35 (1.22-1.48)	1.38 (1.26-1.52)	1.26 (1.15-1.39)	1.35 (1.22-1.48)	1.30 (1.18-1.42)	1.40 (1.28-1.54)	1.21 (1.09-1.33)
Employment							
Unemployed or Others vs Full-Time	1.19 (1.11-1.27)	1.16 (1.09-1.23)	1.14 (1.07-1.22)	1.10 (1.03-1.17)	1.11 (1.03-1.18)	1.13 (1.06-1.20)	1.07 (0.99-1.14)
Part-Time vs Full-Time	0.94 (0.88-1.01)	0.90 (0.84-0.97)	0.92 (0.86-0.99)	0.91 (0.85-0.97)	0.87 (0.82-0.94)	0.88 (0.82-0.94)	0.90 (0.84-0.97)
Annual Family Income							
Less than \$ 20,000 vs \$ 75,000 or More	1.02 (0.93-1.12)	1.00 (0.91-1.10)	0.93 (0.85-1.02)	0.98 (0.90-1.08)	1.03 (0.94-1.14)	0.99 (0.90-1.08)	0.95 (0.86-1.04)
\$ 50,000 to \$ 74,999 vs \$ 75,000 or More	0.97 (0.90-1.05)	0.99 (0.91-1.06)	0.97 (0.89-1.05)	0.97 (0.90-1.05)	1.00 (0.92-1.08)	0.98 (0.91-1.06)	0.97 (0.89-1.05)

Results: Regression Analysis

\$ 20,000 to \$ 49,999 vs \$ 75,000 Or More	1.02 (0.96-1.08)	1.02 (0.96-1.09)	0.98 (0.92-1.04)	1.01 (0.95-1.08)	1.06 (1.00-1.13)	1.02 (0.96-1.09)	1.00 (0.94-1.07)
Insurance Coverage							
Uninsured vs Medicaid Only	0.64 (0.58-0.70)	0.62 (0.57-0.68)	0.71 (0.64-0.78)	0.68 (0.62-0.74)	0.79 (0.71-0.86)	0.66 (0.60-0.72)	0.88 (0.79-0.98)
Private Only vs Medicaid Only	0.74 (0.69-0.79)	0.73 (0.68-0.79)	0.83 (0.76-0.89)	0.79 (0.73-0.84)	0.74 (0.69-0.80)	0.75 (0.70-0.80)	0.87 (0.80-0.94)
Others Only vs Medicaid Only	0.82 (0.75-0.89)	0.80 (0.73-0.87)	0.83 (0.75-0.91)	0.80 (0.73-0.87)	0.76 (0.69-0.84)	0.83 (0.76-0.90)	0.83 (0.75-0.92)
Marital Status							
Never Married or Widowed or Divorced vs Married	1.05 (1.00-1.11)	1.03 (0.99-1.08)	1.01 (0.96-1.06)	1.06 (1.01-1.12)	1.06 (1.01-1.12)	1.02 (0.97-1.07)	1.04 (0.98-1.10)
Education							
Some College vs Less than High School	1.43 (1.31-1.56)	1.45 (1.33-1.57)	1.56 (1.43-1.70)	1.46 (1.33-1.61)	1.36 (1.25-1.49)	1.40 (1.29-1.53)	1.41 (1.28-1.54)

Results: Regression Analysis

High School vs Less than High School	1.19 (1.09-1.31)	1.20 (1.09-1.32)	1.28 (1.16-1.40)	1.22 (1.11-1.35)	1.18 (1.07-1.29)	1.19 (1.09-1.31)	1.23 (1.12-1.35)
College Graduate vs Less Than High School	1.06 (0.98-1.15)	1.03 (0.95-1.11)	1.16 (1.07-1.26)	1.03 (0.94-1.12)	0.94 (0.86-1.02)	0.97 (0.90-1.06)	1.06 (0.96-1.16)
Metropolitan Statistical Area							
Small vs Large	1.06 (1.01-1.12)	1.08 (1.02-1.14)	1.08 (1.02-1.14)	1.07 (1.01-1.13)	1.07 (1.01-1.14)	1.08 (1.02-1.14)	1.05 (1.00-1.12)
Nonmetropolitan vs Large	1.02 (0.96-1.09)	1.06 (0.99-1.13)	1.04 (0.97-1.11)	1.05 (0.98-1.13)	1.06 (0.99-1.13)	1.07 (1.00-1.14)	1.02 (0.95-1.09)
BMI							
Underweight vs Normal	0.94 (0.83-1.06)						0.95 (0.82-1.10)
Overweight vs Normal	1.22 (1.13-1.31)						1.18 (1.10-1.27)
Obese vs Normal	1.63 (1.54-1.72)						1.45 (1.37-1.53)

Results: Regression Analysis

Suicidal Behaviour

One or More Criteria vs No Criteria	1.68 (1.54-1.83)	1.25 (1.12-1.39)
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General health services use

Emergency Department Visit

More than 1 Visits vs None	3.24 (3.02-3.47)	2.22 (2.06-2.38)
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1 Visits vs None	2.79 (2.60-3.00)	2.09 (1.94-2.24)
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Overnight Hospital Stay

More than 1 Visits vs None	3.69 (3.34-4.08)	2.03 (1.83-2.24)
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1 Visits vs None	2.98 (2.55-3.49)	1.85 (1.56-2.20)
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Outpatient Department Visit

More than 1 Visits vs None	3.35	2.38
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Results: Regression Analysis

	(3.14-3.58)	(2.22-2.55)
1 Visits vs None	1.61	1.38
	(1.50-1.72)	(1.28-1.50)
Mental Health Services Use		
One or More Types of Mental Health Service Use vs No Use	2.00	1.49
	(1.88-2.13)	(1.39-1.61)

Results: Regression Analysis

Table 1. 6 Association of BMI, Suicidal Behaviour, General Health Service Use and Mental Health Service Use on POMU:

Univariate Regression Analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
List of Variables	Unadjusted OR	Unadjusted OR	Unadjusted OR	Unadjusted OR	Unadjusted OR	Unadjusted OR
	(95% CI)	(95% CI)	(95% CI)	(95% CI)	(95% CI)	(95% CI)
BMI						
Underweight vs Normal	0.86 (0.64-1.15)					
Overweight vs Normal	0.97 (0.85-1.10)					
Obese vs Normal	1.09 (0.95-1.24)					
Suicidal Behaviour						
One or More Criteria vs No Criteria		4.95 (4.25-5.77)				

Results: Regression Analysis

General Health Services Use

Emergency Department Visit

More than 1 Visits vs None
2.90
(2.56-3.28)

1 Visits vs None
1.85
(1.64-2.10)

Overnight Hospital Stay

More than 1 Visits vs None
1.99
(1.60-2.46)

1 Visits vs None
1.91
(1.38-2.65)

Outpatient Department Visit

More than 1 Visits vs None
1.29
(1.13-1.46)

1 Visits vs None
0.95
(0.82-1.11)

Results: Regression Analysis

Mental Health Services Use

One or More Types of Mental
Health Service Use vs No Use

2.82

(2.48-3.20)

Results: Regression Analysis

Table 1. 7 Association of Socio-demographic Predictors, BMI, Suicidal Behaviour, General Health Service Use and Mental Health Service Use on POMU: Multivariable Regression analysis

List of Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Adjusted OR						
	(95% CI)						
Age							
50 or More vs 18-29 Years	0.50 (0.42-0.60)	0.56 (0.47-0.67)	0.54 (0.45-0.64)	0.51 (0.43-0.60)	0.48 (0.40-0.57)	0.52 (0.44-0.61)	0.54 (0.45-0.64)
30-49 Years vs 18-29 Years	0.88 (0.80-0.97)	0.95 (0.87-1.04)	0.92 (0.84-1.01)	0.90 (0.82-0.99)	0.90 (0.82-0.99)	0.87 (0.80-0.96)	0.92 (0.83-1.01)
Sex							
Males vs Females	1.14 (1.04-1.25)	1.16 (1.06-1.28)	1.20 (1.10-1.32)	1.20 (1.09-1.32)	1.28 (1.16-1.41)	1.26 (1.15-1.38)	1.31 (1.19-1.46)
Ethnicity							

Results: Regression Analysis

Non-Hispanic White vs Hispanic	1.62 (1.37-1.93)	1.54 (1.30-1.82)	1.59 (1.33-1.90)	1.62 (1.37-1.93)	1.57 (1.31-1.87)	1.46 (1.23-1.73)	1.42 (1.19-1.68)
Non-Hispanic Others vs Hispanic	0.78 (0.62-0.97)	0.73 (0.59-0.91)	0.76 (0.61-0.96)	0.77 (0.62-0.96)	0.77 (0.62-0.96)	0.78 (0.62-0.97)	0.75 (0.60-0.95)
Non-Hispanic Black vs Hispanic	0.93 (0.77-1.12)	0.94 (0.78-1.14)	0.88 (0.72-1.07)	0.94 (0.77-1.13)	0.90 (0.75-1.09)	0.96 (0.80-1.16)	0.89 (0.72-1.08)
Employment							
Unemployed or Others vs Full-Time	0.98 (0.86-1.12)	0.95 (0.83-1.09)	0.95 (0.83-1.10)	0.94 (0.81-1.08)	0.96 (0.83-1.10)	0.92 (0.80-1.06)	0.90 (0.77-1.04)
Part-Time vs Full-Time	0.93 (0.81-1.07)	0.90 (0.78-1.03)	0.93 (0.81-1.08)	0.92 (0.80-1.06)	0.89 (0.77-1.02)	0.87 (0.75-1.00)	0.87 (0.75-1.01)
Annual Family Income							
Less than \$ 20,000 vs \$ 75,000 Or More	1.19 (1.02-1.39)	1.16 (0.99-1.36)	1.13 (0.97-1.32)	1.16 (0.99-1.36)	1.19 (1.02-1.38)	1.16 (0.99-1.35)	1.11 (0.95-1.29)
\$ 50,000 to \$ 74,999 vs \$ 75,000 or More	1.15 (0.96-1.38)	1.16 (0.96-1.39)	1.16 (0.97-1.39)	1.15 (0.96-1.38)	1.16 (0.97-1.39)	1.16 (0.97-1.39)	1.17 (0.98-1.40)

Results: Regression Analysis

\$ 20,000 to \$ 49,999 vs \$ 75,000 or More	1.03 (0.88-1.21)	1.02 (0.86-1.20)	1.01 (0.86-1.19)	1.02 (0.87-1.20)	1.06 (0.90-1.25)	1.04 (0.88-1.22)	1.02 (0.87-1.21)
Insurance Coverage							
Uninsured vs Medicaid Only	0.81 (0.68-0.97)	0.81 (0.68-0.96)	0.87 (0.73-1.04)	0.85 (0.72-1.01)	0.90 (0.75-1.08)	0.86 (0.72-1.03)	0.97 (0.81-1.17)
Private Only vs Medicaid Only	0.64 (0.56-0.75)	0.66 (0.57-0.76)	0.70 (0.60-0.82)	0.68 (0.58-0.79)	0.65 (0.56-0.76)	0.66 (0.56-0.77)	0.74 (0.63-0.87)
Others Only vs Medicaid Only	0.57 (0.44-0.73)	0.57 (0.45-0.73)	0.58 (0.45-0.74)	0.56 (0.43-0.73)	0.57 (0.44-0.74)	0.59 (0.46-0.76)	0.61 (0.47-0.80)
Marital Status							
Never Married or Widowed or Divorced vs Married	1.41 (1.24-1.60)	1.34 (1.18-1.52)	1.35 (1.19-1.53)	1.41 (1.24-1.60)	1.39 (1.23-1.58)	1.33 (1.17-1.51)	1.27 (1.11-1.45)
Education							
Some College vs Less than High School	1.29 (1.04-1.60)	1.29 (1.04-1.59)	1.35 (1.08-1.69)	1.32 (1.06-1.64)	1.26 (1.01-1.57)	1.26 (1.01-1.57)	1.25 (0.99-1.58)

Results: Regression Analysis

High School vs Less than High School	1.13 (0.92-1.39)	1.15 (0.94-1.41)	1.15 (0.93-1.42)	1.15 (0.93-1.42)	1.13 (0.91-1.39)	1.15 (0.93-1.41)	1.15 (0.92-1.43)
College Graduate vs Less than High School	0.90 (0.69-1.18)	0.91 (0.70-1.19)	0.97 (0.73-1.29)	0.91 (0.69-1.20)	0.84 (0.64-1.11)	0.83 (0.63-1.10)	0.89 (0.67-1.18)
Metropolitan Statistical Area							
Small vs Large	0.96 (0.87-1.07)	0.97 (0.88-1.08)	0.96 (0.86-1.07)	0.97 (0.88-1.07)	0.96 (0.86-1.08)	0.97 (0.88-1.08)	0.97 (0.87-1.09)
Nonmetropolitan vs Large	0.85 (0.74-0.97)	0.87 (0.76-0.99)	0.84 (0.74-0.96)	0.86 (0.76-0.99)	0.86 (0.75-0.99)	0.88 (0.77-1.01)	0.86 (0.75-0.99)
BMI							
Underweight vs Normal	0.75 (0.56-1.01)						0.81 (0.60-1.09)
Overweight vs Normal	1.08 (0.96-1.22)						1.05 (0.92-1.19)
Obese vs Normal	1.18						1.07

Results: Regression Analysis

	(1.03-1.34)		(0.94-1.23)
Suicidal Behaviour			
One or More Criteria vs No Criteria	3.44 (3.00-3.94)		2.58 (2.21-3.02)
General health services use			
Emergency Department Visit			
More than 1 Visits vs None	2.69 (2.40-3.01)		2.10 (1.84-2.39)
1 Visits vs None	1.89 (1.65-2.16)		1.53 (1.32-1.78)
Overnight Hospital Stay			
More than 1 Visits vs None		2.48 (1.92-3.20)	1.40 (1.06-1.84)
1 Visits vs None		2.47 (1.79-3.41)	1.64 (1.16-2.34)

Results: Regression Analysis

Outpatient Hospital Stay

More than 1 Visits vs None	1.80 (1.57-2.06)	1.29 (1.11-1.51)
1 Visits vs None	1.21 (1.04-1.41)	1.06 (0.90-1.24)

Mental Health Services Use

One or More Types of Mental Health Service Use vs No Use		2.62 (2.33-2.95)	1.90 (1.66-2.18)
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Results: Regression Analysis

Table 1. 8 Association of BMI, Suicidal Behaviour, General Health Service Use and Mental Health Service Use on POUD:

Univariate Regression Analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
List of Variables	Unadjusted OR	Unadjusted OR	Unadjusted OR	Unadjusted OR	Unadjusted OR	Unadjusted OR
	(95% CI)	(95% CI)	(95% CI)	(95% CI)	(95% CI)	(95% CI)
BMI						
Underweight vs Normal	0.65 (0.36-1.16)					
Overweight vs Normal	0.74 (0.55-1.00)					
Obese vs Normal	1.04 (0.80-1.36)					
Suicidal Behaviour						
One or More Criteria vs No Criteria		10.52 (8.2-13.5)				

Results: Regression Analysis

General Health Services
Use

Emergency Department
Visit

7.63
(6.37-9.13)

More than 1 Visits vs None

3.22
(2.38-4.36)

1 Visits vs None

Overnight Hospital Stay

More than 1 Visits vs None

5.30
(4.08-6.88)

1 Visits vs None

2.64
(1.71-4.08)

Outpatient Department Visit

More than 1 Visits vs None

1.84
(1.45-2.33)

1 Visits vs None

0.66

Results: Regression Analysis

(0.45-0.97)

Mental Health Services Use

One or More Types of
Mental Health Service Use
vs No Use

7.97

(6.37-9.97)

Results: Regression Analysis

Table 1. 9 Association of Socio-demographic Predictors, BMI, Suicidal Behaviour, General Health Service Use and Mental Health Service Use on POUD: Multivariable Regression Analysis

List of Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
	Adjusted OR						
	(95% CI)						
Age							
50 or More vs 18-29 Years	0.83 (0.57-1.21)	1.00 (0.66-1.51)	0.94 (0.63-1.40)	0.79 (0.54-1.18)	0.75 (0.50-1.12)	0.81 (0.56-1.19)	1.01 (0.65-1.56)
30-49 Years vs 18-29 Years	1.21 (0.95-1.55)	1.35 (1.06-1.71)	1.28 (1.00-1.64)	1.17 (0.91-1.51)	1.22 (0.96-1.56)	1.11 (0.88-1.40)	1.27 (0.98-1.64)
Sex							
Males vs Females	1.30 (1.01-1.67)	1.28 (0.99-1.67)	1.40 (1.07-1.83)	1.37 (1.05-1.80)	1.55 (1.19-2.02)	1.57 (1.20-2.05)	1.66 (1.24-2.22)
Ethnicity							

Results: Regression Analysis

Non-Hispanic White vs Hispanic	5.38 (3.47-8.34)	4.79 (3.16-7.27)	5.18 (3.34-8.02)	5.37 (3.49-8.27)	5.20 (3.36-8.07)	4.00 (2.62-6.09)	3.68 (2.34-5.78)
Non-Hispanic Others vs Hispanic	1.93 (1.08-3.44)	1.81 (1.04-3.14)	2.05 (1.16-3.63)	2.05 (1.17-3.60)	1.94 (1.11-3.38)	2.00 (1.15-3.47)	1.88 (1.04-3.41)
Non-Hispanic Black vs Hispanic	2.17 (1.24-3.81)	2.22 (1.28-3.86)	1.85 (1.05-3.26)	2.08 (1.17-3.70)	2.08 (1.18-3.67)	2.23 (1.28-3.88)	1.85 (1.04-3.29)
Employment							
Unemployed or Others vs Full-Time	1.49 (1.17-1.91)	1.43 (1.12-1.84)	1.41 (1.09-1.83)	1.35 (1.05-1.75)	1.43 (1.12-1.84)	1.24 (0.95-1.61)	1.13 (0.85-1.51)
Part-Time vs Full-Time	0.77 (0.52-1.15)	0.73 (0.48-1.10)	0.79 (0.52-1.18)	0.78 (0.53-1.17)	0.74 (0.50-1.09)	0.66 (0.44-0.98)	0.65 (0.43-0.99)
Annual Family Income							
Less than \$ 20,000 vs \$ 75,000 or More	0.97 (0.70-1.35)	0.92 (0.66-1.28)	0.88 (0.62-1.26)	0.93 (0.66-1.31)	0.97 (0.69-1.35)	0.91 (0.64-1.29)	0.79 (0.54-1.15)
\$ 50,000 to \$ 74,999 vs \$ 75,000 or More	1.15 (0.79-1.69)	1.15 (0.79-1.68)	1.13 (0.76-1.70)	1.17 (0.80-1.72)	1.15 (0.79-1.67)	1.20 (0.82-1.76)	1.23 (0.83-1.83)

Results: Regression Analysis

\$ 20,000 to \$ 49,999 vs \$ 75,000 or More	1.01 (0.74-1.37)	0.98 (0.72-1.35)	0.96 (0.70-1.33)	0.99 (0.72-1.37)	1.04 (0.77-1.42)	1.05 (0.76-1.45)	1.00 (0.72-1.38)
Insurance Coverage							
Uninsured vs Medicaid Only	0.59 (0.43-0.81)	0.58 (0.43-0.79)	0.73 (0.53-1.02)	0.68 (0.49-0.95)	0.75 (0.54-1.04)	0.74 (0.55-0.99)	0.90 (0.64-1.26)
Private Only vs Medicaid Only	0.23 (0.17-0.30)	0.25 (0.19-0.32)	0.28 (0.21-0.37)	0.26 (0.20-0.35)	0.23 (0.17-0.30)	0.25 (0.19-0.33)	0.30 (0.22-0.40)
Others Only vs Medicaid Only	0.26 (0.17-0.41)	0.28 (0.18-0.43)	0.27 (0.17-0.45)	0.26 (0.16-0.42)	0.25 (0.16-0.40)	0.31 (0.20-0.48)	0.30 (0.18-0.50)
Marital Status							
Never Married or Widowed or Divorced vs Married	1.76 (1.29-2.40)	1.63 (1.19-2.24)	1.62 (1.18-2.22)	1.77 (1.29-2.42)	1.75 (1.28-2.39)	1.54 (1.13-2.11)	1.33 (0.97-1.83)
Education							
Some College vs Less than High School	1.12 (0.77-1.62)	1.09 (0.75-1.57)	1.26 (0.86-1.86)	1.17 (0.80-1.72)	1.07 (0.74-1.56)	1.02 (0.72-1.44)	1.09 (0.74-1.61)

Results: Regression Analysis

High School vs Less than High School	0.89 (0.62-1.29)	0.92 (0.64-1.34)	0.94 (0.64-1.37)	0.90 (0.62-1.31)	0.87 (0.60-1.25)	0.91 (0.64-1.31)	0.94 (0.64-1.38)
College Graduate vs Less than High School	0.64 (0.43-0.96)	0.65 (0.44-0.96)	0.79 (0.51-1.21)	0.67 (0.44-1.01)	0.61 (0.41-0.90)	0.53 (0.36-0.80)	0.64 (0.41-0.99)
Metropolitan Statistical Area							
Small vs Large	1.00 (0.76-1.31)	1.02 (0.78-1.34)	0.99 (0.74-1.31)	0.99 (0.75-1.31)	1.01 (0.76-1.33)	1.01 (0.76-1.33)	1.04 (0.77-1.39)
Nonmetropolitan vs Large	0.93 (0.70-1.24)	0.98 (0.74-1.28)	0.92 (0.69-1.23)	0.95 (0.72-1.27)	0.97 (0.72-1.30)	1.00 (0.76-1.33)	1.01 (0.75-1.36)
BMI							
Underweight vs Normal	0.56 (0.29-1.08)						0.55 (0.27-1.15)
Overweight vs Normal	0.84 (0.62-1.15)						0.77 (0.56-1.07)
Obese vs Normal	0.99 (0.73-1.35)						0.81 (0.58-1.14)

Results: Regression Analysis

Suicidal Behaviour

One or More Criteria vs No Criteria	6.61 (4.88-8.96)		3.37 (2.39-4.75)
General health services use			
Emergency Department Visit			
More than 1 Visits vs None	6.08 (4.90-7.56)		3.74 (2.76-5.06)
1 Visits vs None	3.26 (2.32-4.58)		2.27 (1.54-3.35)
Overnight Hospital Stay			
More than 1 stays vs No stay		5.21 (3.70-7.33)	1.70 (1.08-2.69)
1 stay vs No Stay		3.19 (1.80-5.65)	1.43 (0.78-2.61)
Outpatient Department Visit			
More than 1 Visits vs None		3.17	1.43

Results: Regression Analysis

	(2.45-4.11)	(1.06-1.93)
	0.98	0.65
1 Visits vs None	(0.64-1.49)	(0.42-1.01)
Mental Health Services Use		
One or More Types of Mental Health Service Use vs No Use	7.28 (5.60-9.48)	4.34 (3.17-5.96)

8 Chapter 5: Discussion

8.1 Discussion of the Study Population by NSDUH Survey

We found in our research that in 2016-2017, the prevalence of past year PO use without misuse (POU) is 32.4 percent, past year PO misuse without use disorder (POMU) is 5.2 percent and past year PO use disorder (POUD) is 1.0 percent in US adults.

These findings are comparable with other studies which found that the prevalence prescription use irrespective of misuse was 37.8 percent (2015) (Han et al., 2017); PO misuse was 4.1 percent and use disorder was 0.6 percent in 12 years or older (2017) (Bose et al., 2018).

Our study found that in the US adult population, 43.35 percent are 50 years or older; 51.78 percent are females; 64.23 percent are non-Hispanic White; 49.68 percent have full-time employment; 37.96 percent have family income 75,000 or more; 64.45 percent have only private insurance coverage; 51.92 percent are married; 62.82 percent have some college to college graduation and 55.91 percent belongs to large metropolitan areas. This socio-demographic profile of NSDUH survey adult population is consistent with Back's (2010) research.

Our study results show that in the US adult population, the prevalence of overweight is 32.85 percent and the prevalence of obesity is 31.67 percent. Data from the National Health and Nutrition Examination Survey (2015-2016) showed that prevalence of obesity in US adult is 39.8 percent which is higher than our finding (Hales, Carroll, Fryar, & Ogden, 2017). In 2013-2014, the prevalence of overweight was 32.5 percent in the US adult population ("NIDDK," 2019) which is comparable to our findings.

Discussion

In our study, the prevalence of one suicidal behavior (suicidal thoughts or plans or attempts) is 4.21 percent which is comparable to National Institute of Mental Health's (2017) report which stated the prevalence of suicidal thoughts as 4.3 percent and suicidal attempt as 0.6 percent.

We found that the prevalence of past year emergency department visit is 25.85 percent and the prevalence of overnight hospital stay is 10.06 percent in US adults in 2016-2017. Our prevalence rates are higher than reported by the National Center for Health Statistics which found that the prevalence of emergency department visit in US adults was 19.4 percent (2016) ("Natl. Cent. Heal. Stat.," 2018) and the prevalence of one overnight hospital stay was 5.4 percent (2017) ("Natl. Cent. Heal. Stat.," 2018).

We found that 14.48 percent used one types of mental health service in the past year which is comparable to NSDUH report mentioning the prevalence of mental health services use by US adults as 14.8 percent (Bose et al., 2018).

It is noted that the differences in the prevalence of overweight, obesity, emergency health service use, and overnight hospital stay may be due to the use of different data than NSDUH data.

8.2 Discussion of the Prevalence of Predictors by POU, POMU and POU D samples

The prevalence of socio-demographic predictors in the PO Use without Misuse (POU) sample shows that most people are elderly, females and has come college education which is consistent with findings of Han (2017). The prevalence of other socio-demographic predictors in POU is not consistent with Han (2017). It may be because of the difference in the sample. Our sample contains people having PO use without misuse from 2016 to 2017. But Han (2017) examined a sample which includes people from NSDUH survey who had any use of PO in 2015. Moreover,

Discussion

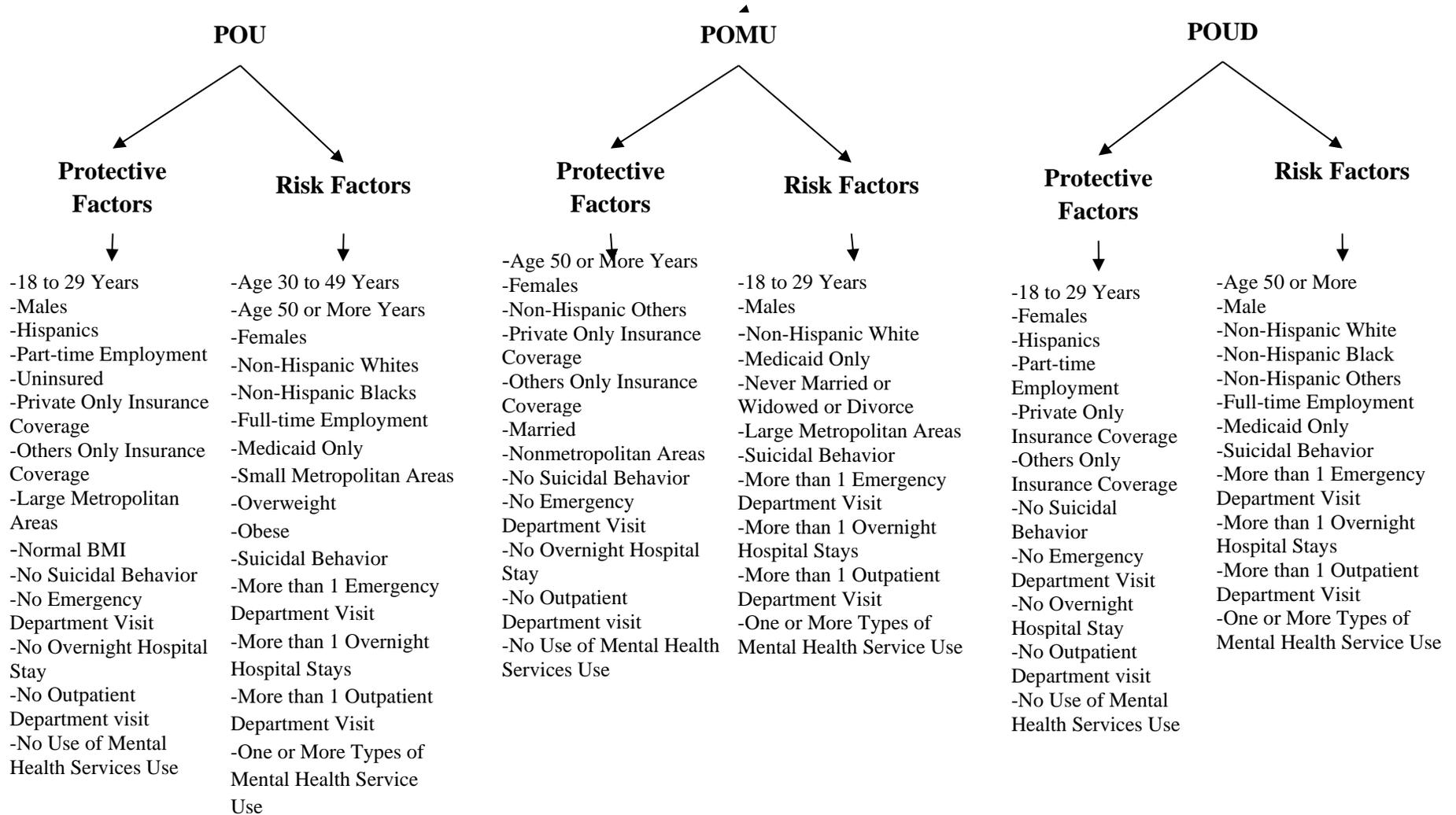
Han (2017) only examined descriptive statistics and did not control for covariates during examining the association. The prevalence of socio-demographic predictors in the POMU and POUD samples could not be compared with prior research due to lack of comparable data from previous studies.

8.3 Discussion of Regression Analysis Findings

Summary of protective and risk factors identified from the multivariable models are shown in Diagram 4.

Discussion

Diagram 4 Summary Findings of Major Similarities and Differences Between Each of the Groups



Discussion

For objective 1, we hypothesized that being elderly, male, non-Hispanic White, unemployed, lower-income, Medicaid insurance coverage, lower level of education, being single and living in non-metropolitan areas have statistically significant higher likelihood of past year POU, POMU and POUD in US adult population in 2016-2017.

In our study, an association of age with past year POU supported the hypothesis. Those who were 30 to 49 years and 50 years or older had a higher likelihood of past year POU as compared to 18 to 29 years. It can be explained by a higher prevalence of pain-associated chronic co-morbidity with increasing age (Raghupathi & Raghupathi, 2018).

Those who are 30 to 49 years and 50 years or older have a lower likelihood of POMU as compared to 18 to 29 years which rejects the hypothesis. It is consistent with the higher prevalence of past year pain reliever misuse in 18 to 25 years older people (7.2 percent) than those who were 26 years or older (3.7 percent) in the previous study (Bose et al., 2018). Age has no association with use-disorder which also rejects the hypothesis.

Association of sex with past year POMU and POUD support the hypothesis. Males have a higher likelihood of POMU and POUD when compared with females. Higher likelihood of misuse and use disorder in males can be explained by the availability of opioids in males at a higher rate from illicit sources than physicians (Back et al., 2010).

Males have a lower likelihood of POU which rejects the hypothesis. Higher likelihood of POU in females than males in our study can be explained by higher pain sensitivity and a higher rate of health service use tendency in females than males (Mazure & Fiellin, 2018; Serdarevic, Striley, & Cottler, 2017).

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Association of ethnicity with past year POU, POMU and POUD support the hypothesis. Non-Hispanic White has a higher likelihood of POU, POMU, and POUD when compared with Hispanics. Still, non-Hispanic Blacks have a higher likelihood of POU and POUD but lower likelihood of POMU when compared with Hispanics.

Stronger association of PO with non-Hispanic Whites than any other ethnic groups are explained by the racial discrimination in healthcare availability in the US which made PO more available to White than others such as Black (Hansen & Netherland, 2016).

Association of employment with past year POU, POMU and POUD reject the hypothesis. We found that full-time employment has a higher likelihood of POU and POUD as compared to part-time employment.

Medicaid insurance coverage has a higher likelihood of POU, POMU, and POUD as compared to some other health insurances which support the hypothesis. The Medicaid insurance covers health care costs for low-income group which is vulnerable to have POMU and POUD which explains the association of Medicaid insurance covered people with POMU and POUD (Belt, 2018; Brande, 2017; Dasgupta et al., 2018; Grol-Prokopczyk, 2018; Han et al., 2017; Woodward, 2013).

Association of marital status with POMU supports hypothesis as being unmarried or widowed or divorced have a higher likelihood of POMU than married. It can be explained by prior findings which states that being widowed or divorced or single is associated with depression and suicidal behavior (Bulloch, Williams, Lavorato, & Patten, 2009; Nyer et al., 2010) which are again linked

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to substance abuse (K. M. Bohnert, Ilgen, Louzon, McCarthy, & Katz, 2017). But this theory can not explain why marital status has no association with POUD.

For objective 2, we hypothesized that obesity is statistically significantly associated with POU, POMU, and POUD in US adult population in 2016-2017.

For past year POU, our findings support the hypothesis as we found that overweight and obesity have a higher likelihood of use. The association with POU can be explained by prior research which mentioned that Obesity and overweight are related to chronic diseases which further shows higher prevalence of POU (Blanco et al., 2016; Han et al., 2017; Okifuji & Hare, 2015; Shah et al., 2017; A. A. Stone & Broderick, 2012; Von Korff & Franklin, 2016).

Our findings support hypothesis for objective 3 as suicidal behavior is statistically significantly associated with past year POU, POMU and POUD which is consistent with prior research (Blanco et al., 2013; K. M. Bohnert et al., 2017). In our research, suicidal behavior shows higher odds ratios from use < misuse < use disorders which indicates the severity of mental health problems in misusers and addicted people. The normal neuronal mechanism in the brain is impaired from drug abuse which is associated with loss of impulse control and suicidal tendencies in abusers (Pompili et al., 2010). The neurological effect can be stronger in people with additional co-morbidities or people with some other co-occurring risk factors like psychiatric illness (Blow, Brockmann, & Barry, 2006; Esang & Ahmed, 2018; Pompili et al., 2010).

For objective 4, we found that more than 1 emergency health services use in the past year is statistically significantly associated with past year POU, POMU and POUD which support the

Discussion

hypothesis. A Similar association with overnight hospital stays and outpatient department visits were found which again supports the hypothesis. These findings have some similarities with previous researches (K. M. Bohnert et al., 2017; Boscarino et al., 2010).

Our research shows that the association with emergency department visits, overnight hospital stays, and outpatient department visits are least in the POMU sample as compared to POU and POUD samples. The rationale of this pattern may be due to managing of PO from other sources than healthcare contact by the misusers.

We also found that the association with emergency department visit is highest in POUD sample. It may result from the overdose or addiction-related emergency health conditions which ultimately made people seek emergency health care. It can also result from those patients visiting the emergency department to mimic pain to get a prescription of opioids.

Our research demonstrates that association with overnight hospital stays and outpatient department visits have the highest association with POU sample. It indicates the higher rate of prescribing opioids for inpatient and outpatient pain management. These inpatient and outpatient PO users may later search for illegal sources of opioids for misuse if not monitored during and after intake of PO.

Examining objective 5 shows that one types of mental health services use is significantly associated with POU, POMU, and POUD which also supports the hypothesis and consistent with prior research.

Discussion

Association with suicidal behavior and mental health services shows an increasing pattern from POU < POMU < POUD. It indicates how the severity of psychiatric illness and the need for mental health services corresponds with PO abuse. It prioritizes the, for screening for co-occurring psychiatric illness before prescribing opioids to a patient. Prescribers must be careful if the patient has a pre-existing psychiatric illness or any history of stress before prescribing opioids to prevent transition to misuse in the future. After the identification of high-risk patients, referral for psychiatric management is recommended.

Examining complex interaction between predictors in each sample and in between three samples would be the next step of this research. It will provide information to understand the complex framework of developing misuse and abuse independently or from use. It is also important to understand the development of suicidal behavior, the purpose of general health services use including mental health services use in POU, POMU, and POUD samples. A prospective cohort study to examine the temporal relationship of predictors and abuse will provide more information to plan long term prevention protocol of PO addiction. Moreover, use to use disorder transition data are lacking (Shah et al., 2017) which is worth to examine in future research. To stop the flow of unnecessary PO from sources to users and to control the unusual number of prescriptions or refills, strict multidisciplinary actions involving healthcare professionals, pharmaceutical companies and patients are necessary.

9 Chapter 6

9.1 Strengths and Limitations

The case definitions of samples are consistent and validated in previous studies. Moreover, in this study when considering the users, we excluded misusers from that sample; when considering the misusers, we excluded those with use disorder from that sample. Also, our reference sample contains those who did not use a prescription pain reliever in the past year at all. Therefore, we minimized the chance of misclassification bias when defining three samples and the reference sample. To my knowledge, this is the first study to classify PO samples in this way to avoid misclassification bias.

NSDUH provides public access data file which is feasible to get access. NSDUH is a large primary data which offer enough sample size to increases the power of the test. NSDUH survey sampling design and use of a probability sample make the data representative to the US population. Study findings using this data are generalizable to similar healthcare context. The sensitive information (drug use and mental health issues) was collected by ACASI method which increased both accuracies of the information and response rate (SAMHSA, 2017). The sampling and non-sampling errors have been minimized during NSDUH data collection and management procedures. The case definitions and the variable measures have been validated in the NSDUH codebook, 2017 and previous studies (SAMHSA, 2017). The cross-sectional study design is a fast and feasible method with no chance to lose follow up. The application of master weights was used to make the study findings representative to the US population.

Strengths and Limitations

NSDUH survey data is self-reported interview data which is prone to recall bias. As it is a public access data, we still don't have access to some significant variables (e.g. Region). NSDUH also have proxy interview data which may provide inaccurate information. The percentage of the proxy interview is not provided with the public use file. NSDUH data is not representative of people who are not included in the survey or people living in a different healthcare setting. People who are severely ill or suffering from severe opioid use disorders may not participate in the survey. During the interview, some respondents still may not share confidential information even after ensuring data confidentiality. The causal relationship between predictors and outcomes cannot be determined in a cross-sectional study. Not all confounders such as depression, psychiatric illness, chronic health conditions, acute health conditions, other substance use history, family history of substance use, physician's prescribing tendency, etc. are included in the study. At last homeless people and adults in criminal justice system are excluded from the survey which are highly associated with substance abuse as compared to the general civilians in US (Compton, Dawson, Duffy, & Grant, 2010; Ferguson, Bender, & Thompson, 2015; Saloner, Bandara, Mcginty, & Barry, 2016) .

9.2 Implications of Research and Future Directions

We used three groups of samples: PO use without misuse (POU), PO misuse without use disorder (POMU) and PO use disorder (POUD). We compared these three samples with the same reference sample 'no use of PO'. So, there is no chance of overlapping of respondents in between the samples. It picturizes the profile of the characteristics of each group of users.

We found a higher likelihood of PO use in elderly people when compared with younger people which suggest caution and policy development for pain management in elderly people especially those who are risked by other factors. It indicates the need for preventing chronic co-morbidities associated with old age and the need for effective pain management rather than opioids.

We found a higher association of abuse and use disorders in young people when compared with older. Policy development and implementation are necessary to stop PO or any other substance availability in younger people in any way than the doctor's prescription. Before prescribing PO, the history of the last prescription with motives of use should be noted. History of psychiatric illness is also important. Initiatives should be taken to prevent over-prescription irrespective of age.

Males are more prone to abuse and having use disorders. So, similar prevention policies are necessary for males as mentioned for elderly and younger people. The association with unemployment status and Medicaid coverage indicate the needs to address the social, psychological and health problems associated with poverty.

PO use is significantly associated with obesity and overweight. Those who are obese and overweight need to be examined for the motive of higher PO use to prevent the development of

Implication of Research

misuse and use disorder in this population in the future. Alternative management (such as weight loss strategies) of conditions associated with obesity and overweight that requires opioid prescription needs to be considered or focus can be given more to prevent the etiology of pain in this group rather than alleviating the pain.

The severity of suicidal behavior shows an increasing pattern from use to use disorder group. It prioritizes the need for screening for mental health problems before prescribing opioids. Follow-up of patients for tracing excessive health care use and the interval between subsequent prescription refills is needed to be monitored in high-risk people. Examining and identifying the motive behind each type of health services use by three samples is important and it can be better studied using medical data. Therefore, misuse cases are needed to be identified and considered to prevent future use disorder development and to cut the huge health care cost that can result from use disorder-related issues and even death. At last, alternative effective treatment of pain with fewer side effects is needed to be considered.

This research provides valuable information to imply in modifying the prescription guideline and physician training regarding prescribing opioids. It may include initiatives to take consideration of socio-demographic profile of the patient before prescribing opioids, to screen for an associated mental health condition or suicidal behavior, to check frequency of health care contact, to check the motive behind last healthcare contact, to prescribe inappropriate dose and to follow up of patients who received a prescription. Use of Prescription Drug Monitoring Program (PDMP) by the prescriber will also provide information on previous use of PO or frequency of PO use by the patient to prevent inappropriate prescription to those patients who present with multiple risk factors. The strengthening of the Lock-In program is important which is targeted to assign the

Implication of Research

high-risk patient to one specific doctor (G. Alexander et al., 2015). Further research is needed to describe the motive of health services use by the POU, POMU and POUD samples and whether the motives are significantly different between emergency department visit, overnight hospital stays, and outpatient department visits. Regular follow up of pharmacies is needed to identify if the PO supply is unusually higher from a pharmacy. It will also help to identify physicians who have a higher opioid prescribing rate. Assessing the effectiveness of a take-back program that is evaluating the proportion of unused PO by the pharmacies may also be helpful (G. Alexander et al., 2015). Prevention of flow of illicit drugs is also important as because even though a person with motive of misuse can not manage opioids from health care provider, he can still get it from other illicit sources or from other persons who have spare PO pills. A healthy person or a potential PO user need education regarding the effect, adverse effect, and outcomes of using PO. Access to Electronic Health Record and PDMP by all clinicians in all states is critical (G. Alexander et al., 2015). At last treatment of the risk factors are necessary. Therefore, special attention to those in low-income category, Medicaid users, with psychiatric illness and elderly people need attention to ensure social security and appropriate management for concerned physical or mental illness which can ultimately be effective by community-based intervention. Based on this study, similar recommendations can also be made to other comparable PO crisis zone like Canada (“Canada.ca,” 2018).

9.3 Conclusions

This research demonstrates that being elderly in comparison to 18 to 29 years, females in comparison to males, non-Hispanic White in comparison to Hispanics, health insurance covered by Medicaid in comparison to any other health insurance coverage, college graduates and high school education in comparison to less than high school education and living in small metropolitan areas in comparison to larger metropolitan areas have higher association with PO use without any kind of misuse.

Being younger in comparison to 40 years or older people, males in comparison to females, non-Hispanic Whites and Non-Hispanic Others except Black in comparison to Hispanics, never married or single or widowed in comparison to married, health insurance covered by Medicaid insurance coverage in comparison to some other insurance coverage and living in large metropolitan areas in comparison to non-metropolitan areas have higher association with PO misuse without any use disorder.

Being Males in comparison to females, Non-Hispanic Whites, Non-Hispanic Blacks and Non-Hispanic Others in comparison to Hispanics, Medicaid insurance coverage in comparison to some other insurance coverage and some college education in comparison to high school education have a higher association with PO use disorders.

The pattern of association with the socio-demographic factors in the three samples have some similarities and dissimilarities. Based on the different profiles of the different PO user groups (use, misuse, and use disorders), it might be possible to develop interventions that focus on different groups and develop different treatment options, e.g., users require better pain

Conclusions

management to avoid the use of PO. Those in the misuse group might need targeted intervention to ensure they no longer misuse while those in the use disorder group might require treatment for possible dependence. It also indicates the need for developing a rigorous conceptual framework to prevent development of use-disorder from use and misuse by interconnected sample-based interventions. Suggested intervention programs include education and awareness program among the POMU and POUD population to inform them about the neuronal mechanism of developing opioid addiction, management of mental health problem if present, physical and psychological outcomes of misusing opioids, etc.

Overweight and obesity are significant risk factors for POU. Further research, pain management protocol or strategies to normalize BMI are needed to prevent future development of PO misuse in obese and overweight users.

The least utilization of general health services by the misusers indicate the need to address and stop supply from the illicit sources of substance in misusers and take back the spare drugs from the users. The highest utilization of mental health services by the POUD indicates the need for identification and management of mental health issues in a potential user or misuser. It is clear from the analysis that people who rely on mental health services are more likely to have POUD than people who do not, it's not clear whether POUD is a result of having mental health conditions requiring treatment (i.e., they are abusing PO to cope with a mental health condition) or whether mental health conditions are perhaps exacerbated by POUD. Having said that, additional research could complement these findings by learning more about the group of people who use mental health services to examine how common POUD is in this population.

Conclusions

Vigorous research is needed based on nationally representative data or hospital data to synthesize further evidence to understand how the risk factors are influencing the use, misuse, and use disorders. The more we specify the underlying mechanism of the PO epidemic among users or misuser or use disorder community, the earlier we can prevent the onset of PO addiction in the high-risk people. Monitoring the use of POs and examining relevant risk factors prior to each prescription is critical. Collaborative and comprehensive efforts by the public health stakeholders, policymakers, pharmaceutical managers, physicians and researchers across all states of the US are needed. To interconnect PDMP data, electronic health record data; to strengthen prescriber guideline, Lock-in program, take-back program, screening of high-risk individuals and to encourage evidence-based research are highly recommended. Combined and evidence-based effort is critical to avoid unnecessary prescription to high-risk individuals and to prevent the development of addiction.

10 References

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11 Appendix

11.1 Appendix A

Variables	Case Definitions	Categories
Outcome Variables		
POU	Any use of past year PO without misuse	<ul style="list-style-type: none"> • Yes • No
POMU	Any misuse of past year PO without use disorder	<ul style="list-style-type: none"> • Yes • No
POUD	Any abuse or dependence of past year PO	<ul style="list-style-type: none"> • Yes • No
Reference Sample	No use of past year PO	<ul style="list-style-type: none"> • Yes • No
Predictors		
Sociodemographic Variables		
Age	Recoded from the age in years reported in the data	<ul style="list-style-type: none"> • 18-29 Years • 30-49 Years • 500 Years or More
Sex	Recoded from the gender identity reported in the data	<ul style="list-style-type: none"> • Males • Females
Ethnicity	Recoded from the ethnic identity reported in the data	<ul style="list-style-type: none"> • Hispanic • Non-Hispanic White • Non-Hispanic Black • Non-Hispanic Others

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Marital Status	Recoded from the marital status reported in the data	<ul style="list-style-type: none"> • Married • Never Married or Widowed or Divorced
Annual Family Income	Recoded from the annual family income reported in data	<ul style="list-style-type: none"> • Less than \$ 20000 • \$ 20000 to \$ 49999 • \$ 50000 to \$ 74999 • \$ 75000 or More
Education	Recoded from the education variable reported in the data	<ul style="list-style-type: none"> • 11 or 12 Grades Completed, No Diploma • High School Diploma • Some College Credit with or without Associated Degree • College Graduate or Higher
Employment	Recoded from the employment variable reported in the data	<ul style="list-style-type: none"> • Employed Full-time • Employed Part-time • Unemployed and Others
Insurance	<p>‘Medicaid only’ are those who are covered only by Medicaid health insurance</p> <p>‘Private Health Insurance’ are those who are covered only by private health insurances</p> <p>‘Others Only’ are those who are covered by any other health insurances except Medicaid and Private health insurances</p> <p>Uninsured are those who do not have any types of health insurance coverages</p>	<ul style="list-style-type: none"> • Medicaid Only • Private Health Insurance Only • Others Only • Uninsured
County	Metropolitan Statistical Areas	<ul style="list-style-type: none"> • Non-metro

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		<ul style="list-style-type: none"> • Small metro • Large metro
Body Mass Index (BMI)	<p>Underweight is BMI < 18.5 Normal is BMI 18.5 to 24.9 Overweight is BMI 25 to 29 Obese is BMI 30 or more</p>	<ul style="list-style-type: none"> • Underweight • Normal • Overweight • Obese
Suicidal Behavior	Presence of suicidal thoughts or plans or attempts in the past year	<ul style="list-style-type: none"> • No Suicidal Thoughts or Plans or Attempts • Suicidal Thoughts or Plans or Attempts Present
Emergency Department Visit	Visited emergency department in the past year for any reason	<ul style="list-style-type: none"> • No Visit • 1 Visit • More than 1 Visit
Inpatient Department Visit	Visited emergency department in the past year for any reason	<ul style="list-style-type: none"> • No Visit • 1 Visit • More than 1 Visit
Outpatient Department Visit	Visited emergency department in the past year for any reason	<ul style="list-style-type: none"> • No Visit • 1 Visit • More than 1 Visit
Mental Health Services Use	Any Overnight hospital stay, or outpatient department visit or doctor's prescription for mental health treatment in the past year	<ul style="list-style-type: none"> • Yes • No

11.2 Appendix B

Objectives	Variables with Types	Statistical Tests
<p>Objective 1: To describe the socio-demographic factors associated with POU, POMU, and POUD in US adult population in 2016-2017</p>	<p>Predictors</p> <p>Age: Categorical</p> <p>Sex: Binary</p> <p>Ethnicity: Categorical</p> <p>Employment: Categorical</p> <p>Family Income: Categorical</p> <p>Insurance: Categorical</p> <p>Marital Status: Categorical</p> <p>Education: Categorical</p> <p>County: Categorical</p> <p>Outcome Variables</p> <p>POU in Past Year: Binary</p>	<p>Univariate logistic regression</p> <p>Multivariable logistic regression control for socio-demographic factors</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use.</p>
	<p>Predictors</p>	<p>Univariate logistic regression</p>

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	<p>Age: Categorical</p> <p>Sex: Binary</p> <p>Ethnicity: Categorical</p> <p>Employment: Categorical</p> <p>Family Income: Categorical</p> <p>Insurance: Categorical</p> <p>Marital Status: Categorical</p> <p>Education: Categorical</p> <p>County: Categorical</p> <p>Outcome Variables</p> <p>POMU in Past Year: Binary</p>	<p>Multivariable logistic regression control for socio-demographic factors</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use.</p>
	<p>Predictors</p> <p>Age: Categorical</p> <p>Sex: Binary</p> <p>Ethnicity: Categorical</p>	<p>Univariate logistic regression</p> <p>Multivariable logistic regression control for socio-demographic factors</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit,</p>

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	<p>Employment: Categorical</p> <p>Family Income: Categorical</p> <p>Insurance: Categorical</p> <p>Marital Status: Categorical</p> <p>Education: Categorical</p> <p>County: Categorical</p> <p>Outcome Variables</p> <p>POUD in Past Year: Binary</p>	<p>inpatient hospital stays, outpatient department visit and mental health services use.</p>
<p>Objective 2: To examine the association of BMI with POU, POMU, POUD in US adult population in 2016-2017</p>	<p>Independent Variable</p> <p>BMI: Categorical</p> <p>Outcome variable</p> <p>POU in the past year: Binary</p>	<p>Univariate logistic regression: Model 1.</p> <p>Multivariable logistic regression control for socio-demographic factors: Model 1.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, suicidal behavior, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.</p>
	<p>Independent Variable</p>	<p>Univariate logistic regression: Model 1.</p>

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	<p>BMI: Categorical</p> <p>Outcome variable</p> <p>POMU in past year: Binary</p>	<p>Multivariable logistic regression control for socio-demographic factors: Model 1.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, suicidal behavior, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.</p>
	<p>Independent Variable</p> <p>BMI: Categorical</p> <p>Outcome variable</p> <p>POUD in the past year: Binary</p>	<p>Univariate logistic regression: Model 1.</p> <p>Multivariable logistic regression control for socio-demographic factors: Model 1.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, suicidal behavior, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.</p>
<p>Objective 3: To examine the association of Suicidal Behavior with POU, POMU, and POUD in US adult population in 2016-2017.</p>	<p>Independent Variable</p> <p>Suicidal behaviour: Binary</p> <p>Outcome variable</p>	<p>Univariate logistic regression: Model 2.</p> <p>Multivariable logistic regression control for socio-demographic factors: Model 2.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, emergency department visit, inpatient hospital</p>

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	POU in the past year: Binary	stays, outpatient department visit and mental health services use: Model 7.
	Independent Variable Suicidal behaviour: Binary Outcome variable POMU in past year: Binary	Univariate logistic regression: Model 2. Multivariable logistic regression control for socio-demographic factors: Model 2. Multivariable logistic regression controlled for socio-demographic factors, BMI, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.
	Independent Variable Suicidal behaviour: Outcome variable POUD in past year: Binary	Univariate logistic regression: Model 2. Multivariable logistic regression control for socio-demographic factors: Model 2. Multivariable logistic regression controlled for socio-demographic factors, BMI, emergency department visit, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.
	Independent Variable	Univariate logistic regression: Model 3.

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Objective 4: To examine the association of General Health Service Utilization with POU, POMU, and POUD in US adult population in 2016-2017.	Emergency department visit: Categorical	Multivariable logistic regression control for socio-demographic factors: Model 3.
	Outcome variable POU in the past year: Binary	Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.
	Independent Variable Emergency department visit: Categorical	Univariate logistic regression: Model 3. Multivariable logistic regression control for socio-demographic factors: Model 3.
	Outcome variable POMU in past year: Binary	Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, inpatient hospital stays, outpatient department visit and mental health services use: Model 7.
	Independent Variable Emergency department visit: Categorical	Univariate logistic regression: Model 3. Multivariable logistic regression control for socio-demographic factors: Model 3.
	Outcome variable	Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, inpatient hospital stays, outpatient

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	POUD in the past year: Binary	department visit and mental health services use: Model 7.
	Independent Variable Inpatient hospital stays: categorical Outcome variable POU in the past year: Binary	Univariate logistic regression: Model 4. Multivariable logistic regression control for socio-demographic factors: Model 4. Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, outpatient department visit and mental health services use: Model 7.
	Independent Variable Inpatient hospital stays: Categorical Outcome variable POMU in past year: Binary	Univariate logistic regression: Model 4. Multivariable logistic regression control for socio-demographic factors: Model 4. Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, outpatient department visit and mental health services use: Model 7.
	Independent Variable	Univariate logistic regression: Model 4.

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	<p>Inpatient hospital stays: Categorical</p> <p>Outcome variable</p> <p>POUD in the past year: Binary</p>	<p>Multivariable logistic regression control for socio-demographic factors: Model 4.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, outpatient department visit and mental health services use: Model 7.</p>
	<p>Independent Variable</p> <p>Outpatient department visit: Categorical</p> <p>Outcome variable</p> <p>POU in the past year: Binary</p>	<p>Univariate logistic regression: Model 5.</p> <p>Multivariable logistic regression control for socio-demographic factors: Model 5.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, inpatient hospital stays and mental health services use: Model 7.</p>
	<p>Independent Variable</p> <p>Outpatient department visit: Categorical</p> <p>Outcome variable</p>	<p>Univariate logistic regression: Model 5.</p> <p>Multivariable logistic regression control for socio-demographic factors: Model 5.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit,</p>

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	POMU in past year: Binary	inpatient hospital stays and mental health services use: Model 7.
	Independent Variable	Univariate logistic regression: Model 5.
	Outpatient department visit: Categorical	Multivariable logistic regression control for socio-demographic factors: Model 5.
	Covariates	Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behavior, emergency department visit, inpatient hospital stays and mental health services use: Model 7.
	Outcome variable	
	POUD in the past year: Binary	
Objective 5: To examine the Mental Health Service Utilization associated with POU, POMU, and POUD in US adult population in 2016-2017.	Independent Variable	Univariate logistic regression: Model 6.
	Mental Health Services Use: Binary	Multivariable logistic regression control for socio-demographic factors: Model 6.
	Outcome variable	Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behaviour, emergency department visit, inpatient hospital stays and outpatient department visit: Model 7.
	POU in the past year: Binary	
	Independent Variable	Univariate logistic regression: Model 6.

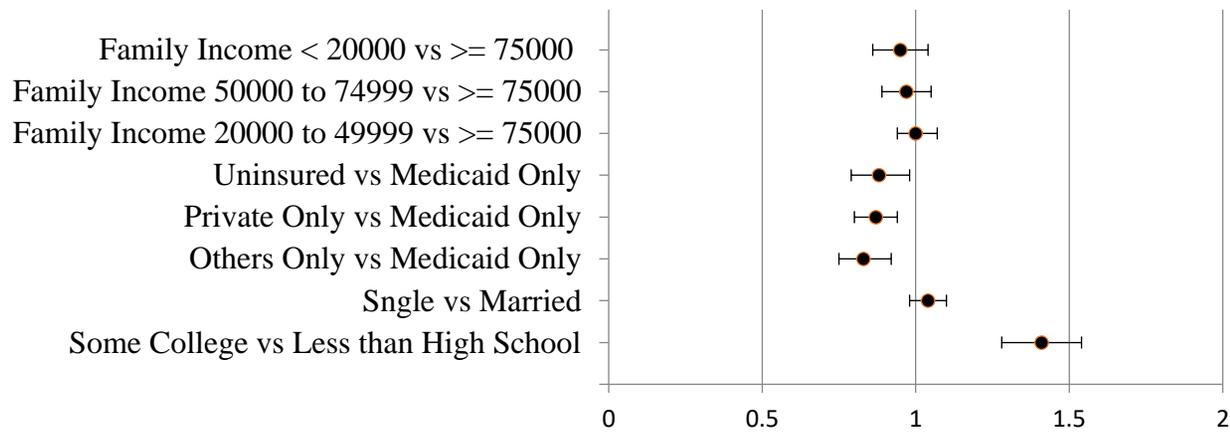
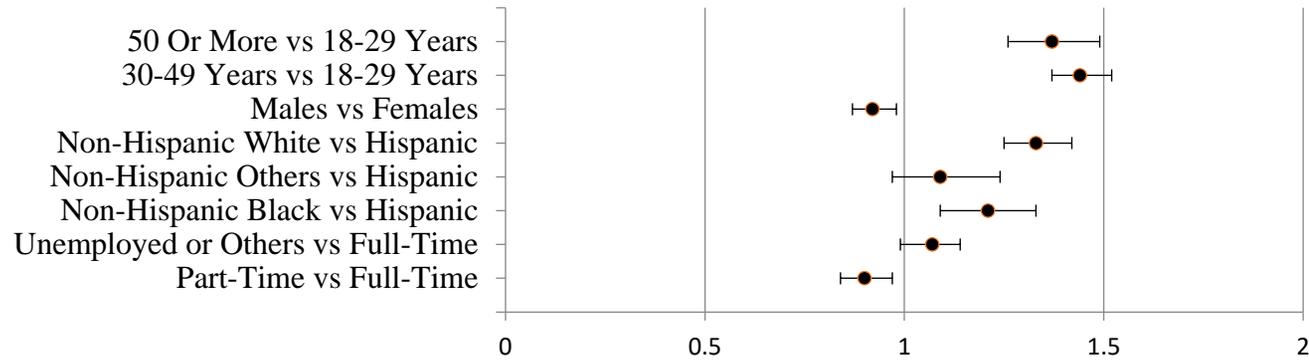
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	<p>Mental Health Services Use: Binary</p> <p>Outcome variable</p> <p>POMU in past year: Binary</p>	<p>Multivariable logistic regression control for socio-demographic factors: Model 6.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behaviour, emergency department visit, inpatient hospital stays and outpatient department visit: Model 7.</p>
	<p>Independent Variable</p> <p>Mental Health Services Use: Binary</p> <p>Outcome variable</p> <p>POUD in past year: Binary</p>	<p>Univariate logistic regression: Model 6.</p> <p>Multivariable logistic regression control for socio-demographic factors: Model 6.</p> <p>Multivariable logistic regression controlled for socio-demographic factors, BMI, suicidal behaviour, emergency department visit, inpatient hospital stays and outpatient department visit: Model 7.</p>

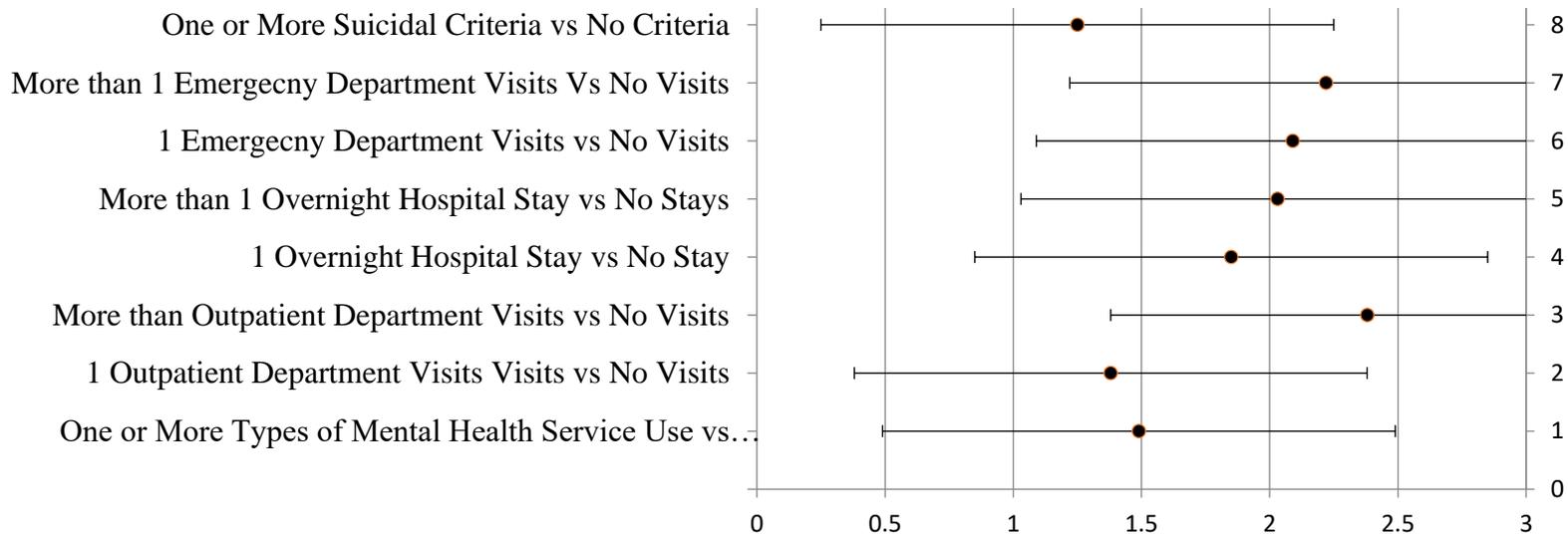
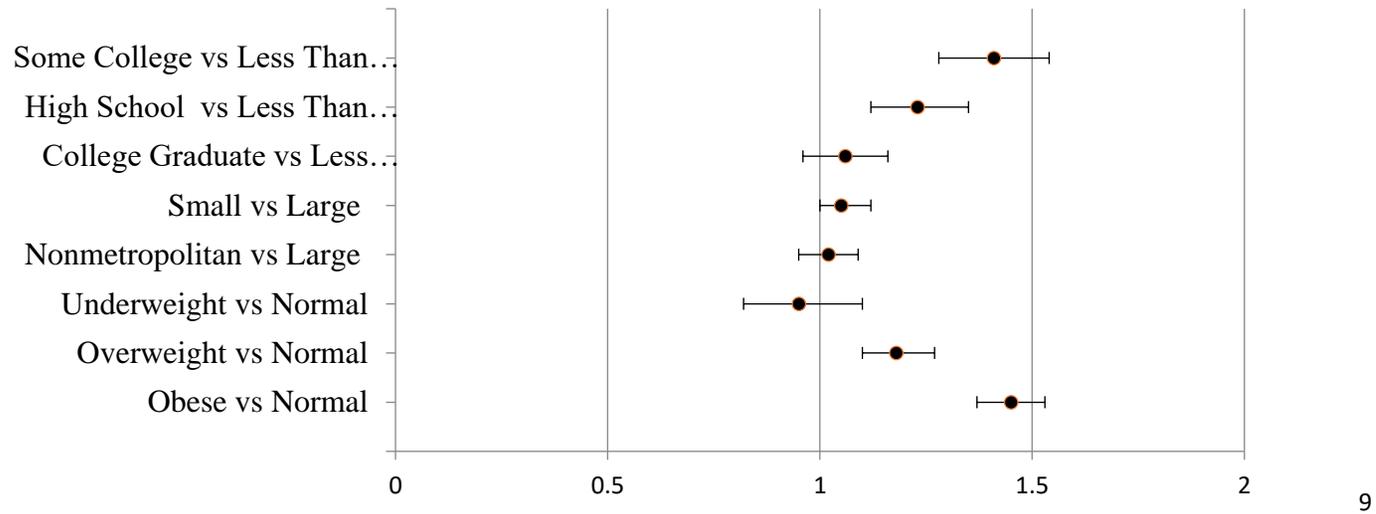
Appendix B

11.3 Appendix C

Figure 1. 12 Model 7: Association of all predictors with PO use (From Table 1.5)



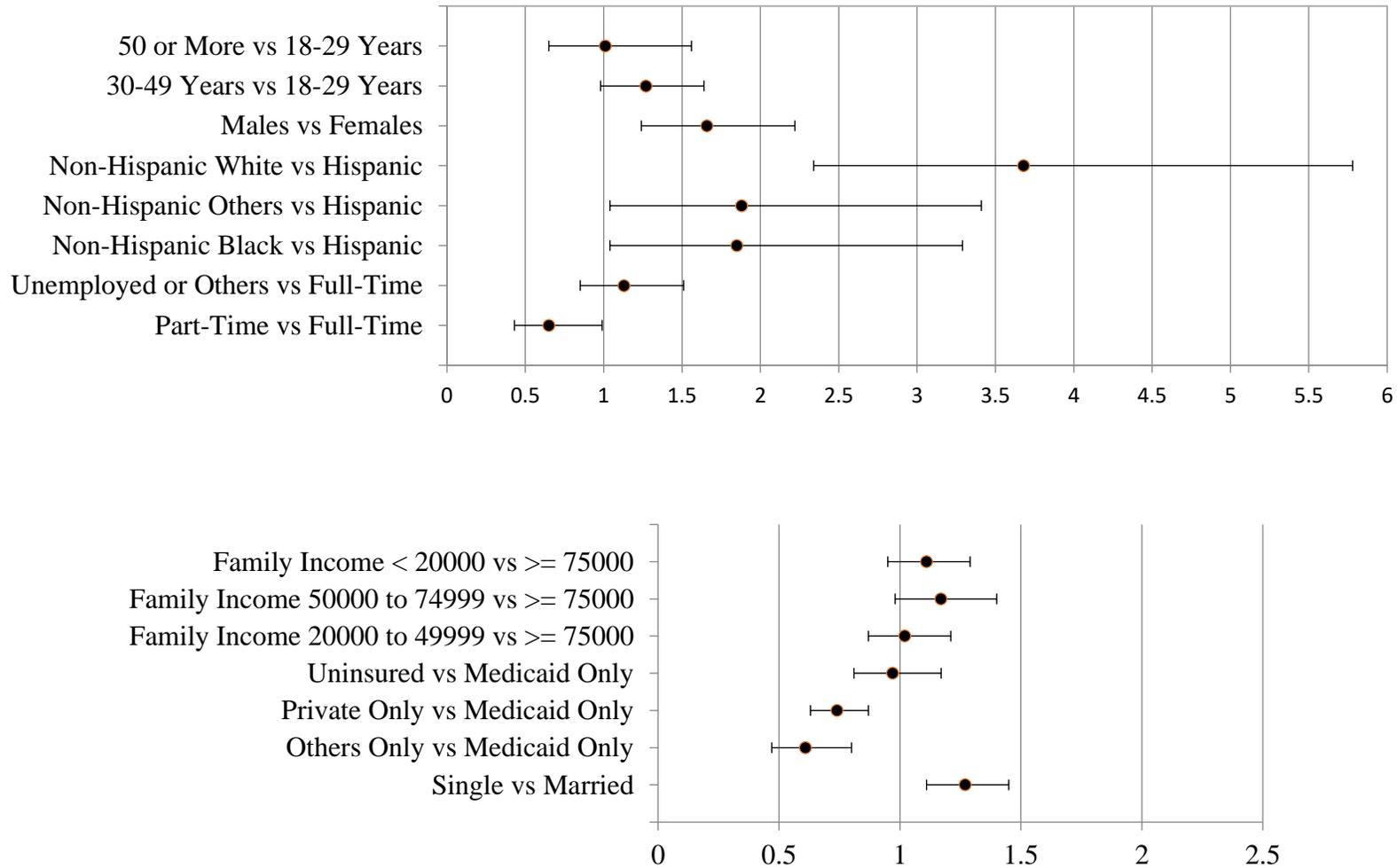
Appendix B



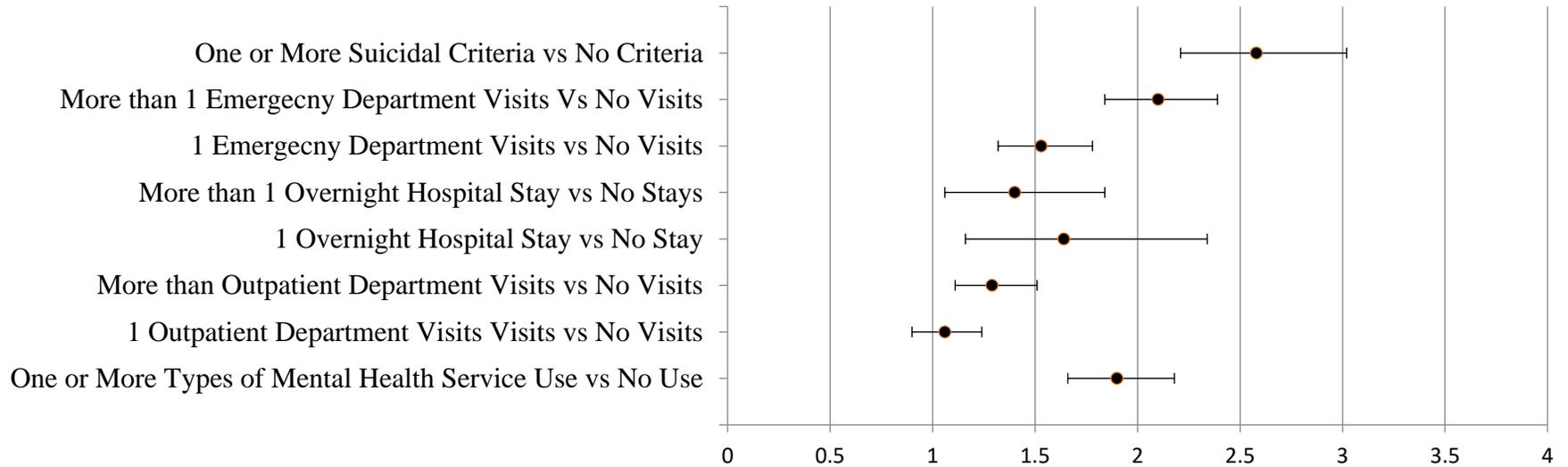
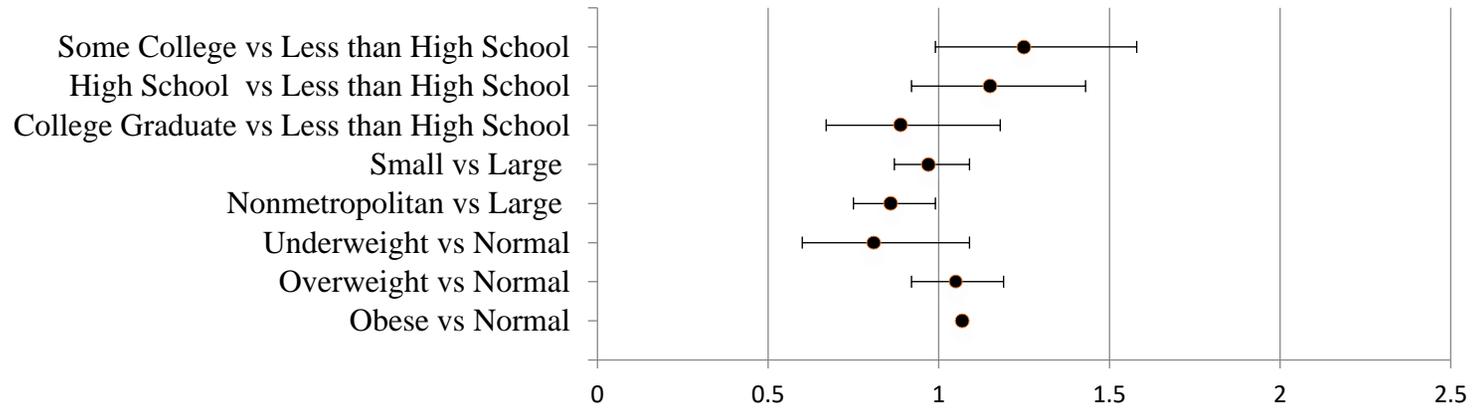
Appendix C

11.4 Appendix D

Figure 1. 13 Model 7: Association of all predictors with PO misuse (From Table 1.7)

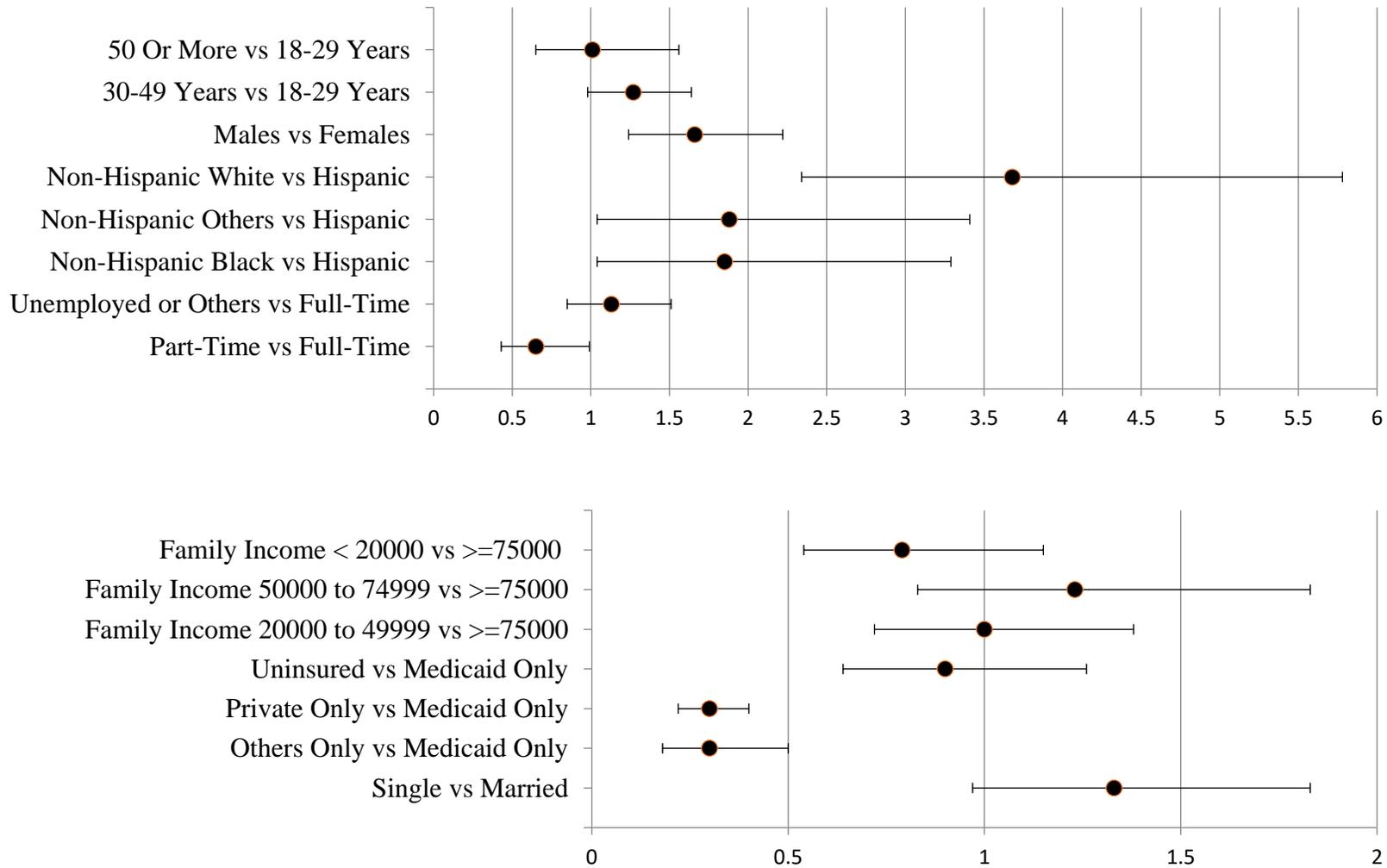


Appendix C



11.5 Appendix E

Figure 1. 14 Model 7: Association of all predictors with PO use disorders (From Table 1.9)



Appendix D

