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Non-medical use, abuse of, and dependence on prescription drugs : relationship between socio-demographic factors and health insurance coverage

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NON-MEDICAL USE, ABUSE OF, AND DEPENDENCE ON PRESCRIPTION DRUGS: RELATIONSHIP BETWEEN SOCIO-DEMOGRAPHIC FACTORS AND HEALTH INSURANCE COVERAGE

BY

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B.S. PHARM
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THESIS

Submitted in Partial Fulfillment of the
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DEDICATION

I dedicate this thesis to my beloved parents, Pritam and Vidya, my brother Vikas, sister Rashmi, my brother in law Deepak and my niece and nephew, Nandini and Naman. This achievement would not have been possible without their unconditional love and support.

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ABSTRACT OF THESIS

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ABSTRACT

Background: Previous studies have found that health insurance and other socio-demographic factors are important predictors of non-medical use of prescription drugs (NMUPD), their abuse and dependence, and use of substance abuse treatment. However, the effect of health insurance in specific subgroups of population on NMUPD, their abuse and dependence, and use of substance abuse treatment, is largely unknown.

Objective: To determine if the effect of health insurance on NMUPD, their abuse and dependence, and use of substance abuse treatment differs by socio-demographic factors. The study also aims to identify prescription drugs that are used non-medically and to assess the relationship between health insurance and use of such drugs.

Methods: This study used data from 2007 National Survey on Drug Use and Health (NSDUH). Sample consisted of individuals who were 12 year and older, non-institutionalized. Bivariate and multiple logistic regression analyses were conducted to estimate the relationship between health insurance, socio-demographic factors on NMUPD, their abuse and dependence, and use of substance abuse treatment.

Results: In 2007, self-reported prevalence of NMUPD was eight percent (N=5190). NMUPD was higher among uninsured individuals. In multivariate analysis, age, race, education, marital status, type of health insurance, level of income, past year use of tobacco, and alcohol were significantly associated with NMUPD. Hispanic people with private health insurance, high school graduates with public health insurance, privately insured individuals with family income less than $20,000 and $40,000-$74,999 were more likely to use prescription drugs than others. Drugs most likely to be used non-medically were Vicodin/Lortab/Lorcet (pain relievers), Valium

/diazepam (tranquilizers), methamphetamine, Desoxyn/Methedrine (stimulants), and Methaqualone/Sopor/ Quaalude (sedatives).

Approximately, one percent of the entire sample and 13% of NMUPD reported abuse dependence on prescription drugs. The classes of prescription drugs most likely to be abused were pain relievers, tranquilizers, stimulants and sedatives. Among individuals who used drugs non-medically, health insurance, age, marital status, general health status and use of tobacco were significant predictors of abuse/dependence. There were no significant interaction effects between health insurance and socio-demographic factors on prescription drug abuse and dependence.

The last part of the study assessed if health insurance improved access to substance abuse treatment programs among those who reported NMUPD. Approximately 6% of the entire sample and 73% of the non-medical users and 76% of the prescription drug abusers/dependents reported some use of substance abuse programs. The Multivariate regression models indicated that health insurance was not associated with use of substance use treatment program. In addition, there were no significant interaction effects between health insurance and other socio-demographic and economic factors.

Conclusions: NMUPD, their abuse/dependence, is common in the United States. Most of the non-medical users of prescription drugs, its abusers/dependents use pain relievers. Health insurance is associated with NMUPD, its abuse and dependence but not with the use of substance abuse treatment. Certain subgroups such as high school graduates with public health insurance privately insured individuals with family income less than $20,000 and $40,000-$74,999 are less likely to use prescription drugs non-medically. On the other hand, Hispanics with private health

insurance are more likely to use prescription drugs non-medically than the others. These individuals are more likely to have lower education as well as poor physical and financial conditions. It is important that non-medical users, prescription drug abusers/dependents are made aware of the harms of NMUPD, their abuse and dependence and the benefits of using substance abuse treatment to overcome these health problems.

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INTRODUCTION

1.1 Specific aims

In the United States, non-medical use of prescription drugs (NMUPD), their abuse and dependence are major health problems. Estimates based on the 2007 National Survey on Drug Use and Health (NSDUH) show that approximately 6.9 million individuals (2.8% of the population) used prescription drugs non-medically in the past month. Pain relievers, tranquilizers and stimulants were the three most frequently misused therapeutic drug class in 2007 (See Table 1) [1].

Table 1: NMUPD, their abuse and dependence among the U.S. individuals in 2007

	Total sample (in millions)	**Pain relievers (in millions)**	**Tranquilizers (in millions)**	**Stimulants (in millions)**	**Sedatives (in millions)**
NMUPD	6.9	5.2	1.8	1.1	0.35
Rx drug abuse/dependence	2.2	1.7	0.44	0.41	0.2

Studies indicate that non-medical use, abuse and dependence on prescription drugs affect quality of life and increase morbidity and mortality [2]. Indeed, unintentional drug poisoning deaths have risen over time, and the misuse of prescription opioids is the primary reason behind this upward trend [3]. Mortality involving prescription opioid analgesics has increased from 2,900 persons in 1999 to 7,500 persons in 2004 - an increase of 159% in just five years. In 2005, deaths resulting from the misuse of prescription opioids, benzodiazepines and antidepressants (45%), exceeded the number of deaths from the illicit use of cocaine, heroin and methamphetamines/amphetamines (39%) [3].

According to a 2002 report, total cost of drug abuse (which also includes illicit drugs) was $180.8 billion per year. Categories of drug abuse costs were [4]:

- Lost productivity - $128.6 billion per year (20%)
- Health care costs - $15.8 billion per year (71%)
- Criminal justice and social welfare - $36.4 billion per year (9%)

Prior studies indicate that demographic factors such as gender, age, ethnicity, health status, education, employment and income are significant predictors of NMUPD, their abuse and dependence [5-13]. Results from these studies point out that individuals who are male, younger, Whites, unemployed, have fair/poor health status, low education level, and lower income are more likely to be involved in non-medical use and abuse/dependence of prescription drugs when compared to other individuals.

Health insurance is an important predictor of NMUPD, their abuse and dependence [5]. Becker et al. (2007) found that uninsured people had 1.2 times greater odds of non-medical use of sedatives and tranquilizers than insured people. In this study, non-medical use of sedatives and tranquilizers was 2.3% and approximately 10% of the non-medical users of sedatives and tranquilizers also met the DSM-IV criteria for abuse or dependence [5]. Despite health insurance being an important predictor of NMUPD, their abuse/dependence (i.e., prescription drug disorders) few studies have investigated this relationship in greater length. Literature does not explain if health insurance has a disproportionate affect among specific subgroups of population e.g., low-income individuals, unemployed individuals, individuals with poor/fair health status, etc. Identifying such subgroups would help decision-makers to create more efficient health insurance policies.

Prescription drug non-medical users who abuse prescription drugs or become psychologically dependent on them seek substance use treatment services [4, 14, 15]. The cost of these treatment services can reach anywhere between $3,840 per admission to $7,415 per admission [16]. Such high cost of treatment can create financial burden, especially among the low-income population, leading to non-compliance. Some studies have indicated that health insurance is an important tool that facilitates access to substance use treatment services among users of illicit drugs [17] but we do not know if the same holds true for prescription drug abuse/dependence. The present study aims to address these issues. Results from this study can help policy-makers in determining whether providing health coverage to the uninsured will help to control the rising problem of NMUPD and subsequent prescription drug abuse/dependence.

Purpose: The purpose of the study was to determine the association between health insurance and socio-demographic factors on NMUPD, their abuse and dependence by using data from the 2007 National Survey on Drug Use and Health (NSDUH).

1.1.1 Aims and hypothesis:

Specific aim 1: To estimate the relationship between health insurance and NMUPD, abuse and dependence, and to assess how socio-demographic and economic factors (age, gender, race/ethnicity, education, marital status, employment, family/individual income and health status) modify the association between health insurance and NMUPD, their abuse and dependence.

Hypothesis (H_1): NMUPD, their abuse and dependence will be lower among individuals with health insurance when compared to the individuals without health insurance. Among the uninsured, individuals who are young (aged 18-24 years), male, Whites, unemployed, unmarried,

belong to the lowest income level, have less than high school education, poor/fair health status, used tobacco and used alcohol will be more likely to indulge in NMUPD, their abuse and dependence, than the others.

Specific aim 2: To estimate the relationship between health insurance and probability of seeking treatment for NMUPD, their abuse and dependence and to assess how age, gender, race/ethnicity, education, marital status, employment, family/individual income and health status will modify the relationship between health insurance and probability of seeking treatment for NMUPD, their abuse and dependence.

Hypothesis (H_1): Uninsured individuals will be less likely to seek treatment for NMUPD, their abuse and dependence than those who have health insurance. Among the uninsured non-medical users, prescription drugs abusers and dependents, individuals who are young (aged 18-24 years), male, Whites, unemployed, unmarried, belong to the lowest income level, have less than high school education, poor/fair health status, used tobacco and used alcohol will be less likely to seek treatment for drug abuse and dependence than others.

Specific aim 3: To quantify and estimate bivariate associations between therapeutic classes of prescription drugs used non-medically and health insurance.

Hypothesis (H_1): Non-medical use of different therapeutic classes of prescription drugs will vary by type of health coverage.

1.2 Study background

1.2.1 Defining non-medical use of prescription drugs, abuse and dependence:

Prescription drug can be defined as a product that requires a doctor's authorization or a prescription to purchase [18, 19]. The Diagnostic and Statistical Manual of Mental Disorders-4th edition (DSM-IV) defines substance abuse and dependence, however, there is no consensus regarding a definition of NMUPD in the literature [20, 21]. Devenyi (1985) defined drug abuse as improper use of a drug in terms of its therapeutic indication or dose, whereas drug dependence is a physical and psychological dependence on drugs [22].

Hertz and Knight (2006) suggested that abuse is "use of a controlled substance outside normally accepted standards of use, resulting in disability or dysfunction," whereas misuse is use of a controlled substance for reasons other than that for which it was prescribed or in dosage form different from one that was prescribed that does not lead to disability among the misusers [23]. Culberson and colleagues (2008) developed a continuum to distinguish misuse of prescription drugs by the patient as well as by the practitioner, and abuse and dependence on prescription drugs by the patient. According to the continuum, misuse of prescription drugs by the patient involves use of prescription drugs in inappropriate doses, for unintended purposes, with other medications or alcohol, and skipping doses or storing drugs. A practitioner misuses the prescription when he/she prescribes a medicine for an inappropriate indication, in an inappropriate dose, and fails to ensure the proper use of the medication. Prescription drugs abuse leads to adverse social, personal and physical outcomes, whereas prescription drug dependence leads to tolerance to the effect of drugs and withdrawal symptoms when the use of the prescription drug is reduced or stopped [24].

In summary, each author has defined misuse, dependence and abuse of prescription drugs as per the objectives/motives of their study as well as clinical or psycho-social beliefs regarding what constitutes appropriate use of prescription medications. Clearly, the terms prescription drug abuse and dependence have been used idiosyncratically and interchangeably [22, 25]. If one measures NMUPD, their abuse and dependence by using the method proposed by Culberson et al. (2008) then one would over-estimate NMUPD, their abuse and dependence since this method is not restricted to misuse of prescription drugs by the patients but also includes misuse of prescription drugs by the physicians. Additionally, the method considers skipping doses/storing drugs as misuse. Thus, the definition of misuse of prescription drugs provided by Culberson and colleagues is very broad and would lead to an over-estimation of the NMUPD and their abuse/dependence. On the other hand, use of definition suggested by Devenyi (1985) would provide narrow estimates of non-medical use, abuse and dependence on the prescription drugs as this definition is limited to dose and therapeutic indication of the prescription drugs used but does not incorporate cases where dosage form or route of administration of the prescription medication is modified. However, all definitions agree that prescription drug misuse is use of prescription drugs without a doctor's order or improper use of a prescription drugs either in different strength, dose, route or indication than recommended by the physician. Additionally, misuse of prescription drug is a broader term that includes NMUPD, abuse of and dependence on prescription drugs. If repeated misuse of prescription drug/s leads to effects that are detrimental to either an individual's physical and mental health or to the welfare of others and if an individual continues with this risky behavior despite harmful personal and social consequences, then the condition is known as prescription drug abuse. Furthermore, persistent long-term abuse can lead to tolerance to the effects of the prescription drug/s and if

person suffers from the withdrawal symptoms when the use of drug is reduced or stopped, then the condition is known as prescription drug dependence.

This study uses definitions from NSDUH to define NMUPD, their abuse and dependence. NSDUH survey items have been evaluated for their accuracy and reproducibility of results [26]. A study conducted to determine the reliability of the responses provided by the respondents found that the survey provided consistent measures of substance use and mental health [27]. NSDUH categorizes a person as a non-medical user of prescription drugs if s/he "had used at least one medication (either pain relievers, tranquilizers, stimulants, or sedatives) without a prescription or had used a medication simply for the experience or feeling that it caused" [28].

NSDUH defines prescription drug abuse and dependence based on the DSM-IV criteria of substance abuse and dependence [20]. The data code an individual as dependent on prescription drugs if s/he meets three or more of the seven dependence criteria. The first six criteria are: 1) respondent has to spend a great amount of time to get, use or to recover from the effects of the prescription drug; 2) uses the prescription drug more often than required and is unable to follow the set limits of use; 3) requires more amount of prescription drug than before to get the desired effects or notes that the same amount of prescription drug has lesser effect than in the past; 4) is unable to cut down or stop using the prescription drugs every time the respondent tries to do so; 5) continues to use the prescription drugs despite emotional, mental and physical problems; 6) prescription drug use leads to stoppage or decrease in involvement or participation in important activities. The seventh criterion is whether the respondent has experienced certain withdrawal symptoms based on the type/s of prescription drug/s used.

The data code an individual as a prescription drug abuser if s/he meets one or more of the four DSM-IV abuse criteria and also has been determined not to be dependent on the respective prescription drug/s in the past year. The abuse criteria are: 1) respondent has serious problems at home, work or school due to the use of prescription drugs; 2) uses the prescription drug regularly and then also engages in activities that might put him/her in physical danger; 3) use of the prescription drug leads to legal problems 4) suffers personal problems that occur probably due to the use of prescription drug/s but the respondent continues using the prescription drugs despite these problems.

Using these criteria, a series of questions were formulated in NSDUH to determine whether a person was suffering from prescription drug dependence or abuse [29]. These questions were re-coded to generate variables that helped determine whether a person engaged in prescription drug abuse or dependence during his lifetime/past year/past month. These data-generated recoded variables were then used to determine whether a person was suffering from prescription drug dependence or abuse.

1.2.2 **Prescription drugs with potential for non-medical use abuse and dependence:**

Prescription drugs are classified into five schedules based on medical use of a drug, its abuse potential, safety, and dependence liability. These are schedule I, II, III, IV, and V. Schedule I drugs have the highest potential for abuse and do not have any accepted medical uses. Schedule II drugs have high abuse potential and approved medical uses but with strict restrictions. Their use can cause severe psychological or physical dependence and as such these drugs are available only by un-refillable prescription. Schedule III drugs have lower abuse potential as compared to the schedule I and II drugs, but their use can still cause psychological or

physical dependence. Schedule IV drugs have relatively lower abuse potential than the Schedule III drugs. Both schedule III and IV drugs are available by prescription, and a patient can have only five refills in six months. Schedule V contains drugs that have low potential for abuse relative to the drugs or other substances in Schedule IV [23, 30, 31]. These schedules are summarized in Table 2.

Table 2: Drug Enforcement Administration drug schedules

Drug schedule	Abuse/dependence potential	Accepted medical use	Need for a prescription	Examples
Schedule I	High	No	Not applicable	Flunitrazepam, LSD, PCP
Schedule II	High	Yes	Yes (un-refillable)	Methadone, cocaine, oxycodone (Percodan®), methylphenidate (Ritalin®) and dextroamphetamine (Dexedrine®)
Schedule III	Low/moderate	Yes	Yes (five refills only)	Anabolic steroids, some barbiturates
Schedule IV	Low	Yes	Yes (five refills only)	Darvon, Talwin, Equanil, Valium and Xanax
Schedule V	May or may not	Yes	No	Over-the-counter medications

The following classes of prescription drugs have the greatest potential for non-medical use, abuse and dependence a) pain relievers (narcotic analgesics); b) tranquilizers (benzodiazepines); c) stimulants; d) and sedatives (barbiturates). Pain relievers include fentanyl, morphine and its derivatives, such as codeine, opium and its derivatives such as oxycodone, meperidine, hydromorphone, hydrocodone and propoxyphene. Tranquilizers are used to reduce stress and tension as they have soothing or calming effect on mood, thought and behavior [32]. These include anti-anxiety agents such as alprazolam, citalopram, clorazepam, diazepam, lorazepam, and flunitrazepam. Stimulants are drugs that increase alertness and awareness,

improve appetite, mood and feeling of well-being [33]. Examples of stimulants are various amphetamines such as laevoamphetamine, dextroamphetamine, methamphetamine and methylphenidate. Sedatives reduce excitement and anxiety and are used to induce drowsiness or sleep. These include barbiturates such as amobarbital, pentobarbital, phenobarbital, secobarbital and tuinal. Table 3 below lists these drugs with their drug class, generic name, brand name, street name, abuse potential based on the Drug Enforcement Administration (DEA) schedule and their therapeutic use [30, 31, 34, 35].

Some of the over-the-counter (OTC) drugs such as cough suppressants, motion sickness pills, and sleep aids contain dextromethorphan, dimenhydrinate and acetamionphen that are not controlled under the Controlled Substances Act (CSA) of 1970. Therefore, these drugs do not require a prescription but still have high potential for non-medical use, abuse and dependence. Although non-medical use, abuse and dependence on OTC drugs are important issues, this study is restricted to prescription drugs only.

TABLE 3: Prescription drugs with generic names, brand names, street names, DEA schedules and therapeutic uses

DRUG CLASS	GENERIC NAME	BRAND NAME	STREET NAME	ABUSE POTENTIAL / DEA SCHEDULE	THERAPEUTIC USES
PAIN RELIEVERS					
	Codeine	Codeine Sulfate, Codeine Phosphate	Empirin with Codeine, Fiorinal with Codeine, Robitussin A-C, Tylenol with Codeine, Captain Cody, Cody, schoolboy, (with glutethimide) doors and fours, loads, pancakes and syrup	V	Mild–moderate pain and symptomatic relief of cough
	Fentanyl	Ionsys, Duragesic-50, Duragesic-25, Actiq, Duragesic, Fentora, Duragesic-100, Duragesic-75, Fentanyl Citrate, Sublimaze, Duragesic-12	Actiq, Duragesic, Sublimaze; Apache, China girl, China white, dance fever, friend, goodfella, jackpot, murder 8, TNT, Tango and Cash	II	Short-acting analgesic in anesthesia
	Morphine	OMS, Morphine IR, Doloral Sirop, Morphitec, Oramorph SR, Mos-60, MS/S, Duramorph PF, Astramorph PF, PMS-Morphine, Rescudose, Morphine HP, M O S, Morphine Sulfate, Morphine Extra Forte, Mos-40, Statex, MSIR, Alti-Morphine, M-Eslon, Morphine Forte, Ratio-Morphine SR, Mos, Morphine Sulfate SR, Kadian, Roxanol, RMS, Mos-50, Avinza, Morphine LP Epidural, Infumorph, MS Contin, Doloral, M. O. S., Roxanol-T	Roxanol, Duramorph, M, Miss Emma, monkey, white stuff		Severe chronic pain, adjunct to general anesthesia, in epidural anesthesia or intrathecal analgesia, for palliative care, antitussive, treatment of dyspnea, antidiarrheal
	Oxycodone	OxyContin, Percolone, Roxicodone Intensol, Oxyfast, Endocodone, ETH-Oxydose, Roxicodone, Dazidox, OxyIR, Oxycodone Hydrochloride ER, Oxycodone Hydrochloride	Oxy, O.C., Hillbilly heroin, Oxycotton and Killer, Oxy80		Pain
	Meperidine	Demerol HCl, Meperidine Hydrochloride, Mepergan, Pethadol,			Pain, adjunct to anesthesia and

DRUG CLASS	GENERIC NAME	BRAND NAME	STREET NAME	ABUSE POTENTIAL / DEA SCHEDULE	THERAPEUTIC USES
		Pethidine HCL			preoperative sedation
	Hydromorphone	Palladone, Dilaudid, Hydromorphone Hydrochloride, Hydrostat IR, Dilaudid-HP, Dilaudid-5, Hydal, Sophidone, Hydromorfan, Hydromorphan, Laudicon	Dust, Juice, Smack, D, Footballs		Pain, as an antitussive
	Hydrocodone	Hydrocodone Bitartrate Combination with others: Anexsia, Hycodan, Hycomine, Lorcet, Lortab, Tussionex, Tylox and Vicodin	Vicodin, Lortab, Lorcet, Hycodan, Vicoprofen, vikes and hydros.		Pain, as an antitussive
	Propoxyphene	Propoxyphene Hydrochloride, PP-Cap, Darvon-N, Darvon		IV	Management of mild to moderate pain
TRANQUILIZERS (anti-anxiety agents)					
Benzodiazepines	Alprazolam	Xanax XR, Xanax, Niravam, Alprazolam ER	Parachuting, Z-bars, bars, Xanies	IV	Anxiety disorders, agoraphobia
	Clonazepam	Klonopin, Clonopin	Pins, Super Valium		Relief of symptoms of anxiety, for petit mal seizures, akinetic seizures and myoclonus, as well as Lennox-Gastaut syndrome
	Diazepam	Dizac, Zetran, Valrelease, Diastat AcuDial, Diastat, Valium, Diastat Pediatric	Vals, blues, mother's little helper, drunk pills, V, ludes, candy (pills), benzos, downers.		Anxiety disorders, status epilepticus, skeletal muscle relaxation, anesthetic premedication
	Lorazepam	Lorazepam Novaplus, Ativan	None		Anxiety disorders, pre-anesthetic medication
	Flunitrazepam	Rohypnol	Rophy, ruffels, roachies, roofies, ruffies, ruff up, rib, roach 2 (R2), roche, rope, ropies, circles, circes, forget it, forget-me-pill, Mexican	I	Not approved by FDA

DRUG CLASS	GENERIC NAME	BRAND NAME	STREET NAME	ABUSE POTENTIAL / DEA SCHEDULE	THERAPEUTIC USES
			Valium, and Run-Trip-And-Fall, roofinol		
STIMULANTS					
Amphetamines	Amphetamine-dextroamphetamine	Adderall XR, Adderall	Beans, Christmas trees, Pep pills, Bennies, Dexies, Speed, Black Beauties, Double Trouble, Uppers	II	Narcolepsy, attention deficit disorder with hyperactivity
	Laevoamphetamine - racemic mixture of amphetamine (dl-amphetamine)	Benzedrine, Obetrol	None		Anorectant
	Dextroamphetamine	Dextrostat, Dextroamphetamine Sulfate, Dexedrine, Dexedrine Spansule	bennies, black beauties, crosses, hearts, LA turnaround, speed, truck drivers, and uppers		Narcolepsy, attention deficit disorder with hyperactivity
	Methamphetamine	Methedrine	Xtc, MDMA, Adam, X, Ecstasy, Crank, Meth, Jib, Ice, Crystal, Tina, Glass, Bathtub crank, speed, chalk, go fast		Narcolepsy, attention deficit disorder with hyperactivity
	Methylphenidate	Metadate, Ritalin-SR, Daytrana, Methylphenidate Hydrochloride, Methylin ER, Methylin, Ritalin LA, Methylphenidate Hydrochloride SR, Metadate ER, Ritalin, Concerta, Metadate CD	Kibbles and Bits, Kiddy-Cocaine, Pineapple, R-Ball, Skippy, Smart Drug, Smarties, Vitamin R, West Coast, JIF, MPH		Attention deficit disorder with hyperactivity
SEDATIVES					
Barbiturates	Amobarbital	Amytal	Downers, blue heavens, blue velvet, blue devils	III	Insomnia, preoperative sedation, emergency management of seizures
	Pentobarbital	Nembutal	Nembies, yellow jackets, abbots, Mexican yellows	II	Insomnia, preoperative sedation, emergency management of seizures

DRUG CLASS	GENERIC NAME	BRAND NAME	STREET NAME	ABUSE POTENTIAL / DEA SCHEDULE	THERAPEUTIC USES
	Phenobarbital	Phenobarbital	Karachi, purple hearts, goof balls	IV	Seizure disorders, status epilepticus, daytime sedation
	Secobarbital	Seconal	Reds, red birds, red devils, lilly, F-40s, pinks, pink ladies, seggy	II	Insomnia, preoperative sedation
	Tuinal	Combination of two barbiturate salts (secobarbital sodium and amobarbital sodium) in equal proportions	Rainbows, reds and blues, tooies, double trouble, gorilla pills, F-66s	II	Sedation

1.2.3 **Prevalence of non-medical use of prescription drugs, abuse and dependence:**

An earliest estimate of non-medical use of prescription drugs comes from the study conducted by Simoni-Wastila et al. (2004). The authors used data from 1991-93 National Household Survey on Drug Abuse, which is now known as the National Survey on Drug Use and Health (NSDUH). NHSDA is an annual survey that collects information about the prevalence of substance misuse among the non-institutionalized population aged 12 years or older [12, 36]. According to the analysis, there were 8.2 million past year non-medical users of prescription drugs (4% of the U.S. population). Of which 1.3 million (0.62%) engaged in heavy NMUPD or experienced drug dependence [9, 12].

Information about change in the prevalence of NMUPD is also present in the study conducted by Blanco et al. (2007). They used National Longitudinal Alcohol Epidemiologic Survey (NLAES) conducted in 1991-92 and its descendant, National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) conducted in 2001-02 to determine changes in the prevalence of NMUPD during this decade. NESARC is a longitudinal survey that primarily collects information about use of alcohol in the civilian, non-institutionalized population aged 18 year and older. Additionally, it provides information on prevalence of non-medical use of prescription opioids, sedatives, tranquilizers and stimulants. Their analysis showed that NMUPD increased significantly from 1.5% in 1991-92 to 2.3% in 2001-02 (53% increases). The largest increase was observed for sedatives (350%); followed by prescription opioids (117%) and tranquilizers (20%). All these changes were significant at one percent alpha level except for the change in the non-medical use of tranquilizers. No change was found in the non-medical use of prescription stimulants during these years. The study also showed that the prevalence of DSM-IV

drug use disorders increased by from 0.3% in 1991-92 to 2.3% in 2001-02 ($p<0.001$), which represents an increase of 67% during this decade [36].

Estimates from the 2000-04 NSDUH show that 14.8 million persons aged 12 years and older (6.2%) used prescription drugs non-medically in the past 12 months. Among these non-medical users, 11.3 million persons (4.8%) used pain relievers; 5.0 million (2.1%) used tranquilizers; 3.0 million (1.2%) used stimulants, and 850,000 (0.4%) used sedatives. Additionally, there were 6.1 million (2.5%) non-medical users in 2004, of which 2.0 million were also involved in their abuse and dependence [37].

Recent data from 2007 NSDUH show that about 6.9 million (2.8%) U.S. individuals aged 12 years and older used prescription drugs non-medically in the past month. Of these, 5.2 million (2.1%) used pain relievers, 1.8 million (0.72%) used tranquilizers, 1.1 million (0.44%) used stimulants, and 346,000 (0.14%) used sedatives non-medically. A similar trend regarding NMUPD has been reported each year since 2002 [1]. The number and percentage rates of NMUPD for the 2007 year were similar to the 2006 year. However, number and percentage of nonmedical users of stimulant decreased from 0.6% in 2006 to 0.4% in 2007. Socio-demographic characteristics of these individuals suggest that the young adults aged 18-20 years had the highest rate (21.6%) of current (past month) NMUPD whereas individuals aged 65 or older (0.7%) had the lowest rate of NMUPD. Males and females had similar rates of past-month non-medical use of tranquilizers, stimulants, sedatives and OxyContin®. Among different races, Asians had the lowest prevalence of NMUPD (4.2%) whereas American Indians and Alaska Natives had the highest rate of NMUPD (12.6%). However, there were no statistical significant differences in the rate of NMUPD among different races in 2006 and 2007. There was a negative relationship between education and NMUPD. College graduates had the lowest rate of NMUPD

(5.1%) vs. the high school graduates (9.3%). As expected from previous years' data, rate of NMUPD was highest for unemployed individuals (18.3%) than for those who were employed part time (10.1%) or full time (8.4%). Referring to different geographic locations, prescription drugs non-medical use in 2007 was highest in the West (9.3%), followed by Midwest (7.9%), Northeast (7.8%), and it was lowest in the South (7.4%). Among people using prescription drugs non-medically, 2.2 million were involved in their abuse and dependence. Most of these individuals abused/were dependent on pain relievers (1.7 million), followed by tranquilizers (0.44 million), stimulants (0.41 million) and sedatives (0.2 million) [1].

Monitoring the Future (MTF) survey looks at the long-term annual prevalence and perceptions of the drug use specifically among high school students i.e., those students who are in the 8^{th}, 10^{th}, and 12^{th} grades and in a subsample of formerly surveyed high school graduates [38-41]. According to the survey, in 2005, NMUPD was highest in the age group 18 to 20 years (22.2 %), which was similar to that reported in the 2007 NSDUH. In contrast to the types of prescription drugs used non-medically nationally, high school students generally used stimulants non-medically (10%), followed by opioids (9.2%), and sedatives and tranquilizers (6.2% each). Among 12^{th} graders, increases in annual non-medical use of prescription drugs during 1991-2007 was highest for opiates (3.5% to 9.2%), followed by sedatives and tranquilizers (2.8% to 6.2%) and lowest for stimulants (7.1% to 10%) [40, 41]. This indicates that more 12^{th} graders are using prescription drugs non-medically in recent times when compared to the previous years. This matter is of serious concern, especially the non-medical use of opioids, which has shown the highest increase in the rate of NMUPD. This might be due to the decrease in the perceived risk of prescription drugs among these students as has been observed for the use of other illicit drugs [41]. Moreover, students perceiving prescription drugs as less harmful have been found to be at

higher risk of their nonmedical use than the others [42, 43]. Other reasons for increase in the abuse of prescription drugs include aggressive marketing by pharmaceutical companies, growing acceptance of these drugs in society and the perception that these drugs are safe to use [44]. This highlights the need for targeted prevention and educational interventions that make the students aware of the harms caused by non-medical use, abuse and dependence on prescription drugs. Prevalence of NMUPD, their abuse and dependence reported in different studies are summarized in Table 4.

Table 4: Prevalence of NMUPD, their abuse and dependence: results from different studies

Source	Dataset	NMUPD	Rx drugs abuse	Rx drugs dependence
Simoni-Wastila et al., 2004	1991-93 NHSDA	4%	-	0.62%
Blanco et al., 2007	1991-92 NLAES and 2001-02 NESARC	1.5% in 1991-92 2.3% in 2001-02	0.3% in 1991-92 2.3% in 2001-02	
DHHS, 2008a	2004 NSDUH	2.5%	0.83%	
DHHS, 2008b	2007 NSDUH	2.8%	0.89%	

1.2.4 **Summary**

Prevalence of life-time non-medical use/abuse of prescription drugs is approximately 20% (48 million persons aged 12 years and older) and this has increased by four percentage points during 2004-07. Increase of non-medical use/abuse of prescription drugs is higher among young adults aged 18-25 years (6.4%) when compared to adolescents aged 12-17 years (3.3%) [45]. Among 12^{th} graders, the increase in rate of non-medical use is highest for pain medications followed by sedatives, tranquilizers and stimulants. Individuals who are male, White, 18-24 years old, have poor/fair health status, use alcohol and/or illicit drugs have been found to be at

higher risk for NMUPD, abuse and dependence. Individuals living in the West, those who are unemployed and have less than college education are more likely to use prescription drugs non-medically than their counterparts.

1.3 **Significance of this study**

Men and women who use prescription drugs non-medically are also more likely to smoke cigarettes, drink alcohol (or binge drink), use illicit/prescription drugs [7, 46, 47]. Concomitant use of prescription drugs and other substances can lead to harmful drug-drug interactions and other life threatening consequences apart from their direct effects. Non-medical users of prescription drugs are also at greater risk of developing prescription drug abuse, dependence and other behavioral problems. Indeed, prescription drug abuse and dependence among the non-medical users of prescription drugs is increasing. Blanco and colleagues (2007) found that prescription drug abuse or dependence changed from 0.3% (in 1991-92) to 0.5% (in 2001-02), which suggests a significant increase of 67% ($p < 0.001$) during this decade [36].

Non-medical use of prescription drugs through I.V. route makes the non-medical user susceptible to other co-morbidities as injection drug use has been found to be the primary risk factor for the spread of human immunodeficiency virus (HIV) and hepatitis C virus (HCV) [48]. Havens and colleagues (2007) found that the prevalence of hepatitis C was higher among the injection users of opioid analgesics (14.8%) than people using opioids analgesics orally (1.7%) [49]. Drug abuse has been found to be a significant risk factor for the prevalence of HIV/Acquired Immune Deficiency Syndrome (AIDS). A report from NIDA suggests that there

were approximately 1 million people suffering from HIV/AIDS in 2003, and 33% of these cases were directly or indirectly related to use of drugs through I.V. route [50].

Increase in morbidity due to NMUPD, abuse and dependence has also led to a rise in emergency department (ED) visits owing to their specialty treatment. Some 741,425 ED visits in the United States in 2006 were associated with the non-medical use of prescription drugs, OTC drugs and dietary supplements. Most of these visits involved non-medical use of more than one type of drugs (54%). Number of individuals entering ED for abuse of drugs was even higher i.e., 1.7 million and 28% of these visits were related to the abuse of drugs [45, 51, 52].

NMUPD, their abuse and dependence have also led to increase in mortality. Accidental deaths due to NMUPD have increased over time. Prescription opioids are the primary reason behind this upward trend, and mortality involving pain killers has increased from 2,900 in 1999 to 7,500 in 2004. This represents an increase of 160% in five years [3].

Rise in ED visits, morbidity and mortality associated with the non-medical use, abuse and dependence on prescription drugs has imposed an economic burden on patients as well as on society [4, 53, 54]. The total economic cost associated with drug abuse has increased from $107.6 billion in 1992 to $180.9 billion in 2002. The largest proportion of the costs of drug abuse was associated with lost productivity (71.2%), followed by non-health "other" costs (20.1%) and health-related costs (8.7%). The loss of productivity represents loss of potential resources such as the inability to contribute in the labor market and in household activities due to the impact of drug abuse. The estimated productivity losses in 1992 were about $69.4 billion, which rose to $128.6 billion in 2002. The 'other cost' involves costs associated with the criminal justice system, crime victim costs, and expenses incurred for the administration of the social welfare

system, and it was $36.4 billion in 2002. The 'health care cost' was approximately $16 billion in 2002. The prime reason behind this cost was the monies spend on community-based specialty treatment for drug abuse [4, 54]. Among the four classes of therapeutic medications, prescription opioids have the highest rate of non-medical use and abuse [55]. Analysis of costs associated with abuse of prescription opioid analgesics reveals that the total costs of opioid analgesic abuse was $8.6 billion in 2001 (or $9.5 billion in 2005 dollars). Of this amount, $2.6 billion were healthcare cost, $1.4 billion were criminal justice cost, and $4.6 billion were workplace costs [56]. This clearly shows that the non-medical use, abuse of/dependence on prescription drugs has a negative financial impact on the people misusing prescription drugs as well as on society. It causes unnecessary utilization of health care resources, leading to an increase in the health care and other costs.

Health insurance is an important predictor of NMUPD, their abuse and dependence [5], however, this relationship between health insurance and these behavioral problems has not been studied in detail. Becker and colleagues (2007) found that uninsured people were 1.2 times more likely to use prescription drugs non-medically than insured people. Uninsured individuals have also been found to be more likely to suffer from opioid use disorder than insured individuals [6]. This study will help determine whether there is an association between health insurance and non-medical use, abuse and dependence of other prescription drugs and how this relationship differs in specific subgroups of population. It is important to study this relationship because health insurance is one of the measures that can be subjected to policy change [57]. If uninsured individuals are more likely to indulge in prescription drug use problems than insured people, then providing health insurance to the uninsured will be an efficient way to control this problem. The results of this analysis will also help to identify specific groups of individuals (with or

without health coverage) who are more likely to engage in NMUPD, their abuse and dependence. This in turn can help health care providers as well as prevention and treatment program developers to become knowledgeable of risk factors and the operating interaction between them.

Most of the individuals who use prescription drugs non-medically and abuse or depend on them do not seek substance abuse treatment [58] because they feel treatment costs too much and that they cannot afford it [59]. Past literature has found mixed association between health insurance and probability of seeking treatment among drug abusers/dependents. Some studies have observed that health insurance does not affect the receipt of treatment [6, 60, 61] whereas other studies have found that the uninsured are less likely to use treatment services than the insured [6, 62-64]. One study noted that health insurance plays a significant role in completion of the substance use treatment among the substance abusers [65]. Clearly, the relationship between health insurance and use of substance abuse treatment for NMUPD, their abuse and dependence is unknown. This study will add knowledge to this under-researched area. Health insurance does not play an independent role in use of treatment, but different socio-demographic factors also affect the use of treatment services (Weisner, et al., 2002). Thus, it's important to see how the association between health insurance and utilization of substance abuse services is modified by socio-demographic characteristics, which also was examined in this study. This will help policy-makers determine whether providing health coverage to the uninsured will help provide treatment to those who are in need of it but could not use it due to cost as a barrier.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a review of the literature. It begins with a review of literature regarding health insurance and its relation with the NMUPD, drug abuse and dependence, and use of substance use services. The latter section describes various predictors and their association with NMUPD, drug abuse and dependence, and use of substance use services.

2.1 Impact of health insurance on NMUPD, their abuse and dependence

Association between substance use problems (use of illegal drugs e.g., heroin, cocaine) and health insurance has been well established [60, 62, 64, 66-70]. In these studies, uninsured individuals have been found to have higher odds of substance use (OR=1.70; CI=1.39-2.07), abuse and dependence (OR=1.44; CI=1.04-2.00) than those who are insured. Literature that has examined the relationship between health insurance and prescription drug use is sparse. Kroutil et al. (2006) observed that uninsured individuals were more likely to use prescription drugs non-medically when compared to insured individuals and the risk of NMUPD was (36%) lowest among individuals with Medicaid coverage [71]. Becker and colleagues (2007) found that the uninsured individual had greater odds (OR=1.2; CI=1.0-1.4) of using sedatives and tranquilizers non-medically than insured adults [5]. In their other study, they found that people with Medicaid coverage (OR=1.70; CI=1.03-2.70) had higher odds of opioids abuse and dependence than people without Medicaid coverage [6]. This could be so because individuals without helath coverage or those who have Medicaid coverage are more likely to be poor and uneducated. Hence, they are less likely to perceive the risk associated with NMUPD and their abuse/dependence which places them at higher risk of prescription drug aubse/dependence.

Another possible reason could be that health insurance provides financial access for the use of prescription drugs [72] and this use in the long run may translate into non-medical use, abuse or dependence on prescription drugs. However, largely the relationship between health insurance, non-medical use, prescription drug abuse and dependence still remains unclear [5, 6, 62].

2.2 **Impact of health insurance on the use of substance abuse treatment services**

Past literature suggests mixed association between health insurance and use of substance abuse treatment among people who used substances. Wu and Ringwalt (2005) found that uninsured people were more likely to use substance abuse services than the insured individuals [67]. In contrast, Schoenbaum and associates (1998) found that of all the members who were covered under private, employer-sponsored, managed behavioral health care plans, only 0.3% of the plan members used any substance abuse services [73]. Possible reasons could be that these individuals do not want to get noticed by their employer or they may be unaware that substance abuse treatment is covered by their health insurance as a study found that 25%-38% of the employees who used such services were not aware that their health insurance covered substance abuse services [74, 75].

Other studies have observed that health insurance aids in making use of substance abuse services [64, 69] and that insured people are more likely to use them than the uninsured (OR=6.0; significant at $p < 0.01$). This is perhaps because their health insurance subsidizes or reimburses the use of substance abuse services. Among insured individuals, use of substance use services has also been found to differ by type of health insurance coverage. People using treatment programs for alcohol, drug abuse and mental health problems have been found to get it

through Medicaid or through other public insurance [64, 69, 70]. Similarly, McAlpine et al. (2000) found that people with public insurance were six times more likely to have access to specialty care than uninsured individuals. It is possible that public insurance is acting as an important source for providing substance use treatment to the people of lower socioeconomic status (SES) [68, 69]. In contrast to the aforesaid results, some studies did not observe any association between health insurance statuses or type of health insurance and the receipt of/entry to drug abuse treatment [6, 60, 61].

2.3 **Predictors of NMUPD, their abuse and dependence**

Non-medical use of prescription drugs, their abuse and dependence have been found to differ by demographic and economic factors. These include age, gender, race/ethnicity, education, marital status, employment, family income, health status, use of tobacco and use of alcohol. This section deals with the impact of these predictors on NMUPD, their abuse and dependence.

Age: Young individuals (18-24 years) were found to be at higher risk of using prescription drugs non-medically than older individuals (65 years and above) [5, 12, 36, 76]. This could be due to the decrease in the perceived risk of prescription drugs among young individuals as a study found that the students studying in 12^{th} grade perceive illicit drugs as less harmful [41], and the same might hold true for NMUPD. This observation is further supported by the fact that students who perceive prescription drugs as less harmful were found to have a higher risk of using drugs non-medically than the students who perceive prescription drugs as more harmful [42, 43]. Some studies also reported higher likelihood of NMUPD among older

individuals [9, 12], but NMUPD among older individuals has been mostly found to be accidental rather than intentional as opposed to the non-medical use observed among children and adults [77].

Results from the previous literature suggest mixed association between age and prescription drug abuse/dependence [36, 78, 79]. In addition, individuals who start NMUPD at the age of 13 years or before have been found to be at higher risk of developing prescription drug abuse and dependence than those who engage in NMUPD after 21 years of age [7].

Gender: Studies indicate mixed association between gender and NMUPD. Women have been found to be at higher risk for NMUPD and prescription drug disorders than men during 1991-92 [9, 12, 36, 47] but this was not the case in 2001-02 [62, 80], and 2004 [81]. Other studies have also found males to have higher prevalence of NMUPD than females [82-84]. However, in 2007, males and females were reported to have similar rates of past-month use of tranquilizers, stimulants, sedatives and OxyContin® [55]. Gender has also been found to influence the type of prescription drug abused or used non-medically. Women have been observed to be at higher risk of non-medical use of tranquilizers and narcotic analgesics but not for sedative-hypnotic and stimulant use [12, 36]. This might be due to the greater exposure of women to prescription drugs as research has shown that women are more likely to be prescribed prescription drugs with high abuse potential [72, 77, 85-87]. This could be because women have poorer health or better access to medical care when compared to men [72].

Race/ethnicity: Significant racial and ethnic differences have been observed in the NMUPD, prescription drug abuse and dependence. In 1991-93, Whites have been found to be more likely to use prescription drugs non-medically [9, 12, 36]. However, in 2001-02, Native Americans had the highest likelihood of NMUPD, their abuse and dependence [80]. Recent

national estimates from 2006 and 2007 NSDUH reveal a similar picture where American Indians or Alaska Natives (12.6%) had the highest rate of non-medical use and Asians (4.2%) had the lowest rate of NMUPD [55].

Education: Results from various national surveys suggest that education is inversely related to NMUPD, their abuse and dependence. As expected, individuals with a college education have been found to be at lower risk of NMUPD, drug abuse and dependence than those with a lower education [5, 7, 9, 36, 55, 80, 81, 88]. In contrast, Huang and colleagues (2006) found that non-medical use increased with the increase in level of education. However, the study determined life-time prevalence of NMUPD whereas other studies were based on past year NMUPD. Students in the age group 18-20 years have been found to be at the highest risk of non-medical use of prescription drugs than the others [38]. This could be because uneducated people are unaware of the harm of prescription drug abuse and are less likely to perceive the risk associated with them. Research has shown that college students who perceive prescription drugs as less harmful are at higher risk of their non-medical use than the others [42, 43].

Marital status: Individuals who are married/cohabitating have been found to be at lower risk of NMUPD, their abuse and dependence than those who were widowed/separated/divorced or never married [5, 9, 36, 79, 80]. 'Social Control Theory' suggests that strong bonds with family, friends, school, work, religion and other aspects of the conventional society motivate individuals to engage in responsible behavior and refrain from drug abuse and other health behavior problems [89].

Employment: Review of the literature shows that employment has a protective association with NMUPD [9]. Individuals who are unemployed have been found to have greater probability of engaging in these behavioral problems when compared to those who were

employed full time or part time [6, 7, 81]. This could be because employed individuals are healthier than unemployed individuals and are thus, less likely to use and consequently, abuse prescription drugs [72].

Income: In 1991, individuals with higher annual income were found to have greater odds of NMUPD than those with lower annual family income [12]. However, analysis from the 1991-92 NLAES and 2001-02 NESARC, and more recent 2004-05 NESARC, reveals change in this trend, and individuals with higher annual income have been found to be less likely to engage in NMUPD than those with lower incomes [36, 80]. For example, individuals with annual income less than $20,000 were more likely to engage in substance abuse, non-medical prescription drug use, use of alcohol and inhalants compared to those with annual income of $75,000 or more [90]. The possible explanation can be that individual with lower income might be employed in high risk conditions and therefore, take these drugs (simply for the experience or feeling that they cause) to relieve stress and exhaustion caused by the work [60]. Another reason can be that individuals with lower income are unemployed and thus, have more leisure time to engage in these activities.

Health status: Individuals reporting poor/fair health status have been found to be more likely to use prescription drugs non-medically, abuse them and/or become psychologically dependent upon them when compared to individuals reporting good health [7, 9, 12, 91-93].

Use of tobacco: Individuals who use tobacco have been found to be more likely to engage in NMUPD, their abuse and dependence when compared to those who do not use tobacco [5, 7, 8, 46, 94, 95]. The results from these studies show that the individuals who use tobacco have 1.3-9 times greater risk of using prescription drugs non-medically when compared to those who do not use tobacco. The same was true for prescription drug abuse/dependence among the

users of tobacco [96]. Interestingly, some studies also found that people indulging in NMUPD were 5-7 times more likely to smoke as compared to those who did not engage in NMUPD [46, 97].

Use of alcohol: Use/abuse/dependence on alcohol is also a strong predictor of non-medical use of prescription drugs. Past literature reports that individuals who use, abuse and become dependent on alcohol have a greater probability of NMUPD, their abuse/dependence when compared to those who do not use, abuse and become dependent on alcohol [5, 7, 8, 12, 36, 47, 93-95, 98-103]. But surprisingly, Becker and colleagues (2007, 2008) found that individuals using/abusing/depending on alcohol were 50%-80% less likely to use prescription drugs non-medically when compared to their counterparts [5, 7]. Some studies showed that people indulging in NMUPD also had four times higher risk of binge drinking as compared to those who did not engage in NMUPD [46, 97].

Use of illicit drugs: Individuals using illicit drugs have been found to be more likely to use prescription drugs non-medically, abuse them or become dependent on them when compared to those who did not use illicit drugs in the past year [5, 7, 8, 12, 13, 36, 47, 93-95, 98-103]. Furthermore, individuals using prescription drugs non-medically have been found to have 7-21 times greater probability of using illicit drugs as compared to those who did not engage in NMUPD [11, 46]. The above literature review suggests that use of alcohol, tobacco and illicit drugs can lead to NMUPD, its abuse/dependence and vice versa.

2.4 Predictors of substance use treatment services

Literature that has explored the relationship between socio-demographic factors and use of substance abuse treatment services for prescription drug disorders is scarce.

Age: Becker et al. (2008) did not find any relationship between age and the probability of seeking treatment for opioid use disorders though they found that probability of seeking treatment decreases with age among the people with substance use disorders [6]. Results from another study show that older people are more likely to use substance abuse treatment than the younger people for alcohol abuse and dependence [61, 70].

Gender: Some researchers have found that women are less likely than men to receive substance abuse treatment [60, 67] whereas other studies have found the opposite [70, 104, 105].

Race: Racial disparities have been observed in the probability of using substance abuse treatment. In some studies, Whites have been found to be less likely to enter treatment [61, 106, 107] whereas, opposite results were found in other studies [60, 62, 67, 91, 108, 109]. This could be due to the lack of perceived need for the use of drug abuse treatment. A study has found that both Hispanics and Blacks are less likely to perceive the need for treatment of prescription drug use disorders than the other races [108]. Low perceived need could lead to lower use of substance abuse services among Hispanics and Blacks [110-112].

Education: Some studies indicate that individuals with lower education are less likely to enter treatment [61, 105], whereas other studies suggest that people with lower education are more likely to enter treatment than those having higher education [70, 104].

Marital status: A study conducted by Wu et al. (2003) suggests there is no relationship between marital status and odds of seeking substance abuse treatment among substance abusers.

Employment: Employment has been found to be negatively correlated with the likelihood of use of substance abuse services. Unemployed individuals have been found to be more likely to complete drug abuse treatment than those who are either employed in a part-time

or full-time job [6, 70]. As mentioned previously, employed individuals might not want their employer to know about their use of substance abuse treatment or they might be unaware that their health insurance covers substance abuse treatment. This explanation is supported by the finding of Jean Oggins (2003) who found that 25%-38% of the employees who used substance use services did not know their health insurance covered substance use treatment [74, 75].

Income: Income has been found to have a positive relationship with the probability of seeking substance abuse treatment. People with higher income have been found to be more likely to use substance abuse treatment services than those with lower income [113-115]. The possible justification could be that lower income individuals usually have lower health coverage which might limit their use of substance abuse services as research has shown that people without health insurance are less likely to use and complete treatment services than those with health insurance [17, 64, 67].

Health status: There is not any study that has looked at the relationship between health status and likelihood of seeking substance abuse services for prescription drug disorders.

Illicit drugs: Individuals using either prescription drugs non-medically, illicit drugs or both have been found to be more likely to use substance abuse services when compared to those who did not misuse prescription drugs or both prescription drugs and illicit drugs in the past year (Wu et al., 2003).

2.5 Summary of literature review

Uninsured individuals have found be more likely to use prescription drugs non-medically although the relationship between health insurance and prescription drug abuse and dependence is not clear. Risk of prescription drug abuse and dependence has been found to differ by type of

health coverage, and individuals with Medicaid coverage have been found to be more likely to indulge in prescription drug abuse and dependence when compared to the other groups.

The review of the literature suggests mixed impact of health insurance on use of treatment services among substance abusers. In two out of five studies, uninsured individuals were more likely to use substance abuse services. Additionally, among the insured, use of substance use services has been found to differ by type of health coverage, and individuals with Medicaid and other public programs have been found to be more likely to use treatment services.

Other demographic and economic factors have also been observed to be important predictors of NMUPD, their abuse and dependence, and use of treatment services. Younger individuals have been found to be at higher risk of NMUPD, their abuse and dependence, but older individuals have been found to more likely to use substance abuse treatment for these problems. Gender and race have been found to have a mixed association with NMUPD, their abuse and dependence, and use of substance abuse treatment. Individuals with some college education have been found to be at lower risk of NMUPD, drug abuse and dependence, but the relationship between education and substance abuse treatment is not clear. Marriage and employment were found to have a protective relationship with NMUPD, prescription drug abuse and dependence. The existing literature did not suggest any association between marital status and use of substance abuse services. But employed individuals have been found to be less likely to use substance abuse treatment than unemployed individuals. Previous literature suggests mixed association between family income and NMUPD although individuals with higher family income have been found to be more likely to use substance abuse treatment for NMUPD, their abuse and dependence than those having lower family income. People with poor/fair health status have been observed to be more likely to engage in NMUPD, abuse and dependence but the

relationship between health status and the use of substance abuse treatment has not been examined for these health behavior problems. Use of alcohol, tobacco and illicit drug has been found to lead to NMUPD, its abuse/dependence and vice versa. The impact of the use of alcohol, and tobacco on the use of substance abuse treatment has not been investigated but individuals using illicit drugs have been found to be more likely to use substance abuse treatment than their counterparts.

Largely, the relationship between socio-demographic and economic factors and NMUPD, their abuse/dependence is unclear. Although health insurance has been found to be an important predictor of these health problems, its effect on different sub groups of population has not been studied. It is important to study the effect of health insurance and different demographic factors on these health problems because health insurance is amenable to policy change. This investigation can help identify various high risk groups (with and without health insurance) who should be focused while implementing health policy changes and developing prevention and treatment programs. Table 5 presents list of studies finding positive relationship between the NMUPD, their abuse and dependence. Table 6 presents list of studies finding negative relationship between the NMUPD, their abuse and dependence. Summary of the review of literature is also been presented in Table 7.

Table 5: Studies finding positive relationship between the independent and dependent variables

Positive relationship	**Dependent variables**		
Independent variables	**NMUPD**	**Prescription drug abuse and dependence**	**Use of substance abuse treatment**
Health insurance (insured)	-	Becker et al., 2008	Waehrer et al., 2008 Weaver et al., 2008
Age	Simoni-Wastila, et al., 2004 Simoni-Wastila, L., & Strickler, G., 2004 Wu et al., 2008	Simoni-Wastila, L., & Strickler, G., 2004 Becker et al., 2007 Carise et al., 2007	Weisner et al., 2002 Wu et al., 2003
Gender (male)	Wu et al., 2003 McCabe et al., 2004 McCabe et al., 2005 Huang et al., 2006 Kroutil et al., 2006 McCabe et al., 2007	Huang et al., 2006 Carise et al., 2007 Compton et al., 2007	Weisner et al., 2002
Race and ethnicity (other than Whites)	Huang et al., 2006 Becker et al., 2007 Compton et al., 2007	Wu et al., 2008 Huang et al., 2006	Weisner et al., 2002 Keyes et al., 2008 Perron et al., 2009
Level of education	Huang et al., 2006		Weisner et al., 2002 Wu et al., 2005
Marital status (married)			Weisner et al., 2002
Employment status (unemployed)	Simoni-Wastila, L., & Strickler, G., 2004 Becker et al., 2007 Becker et al., 2008	Simoni-Wastila, L., & Strickler, G., 2004 Becker et al., 2008	Wu et al., 2003 Becker et al., 2008
Family income	Simoni-Wastila, et al., 2004		S Green-Hennessy, 2000, Mertens & Weisner, 2000, Pollack & Reuter, 2006.
Health status (fair /poor)	Simoni-Wastila, L., & Strickler, G., 2004 Simoni-Wastila, et al., 2004 Matzger and Weisner., 2007	Simoni-Wastila, L., & Strickler, G., 2004 Becker et al., 2008 Wu et al., 2008	
Tobacco use/abuse/dependence	McCabe et al., 2005	Compton et al., 2007	

Positive relationship	**Dependent variables**		
Independent variables	**NMUPD**	**Prescription drug abuse and dependence**	**Use of substance abuse treatment**
	McCabe et al., 2005 Boyd et al., 2006 Becker et al., 2007 Tetrault et al., 2008 Becker et al., 2008		
Alcohol use/abuse/dependence	Simoni-Wastila, L., & Strickler, G., 2004 Simoni-Wastila, et al., 2004 McCabe et al., 2005 McCabe et al., 2005 Boyd et al., 2006 Ives et al., 2006 Stahl et al., 2006 McCabe et al., 2006 McCabe et al., 2007 Novak et al., 2007 Becker et al., 2007 Blanco et al., 2007 Tetrault et al., 2007 Becker et al., 2008 Simoni-Wastila, et al., 2008 Matzger and Weisner., 2007 Herman-Stahl et al., 2007	Simoni-Wastila, L., & Strickler, G., 2004 Blanco et al., 2007 Carise et al., 2007 Compton et al., 2007 McCabe et al., 2007 Becker et al., 2007 Wu et al., 2008	
Illicit drugs use/abuse/dependence	Simoni-Wastila, et al., 2004 McCabe et al., 2005 McCabe et al., 2005 McCabe et al., 2005 Boyd et al., 2006 Ives et al., 2006 Pletcher et al., 2006 Stahl et al., 2006 Becker et al., 2007 Blanco et al., 2007 Herman-Stahl et al., 2007 Matzger and Weisner., 2007 Novak et al., 2007	Blanco et al., 2007 Becker et al., 2008	Wu et al., 2003

Positive relationship	**Dependent variables**		
Independent variables	**NMUPD**	**Prescription drug abuse and dependence**	**Use of substance abuse treatment**
	Tetrault et al., 2007 Becker et al., 2008 Simoni-Wastila, et al., 2008		

Table 6: Studies finding negative relationship between the independent and dependent variables

Negative relationship	**Dependent variables**		
Independent variable	**NMUPD**	**Prescription drug abuse and dependence**	**Use of substance abuse treatment**
Health insurance (insured)	Kroutil et al., 2006 Becker et al., 2007 Tetrault et al., 2007	Becker et al., 2008	Wu et al., 2003
Age	Simoni-Wastila, et al., 2004 Simoni-Wastila, L., & Strickler, G., 2004 Huang et al., 2006 Ives et al., 2006 Johnston et al., 2006 Kroutil et al., 2006 Becker et al., 2007 Blanco et al., 2007 Becker et al., 2008	Miller et al., 2004 Huang et al., 2006 Blanco et al., 2007 Compton et al., 2007 Kaloyanides et al., 2007 McCabe et al., 2007 Wu et al., 2008	Waehrer et al., 2008 Becker et al., 2008
Gender (male)	Simoni-Wastila, et al., 2004 Simoni-Wastila, L., & Strickler, G., 2004 Boyd et al., 2006 Stahl et al., 2006 Blanco et al., 2007 Simoni-Wastila, et al., 2008	Miller et al., 2004 Simoni-Wastila, L., & Strickler, G., 2004 Compton et al., 2007 Wu et al., 2008 Becker et al., 2008 Simoni-Wastila, et al., 2008	Waehrer et al., 2008 Wu et al., 2005
Race and ethnicity (other than Whites)	McCabe et al., 2003 McCabe et al., 2004 Simoni-Wastila, et al., 2004 Simoni-Wastila, L., & Strickler, G., 2004 McCabe et al., 2005 McCabe, Boyd, & Teter., 2005 Huang et al., 2006 Kroutil et al., 2006 Stahl et al., 2006 Blanco et al., 2007 McCabe et al., 2007 Herman-Stahl et al., 2007 Simoni-Wastila, et al., 2008	Miller et al., 2004 Carise et al., 2007 Simoni-Wastila, et al., 2008	Wells et al., 2001 Wu et al., 2003 Wu, Ringwalt & William, 2003 Wu et al., 2005 Wu et al., 2007 Waehrer et al., 2008 Weaver et al., 2008

Negative relationship	**Dependent variables**		
Independent variable	**NMUPD**	**Prescription drug abuse and dependence**	**Use of substance abuse treatment**
Level of education	McCabe et al., 2004 Blanco et al., 2007 Becker et al., 2008 Durell et al., 2008	Becker et al., 2007 Blanco et al., 2007	Wu et al., 2003 Wu et al., 2005 Waehrer et al., 2008
Marital status (married)	Simoni-Wastila, et al., 2004 Huang et al., 2006 Becker et al., 2007 Blanco et al., 2007	Simoni-Wastila, L., & Strickler, G., 2004 Huang et al., 2006 Blanco et al., 2007 Becker et al., 2007 Compton et al., 2007	
Employment status (unemployed)		Carise et al., 2007	
Family income	Huang et al., 2006 Blanco et al., 2007 Kroutil et al., 2006	Compton et al., 2007	Wu et al., 2003 Waehrer et al., 2008
Health status (fair /poor)	Simoni-Wastila, et al., 2008	Simoni-Wastila, et al., 2008	
Tobacco use/abuse/dependence			
Alcohol use/abuse/dependence		Becker et al., 2007 Becker et al., 2008	
Illicit drugs use/abuse/dependence		Simoni-Wastila, L., & Strickler, G., 2004	

Table 7: Summary of literature review

	Greater probability of		
Independent variables	**NMUPD**	**Prescription drug abuse and dependence**	**Use of substance abuse treatment**
Health insurance status	Uninsured individuals	-	Mixed effect
Type of health insurance	-	Medicaid	Medicaid/other public insurance
Age	Younger individuals	Younger individuals	Older individuals
Gender	Mixed effect	Mixed effect	Mixed effect
Race and ethnicity	Mixed effect	Mixed effect	Mixed effect
Level of education	Lower education	Lower education	Mixed effect
Marital status	Unmarried individuals	Unmarried individuals	No effect
Employment status	Unemployed individuals	Unemployed individuals	Unemployed individuals
Family income	Mixed effect	-	Higher income
Health status	Poor/fair health	Poor/fair health	-
Use of tobacco	Users of tobacco	Users of tobacco	Users of tobacco
Use of alcohol	Users of alcohol	Users of alcohol	Users of alcohol
Use of illicit drugs	Users of illicit drugs	Users of illicit drugs	Users of illicit drugs

CHAPTER 3: METHODOLOGY

This chapter provides a description of the method, which includes: 1) research design, 2) description of the dataset, 3) description of the study sample, 4) independent and dependent variables, 5) data analysis, 6) regression diagnostics, 7) interpretation of the odds ratio in case of interaction between two independent variables.

3.1 Research design and data

This is a retrospective cross-sectional study design. The study used the 2007 National Survey on Drug Use and Health (NSDUH) data. NSDUH is sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA), and data is collected by the Research Triangle Institute (RTI) International. NSDUH provides estimates of substance use and related disorders for the U.S. general population. The purpose of NSDUH is to determine changes in the pattern of use of tobacco, alcohol and other drugs with time, their consequences on individuals' health and to identify individuals who are at high risk for substance use and abuse. Precisely, NSDUH collects nationwide information on the prevalence, patterns and consequences of the use of alcohol, tobacco and nine categories of illicit and prescription drugs in the general U.S. civilian non-institutionalized population aged 12 years and older. Drugs included in this survey are illicit drugs such as marijuana, cocaine, crack, heroin, hallucinogens, inhalants and four categories of prescription drugs such as pain relievers, tranquilizers, stimulants and sedatives [116]. The data also collects other information such as socio-demographic characteristics and the mental health of the individuals.

NSDUH makes use of multistage area probability sampling methods to select a representative sample in all 50 states. Data are collected from household residents, residents of

shelters, rooming or boarding houses, halfway houses, college dormitories, group homes and civilians residing on military bases. Individuals from the age groups 12–17, 18–25 and 26 years and older are oversampled to create equal sample sizes to improve the precision of drug use estimates for these key subgroups. One or two residents of a household are selected by the field interviewer through an in-person interview. Once selected, participation by a respondent is voluntary. Those individuals, who agree to participate, complete an interview on a laptop in their home. Participants are assured that their names will not be recorded and that their responses will be kept confidential. All study procedures and protections are carefully explained to them. For adolescents aged 12–17 years, the field interviewer first seeks verbal consent from their parents or guardians. After obtaining parental permission, field interviewer approaches the adolescents to obtain their agreement to participate in the study. Parents are then asked to leave the interview setting to ensure the confidentiality of their children's responses. The interview takes about one hour, and at the completion of the interview respondent receives an incentive of $30 for their participation. Details of NSDUH are described elsewhere [117].

3.1.1 **Reliability and validity of NSDUH:**

The NSDUH survey items have been evaluated for accuracy and reproducibility of results [26]. The survey has been refined several times since its initiation. NSDUH being a survey is prone to non-response bias and social desirability bias. Non-response bias occurs when sampling units selected for the survey are either unable to provide responses or are unable to participate in the survey. This leads to a situation where respondents are different from non-respondents [118]. In 2007 NSDUH, non-response-adjusted and post stratified analysis weights were used to calculate unbiased estimates of drug use. Survey administrators try to minimize non-response

bias by providing a $30 incentive to the respondents. Missing or inconsistent responses are resolved where possible through a logical editing process, or they are imputed using statistical methodology. These imputation procedures are based on responses to multiple questions. Thus, the maximum amount of information possible is used in determining whether a respondent is a user or nonuser.

Social desirability bias, also known as self report bias takes place when individuals provide socially acceptable responses to questions. This causes under-reporting of behaviors deemed unacceptable by society and over-reporting of behaviors acceptable in society [119]. This occurs due to either social stigma or fears of disclosure. ACASI (Audio Computer Assisted Self Interview) technology has been used in the NSDUH since 1999. This technology was also used in the 2007 NSDUH and helps to control social desirability bias. In this method, questions that involve sharing of private, confidential and sensitive information are administered using a computer, and participants read the questions on a computer screen or listen to them through headphones and then enter their responses into the computer. This encourages privacy and makes respondents comfortable in providing information regarding illicit drug use and other sensitive behaviors. Moreover, respondents are assured that their responses will be kept confidential. These measures have been found to be effective in reducing reporting bias [120]

A study was conducted to determine the reliability of the responses provided by the respondents in NSDUH. The study used an interview/re-interview method and 3,136 individuals were interviewed on two occasions during 2006 at a gap of five to fifteen days. The reliability of the responses was assessed by comparing the responses of the first interview to the responses from the re-interview. Results showed that respondents provided consistent answers on the

substance use and mental health measures [27]. Jordan and coworkers (2008) conducted a clinical validation study to determine the validity of the estimates of substance use disorder (SUDs) obtained from the NSDUH. SUDs in this study also included abuse or dependence on prescription drugs. The sample consisted of 288 adults and adolescents recruited from the community and outpatient substance abuse treatment programs in North Carolina. They used the Structured Clinical Interview for DSM-IV (SCID-IV) for adults and the Pittsburgh Adolescent Alcohol Research Center's Structured Clinical Interview (PAARC-SCID) for adolescents to calculate the validity of the NSDUH questions in measuring SUDs. Kappa value for any drug abuse, dependence or drug abuse/dependence varied from 0.59-0.74, which indicates fair to moderate level of agreement between the NSDUH and the SCID/PAARC-SCID interviews [121].

A recent study was conducted by SAMHSA and NIDA, which examined the validity of self-reported data of NSDUH on drug use among persons aged 12-25 years. This study compared self-reported data with the results of drug tests obtained from urine and hair specimens of the same respondents who provided the self-reported data. The results of the study showed that most of the people in that age group accurately reported their drug use [122].

3.2 **Sample Selection**

2007 NSDUH survey had a sample size of 67,870 persons. However, before making the file public; micro agglomeration, substitution, sub-sampling and calibration (MASSC) method was used to control the risk of disclosing the identity of any respondent. This method involves

removing variables that presented higher risk of identifying the respondents and collapsing the values of other variables. Some of the records were also randomly sampled and removed from the original file. Additionally, substitution of the data was done to maintain confidentially of the responses and the resulting data were checked for any effect on the level and accuracy of estimates. As a result of the MASSC method, only 55,435 records are available on the public use file.

Inclusion criteria:

Individuals who were 12-64 years old and non-institutionalized were considered for the analysis.

Exclusion criteria:

Individuals receiving health coverage through Medicare and 'other' health insurance programs were excluded from the analysis. Medicare enrollees were excluded from the analysis because most of them were elderly individuals (65 years and older) who had health coverage. Thus, there was no variability in health coverage among this age group. They were also different from the rest of the population in other socio-demographic and economic characteristics such as income, employment etc.

Individuals with 'other' health insurance were excluded from the analysis because this group included individuals who had health insurance, but did not know what kind of health insurance they had. Use of this group would have contaminated the sample and might have biased the study results.

3.3 **Sample size calculation**

For sample size calculations, alpha = 0.05, and power = 0.80 were used in this study. Other required estimates such as baseline probability (probability of NMU/ prescription drug abuse/ dependence among the uninsured), percentage of people having health insurance among those who engage in these problem health behaviors and odds ratio were obtained from the literature.

Effect size:

The effect size calculation was based on the primary objective of this study, which was to assess the relationship between health insurance and other socio-demographic factors on NMUPD, their abuse and dependence. Correlation coefficients were used to state the relationship between health insurance coverage and other independent variables such age, gender, race and ethnicity, type of education, marital status, employment, family income, health status, use of tobacco and use of alcohol.

Correlation coefficient is a measure of correlation between two variables. For the sample size calculation, correlation between two independent variables was used. Review of the literature suggested that it lie in the range of - 0.36 to less than 0.60 [8, 71]. A conservative effect size of r = - 0.36 (r^2=0.13) was used for sample size calculations.

Other estimates used for calculation of NMUPD, prescription drug abuse and dependence, and substance abuse treatment:

Besides effect size, other estimates were used for the calculation of sample size. These include baseline probability (probability of NMU/prescription drug abuse/dependence among the

uninsured), percentage of people having health insurance among those who engage in these problem health behaviors, and odds ratio. These parameters are presented in Table 8.

Table 8: Parameters required for sample size calculation

Parameter	**For NMUPD**	**For prescription drugs abuse or dependence**	**For utilization of substance abuse services**
Baseline probability	4.5% to 8.2% [5, 7, 91]	2.0% to 13.8% [5-7]	1.6% to 12.6% [6, 62, 105]
Percentage of people having health insurance among those who engage in the respective problem health behavior	80.6% to 91.4% [5, 7, 91]	62.20% to 85.80% [5-7]	84% [6]
Odds ratio	1.2 to 1.7 [5, 7, 60]	1.4 – 3.2 [5-7, 62]	0.5 to 4.9 [62, 105]

For NMUPD:

Baseline probability = 4.5% (0.045), odds ratio =1.2, and percentage of those having health insurance= 80.6% were used for this study.

For prescription drugs abuse or dependence:

Sample size calculations were performed using the following parameters: baseline probability = 2.0% (0.020); odds ratio =1.4 and percentage of those having health insurance= 62.20%.

For utilization of substance abuse services:

Employing a more conservative approach, baseline probability = 1.6% (0.016), odds ratio =0.5, and percentage of those having health insurance= 84% were used for the calculation of sample size.

Estimated sample size:

By using logistic regression analysis and an effect size (r^2) = 0.13, power = 80%, significance level of 0.05, and the above mentioned parameters; the most conservative sample size required to detect minimum detectable odds ratio would be: 37,956 for 'NMUPD', 12,635 for 'prescription drug abuse and dependence', and 2,956 for 'substance abuse services'. NCSS/PASS software was used for the sample size calculations [123]. Preliminary analyses indicated that the required sample size was available from the 2007 NSDUH.

All of the respondents in the 2007 NSDUH were considered for the analysis of NMUPD. Individuals who had used at least one prescription drug non-medically in the past year were considered for the analysis of prescription drug abuse and dependence. In 2007 NSDUH, questions regarding use of substance abuse treatment were asked only to those individuals who reported non-medical use of prescription/illicit drugs ever in their life. However, for this study, the sample was limited to those individuals who reported non-medical use of prescription drugs or both prescription drugs and illicit drugs ever in their life.

3.4 **Definition of dependent variables**

Non-medical use:

It was defined as a binary variable where one refers to non-medical use of at least one medication (in the past year) from the pain relievers, tranquilizers, stimulants or sedatives class without a prescription or the use of medication that had occurred simply for the experience or feeling that it cause, and individuals who did not meet the above criteria were assigned zero.

Prescription drug abuse or dependence:

Prescription drug abuse was defined as a binary variable where one refers to the abuse/dependence on psychotherapeutic drugs in the past year, and zero refers to absence of such an abuse/dependence in the past year.

Use of substance use services:

Individuals' use of substance use treatment services were determined from the following question: "During the past 12 months, when you received treatment, was the treatment for alcohol use only, drug use only, or both alcohol and drug use?" The term 'drug' in this question includes marijuana, cocaine, heroin, hallucinogens, inhalants, methamphetamine or lifetime use of prescription pain relievers, tranquilizers, stimulants, or sedatives. Individuals were considered as having received treatment if they received treatment for drugs, for both drugs and alcohol, for alcohol only (but last treatment was also for drugs), drugs only (but the last treatment was also for alcohol).

3.5 **Definition of independent variables**

Based on the review of literature, the following independent variables were used for the analysis: health insurance status, age, gender, race/ethnicity, type of education, marital status, employment, family income, health status, use of tobacco and use of alcohol.

Health insurance coverage:

Individuals were classified into three health insurance categories: private; public (having Medicaid/S-CHIP, Tricare, Champus, Champva , VA, military insurance or any other type of public health insurance); and uninsured.

Other Independent variables:

Based on the previous literature, different demographic variables were categorized as age (aged 12-17, 18-25, 26-34, 35-49 and 50-64 years); sex; race/ethnicity (categorized as non-Hispanic white, non-Hispanic black, Hispanic and other); years of schooling categorized as less than high school, high school graduate, some college and college graduate); marital status (categorized as married, widowed/divorced/separated and never been married); employment status was classified as employed, unemployed or not in labor force; income (categorized as less than 20,000, 20,000-39,999, 40,000-74,999 and 75,000 or above); reported general health (categorized as excellent/very good/good and fair/poor); use of tobacco (yes/no) and use of alcohol (yes/no).

3.6 **Data analysis**

Data analysis were conducted using SAS® statistical software version 9.1 [124]. Bivariate association between demographic factors and dependent variables were determined through chi square test for categorical variables. All the independent variables in bivariate analyses were tested for significance at $p<0.05$. Multivariate logistic regression analysis was used to determine the relationship between dichotomous or binary dependent variables and one or more independent variables. It predicts the odds of the occurrence of an event (i.e., dependent variable). For this study, the following Logistic regression model was used.

$$\text{Logit}[P(Y=1)] = \beta_o + \beta_1(\text{insur}) + \beta_2(\text{age}) + \beta_3(\text{gender}) + \beta_4(\text{race}) + \beta_5(\text{edu-type}) + \beta_6(\text{marital status}) + \beta_7(\text{employ}) + \beta_8(\text{income}) + \beta_9(\text{health status}) + \beta_{10}(\text{tobacco use}) + \beta_{11}(\text{alcohol use}) + \beta_{12}(\text{insur} \times \text{age}) + \beta_{13}(\text{insur} \times \text{gender}) + \beta_{14}(\text{insur} \times \text{race}) + \beta_{15}(\text{insur} \times \text{edu-type}) + \beta_{16}(\text{insur} \times \text{marital status}) + \beta_{17}(\text{insur} \times \text{employ}) + \beta_{18}(\text{insur} \times \text{income}) + \beta_{19}(\text{insur} \times \text{health status}) + \beta_{110}(\text{insur} \times \text{tobacco use}) + \beta_{111}(\text{insur} \times \text{alcohol use}) + \varepsilon$$

Where Y denotes dependent variable (i.e., NMUPD, abuse or use of substance use services).

β_o is the intercept.

β_1 denotes the logistic regression coefficients for health insurance.

Insur denotes type of health insurance.

β_{12} indicates the logistic regression coefficient for interaction between health insurance and age.

ε indicates the error term.

3.6.1 **Sample weights:**

The study data for the 2007 NSDUH is obtained through multistage area probability sampling. This means estimates obtained from the 2007 NSDUH are based on sample survey and information is not collected from the entire U.S. population. Thus, to get unbiased estimates of the drug misuse, sample weights provided by the survey were used for the analyses. Use of weights helps to account for the complex sampling methodology and for non-response in the NSDUH. Sampling weights also normalized the data to the distributions based on the 2000 census.

3.6.2 **Model fit**

Several measures of model fitness were assessed. Logistic regression analysis predicts the probability of a binary outcome. In assessing model fitness, the objective is to compare the observed outcome with the expected outcome. If the model can accurately predict those with and without the outcome, then the model is considered to be robust.

Goodness of fit of the model:

Goodness of fit of the model describes how well the model fits the data. It can be measured by the Hosmer and Lemeshow chi-square test of goodness of fit or R square. The Hosmer and Lemeshow chi-square test of goodness of fit tests the null hypothesis that there is no difference between the observed and predicted values of the outcome variable. This test divides the observations into 10 equal sized groups (deciles) based on the predicted probabilities. The test statistics follows a chi square distribution, and if the results of this test are non-significant, then one cannot reject the null hypothesis. This means there is no difference between the

observed and predicted values of the outcome variable, which suggests that the selected model adequately describes the outcome of the study [125, 126].

R square:

It is also known as coefficient of determination. It does not measure the goodness of fit of the model but explains how much variability in the outcome variable is accounted for by the statistical model used for the analysis. Thus, it indicates usefulness of the model in explaining the outcome variable. It is regarded as the measure of effect size.

Nagelkerke's R^2 will be used in this study. It's an adjustment of the Cox & Snell's R^2 and its value varies from zero to one. Zero denotes that independent variables do not explain the outcome variable, and one denotes that they perfectly explain the outcome [125, 126].

Percent concordant:

The percent concordant values provide an indication of overall model quality through the association of predicted probabilities and observed responses. These values are based on the maximum likelihood estimation of the percent of paired observations of which values differ from the response variable [127]. A pair of observations with different observed responses is said to be concordant if the observation with the lower ordered response value (for e.g. nmu = 0) has a lower predicted mean score than the observation with the higher ordered response value (nmu = 1). Thus, the higher the predicted event probability of the higher response variable, the greater will be the value of the percent concordant. The literature does not provide any range of values for percent concordant to check for the goodness of the model.

Model discrimination

Area Under the Receiver Operating Characteristics Curve (AUROC) compares expected predicted probability with the observed outcome and compares if the model was able to accurately distinguish those with and without the outcome. An area of one indicates that the test correctly distinguishes between those with and without the outcome whereas an area of 0.5 or less suggests that the model may not have been appropriate [125, 126].

Test for interaction effects:

The likelihood ratio test (LRT) was performed to assess the importance of interaction terms. LRT for a particular parameter compares the likelihood of obtaining the data when the parameter is zero with the likelihood of obtaining the data when the parameter is not zero. The LRT is used only when a simple model is nested within the more complex model, i.e. complex model must differ from the simple model only by the addition of one or more parameters. The test follows a chi square distribution. If the p value of the test is less than 0.05, this suggests that the parameter contributes to the model and should be retained in the model [125, 126].

In this study, joint test of significance was used. It is a type of LRT where all the interaction terms to be tested are entered into the model all at once. If the overall model is significant, this means there are some interaction terms that contribute significantly to the model. The next step is to obtain the reduced model by dropping the insignificant interaction term. The joint test of significance is conducted again for the reduced model, and if the result of test is significant, this suggests that interaction terms in the reduced model contribute significantly to

the overall model and should be retained in the model. The final model used for the analysis is the model from which all the insignificant interaction terms have been dropped.

3.7 **Human subjects' approval**

The study was submitted to the University of New Mexico Health Science Center Human Research Review (HRRC) committee for an exempt review because this study involves use of publicly available existing data from which all the identifiers have been removed before making the data public. The study was approved for exempt review by the HRRC committee.

CHAPTER 4: RESULTS

This chapter presents results of the study and has three sections. Section-I describes association between health insurance coverage and non-medical use of prescription. Section-II describes the relationship between health insurance and prescription drug abuse/dependence. Section-III presents association between health coverage and use of substance abuse treatment year among those who reported non-medical use of prescription drugs in their life.

4.1 Association between health insurance and NMUPD

4.1.1 Descriptive statistics by health insurance

Table 9 presents the descriptive statistics of the study sample. The sample consisted of 52,530 respondents out of which 82% had health insurance. Sixty nine percent had private health insurance, and 13% had public health insurance. Eight percent of the population reported NMUPD. NMUPD was highest among uninsured individuals and lowest among individuals with private health coverage. Uninsured individual were also found to have greater use of tobacco (49%) and illicit drugs (23%) whereas use of alcohol was higher among individuals with private health coverage (69%).

Private health insurance was common among 35-49 year old individuals (33%), Whites (74%), college graduates (32%), married (59%), employed (83%), those with higher family income greater than $75,000 (45%), and among individuals with excellent/very good/good health (94%). On the other hand, individuals with public health coverage were mostly females (57%), and 12-17 year old (27%). They were more likely to have never been married (47%), have lower education (47%) and family income (43%). Around one-fifth of the respondents did not have

health coverage and they were generally males (54%), had either less than high school (35%) or high school education (35%), were never been married (44%) and reported $20,000-$40,000 as the family income (34%).

Table 9: Characteristics of the sample by health insurance categories (Weighted %)

Variable category	Total sample	Private insurance	Public insurance	Uninsured	P-value
Gender					
Male	49.39	49.52	43.55	53.58	<0.0001
Female	50.61	50.48	56.45	46.42	
Age					
12-17	12.11	11.10	26.74	5.49	<0.0001
18-25	15.70	12.88	18.03	23.92	
26-34	16.87	15.59	14.43	23.25	
35-49	30.73	33.10	20.08	30.17	
50-64	24.58	27.33	20.72	17.18	
Race					
White, non-Hispanic	66.01	73.91	48.44	50.30	<0.0001
Black, non-Hispanic	12.06	9.38	24.78	13.05	
Hispanics	15.40	10.28	20.02	30.92	
Others	6.52	6.43	6.76	5.73	
Education					
Less than high school	24.73	17.54	47.29	35.34	<0.0001
High school graduate	26.19	23.95	26.45	35.15	
Some college	23.97	25.87	19.10	20.05	
College graduate	25.11	32.64	7.16	9.46	
Marital status					
Married	51.53	59.44	33.78	34.60	<0.0001
Widowed/ divorced/separated	14.46	11.83	18.95	21.31	
Never been married	34.01	28.73	47.27	44.08	
Employment status					
Employed	75.63	82.63	46.35	69.87	<0.0001
Unemployed	4.33	2.25	8.27	9.64	
Other	20.04	15.40	45.39	20.49	
Annual household income					
< $20, 000	16.22	6.48	43.29	32.72	<0.0001
$20, 000-$39,999	19.96	14.87	26.48	34.09	

Variable category	Total sample	Private insurance	Public insurance	Uninsured	P-value
$40, 000-$74,999	29.94	33.88	18.63	23.73	
≥ $75,000	33.88	44.77	11.60	9.47	
Reported general health					
Excellent/very good/good	90.80	94.08	82.08	85.17	<0.0001
Fair/poor	9.20	5.92	17.92	14.83	
Past year use of tobacco					
Yes	36.97	33.38	39.72	48.58	<0.0001
No	63.03	66.62	60.28	51.42	
Past year use of alcohol					
Yes	68.79	72.83	52.95	65.39	<0.0001
No	31.21	27.17	47.05	34.61	
Past year use of illicit drugs					
Yes	16.60	14.39	19.10	22.84	<0.0001
No	83.40	85.61	80.90	77.16	
NMU					
Yes	7.51	6.46	8.41	10.66	<0.0001
No	92.49	93.54	91.59	89.34	
Rx drug abuse/dependence					
Yes	0.97	0.64	1.45	1.84	<0.0001
No	99.03	99.36	98.55	98.16	
Treatment					
Yes	5.60	3.43	7.09	9.33	<0.0001
No	94.40	96.57	92.91	90.67	
Total Observation	**52530**	**31939 (69.16%)**	**9668 (12.93%)**	**9407 (17.91%)**	**-**

4.1.2 **Descriptive statistics by NMUPD**

Table 10 presents descriptive statistics for those who engaged in NMUPD compared to those who did not engage in NMUPD in the past year. Out of the total sample, 5190 (10%) individuals reported NMUPD. About three-fourths of the people using prescription drugs non-medically were insured and about 13% of the non-medical users of prescription drugs also abused or were dependent on prescription drugs. Use of tobacco (68%), alcohol (87%), and illicit drugs (100%) was considerably higher among non-medical users compared to those who abstained from NMUPD. More than 70% of the non-medical users received treatment for NMUPD, illicit drug use, and abuse or dependence on prescription and illicit drugs.

Prevalence of NMUPD was higher among males (53%) and younger adults aged 18-25 year old (32%). Whites (75%) had significantly greater non-medical use of prescription drugs followed by Hispanics (12%), Blacks (8%) and others (5%). People engaging in NMUPD were also more likely to have less than a high school education (29%), had never been married (55%) and were employed (72%). The number of people using prescription drugs non-medically increased with the increasing income and it was highest in the income category $40,000-$74,999.

Table 10: Characteristics of the non-medical users of prescription drugs (weighted %)

Variable category	NMUPD	Absence of NMUPD	P - value
Health insurance			
Insured	74.42	82.71	<0.0001
Uninsured	25.58	17.29	
Gender			
Male	52.94	49.10	0.0002
Female	47.06	50.90	
Age			
12-17	13.00	12.04	<0.0001
18-25	31.96	14.39	
26-34	19.50	16.66	
35-49	23.82	31.29	

Variable category	NMUPD	Absence of NMUPD	P - value
50-64	11.72	25.62	
Race			
White, non-Hispanic	75.05	65.28	<0.0001
Black, non-Hispanic	8.32	12.37	
Hispanics	11.86	15.69	
Others	4.76	6.67	
Education			
Less than high school	28.70	24.40	<0.0001
High school graduate	27.36	26.10	
Some college	26.44	23.77	
College graduate	17.49	25.73	
Marital status			
Married	30.89	53.25	<0.0001
Widowed/divorced/separated	13.72	14.52	
Never been married	55.39	32.22	
Employment status			
Employed	72.35	75.90	<0.0001
Unemployed	7.34	4.08	
Other	20.31	20.01	
Annual household income			
< $20, 000	22.33	15.72	<0.0001
$20, 000-$39,999	22.56	19.75	
$40, 000-$74,999	28.85	30.03	
≥ $75,000	26.26	34.50	
Reported general health			
Excellent/very good/good	89.88	90.88	<0.0001
Fair/poor	10.12	9.12	
Past year use of tobacco			
Yes	68.16	34.44	<0.0001
No	31.84	32.72	
Past year use of alcohol			
Yes	87.32	67.28	<0.0001
No	12.68	32.72	
Past year use of illicit drugs			
Yes	99.76	9.85	<0.0001
No	0.24	90.15	
Rx drug abuse/dependence			
Yes	12.97	-	<0.0001
No	87.03	100.00	
Treatment			
Yes	72.62	3.40	<0.0001
No	27.38	96.60	
Total Observation	**5190 (9.88%)**	**47340 (90.12%)**	**-**

4.1.3 **Prevalence of NMUPD by different therapeutic classes:**

Figure 1 shows prevalence of NMUPD by therapeutic class. Non-medical use was highest for pain relievers (76%) followed by tranquilizers (29%), stimulants (19%) and sedatives (5%). Table 11 presents non-medical use of the top five drugs within each therapeutic class. Among different pain relievers, Vicodin/Lortab/Lorcet was used most frequently non-medically (9%), whereas codeine was used the least (4%). Among different types of tranquilizers, most of the respondents reported using Valium/Diazepam (6%) non-medically followed by Xanax (5%), Klonopin (2%), Soma (1%) and Flexeril (1%). Most of the individuals using prescription stimulants non-medically reported non-medical use of methamphetamine/Desoxyn/Methedrine (5%) and some of them also used Dextroamphetamine (0.2%). In the list comprising the top five sedatives used non-medically, Methaqualone/Sopor/Quaalude was used most commonly non-medically (3%) whereas the least amount of non-medical use observed for Placidyl (0.3%).

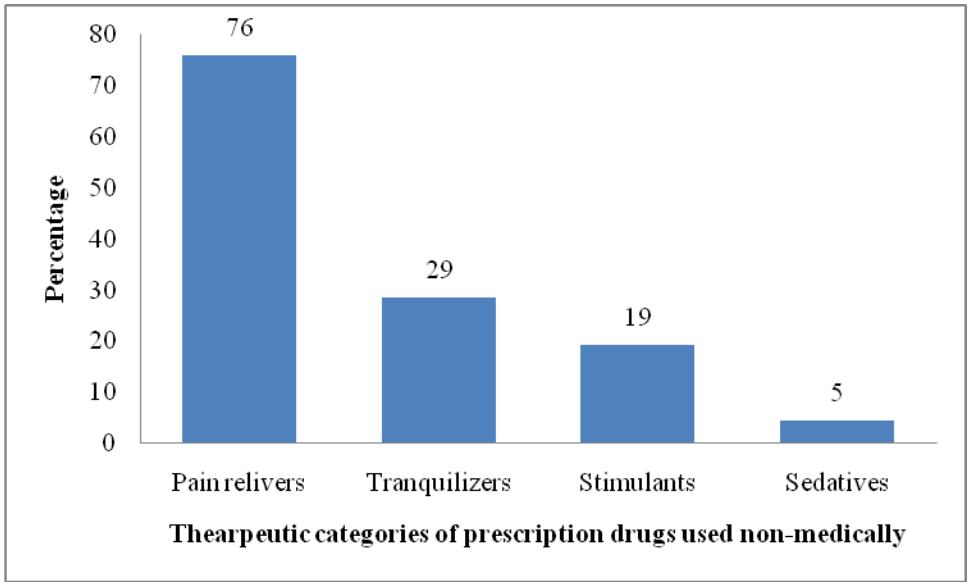

Figure 1: Prevalence of NMUPD by different therapeutic classes

Table 11: Top five prescription drugs ever used non-medically by the U.S. individuals (Weighted %)

S. No.	Pain relievers (%)	Tranquilizers (%)	Stimulants (%)	Sedatives (%)
1	Vicodin/Lortab/Lorcet (9.26)	Valium /Diazepam (6.04)	Methamphetamine, Desoxyn/Methedrine (4.91)	Methaqualone/Sopor/ Quaalude (2.67)
2	Darvocet/Darvon/Tylenol with Codeine (8.67)	Xanax/Alprazolam, Ativan/Lorazepam (5.40)	Diet pills such as amphetamines (3.45)	Barbiturates such as Nembutal (1.08)
3	Percocet/Percodan/ Tylox (5.44)	Klonopin /Clonazepam (1.77)	Ritalin/Methylphenidate (2.14)	Restoril/Temazepam (0.41)
4	Hydrocodone (3.96)	Soma (1.34)	Dexedrine (1.05)	Phenobarbital (0.38)
5	Codeine (3.48)	Flexeril (1.21)	Dextroamphetamine (0.22)	Placidyl (0.25)

4.1.4 **Descriptive statistics of NMUPD by therapeutic classes:**

Table 12 presents descriptive statistics of non-medical users of prescription drugs by different therapeutic classes. Uninsured individuals were more likely to use prescription stimulants non-medically whereas individuals with private and public health coverage were more likely to use sedatives non-medically. Tobacco use was highest among people using stimulants non-medically (79%). Individuals using pain relievers non-medically were least likely to abuse/depend on prescription drugs (15%) and were most likely to seek substance abuse treatment (72%) than the other non-medical users.

Non-medical use of pain relievers was common among males (56%), those who had either less than high school (29%) or high school education (29%). Individuals using tranquilizers non-medically were more likely to be high school graduates (30%) and married (31%). Individuals using stimulant non-medically were female (51%) and young adults of 18-25 years of age (39%). Most had some college education (31%), had never been married (66%), and were also more likely to use tobacco (79%) and alcohol (91%). Fewer of the individuals used

sedatives non-medically. Individuals engaging in non-medical use of sedatives were 35-49 years old (28%), Whites (83%), employed (77%), and had either some college (28%) or more than college education (29%).

Table 12: Characteristics of non-medical users of prescription drugs by therapeutic classes (Weighted %)

Variable category	Pain relievers	Tranquilizers	Stimulants	Sedatives	P - value
Health insurance					
Private	58.27	61.55	55.98	62.09	0.0004
Public	14.21	11.64	12.01	14.76	
Uninsured	27.52	26.81	32.01	23.16	
Gender					
Male	55.87	50.49	49.46	51.66	<0.0001
Female	44.13	49.51	50.54	48.34	
Age					
12-17	12.46	8.78	13.27	12.62	<0.0001
18-25	34.08	33.97	39.06	22.31	
26-34	20.05	22.50	20.34	18.37	
35-49	23.89	21.44	21.98	27.56	
50-64	9.52	13.31	5.35	19.15	
Race/ethnicity					
White, non-Hispanic	74.93	80.07	78.72	82.67	<0.0001
Black, non-Hispanic	8.67	6.55	5.55	6.29	
Hispanics	11.55	9.69	9.82	7.01	
Others	4.85	3.69	5.91	4.03	
Education					
Less than high school	28.55	24.25	28.94	26.01	<0.0001
High school graduate	29.37	30.39	23.23	17.61	
Some college	26.38	25.42	30.63	27.52	
College graduate	15.70	19.93	17.20	28.86	
Marital status					
Married	28.76	30.80	21.23	30.21	<0.0001
Widowed/divorced/separated	13.96	11.51	12.86	22.72	
Never been married	57.28	57.70	65.91	47.07	
Employer status					
Employed	73.51	71.73	66.27	76.73	<0.0001

Variable category	Pain relievers	Tranquilizers	Stimulants	Sedatives	P - value
Unemployed	7.60	8.12	8.01	5.22	
Other	18.89	20.15	25.71	18.05	
Annual household Income					
< $20, 000	22.86	19.07	28.70	26.18	<0.0001
$20, 000-$39,999	23.76	23.04	21.66	16.99	
$40, 000-$74,999	28.30	29.97	20.60	28.40	
≥$ 75,000	25.07	27.92	29.04	28.43	
Reported general health					
Excellent/very good/good	89.61	89.56	90.66	87.04	0.2185
Fair/poor	10.39	10.44	9.34	12.96	
Past year use of tobacco					
Yes	70.72	73.44	78.76	63.93	<0.0001
No	29.28	26.56	21.24	36.07	
Past year use of alcohol					
Yes	88.61	91.75	90.73	87.09	<0.0001
No	11.39	8.25	9.27	12.91	
Past year use of illicit drugs					
Yes	100.00	100.00	100.00	100.00	-
No	00.00	00.00	00.00	00.00	
Rx drug abuse/dependence					
Yes	15.39	19.12	23.67	26.72	<0.0001
No	84.61	80.88	76.33	73.28	
Treatment					
Yes	72.08	70.01	67.91	68.33	0.0257
No	27.92	29.99	32.09	31.67	
Total Observation	**3949 (5.52%)**	**1490 (2.33%)**	**1006 (1.27%)**	**238 (0.36%)**	**-**

4.1.5 **Logistic regression: association between health insurance and NMUPD**

The joint test of significance was used to test if interaction terms contributed significantly to the model. It is a likelihood ratio test where all the interaction terms to be tested are entered into the model all at once. The unrestricted model contained the main effects and the interaction terms. In the next step, restricted model was obtained by dropping the insignificant interaction terms. The joint test of significance was then performed for the interaction terms that were dropped from the model, and it was insignificant ($p=0.2093$). This suggested that these interaction terms did not contribute significantly to the overall model, and for parsimonious reasons these interaction terms were dropped from the unrestricted model. Table 13 shows the final model used for the analysis.

Results of the logistic regression analysis showed that age, race, education, marital status, type of health insurance, level of income, past-year use of tobacco and past-year use of alcohol were significantly associated with NMUPD. Significant interaction effects were observed between race and health insurance ($p<0.001$), education level and health insurance ($p<0.05$), and income and health insurance ($p<0.05$).

Probability of NMUPD was found to decrease with increase in age. It was highest among people aged 18-25 years (OR: 2.653, 95% CI: 1.967-3.578) and lowest among those aged 35-49 years (OR: 1.470, 95% CI: 1.102-1.961) when compared to 50-64 year old.

Controlling for all other variables in the model, individuals who were either widowed/ divorced/separated or had never been married were 36% (OR: 1.358, 95% CI: 1.071-1.720) and

53% (OR: 1.534, 95% CI: 1.285-1.831) more likely to indulge in NMUPD when compared to those who were married, respectively.

People engaging in risky health behaviors such as smoking and drinking were also at a higher risk of NMUPD when compared to their counterparts. Persons who used tobacco in the last year had 2.6 times greater odds (OR: 2.643, 95% CI: 2.305-3.032) of using prescription drugs non-medically when compared to those who did not use tobacco in the last year. Similarly, use of alcohol increased the probability of NMUPD by a factor of 2.4 (OR: 2.367, 95% CI: 1.913-2.928).

Results of the interaction effects showed that Hispanic people with private health insurance had 24% (OR: 1.978, $p<0.001$) greater odds of engaging in NMUPD when compared to uninsured Hispanic individuals. The interaction effect between education level and health insurance was significant for high school graduates with public health insurance. These individuals had a 14% (OR: 0.1773, $p<0.05$) lower likelihood of using prescription drugs non-medically when compared to uninsured high school graduates ($p<0.05$). Likelihood of using prescription drugs non-medically decreased with increasing income among individuals with private health insurance. Privately insured individuals reporting family income less than $20,000 were 11% (OR: 1.1081, $p<0.05$) more likely to engage in NMUPD when compared to uninsured individuals with family income less than $20,000. This likelihood decreased to 7% among the privately insured individuals with family income of $40, 000 - $75,000 when compared to uninsured individuals with family income of $40,000-$74,999 (OR: 1.1066, $p<0.01$).

Table 13: Logistic regression model: association between health insurance and NMUPD

Variable category	Odds ratio	95% confidence interval	P - value
Health insurance			
Private	0.625	0.357-1.097	0.1013
Public	0.309	0.116-0.821	0.0185
Uninsured	Ref	-	-
Gender			
Male	0.941	0.839-1.056	0.3016
Female	Ref	-	-
Age			
12-17	2.625	1.742-3.956	<0.0001
18-25	2.653	1.967-3.578	<0.0001
26-34	1.882	1.400-2.530	<0.0001
35-49	1.470	1.102-1.961	0.0087
50-64	Ref	-	-
Race			
Black, non-Hispanic	0.641	0.405-1.017	0.0588
Hispanic	0.427	0.323-0.565	<0.0001
Others	0.586	0.337-1.018	0.0581
White, non-Hispanic	Ref	-	-
Education			
Less than high school	1.657	1.056-2.602	**0.0281**
High school graduate	1.156	0.747-1.789	0.5162
Some college	1.512	0.961-2.377	0.0735
College graduate	Ref	-	-
Marital status			
Widowed/ divorced/separated	1.358	1.071-1.720	0.0114
Never been married	1.534	1.285-1.831	<0.0001
Married	Ref	-	-
Employment status			
Unemployed	1.196	0.998-1.434	0.0526
Other (including not in labor force)	1.026	0.869-1.212	0.7621
Employed	Ref	-	-
Annual household income			
< $20, 000	0.798	0.557-1.142	0.2168
$20, 000-$39,999	0.866	0.612-1.228	0.4202
$40, 000-$74,999	0.702	0.494-0.997	0.0483
≥ $75,000	Ref	-	-
Reported general health			
Fair/poor	1.204	0.971-1.493	0.0906
Excellent/very good/good	Ref	-	-
Smoking			
Yes	2.643	2.305-3.032	<0.0001
No	Ref	-	-

Variable category	Odds ratio	95% confidence interval	P - value
Use of alcohol			
Yes	2.367	1.913-2.928	<0.0001
No	Ref	-	-
Interaction effects			
Race × Insurance			
Black × private insurance	0.608	0.329-1.121	0.1107
Black × public insurance	0.824	0.460-1.474	0.5137
Black × uninsured	Ref	-	-
Hispanic × private insurance	1.237	0.6293-2.4320	0.5372
Hispanic × public insurance	1.179	0.736-1.891	0.4932
Hispanic × uninsured	Ref	-	-
Others × private insurance	0.967	0.497-1.883	0.9225
Others × public insurance	2.168	0.682-6.890	0.1898
Others × uninsured	Ref	-	-
Education × Insurance			
Less than high school × private insurance	0.794	0.463-1.362	0.4025
Less than high school × public insurance	1.807	0.758-4.307	0.1817
Less than high school × uninsured	Ref	-	-
High school graduate × private insurance	0.872	0.532-1.428	0.5850
High school graduate × public insurance	0.8614	0.5006-1.4821	0.5900
High school graduate × uninsured	Ref	-	-
Some college × private insurance	0.717	0.434-1.185	0.1946
Some college × public insurance	1.770	0.728-4.303	0.2081
Some college × uninsured	Ref	-	-
Income × Insurance			
Le20K × private insurance	1.108	0.6650-1.8464	0.6936
Le20K × public insurance	1.388	0.786-2.453	0.2589
Le20K × uninsured	Ref	-	-
Le40K × private insurance	1.207	0.800-1.821	0.3694
Le40K × public insurance	1.178	0.660-2.101	0.5802
Le40K × uninsured	Ref	-	-
Le75K × private insurance	1.0666	0.6635-1.7148	0.7900
Le75K × public insurance	1.485	0.768-2.874	0.2398
Le75K × uninsured	Ref	-	-
Number of Observations	42759		
P-value for joint test of significance for the interaction terms that were not significant	0.2093		

Model fitness:

The Hosmer and Lemeshow goodness-of-fit test was conducted for the final model (un-weighted). The result was significant ($p<.0001$) suggesting that model does not adequately describe the non-medical use of prescription drugs.

Although the Hosmer and Lemeshow test failed, percent concordant value and AUROC value were relatively high i.e., around 76.2%, and this indicates model correctly distinguishes between people who use prescription drugs non-medically vs. those who do not use prescription drugs non-medically.

The r square value for the model was 0.0863. This suggested that nine percent of the variability in the NMUPD is explained by independent variables used in the model.

4.2 **Association between health insurance and prescription drug abuse/dependence**

4.2.1 **Characteristics of prescription drugs abusers/dependents:**

Out of the 5,190 non-medical users of prescription drugs, 774 (13%) reported abuse or dependence on prescription drugs. Characteristics of these individuals are presented in Table 14. Sixty-six percent of the individuals who abused or were dependent on prescription drugs had health insurance. These individuals were also more likely to use tobacco in the previous year (76%). However, there was no significant difference in the use of alcohol and illicit drugs among those who abused/were dependent on prescription drugs when compared to those who did not abuse/were dependent on them. More of prescription drug abusers/dependents used treatment

services for non-medical use, abuse/dependence on prescription/illicit drugs (76%) compared to those who did not abuse/were dependent on them (71%).

Socio-demographic characteristics of the prescription drug abuser/dependents indicated that more than half were males (51%). Prescription drug abuse/dependence increased with age ($p<0.05$), and it was highest in the age group 26-64 years (49%). Whites had greater percentage of abuse or dependence on prescription drugs (72%) when compared to other races (28%). There was a significant relationship between prevalence of prescription drug abuse/dependence and education. Individuals with less than a high school education were most likely to abuse/depend on prescription drugs (37%). More than three-fourths of the individuals abusing/depending on prescription drug were unmarried (79%), and employed (86%) at the time of survey. Prescription drug abuse/dependence was lowest among individuals reporting family income $40,000-$74,999 (22%). This indicates that abuse/depend on prescription drugs was inversely related to the income. Like NMUPD, prescription drug abuse/dependence was higher among people reporting excellent/very good/good health (81%) when compared to those reporting fair/poor health (19%).

Table 14: Characteristics of prescription drug abusers/dependents (weighted %)

Variable category	Abuse or dependence on prescription drugs		P - value
	Yes	No	
Health insurance			
Yes	65.71	75.71	0.0007
No	34.29	24.29	
Gender			
Male	51.07	53.22	0.0623
Female	48.93	46.78	
Age			
12-17	16.54	12.48	0.0348
18-25	34.20	31.62	
26-64	49.26	55.90	
Race			
White, non-Hispanic	71.75	75.54	0.9301

Variable category	Abuse or dependence on prescription drugs		P - value
	Yes	No	
Others	28.25	24.46	
Education			
Less than high school	37.42	27.40	<0.0001
High school graduate	26.71	27.46	
College	35.87	45.14	
Marital status			
Married	21.22	32.33	0.0003
Unmarried	78.78	67.67	
Employment status			
Employed	86.33	91.39	<0.0001
Unemployed	13.67	8.61	
Annual household income			
< $20, 000	28.08	21.48	0.0109×
$20, 000-$39,999	26.37	21.99	
$40, 000-$74,999	21.55	29.93	
≥ $75,000	24.00	26.60	
Reported general health			
Excellent/very good/good	81.09	91.19	<0.0001
Fair/poor	18.91	8.81	
Past year use of tobacco			
Yes	77.58	66.76	<0.0001
No	22.42	33.24	
Past year use of alcohol			
Yes	83.75	87.85	0.4057
No	16.35	12.15	
Past year use of illicit drugs			
Yes	99.99	99.73	0.5218
No	0.01	0.27	
Treatment			
Yes	76.23	70.92	<0.0001
No	23.77	29.08	
Total Observation	**774 (14.91%)**	**4416 (85.09%)**	-

4.2.2 Logistic regression: association between health insurance coverage and prescription drug abuse/dependence:

Logistic regression analysis was performed to determine the relationship between socio-demographic factors and past-year abuse/dependence on prescription drugs among the U.S. individuals younger than 65 years. As shown in Table 15, the likelihood ratio test was performed

to see if interaction terms contributed significantly to the model. The chi square test value for the fully interacted model was not significant (p=0.1342). This indicated that interaction terms did not contribute significantly to the full model. Thus, all the interaction terms were dropped from the full model.

Health insurance ($p<0.05$), age ($p<0.01$), marital status ($p<0.05$), reported general health status ($p<0.01$) and tobacco use ($p<0.01$) were significant predictors of past-year abuse/dependence on prescription drugs.

Persons with health insurance were found to have 39% lower probability (OR: 0.607, 95% CI: 0.403-0.915) of prescription drug abuse/dependence as compared to uninsured individuals at $\alpha=0.05$. Age was another important predictor of prescription drug abuse/dependence. Individuals aged 12-17 years had 90% higher likelihood (OR: 1.904, 95% CI: 1.117-3.246) of prescription drug abuse/dependence than those aged 26-64 years. Similarly, individuals aged 18-25 years had 80% greater chances (OR: 1.804, 95% CI: 1.308-2.487) of prescription drug abuse/dependence than the reference group. Unmarried people had three times greater chances (OR: 2.555, 95% CI: 1.455-4.484) of abusing/becoming dependent on prescription drugs as compared to those who were married. Probability of abuse/dependence on prescription drugs increased by a factor of 2.3 (OR: 2.326, 95% CI: 1.448-3.737) among individuals who reported fair/ poor health status when compared to those who reported excellent/very good/good health status. Use of tobacco was significantly associated with prescription drug abuse/dependence. Individuals who used tobacco had three times greater risk (OR: 3.267, 95% CI: 2.204-4.841) of prescription drug abuse/dependence than those who did not use tobacco in the past year.

Table 15: Logistic regression: association between health insurance and prescription drug abuse/dependence

Variable category	Odds ratio	95% confidence interval	P – value
Health insurance			
Yes	0.607	0.403-0.915	0.0170
No	Ref	-	-
Gender			
Male	1.021	0.747-1.394	0.8982
Female	Ref	-	-
Age			
12-17	1.904	1.117-3.246	0.0179
18-25	1.804	1.308-2.487	0.0003
26-64	Ref	-	-
Race			
Others	0.690	0.470-1.013	0.0581
White, non-Hispanic	Ref	-	-
Education			
Less than high school	1.224	0.770-1.946	0.3935
High school graduate	0.930	0.643-1.345	0.6999
College	Ref	-	-
Marital status			
Unmarried	2.555	1.455-4.484	0.0011
Married	Ref	-	-
Employment status			
Unemployed	1.422	0.974-2.076	0.0682
Employed	Ref	-	-
Annual household income			
<$ 20, 000	1.151	0.654-2.025	0.6257
$20, 000-$39,999	1.000	0.606-1.650	0.9993
$40, 000-$74,999	0.921	0.578-1.467	0.7286
≥ $75,000	Ref	-	-
Reported general health			
Fair/poor	2.326	1.448-3.737	0.0005
Excellent/very good/good	Ref	-	-
Use of tobacco			
Yes	3.267	2.204-4.841	<0.0001
No	Ref	-	-
Use of alcohol			
Yes	1.671	0.931-2.999	0.0854
No	Ref	-	-
Number of observations	3,629		

P value for the joint test of significance for interaction	0.1342

Model fitness:

The Hosmer and Lemeshow goodness-of-fit test was insignificant (p=0.49) suggesting that model adequately describe abuse/dependence on prescription drugs.

The percent concordant value of the model was 76.0%.

The value of AUROC was 0.776 for the model, indicating the model correctly distinguishes between people who abuse/depend on prescription drugs vs. those who do not abuse/depend on prescription drugs.

The r square value for the model was fairly low, around 0.0154, suggesting that only two percent of the variability in the prescription drug abuse/dependence is explained by independent variables used in the model.

4.3 Association between health insurance and use of substance abuse treatment

4.3.1 Descriptive statistics of users of substance abuse treatment:

In the 2007 NSDUH, the question about use of substance abuse treatment was asked only to those people who had ever used either prescription drugs or illicit drugs non-medically. Among these individuals, only 689 respondents answered the question about use of treatment services either for NMUPD only or for both NMUPD and illicit drug use. Of these 689 respondents, only 503 (69%) individuals reported that they had used substance abuse treatment for these health issues.

Characteristics of these individuals are presented in Table 16. There was no statistically significant difference in the use of treatment services among insured and uninsured individuals. Among those who used substance abuse services, most had used tobacco (89%), alcohol (80%) and other illicit drugs (77%) but comparatively lesser numbers of individuals abused or were dependent on prescription drugs (19%).

Socio-demographic characteristics of the people seeking treatment suggested that males (69%) were significantly more likely to receive treatment than females (31%). Number of people using treatment services for the prescription drugs increased with the increasing age, and the use of treatment services was highest among the people aged 26-64 years (63%). Whites (78%) were more likely to receive substance abuse treatment than other race (22%). Individuals using treatment services were most likely to be high school graduates (36%), unmarried (83%), employed (86%), belonged to lower income level (34%) and reported excellent/very good/good health (84%).

Table 16: Characteristics of individuals who used substance abuse treatment (Weighted %)

Variable category	Received treatment		P - value
	Yes	No	
Health insurance			
Yes	62.44	61.72	0.9214
No	37.56	38.28	
Gender			
Male	69.04	72.65	0.0410
Female	30.96	27.35	
Age			
12-17	11.93	3.44	<0.0001*
18-25	25.81	23.81	
26-64	62.27	72.75	
Race			
White, non-Hispanic	78.05	77.30	0.0340
Others	21.95	22.70	
Education			
Less than high school	33.37	21.23	<0.0001
High school graduate	36.15	34.91	

Variable category	Received treatment		P - value
	Yes	No	
College	30.48	43.86	
Marital status			
Married	16.94	31.90	0.0323
Unmarried	83.06	68.10	
Employment status			
Employed	86.21	92.54	<0.0001
Unemployed	13.79	7.46	
Annual household income			
< $20, 000	34.10	21.50	0.7710
$20, 000-$39,999	26.86	38.37	
$40, 000-$74,999	21.72	19.61	
≥ $75,000	17.31	20.52	
Reported general health			
Excellent/very good/good	84.09	86.64	0.3025
Fair/poor	15.91	13.36	
Past year use of tobacco			
Yes	87.88	80.33	0.2113
No	12.12	19.67	
Past year use of alcohol			
Yes	80.31	77.65	0.1756
No	19.69	22.35	
Past year use of illicit drugs			
Yes	76.77	63.01	<0.0001
No	23.33	36.99	
NMU			
Yes	55.13	46.78	<0.0001
No	44.87	53.22	
Prescription drug abuse/dependence			
Yes	18.46	12.96	<0.0001
No	81.54	87.04	
Total Observation	**503 (73.00%)**	**186 (27.00%)**	**-**

4.3.2 **Logistic regression: association between health insurance and use of substance abuse treatment**

Likelihood ratio test was performed to see if interaction terms contributed significantly to the model. This test is shown in Table 17. The joint test of significance showed that full model containing all the interaction terms was not significant (p=0.2403). Thus, all the interaction terms were dropped from the full model. The final model is represented in Table 17.

Logistic regression analysis was conducted to determine the relationship between independent variables and the use of substance abuse treatment for misuse of prescription/drugs. The results suggested that education level was the only significant predictor of the use of substance abuse treatment (p=0.01). Controlling for all other variables in the model, individuals with high school education had 2.6 times greater odds (OR: 2.575, 95% CI: 1.243-5.332) of using substance abuse treatment for prescription drug problems when compared to college graduates. Individual with less than a high school education had 56% greater likelihood of using substance abuse treatment for misuse of prescription drugs as compared to college graduates. However, this relationship was insignificant at α =0.05 (OR: 1. 557, 95% CI: 0.480-5.047). People with health insurance were found to have 37% greater odds (OR: 1.371, 95% CI: 0.657-2.861) of using substance abuse treatment for misuse of prescription drugs as compared to uninsured individuals. However, this relationship was not significant at α=0.05.

Table 17: Logistic regression: association between health insurance coverage and use of substance abuse treatment

Variable category	Odds ratio	95% confidence interval	P - value
Health insurance			
Yes	1.371	0.657-2.861	0.4001
No	Ref	-	-
Gender			
Male	0.783	0.362-1.696	0.5351
Female	Ref	-	-
Age			
18-25	0.304	0.075-1.225	0.0940
26-64	0.363	0.073-1.816	0.2172
12-17	Ref	-	-
Race			
Others	1.907	0.614-5.915	0.2640
White, non-Hispanic	Ref	-	-
Education			
Less than high school	1.557	0.480-5.047	0.4604

Variable category	Odds ratio	95% confidence interval	P - value
High school graduate	2.575	1.243-5.332	**0.0109**
College	Ref	-	-
Marital status			
Unmarried	0.985	0.414-2.347	0.9733
Married	Ref	-	-
Employment status			
Unemployed	1.887	0.551-6.467	0.3120
Employed	Ref	-	-
Annual household income			
< $20, 000	2.386	0.871-6.540	0.0909
$20, 000-$39,999	2.232	0.469-3.241	0.6718
$40, 000-$74,999	1.280	0.516-3.178	0.5941
≥ $75,000	Ref	-	-
Reported general health			
Fair/poor	1.312	0.401-4.297	0.6358
Excellent/very good/good	Ref	-	-
Use of tobacco			
Yes	2.101	0.680-6.491	0.1972
No	Ref	-	-
Use of alcohol			
Yes	0.393	0.141-1.101	0.0755
No	Ref	-	-
Number of observations	484		
Joint test of significance			
P value for the joint test of significance for interaction terms	0.2403		

Model fitness:

The Hosmer and Lemeshow goodness-of-fit test conducted for the final model (unweighted) was insignificant ($p<.5530$). The percent concordant value of the model was 68.0%. The value of AUROC was 0.684 for the model. The r square value for the model was 0.0818. These results indicate that the model was able to predict the observed and expected outcome.

4.4 **Summary of results of the study**

The results from the logistic regression analyses show that uninsured individuals were at higher risk of NMUPD, their abuse and dependence than insured individuals. Age was found to be an important predictor of NMUPD only. Younger individuals aged 18-25 years were more likely to use prescription drugs non-medically than the individuals aged 50-64 years. Hispanic individuals were less likely to use prescription drugs non-medically. Additionally, there were significant interaction terms between race and health insurance, and Hispanic individuals with private health insurance were more likely to use prescription drugs non-medically than uninsured Hispanic individuals. Individuals with a high school education were found to have a greater probability of NMUPD and use of substance abuse treatment. In contrast, publicly insured individuals with a high school education were found to have lower probability of NMUPD. Individuals reporting $40, 000 - $74,999 incomes were less likely to engage in NMUPD than those reporting ≥$75,000 family incomes. Moreover, significant interaction effects were observed between income and health insurance, and privately insured individuals reporting less than $20,000 and $40,000-$74,999 were more likely to engage in NMUPD than their counterparts. Unmarried individuals were found to have a greater likelihood of NMUPD, their abuse and dependence than married individuals. Similarly, individuals using tobacco were also found to have greater likelihood of NMUPD, their abuse and dependence than those who did not use tobacco. Alcohol use was associated with NMUPD only, and individuals using alcohol were found to be more likely to use prescription drugs non-medically than those who did not use alcohol. These results have been shown in the Table 18 below.

Table 18: Summary of logistic regression analyses conducted in the study

	Dependent variables		
Independent variable	**NMUPD**	**Prescription drug abuse/dependence**	**Use of substance abuse treatment**
Health insurance	Uninsured individuals more likely	Uninsured individuals more likely	No association
Age	Young individuals more likely	No association	No association
Gender	No association	No association	No association
Race and ethnicity	Hispanics less likely	No association	No association
Level of education	Individuals with less than high school more likely	No association	Individuals with high school more likely
Marital status	Unmarried individuals more likely	Unmarried individuals more likely	No association
Employment status	No association	No association	No association
Family income	Individuals with $40,000-74,999 income less likely	No association	No association
Health status	No association	More likely among individuals with poor health	No association
Tobacco use	More likely	More likely	No association
Alcohol use	More likely	No association	No association
Interaction effects			
Hispanic × private insurance	More likely	Not applicable	Not applicable
Less than $20K × private insurance	More likely	Not applicable	Not applicable
$40K-$75K × private insurance	More likely	Not applicable	Not applicable
High school graduate × public insurance	Less likely	Not applicable	Not applicable

CHAPTER 5 – DISCUSSION

This chapter presents a discussion of the results of this study. It starts with discussion of the results and is followed by the limitations, strengths, recommendations for future research and conclusions.

5.1 Effect of health insurance on NMUPD, their abuse/dependence

The first aim of this study was to examine the relationship between health insurance and NMUPD, their abuse and dependence, and how this relationship is modified by different covariates. This was achieved by performing multiple logistic regression analyses. The used model predicted NMUPD, their abuse and dependence as a function of health insurance, socio-demographic, economic, health-behavioral characteristics, and first order interactions between health insurance, socio-demographic, economic and health-behavioral characteristics.

Eighty-two percent of the respondents were insured, and the majority had private health insurance (69%). Eight percent of the sample reported using prescription drugs non-medically. One percent of the entire sample and 13% of NMUPD reported abuse dependence on prescription drugs. Prevalence rate of prescription drug abuse/dependence in this study was similar to those observed by other researchers [5, 7, 8, 25, 91]. Approximately, six percent of the sample, 73% of non-medical users and 76% of the prescription drug abusers/dependents reported some use of substance abuse programs. NMUPD, abuse and dependence was highest among uninsured. This differential behavior between uninsured and insured individuals could be driven by the fact that those with health insurance were in higher economic strata, more educated, in better physical condition and perhaps wise enough to abstain from problem health behaviors.

Consistent with prior research, this study found that males were more likely to be uninsured (54%). Most of the adolescents aged 12-17 years had public health insurance (27%), whereas individuals aged 35 years and older were more likely to have private health insurance (33%). Whites represented a major proportion of the population (66%) and they commonly had private health insurance (74%). Hispanics were more mostly uninsured (31%). Private health insurance was also common among those who had a college education, were married, employed, reported higher family income (>$75,000) and were in good health. These individuals were also less likely to use tobacco and illicit drugs. These results are similar to a published report suggesting that the sample is representative of the U.S. population [128].

In the overall sample, most of the individuals used pain relievers non-medically (6%) and fewer of them used sedatives (0.4%). These numbers are similar to other studies except for sedatives. Becker et al. (2007) reported higher prevalence of sedatives; this could be due to differences in the samples. Becker et al. conducted their analysis among 18-80 year old individuals whereas we conducted analysis among 12-64 year old individuals.

These results hold true in multivariate logistic regression analysis. Risk factors for prescription drug abuse/dependence were mostly similar to the risk factors for NMUPD. Health insurance was an important predictor of NMUPD, their abuse and dependence. Individuals with public health insurance were found to be 69% less likely to use prescription drugs non-medically. This finding was similar to the finding of the previous studies which found uninsured individuals to be 1.2- 2.0 times more likely to use prescription drugs non-medically than the insured individuals [5, 8, 71]. In contrast, Kroutil, et al. (2006) found individuals with 'other' type of health insurance to be least likely to use of stimulants non-medically (O.R.-0.29, 95% CI:

0.19-0.44) [71]. Interestingly, this study found insured individuals to be 39% less likely to abuse/depend on prescription drugs than the uninsured individuals. Previous studies did not find any significant association between health insurance and prescription drug abuse/dependence [5, 7].

An important contribution of this thesis is to identify specific subgroups of the population where providing insurance will be most crucial. This study found significant interaction effect between Hispanic race and private insurance; income category less than $20,000 and private insurance; income category $40,000-$74,999 and private insurance; and high school education and public health insurance. Hispanic people with private health insurance had 24% (O.R.-1.237, $p<0.001$) greater risk of using prescription drugs non-medically when compared to the uninsured Hispanic individuals. Privately insured individuals reporting less than $20,000 as family income were found to have 11% (O.R.-1.1081, $p<0.05$) higher risk of using prescription drugs non-medically whereas privately insured individual reporting family income $40,000-$74,999 had seven percent (O.R.-1.0666, $p<0.05$) higher risk of using prescription drugs non-medically when compared to the uninsured individuals having family income $40,000-$74,999. Publicly insured individuals with high school education were found to be 14% (OR: 0.8614, $p<0.05$) less likely to use prescription drugs non-medically when compared to the uninsured individuals with high school education ($p<0.05$).

Hispanic people with private health insurance have been found to be at greater risk of using prescription drugs non-medically when compared to the uninsured Hispanic individuals. This indicates that even among those who have health insurance certain sub groups (like Hispanics) are at increased risk of NMUPD. High prevalence of NMUPD among insured

Hispanics can be due to acculturation to the US culture and lower education. Studies have found acculturated Hispanics to be more likely to engage in NMUPD and illicit drug use than the non-acculturated Hispanics [129, 130]. Hispanic people have also been known to have lower education level and high school dropout rate [131]. Therefore, they are more likely to be uninformed about the harms of NMUPD. If this is case, then increasing awareness about the harms of NMUPD might help in addressing the problem of NMUPD among Hispanic individuals.

Increasing awareness about harms of NMUPD is also important among privately insured individuals with lower family income (<$20,000) as they were found to have higher risk of using prescription drugs non-medically than the privately insured individual with higher family income ($40,000-$75,000). Previous studies report mixed association between income and NMUPD. Individuals with lower family incomes are less likely to be educated, and more likely to be unaware of the harms of NMUPD [132]. This predisposes them to higher risk of NMUPD than those with higher income.

In contrast to the above mentioned sub groups, publicly insured individuals with a lower level of education were less likely to use prescription drugs non-medically than the uninsured individuals with lower education. Prior literature indicates that individuals with lower education level are at greater risk of NMUPD than individuals with higher level of education [6, 8, 25, 36]. This study adds knowledge to this area and we demonstrate that providing some form of health coverage to those who have lower education might help in controlling NMUPD.

Overall, uninsured individuals are more likely to use prescription drugs non-medically, abuse and depend on them. Possible reasons could be imprudent drug use, unawareness about

prescription drug misuse, work environment. This could be due to lower education; infrequent access to the health care provider which decreases their chances of getting knowledge about judicious use of prescription drugs and harms of their non-medical use, abuse and dependence. Uninsured individuals might be employed in work place that lack substance abuse policies and this gives them the opportunity to misuse prescription drugs without fear of losing their livelihood.

On the other hand, insured individuals have better access to health care provider and are more likely to gain information about the proper use of prescription drugs, harms of prescription drug misuse which might discourage them from these risky behaviors. Individuals with health coverage are also more likely to be educated and as a result, more likely to perceive the risk, and understand the sign and symptoms of these problem health behaviors. They might have health coverage through the employer which makes them avoid NMUPD, their abuse and dependence due to fear of losing job.

5.2. **Effect of other independent variables on NMUPD, their abuse/dependence:**

Results from logistic regression analysis support our hypothesis that younger individuals are at higher risk of NMUPD, their abuse and dependence than the older individuals. Probability of NMUPD was found to be highest among 18-25 year old individuals and lowest among 35-49 year old individuals. Similarly, probability of abuse/depend on prescription drugs was highest among 12-17 year old individuals. Prior literature suggests mixed relationship between age and prescription drug abuse/dependence. Consistent with our findings, some authors have found

younger individuals to be 3-37 times more likely to abuse/depend on prescription drugs [7, 12, 25, 36, 71, 133]. On the other hand, Simon-Wastila et al. (2004) and Becker et al. (2007) found younger individuals to be 50%-80% less likely to abuse/depend on prescription drugs [5, 9]. The higher risk of prescription drug abuse/dependence among younger individuals could be due to either the age of onset of drug use or the age of onset of NMUPD. A previous study has found initiation of drug use before the age of 15 as one of the predictors of prescription drug abuse/dependence [134]. Another study found that individuals who start NMUPD at the age of 13 years or before have higher risk of developing prescription drug abuse/dependence than those who start NMUPD after 21 years of age [7]. Similar to previous studies, individuals in this study who used prescription drugs non-medically, abused/were dependent on them were also found to have greater use of tobacco and alcohol [94, 95, 135, 136]. It is possible that they might be using tobacco and alcohol along with prescription drugs. Concomitant use of prescription drugs and other substances can lead to harmful drug-drug interactions and other life threatening consequences.

Moreover, there was strong association between use of tobacco and NMUPD, their abuse and dependence. However use of alcohol was only related to NMUPD. In this study, use of tobacco, alcohol, and illicit drugs was found to be significantly higher among people indulging in NMUPD, their abuse and dependence. These finding are similar to the findings of the previous studies [5, 9, 36]. It is possible that most of the non-medical users/abusers/dependents of prescription drugs are smokers, drinkers and illicit drug users and they misuse prescription drugs either along with tobacco, alcohol, and illicit drugs or when they do not have access to tobacco,

alcohol and illicit drugs. In these cases, these individuals are at higher risk of perceiving NMUPD, their abuse and dependence as less harmful than the use of tobacco and alcohol.

Besides people indulging in risky behavior, people who were single like unmarried people were found to have higher likelihood of NMUPD, and their abuse/dependence than the married people. Other researchers have also reported similar finding in their studies where individuals who had never been married had 10%-45% greater odds of using prescription drugs non-medically and individuals who were widowed/ divorced/separated had 20%-45% greater odds of using prescription drugs non-medically when compared to the married individuals [5, 9, 12, 36, 137]. Similarly, unmarried individuals were also found to have 1.2-2.7 times higher risk of prescription drug abuse/dependence than the married individuals [5, 25, 36, 80]. It is very likely that unmarried/widowed/ divorced/separated or those who had never been married might have weak social bonds. Research has shown that individuals with weak bonds with the family, friends, school, work, religion, and other aspect of traditional society are less likely to engage in responsible behavior, refrain from drug abuse and other problem behaviors [89, 138]. Also, married individuals are less likely to be alone and more likely to take decision together. Support of the spouse and good decision making help married individuals to be more responsible toward their behavior and thereby avoid problem health behaviors [139].

Controlling for all other variables in the model, health status was found to be associated with prescription drug abuse/dependence but not with NMUPD. Individuals reporting fair/poor healths in this study were 2.5 times more likely to use abuse/depend on prescription drugs when compared to those who reported excellent/very good/good health. Some of the prior studies also suggest that individuals reporting fair/poor are 2.04 to 2.4 more likely to abuse/dependence on

prescription drugs than those reporting excellent/very good/good health [7, 9, 91]. In contrast to our study, Simoni-Wastila et al. (2008) found 48%-51% lower risk of abuse/dependence on prescription drugs among adolescents reporting fair/poor health when compared to those who reported excellent health [47]. This could be either due to difference in the samples or due to different definition of misuse of prescription drugs. Higher prescription drug abuse/dependence among people reporting fair/poor health could be due the reason that these individuals as such have been observed to more likely to use prescription drugs [140, 141] which predisposes them to their abuse/dependence in the long run. It is possible that these individuals might be self medicating for some unrecognized suffering like pain, anxiety, distress etc which increases their risk of prescription drug abuse/dependence [142-145].

5.3 **Effect of health insurance on the use of substance abuse treatment**

The second aim of this study was to determine the relationship between health insurance and probability of seeking treatment for nonmedical use/abuse/dependence on prescription drugs and how different covariates modify the relationship between health insurance and probability of seeking treatment for nonmedical use/abuse/dependence on prescription drugs.

The data revealed that a large number of non-medical users of prescription drugs (73%) and prescription drug abusers/dependents (76%) used substance abuse treatment. These results are dissimilar to the previous literature [80]. High use of treatment services among this sub group of population could be because the study was not able to separate out the use of substance abuse treatment for the misuse of prescription drugs from the use of substance abuse treatment for the abuse/dependence on alcohol.

Although NMUPD, their abuse and dependence was higher among uninsured individuals but the use of substance abuse treatment did not vary by the health insurance status of an individual. Results from the Logistic regression analysis support this observation and health insurance was not an important predictor of use of substance abuse treatment for misuse of prescription drugs. This could be because the purpose of health insurance is to subsidize the cost of the treatment and most of these treatments institutions already provide subsidized services to the patients 1) either for no charge and/or using sliding fee scale where payment for the substance abuse treatment is based on an individuals' income and other factors besides health insurance, 2) through other payment assistance. These payment assistances might be helpful to the lower income and uninsured individuals who could not seek treatment due to cost as a barrier.

Use of substance abuse treatment was significantly associated with education level and individuals with high school education were 2.6 times more likely to use substance abuse treatment when compared to the college graduates. Prior studies have found mixed relationship between education and use of treatment services. Similar to our study, Wu et al., (2003) and Waehrer et al. (2008) found that use of substance abuse services decreased significantly with an increase in level of education [60, 62], whereas Weisner and colleagues (2002) found that individuals with higher education were more likely to use treatment services than those having lower education [104]. Strong association between use of substance abuse treatment and high school education could be because of highest prevalence of NMUPD (29%), their abuse and dependence (36%) among this group. On the other hand, NMUPD (18%), their abuse and dependence (37%) was lowest among individuals having college education. So, it is possible that

they will be less likely to seek treatment. Individuals with lower education are less likely to be aware of the harms of misuse use of prescription drugs and are thus, less likely to perceive the need for the treatment. Other reasons could be stigma [104, 146], lack of information and confidence in the treatment [147-149]

5.4 **Effect of health insurance on non-medical use of different therapeutic classes of prescription drugs**

The last aim of this study was to examine whether non-medical use of different therapeutic classes of prescription drugs varies with health insurance. This was done by performing chi square tests which estimated the bivariate associations between non-medical use of different therapeutic classes of prescription drugs and health insurance.

The results from the chi square test show that individuals with private health insurance were more likely to use tranquilizers (62%) and sedatives (62%). Previous studies have not looked into the association between type of health insurance and non-medical use of tranquilizers and sedatives. There is only one study that examined the association between health insurance status and non-medical use of sedatives and tranquilizers and in this study individuals who were either uninsured or had Medicaid coverage were more likely to use tranquilizers and sedatives non-medically than their counterparts [5].

Uninsured individuals in this study were significantly more likely to use stimulants (32%). Kroutil and colleagues (2006) found similar results in their study. In fact, their analysis

indicates that individuals with any kind of health insurance are less likely to use stimulants non-medically than the uninsured individuals [71].

Prevalence of NMUPD was lowest among individuals having public health insurance and they were more likely to use pain relievers non-medically (14%). Becker and colleagues (2008) found that uninsured individuals or those who had Medicaid coverage were at higher risk of non-medical use of opioids than the others [7].

Non-medical use of different therapeutic classes of prescription drugs seems unrelated to their cost. Desoxyn and Butisol are stimulant and sedative medication respectively that were found to be used most frequently non-medically in this study. Analysis of the cost estimates of these drugs suggests that Desoxyn is more expensive than Butisol [150, 151]. If cost would have been a deciding factor for the non-medical use of these drugs, then non-medical use of Desoxyn would have been higher among individuals having private health coverage and not among uninsured individuals.

In summary, results from these bivariate analyses suggest that therapeutic classes of prescription drug used non-medically vary with the type of health insurance.

5.5 **Study implications**

Results of this study have implication for treatment program developers, health care providers and policy makers. The results of this study indicate that people with health insurance are less likely to use prescription drugs non-medically and abuse/depend on them when compared to the insured individuals. The risk for NMUPD and prescription drugs abuse and

dependence was 69% and 39% lower for people with health coverage respectively. Health insurance did not disproportionately impact people of different gender, age groups, marital status, employment status, health status, alcohol use status and tobacco use status. However, health insurance is likely to be important for at least one significant group e.g. high school graduates. The study hypothesizes that for these individuals access to health care providers is likely to reduce NMUPD among this group. Irrespective of health insurance, Hispanics and individuals with less than $20,000 and $40,000-$74,999 incomes were more likely to use prescription drugs non-medically. This could be due to poor knowledge about harmful effects of the drugs in this group. This is an area of research that needs further investigation.

Besides being uninsured, individuals who were younger than 25 years of age were also found to have higher risk of NMUPD, prescription drugs abuse/dependence. Previous literature suggests that initiation of drug use at a younger age of 15 years or before and initiation of NMUPD at the age of 13 years or before makes a person susceptible to these health problem behaviors. Thus, it is important for the parents to be watchful for their kids about their drug use. At this impressionable age, young minds are unaware of harms of NMUPD, prescription drugs abuse/dependence. So, it might be helpful to provide counseling about the harms of these risky health behaviors from early grade levels of the middle school years and this information can be provided as part of the curriculum. These individuals were also found to have higher use of tobacco and alcohol. Thus, the information about prescription drug misuse should be supplemented with the information about other risky behaviors. Moreover, NMUPD was strongly associated with alcohol and other substance use. Clearly, those who are more likely to use tobacco and alcohol are also at higher risk of non-medical use and abuse of prescription

drugs. Thus, physicians and treatment providers should screen individuals with NMUPD, their abuse and dependence for substance abuse problems and vice versa. It is also important to make these individuals understand that NMUPD, their abuse and dependence is as harmful as use of tobacco, alcohol, and other substances.

There was strong association between marital status and NMUPD, their abuse and dependence. Unmarried individuals were more likely to engage in these problem health behaviors. As mentioned previously, these individuals are more likely to be alone, have weak bonds with family, friends and are more likely to take bad decisions. So, it is important for them to become socially active, get involved with their family and friends, and join some social groups who can guide and help them with their choice of health behaviors. People reporting fair/poor healths were more likely to abuse/depend on prescription drugs than those who reported excellent/very good/good health. Thus, health care providers needs to be careful while prescribing medicines with high abuse potential to these individuals and should regularly monitor them for any sign and symptoms of NMUPD, their abuse and dependence.

Use of treatment services was not associated with health insurance. This indicates that regardless of health insurance status those who want to get the treatment services can usually obtain it. However, high school education had a significant impact of on the use of substance abuse treatment. Educating individuals about the harms of prescription drug misuse, benefits and effectiveness of treatment; and places where they are located might help in directing individuals in need to these treatment facilities. Health professionals can help in addressing stigma by providing treatment in an anonymous manner and by educating general public about NMUPD, their abuse and dependence.

5.6 **Limitations and Strengths**

Limitations due to the design of the study:

The results of this study should be interpreted in the light of some limitations. This study uses a cross-sectional data and therefore, cause and effect relationship between independent and dependent variable cannot be established. A longitudinal study where individuals with and without health insurance coverage are followed over time can provide more robust estimates.

Use of a continuous measure of NMUPD, abuse and dependence on prescription drugs would have provided a clearer idea about the association between different covariates and non-medical use/abuse/dependence on prescription drugs. However, this was not possible using the 2007 NSDUH dataset as around 90% of the respondents had reported no NMUPD in the past year, 99% had reported no abuse/dependence on prescription drugs in the past year.

The impact of different types of health insurance on prescription drugs abuse/dependence, and use of substance treatment services could not be examined due to insufficient sample size across different health insurance categories.

Limitations due to the use of NSDUH dataset:

NSDUH excludes some important sub-populations like active military personnel, who have been found to have significantly lower rates of illicit drug use. Also, individuals living in institutional settings like prisons and residential drug use treatment centers, and those who are homeless or living in a shelter are not included in NSDUH. These types of individuals have been found to have higher rates of illicit drug use than the others [29]. Thus, the prevalence rates from the NSDUH do not represent the entire population.

Individuals living in institutional settings like prisons and residential drug use treatment centers are more likely to get treatment from other public sources. It is likely that role of public funding might be underestimated using the NSDUH. Thus, results obtained using NSDUH dataset should be considered conservative. Information about these kinds of population can be obtained from other sources like the Department of Defense (DoD) Survey of Health Related Behaviors Among Active Duty Military Personnel and the Survey of Inmates in State and Federal Correctional Facilities (SISCF) [152].

Respondents who reported that they use substance abuse treatment but were unsure whether the treatment was for alcohol or for drug abuse and dependence were dropped from the analysis. Thus, people who have used substance abuse treatment but failed to recall would be missed and this might lead to underreporting of the use of substance abuse treatment services.

This study determines how socio-demographic factors will modify the effect of health insurance on probability of seeking treatment for drug abuse and dependence among non-medical users of prescription drugs. Besides socio-demographic factors, other behavioral factors like personal motivation, perceived need and family and social pressure also play an important role in coercing these individuals to seek treatment. However, this information is not collected in the NSDUH and thus, we are not able to analyze these factors in our study.

NSDUH does not distinguish between individuals who use someone else's prescription medication but use them properly for rightful medical conditions vs. those who use these medications only for the feeling or the experience that these medications provide. If there is a significant proportion of the population that uses somebody else's medication but in a rightful

manner, then labeling them as non-medical users will lead to over estimation of non-medical users which might bias the results of study.

Questions about prescription drug/s abuse and dependence were asked only to those respondents who reported past year non-medical use of respective drug/s. It is possible that individuals might engaged in NMUPD but have answered no to the above question due to social desirability or due to stigma attached to NMUPD. These people might have also engaged in prescription drug abuse and dependence but would be missed and this could lead to under reporting of prescription drug abuse and dependence than the actual prevalence.

NSDUH relies on self report of the respondents which cannot be cross checked through other sources like clinical and biological measures. Other biases like recall bias and social desirability bias might also lead to under reporting of these problem health behaviors. However, The NSDUH survey items have been evaluated for their accuracy and reproducibility of results [26]. Moreover, technique like ACASI (Audio Computer Assisted Self Interview) is used for questions that involve sharing of private, confidential and sensitive information. So, it is very unlikely that self reporting bias will be large enough to affect the results of the study.

Strengths of the study:

1. Generalizability of this study is high since this study uses data from NSDUH which collects data from nationally representative sample of individuals living in households, persons aged >12 years, and non-institutionalized civilian population.

2. This is the first study to determine the differential impact of health coverage on NMUPD/abuse/dependence on prescriptions drugs within subgroups of population. This was

done by examining the interaction effect of health insurance and other socio-demographic factors on NMUPD, their abuse and dependence.

3. This study also shows that health insurance impacts therapeutic classes of prescription drug used non-medically.

4. Use of large sample size provided precise estimates of NMUPD, their abuse and dependence and facilitated comparison with in subgroups of population.

5. Use of 'sampling weights' in this study helps to account for the complex sampling methodology and for non-response in the NSDUH. This helps to obtain robust estimates of NMUPD, their abuse and dependence.

6. The method used for the analysis accounted for the complex survey design used in the NSDUH to provide appropriate parameter estimates and standard errors thereby yielding accurate estimates of NMUPD, their abuse and dependence.

5.7 **Recommendations for future research**

A more clear and concise definition of non-medical use of prescription drugs should be employed in future studies so as to avoid any ambiguity regarding what constitutes non-medical use of prescription drugs. This will help other researchers to replicate the results of previous studies in broader and different populations. Use of Longitudinal studies can help in obtaining unbiased estimates of the relationship between health insurance and non-medical use/abuse/depend on prescription drugs; and use of substance abuse services for these health

problems. It is also important to conduct studies using continuous measures of NMUPD, abuse/dependence, and use of substance abuse services to get a clear understanding about how change in health insurance and other covariates affects these dependent variables. Studies that help in identifying various high risk groups for NMUPD, their abuse and dependence are important as well. However, there is a need to conduct longitudinal studies that examine the reason behind the greater risk of NMUPD among these individuals. Health insurance was an important predictor of NMUPD, their abuse and dependence but we do not why someone with health insurance is less likely to use prescription drugs non-medically, abuse and misuse them. Health insurance was not related to the use of treatment services among people misusing prescription drugs. However, we did not determine the source/s of payment (by type of health insurance, out of pocket etc.) for the use of substance abuse services for misuse of prescription drugs. It's important to find out the source/s of payment for use of treatment services for these health problems as it is possible that health insurance might or might not cover the cost of treatment.

5.8 Conclusions

This study contributes to the already existing literature on NMUPD, their abuse and dependence and use of substance abuse treatment for these health problems. Around eight percent of respondents in this study reported using prescription drugs non-medically and 13% percent of the non-medical users also reported abuse/dependence on the prescription drugs. In bivariate analyses, non-medical use of tranquilizers and sedatives was common among

individuals with private health insurance. Uninsured individuals were more likely to use stimulants. Individuals with public health insurance generally used sedatives non-medically.

In multivariate analyses, uninsured individuals were more likely to use prescription drugs non-medically, abuse and depend on them when compared to the insured individuals. For the first time, this study informs us about the differential impact of health coverage on NMUPD/abuse/dependence on prescriptions drugs within subgroups of population. Results from the study suggest that providing health coverage to the Hispanic people, those who had income less than $20,000 and $40,000-$74,999 might not help in controlling the problem of NMUPD. These sub groups are more likely to be unaware of the harms of NMUPD. Thus, increasing awareness about the harms of NMUPD might be beneficial in managing the problem. However, extending health coverage to the individuals with high school education seems beneficial in addressing this problem. Besides the above motioned subgroups of population, individuals who were young and engaged in risky behavior like tobacco use were also at higher risk of NMUPD than the others. These individuals are less likely to perceive the harms of NMUPD so, it is important that they should be made aware of the harms of NMUPD. Encouraging unmarried people to become socially active might also help in controlling the problem of NMUPD, their abuse and dependence among this group. Moreover, physicians need to be careful while prescribing medication with huge abuse potential to people reporting poor/fair health

Extending health coverage to the uninsured individuals who misuse prescription drugs/drugs might not help them in seeking substance abuse treatment. These individuals have lesser education and seem to be unaware about the harms of misuse use of prescription drugs. Therefore, do not perceive the need for the treatment. Also, they might lack knowledge about the

benefits of the treatment; and might not use it due to stigma. Thus, there is a need to increase awareness about the harms of prescription drug misuse, benefits of treatment, and address the stigma associated with the use of substance abuse treatment.

LIST OF ACRONYMS

ADHD - Attention Deficit Hyperactivity Disorder

AIDS - Acquired Immune Deficiency Syndrome

AOR – Adjusted Odds Ratio

AUDs - Alcohol Use Disorders

ADHD - Attention Deficit Hyperactivity Disorder

CI - Confidence Interval

CSA - The Controlled Substances Act

DAWN - Drug Abuse Warning Network

DSM-IV Diagnostic and Statistical Manual of Mental Disorders

ED - Emergency Department

HCV - Hepatitis C Virus

HIV - Human Immunodeficiency Virus

NESARC - National Epidemiologic Survey on Alcohol and Related Conditions

NIDA - National Institute on Drug Abuse

NLAES - National Longitudinal Alcohol Epidemiologic Survey

NMUPD - Non-Medical Use of Prescription Drugs

NSDUH - National Survey on Drug Use and Health

OTC - Over The Counter

SAMHSA - Substance Abuse and Mental Health Services Administration

USFDA - US Food and Drug Administration

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