12-1-2019

SYNTHETIC CANNABINOIDS: CHARACTERIZING THEIR USE AND CESSATION

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A Dissertation
Submitted in Partial Fulfillment of the Requirements for the
Doctor of Philosophy Degree

School of Health Sciences
in the Graduate School
Southern Illinois University Carbondale
December 2019

DISSERTATION APPROVAL

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A Dissertation Submitted in Partial

Fulfillment of the Requirements

for the Degree of

Doctor in Philosophy

in the field of Rehabilitation

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August 23, 2019

AN ABSTRACT OF THE DISSERTATION OF

RICHARD V. TURNER, for the Doctor of Philosophy degree in Rehabilitation, presented on August 23, 2019, at Southern Illinois University Carbondale.

TITLE: SYNTHETIC CANNABINOIDS: CHARACTERIZING THEIR USE AND CESSATION

MAJOR PROFESSOR: Dr. Thomas D. Upton

Since their introduction to the United States in 2008, synthetic cannabinoids became the most widely used recreational drug behind marijuana, then regressed to an estimated prevalence of less than 1%. Contrary to expectations for a drug declining in use, emergency department presentations and acute poisonings related to the use of synthetic cannabinoids are increasing. Alongside this phenomenon, a growing body of literature is beginning to uncover a relationship between psychosis and synthetic cannabinoid use. A current gap in the literature exists surrounding harm prevention methods and targeted intervention strategies for users of synthetic cannabinoids. To date, no known studies have examined individuals with a history of use of these substances and investigated the reasons they decided to discontinue recreational use. The purpose of the current study was to fill this gap in the literature while also further confirming and expanding existing research on the characterization of synthetic substance use, perceived harm of synthetic cannabinoids, and users' knowledge about synthetic cannabinoids. Cross sectional survey methods in a non-experimental comparative design was utilized with participants recruited through the online crowd sourcing platform Amazon MTurk. Significant motivating factors for both discontinuation and continuation of synthetic cannabinoid use were found including personal experience, accessibility, preference towards other substance, and questions surrounding the source and purity of the synthetic cannabinoids. It was also found that individuals who currently use synthetic cannabinoids have less general knowledge about the

substance class when compared to individuals who have discontinued use. These results suggest that psychoeducational campaigning surrounding general knowledge about the substance class as well as information on the physiological effects of synthetic cannabinoids may be an effective harm reduction method.

Key words: Synthetic cannabinoids, substance use, harm reduction, drug induced psychosis

ACKNOWLEDGMENTS

Many people have contributed to my educational success. First, I would like to acknowledge my undergraduate Advisor, Dr. Mary Cain. Through my undergraduate studies, I was so fortunate to have you assigned as an advisor. You were a guide and became a mentor, offering me the opportunity to begin research very early in my career. Providing me a foundation for success, you helped guide me into my graduate career. The next I need to acknowledge is Mary Titterington. Your willingness to let me, a college student and near stranger, shadow and observe your professional work was the deciding factor for entering the field of Rehabilitation Counseling. You have also served as a mentor over my years of graduate education, guiding me to the position that I am in today. I need to acknowledge Dr. John Wadsworth for your mentorship through my master's degree, as well as encouraging and guiding me to pursue my doctorate. You are the reason that I attended Southern Illinois University among all possible choices. You also taught me many of the guiding principles that I have applied to my entire graduate career to be successful. Next I would like to acknowledge Dr. Jane Nichols. I am so fortunate to have had the opportunity to study under you as well as utilize your expertise on many projects, including this dissertation. In any time of need, you have always been available and advocated so strongly on my behalf. I would also like to acknowledge Dr. Kathy Taylor. Your mentorship, guidance, and direct training has laid the groundwork for my professional career. You have taught me so much about collegiality, professional practice, ethics, supervision, and empathy. You were formative in my development as a professional and served as a role model in rehabilitation that I try to emulate every day. I would like to acknowledge my entire dissertation committee, Dr. D. Shane Koch, Dr. Ryan Redner, Dr. Michael Olson, and Dr. Mattew Sprong. My dissertation topic was niche and my data collection methods were novel,

however your feedback and suggestions were invaluable in the development and completion of my study. The last person I need to acknowledge is my advisor, Dr. Thomas Upton. You have provided me years of support and opportunity through my doctoral education. I had the opportunity to teach, supervise, learn, and develop in ways I did not think were accessible while completing my education. You have treated me as a colleague from the first day that we met and tolerated my very strong will and independent nature through the years. I would not be where I am today without your support.

DEDICATION

I would like to dedicate this Dissertation to my parents Richard and Linda Turner. They have provided me with overwhelming and unending support through all my educational and professional goals. Without them, this would not be possible.

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CHAPTER 1

INTRODUCTION TO THE PROBLEM

Since the first synthetic drug, synthetized in 1869, an age of pharmaceutical chemistry has been ushered in providing unprecedented advances in the ability to treat diseases. However, much like their naturally occurring counterparts, synthetic pharmaceuticals also present the capacity for misuse and abuse. Famous synthetic or designer substances such as Lysergic Acid Diethylamide (LSD or Acid) first synthesized in 1938 or Methylenedioxymethamphetamine (MDMA or Ecstasy) first patented in 1914 both fueled a cultural revolution of drugs of abuse in society (Lee & Schlain, 1985; McDowell & Kleber, 1994). These substance, often revered in pop-culture, served as the precursor for the deluge of synthetic substances that are seen today.

New legal forms of synthetic drugs are emerging at a rate faster than the current pace of research. The most widely known and thoroughly studied class of synthetic drugs are synthetic cannabinoid receptor agonists. These synthetic cannabinoids (SCs) were originally developed in the 1970s in an attempt to explore their pharmacological uses (Debruyne & Le Boisselier, 2015). Designed to mimic the effects of the primary psychoactive component of marijuana (Δ9-THC), SCs bind to the same CB1R and CB2R receptors as THC found in marijuana however at a much higher affinity (Castaneto et al., 2014, Deng, Verrico, Kosten, & Nielsen, 2018). These synthetic analogues can be as much as 2 – 100 times more potent than Δ9-THC (Riederer et al., 2016). The first synthetic cannabinoid analogue (HU-210) was synthesized in 1988, however since then many different synthetic cannabinoids have been isolated and five distinct categories were formed (Langford & Bolton, 2018). Twenty years later, the first synthetic cannabinoid to be detected in a smoking blend designed for recreational use was JWH-018 in 2008. Though epidemiological data has been available concerning SCs since 2009, large scale data collection

on incidence of SC use did not begin until 2011 through the Monitoring the Future survey program (Vandry, Dunn, Fry, & Girling, 2012).

When prevalence of SC usage first began being monitored in 2011, annual prevalence was found to be 11.4%, becoming the second most widely used class of drugs behind marijuana that year (Monitoring the Future, 2016). Though the exact causes are unknown, the overall prevalence of use has declined steadily since 2011 reaching annual prevalence rates as low as 1% in young adult populations (Schulenberg et al., 2016). Over time there has also been an increase in the perceived risk of using SCs. Though the decrease in prevalence of annual use and an increase in perceived risks involved with SC usage is promising, the rates of acute poisonings resulting from SC usage is increasing (Riederer et al., 2016). Though only one death has occurred with SCs being identified as a sole agent involved, systematic case studies of existing data have identified a strong correlation with SC usage and psychotic symptoms (Deng et al., 2018). Though the role of SCs in psychosis is more complex than a single chemical component may explain, both new onset of psychotic symptoms as well as relapse of psychotic symptoms have been associated with SC use.

A major challenge presented to all disciplines attempting to study the physiological and psychological effects of SCs are their difficulty to metabolically detect using both common and sophisticated screening methods. Common urinary analysis methods used for detection of drugs are not suitable for identification of SC use (Hu, Primack, Barnett, & Cook, 2011; Fantegrossi, Moran, Radominska-Pandya, & Prather, 2015; Debruyne & Boisselier, 2015; Hutter, Kneisel, Auwarter, Neukamm, 2012; Seeley, Lapoint, Moran, & Fattore, 2012). Though Hutter et al. (2012) developed procedural methods for detection of 22 different synthetic cannabinoids in human hair through liquid chromatography, the rapid progression of new SC formulations

presenting often to evade regulation present a notable challenge in detection and screening. Often once assay methods such as those by Hutter et al. (2012) have been developed to detect a variety of SCs, illicit laboratories have moved on to new compounds resulting in many months of delay before confirmatory tests for the new compounds become available (Trecki, Gerona, & Schwartz, 2015). Difficulty in detection has been identified as a motivation for use of SCs. Vandry et al. (2013) identified that 30% of their sample population endorsed achieving intoxication while evading detection in urinary analysis as a primary reason for use. When comparing usage patterns between SCs and marijuana, 14.5% of respondents who endorsed a preference towards SCs cited evasion of detection as their primary reason for preference (Winstock & Barratt, 2013). In a unique investigation of prevalence, it was identified that 4.5% of athletes subject to routine screening for substance use were using SCs presumably to evade detection (Heltsley et al., 2012). Avoidance of detection is one of several reasons that could be linked to usage of SCs.

Another potential contribution to the rapid rise in SC use is its wide availability. Though legislation enacted shortly after the rise of SC use has reduced availability, initially herbal mediums containing SCs were available at gas stations, convenience stores, vape stores, tobacco stores, online, and shops that sell paraphernalia for tobacco and marijuana use (head shops) among others (Castellanos & Gralnik, 2016; Hudson & Ramsey, 2011; Spaderna, Addy, D'Souza, 2013). As personal vaporizers or "e-cigarettes" became increasingly popular as an alternative to tobacco use, SCs also became available in a liquid form that could be administrated through these devices (Debruyne & Le Boisselier, 2015; Trecki, et al. 2015). The Monitoring the Future survey project, while investigating perceived availability of other drugs, has not investigated perceived availability of synthetic cannabinoids. However, some data exists

suggesting that availability may contribute to SC use. Cooper (2014) reported that 14% of individuals who do not use SC's but have friends who engage in SC use identified low cost and availability as a factor motivating their peers' use. Fattore and Fratta (2011) also discussed the ease of acquisition of SCs from online sources and local shops. The ability to easily acquire SCs through processes that are much safer than other illicit drugs may have contributed to their initial popularity and continued use.

Another unique factor contributing to the rise of popularity in SCs were their legal status. It should come as no surprise that legal methods of intoxication are in great demand (United Nations Office on Drugs and Crime "UNODC", 2018). Since their emergence in 2008 and prior to 2012, the legal status of these substances remained in flux. Pieces of state legislation were proposed to regulate the legal status of SCs, however SCs were often scheduled on a substance-by-substance basis and easily skirted by reformulation (Debruyne & Le Boisselier, 2015). This legislation cascade was a contributory factor to the current multitude of different types of SCs that have been identified. To date, there have been 251 different SCs reported internationally by the United Nations Office on Drugs and Crime (2018), representing the largest category in terms of different substances reported. In 2012, the United States Congress passed the Synthetic Drug Abuse Prevention Act of 2012, effectively blanket scheduling SCs and allowing subsequent scheduling of new SC formulations under the auspices of The Federal Analogues Act. Though it has reduced since 2012, the United States seized 5 tons of SCs in 2016 in response to the passing of this legislation (UNODC, 2018).

Significance of the Problem

The population with the highest prevalence of use of SCs are high school aged men, though carryover into 18-24 year-olds exists (Schulenberg et al., 2016). In a recent review of

acute poisonings, 27.4% of individuals requesting medical treatment after exposure to SCs were under 18 years of age (Riederer et al., 2016). Though there has been a notable drop in prevalence of use, these younger populations remain at high risk. Acute poisonings as a result of SC usage is also increasing despite a drop in overall use. The first four months of 2015 showed a 330% increase in SC related calls to United States poison control centers (Riederer et al., 2016). However, because many presentations for psychiatric problems do not indicate assessment for SCs use, SC related emergency medical care may be seriously underreported (Tait et al., 2016).

There is a growing body of evidence suggesting a relationship between presentation of psychiatric symptoms and SC use (Fattore, 2016; Fattore & Fratta, 2011; Cooper, 2016; Trecki et al., 2015; Debruyne & Le Boisselier, 2015; Spaderma et al., 2013; Castellanos & Gralnik, 2015; Every-Palmer, 2010). It comes as little surprise as existing research has provided evidence to the association of adolescent marijuana use and likelihood of developing psychotic disorders later in life (Pierre, 2011). However, the psychotic symptoms associated with SC use are generally observed in instances of acute intoxication. It is currently unclear if SCs pose the same risks of increased chance of later development of psychotic disorders in the same way that marijuana does, especially with use during adolescence (Deng et al., 2018). SCs have also been shown to have the potential to trigger psychotic symptoms in individuals with a history of psychotic episodes (Seely, Lapoint, Moran, & Fattore, 2012).

There are compelling reasons to use SCs as a recreational substance. Low cost, availability, legal status, difficulty in screening/detection, and perceived safety are some contributing factors. A 3-gram packet of spice generally sells for about $30 - $40 and can be acquired through both retail and illicit channels (Spaderna et al., 2013). As discussed previously, effective and widely distributed methods of screening for SCs such as urinary analysis are not

widely available and add significant complexity and cost to extant drug screening protocols (Trecki et al., 2015). A survey conducted by Bonar, Ashrafioun, and Ilgen (2014) demonstrated that 30% of individuals who use SCs endorsed safety as a motivating factor. These factors, among others may be contributing to the current rise in acute intoxications and the increase in presentation of psychotic symptoms related to SC use. The U.S. Department of Health and Human Services has underscored the importance of the development of targeted prevention interventions for synthetic cannabinoids and the need for education on the consequences of using these substances (Riederer at al., 2016).

Purpose of the Study

Synthetic cannabinoids briefly became the most commonly used recreational drug behind marijuana, and then in a span of 5-years had a reduction in prevalence to below 1%. Therefore, it seems plausible that there are significant contributing factors that may be able to explain this seemingly unusual rapid rise and fall of use of a drug. While some research has attempted to explain why individuals may be motivated to use SCs or may choose them as opposed to other substances, no known current research exists examining why prevalence has decreased so sharply in a relatively short period of time. Furthermore, while many studies and articles exist explaining the intricacies of the different SC formulations and their risks, no known research exists that examines end users individual knowledge about SCs and the potential for negative health effects.

An understanding of why individuals are choosing to discontinue or avoid use of SCs may be able to inform targeted intervention and prevention strategies as well as assist in the development of education programs on the potential consequences of SC use. Concurrently, an understanding of why individuals continue to use SCs despite the consequences may also inform

intervention and prevention strategies. Because SCs fall into a niche category as a synthetic analogue of a recreational drug that is already widely used, it is unclear if motivations surrounding the use of SCs are unique to this class or generalizable to other substances.

The purpose of the study was to develop an understanding of why individuals with a history of synthetic cannabinoid use have decided to either discontinue use of these substances or continue use. In addition, the study investigated general knowledge about synthetic cannabinoids of individuals with a history of use as well as investigating the perceived risks of synthetic cannabinoids relative to other drug classes. The research questions of this study are listed below.

Research Questions

1) What factors have motivated individuals to discontinue synthetic cannabinoid use?
2) What factors contribute to the continued use of synthetic cannabinoids?
3) What knowledge do individuals who currently use or have used synthetic cannabinoids possess on the physiological effects and known consequences of synthetic cannabinoid use?
4) What are the perceived risks of using synthetic cannabinoids?

Definition of Terms

1) CB1R & CB2R Receptors: Receptors located in the central and peripheral nervous system (CB1R) and in the immune system (CB2R). These receptors are the targets with which synthetic cannabinoids interact and elicit cannabimimetic effects similar to that of Δ9-tetrahydrocannabinol (THC). (Castaneto et al., 2014).
2) Δ9-THC: The primary psychoactive compound found in marijuana which recreational use of synthetic cannabinoids attempt to mimic.

Summary

The present study investigated the reasons that individuals decide to discontinue using synthetic cannabinoids, continue to use synthetic cannabinoids, and investigate how much knowledge they possessed about these substances both chemically and their physiological effects. In addition, the present study investigated the relative perceived risks of using synthetic cannabinoids with regards to the deleterious physical and psychological effects that have been detailed in the literature.

This dissertation was organized into five different chapters. Chapter one provided an introduction, chapter two consisted of a comprehensive review of literature relevant to this topic, chapter three detailed the methodology of the present study, chapter four described the data and findings of the study, and chapter five included discussion and implications of the study based on the findings.

CHAPTER 2

LITERATURE REVIEW

Since 2008, synthetic cannabinoids have emerged as one of the more commonly used drug of abuse and then regressed in popularity to observed prevalence rates of less than 1%. While the majority of information on these drugs is surveyed from young adults, most research has found that this is also the most common population for use, making data repositories such as Monitoring the Future particularly important when making observations of synthetic cannabinoid use. However, since their emergence in 2008, limited research has been carried out to understand the drugs from an abuse standpoint. Further complicating these issues, the legal status and landscape of these substances has changed several times since their introduction which has had a notable impact on the presentation and use patterns of synthetic cannabinoids. Their structures have become increasingly complicated through the creation of not only novel compounds, but from the modification of existing compounds to skirt legal regulations as well as evade current drug detection methods.

The following chapter is structured in several sections to provide both an understanding of the mechanisms underlying synthetic cannabinoids that differentiate them from not only marijuana but also from other drugs of abuse as well as an overview of current literature relevant to the current study. Analysis is made of current literature surrounding the characterization of use of synthetic cannabinoids as well as their toxicity and association with the presentation of psychiatric symptoms and disorders. Overall research methodology relevant to the current study are discussed and critiqued to form the basis for the study at hand.

Structure and Pharmacology of Synthetic Cannabinoids

The complexity of synthetic cannabinoids in both their presentation as well as structure is

very misunderstood. The United nations Office on Drugs and Crime (2018) identified that to date there have been 251 different formulations of synthetic cannabinoids reported internationally, which represents the largest discrete drug category in terms of variety of substances reported. Synthetic cannabinoids can be grouped into five categories (Castellanos & Gralnik, 2016; Langford & Bolton, 2018):

1) Classical cannabinoids, which have a structural relationship with Δ9-THC.
2) Non-classical cannabinoids, which are based on derivatives of cyclohexylphenol.
3) Hybrid-forms, which arise from combinations of classical and non-classical structures.
4) Aminoalkyl indoles, which can be further subdivided into naphotoylindoles, phenylacetylindoles, naphtylmethylindoles, and benzoylindoles, are cannabinergic compound that can act as a cannabinoid receptor agonists.
5) Endocannabinoids (eicosanoids), endogenous molecules involved in nervous system and immune system functioning.

Starting in the late 1960s following the isolation of Δ9-THC, classical synthetic cannabinoids were the first to be derived and remained the only synthetic cannabinoids for nearly a decade (Law, Schier, Martin, Chang, & Wolkin, 2015; United Nations Office on Drug and Crime, 2011). Classical cannabinoids are not often observed in recreational synthetic cannabinoid blends because of the difficulty and expense involved in their synthesis. Non-classical cannabinoids were developed in the late 1970s by Pfizer as potential analgesic compounds (Seely et al., 2012). The hallmark of these non-classical cannabinoids' popularity in the market is the each in which they are synthesized and their retention of full antagonistic effect on CB1R receptors causing psychoactive effects similar to that of Δ9-THC. Hybrid forms have a combination of classical and non-classical structural features. Aminoalkyl indoles are another class of CB1R agonists that

mimic the effects of Δ9-THC. They also represent the largest group of identified compounds and the easiest group to create more novel compounds through the addition of halogen, alkyl, alkoxy, or other substituents to one of the aromatic ring systems among other relatively simple alterations (United Nations Office on Drug and Crime, 2011). The Endocannabinoid class represents synthetic analogues of cannabinoids that are naturally occurring in the body (United Nations Office on Drug and Crime, 2011). Trade names of synthetic cannabinoids follow a relatively simple system of identification. They are represented by an alphanumeric code referencing the institution or individual who isolated them as well as their identification number (e.g. JWH-XXX – John W. Huffmann, HW-XXX – Hebrew University) (Debruyne & Le Boisselier, 2015).

Characterization of Synthetic Cannabinoid Use in General Populations

To date, few studies have been carried out the characterize the use of synthetic cannabinoids relative to other drugs of abuse. Of these studies, even fewer extend beyond interpretation of large scale sampling sources such as the Monitoring the Future program or outside of niche populations like athletes, individuals engaged in treatment programs, or poly-drug users. The most recent publication interpreting the Monitoring the Future data, Palamar and Acosta (2015), shown that 10.1% of high school seniors reported using synthetic cannabinoids in the last 12 months and 3.2% reported frequent use. Males reported using synthetic cannabinoids more than females and compared to white students, black students were at low odds for use. Though their analysis eliminated many contributing variables to use when controlling for other drugs use, a consistent correlate for use was how many evenings were spent out for fun. Lifetime alcohol use nearly doubled the odds that high school seniors would use synthetic cannabinoids, as well as ever smoking. Notably, lifetime marijuana use greatly increased the odds for use of

synthetic cannabinoids. Considering frequent use of synthetic cannabinoids, Palamar and Acosta (2015) found that males, students with higher levels of income, individuals who go out for fun more frequently, who have used alcohol, cigarettes, marijuana, or any other illicit drugs were more likely to use synthetic cannabinoids frequently.

Palamar and Acosta's (2015) methodology involved analysis of a nationally representative study of high school students, surveyed yearly in over 100 schools, both public and private throughout the contiguous United States. Yearly, approximately 15,000 high school seniors are surveyed each year. Though all forms of this survey assess sociodemographic factors and use of various drugs, only forms concerning use over the past 12-month period have questions to assess synthetic cannabinoid use. Thus, while utilizing the most robust sample of young adult drug use, only about one third of the total sample are asked questions about synthetic drug use, representing an approximate n = 5,000. The Monitoring the Future project began asking about synthetic cannabinoid use starting in 2011, thus this sampling range represents aggregated data of the three most recent cohorts (2011 – 2013) at the time of publishing. While this seems to be the only large scale analysis of Monitoring the Future data as it relates to synthetic cannabinoid use, since 2013 prevalence of use has shifted notably to rates of less than 1%, representing a marked decline and potentially rendering the results of this investigation outdated and of limited current use.

Differing from the previous analysis, Caviness, Tzilos, Anserdon, and Stein (2015) sampled1080 individuals aged 18-25 to investigate predicting factories of synthetic cannabinoid use in a community sample. Participants averaged 21.4 years old, were 53.4% male, and 58.9% non-Hispanic white. Nine point three percent of respondents reported using synthetic cannabinoids in the past month, surpassing the rate of reported use of opioids, cocaine, and

hallucinogens. 99% of respondents who reported using synthetic cannabinoids had used marijuana in the past and 62% reported daily use of marijuana. Consistent with other studies, males used synthetic cannabinoids more than females as well as a high rate of use among white respondents. Those not in college and in the workforce were also found to use synthetic cannabinoids compared to college engaged peers. Caviness et al. (2015) suggest that this is potentially a result of individuals motivated by avoidance of detection in drug screens implemented in the workforce. Individuals who used synthetic cannabinoids also had much riskier poly-drug use profiles when compared to non-synthetic cannabinoid using counterparts.

Caviness et al.'s (2015) data collection method utilized telephone interviews targeting individuals ages 18-25. Advertising on public transportation, college newspaper, and on public radio, the researchers invited interested persons to call the study phone number or send an email to the study address to recieve a return call to be screened. Individuals provided verbal informed consent, and provided their answers confidentially to a researcher during a 10-minute phone interview; respondents were queried about their recent use of alcohol and drugs, including synthetic cannabinoids. This collection method, over a 18-month period, proved effective and allowed the researchers to recruit 1080 participants within the defined age range for the purpose of this study.

Gunderson, Haughey, Ait-Daoud, Joshi, and Hart (2014) took a different approach to characterization of synthetic cannabinoid use. Their study stands alone as the only investigation into synthetic cannabinoid use by current marijuana users. Considering previously discussed studies, it was known and later corroborated that individuals who use synthetic cannabinoids have a very high likelihood of also having a history of marijuana use or concurrent use. Potentially as high as 99% of synthetic cannabinoid users also use marijuana. What differentiates

Gunderson et al. (2014) from other studies, is that their analysis allows for estimation of the inverse of this metric, and an understanding of the prevalence of synthetic cannabinoid use among those already participating in an activity identified as a risk factor for synthetic cannabinoid use. While nearly all respondents were familiar with synthetic cannabinoids, 50% reported a history of synthetic cannabinoid use, and 24% reported current synthetic cannabinoid use. Gunderson et al. (2015) also investigated motivations for use among this population. Common reasons for use included seeking a new high similar to that of marijuana and avoiding detection via drug use screening methods (urinary analysis). Relevant to the current study, Gunderson et al. (2015) reported that respondents commonly experienced adverse effects as a result of synthetic cannabinoid use. These effects included difficulty with thinking clearly, headache, xerostomia, and anxiety. No individuals in this study reported experiences of paranoia or psychosis, which may be mediated by biologic vulnerability of the sample population.

Several limiting factors are present for this analysis. Potential participants had to report regular cannabis use or tobacco use over 10 cigarettes per day, and consent to be contacted for future research after participation in a previous study. Utilizing telephone data collection methods similar to Caviness et al. (2015), the study at hand yielded N=42. Compared to other samples, this relatively small number of participants is a limiting factor in this analysis. Though it provides useful and unique data, it's generalizability is limited due to low power and regional constraints of the participants. The target population, though, is also small and difficult to access causing studies of this nature with a large randomized sample to be particularly difficult. That being considered, data yielded from this study is particularly important considering the prevalence of marijuana among users of synthetic cannabinoid users in previous research. It is useful to understand that though the overwhelming majority of synthetic cannabinoid users use

marijuana, potentially less than one quarter of frequent marijuana users also use synthetic cannabinoids representing a non-bi-directional relationship of use that might have been inferred from previous studies.

Winstock and Barratt (2013) performed the most recent analysis characterizing synthetic cannabinoid use utilizing, to date of publication, the largest self-report sample of recent synthetic cannabinoid users describing their demographic and drug use characteristics. Utilizing online sampling methods, a total of 14,855 responses were received from global participants. 22.6% (n = 3362) were from the United States, approaching the number of respondents sampled in the Monitoring the Future data set analyzed by Palamar and Acosta (2015). 91.5% of participants in the global sample identified as white, with a median age of 26 and 70.6% of respondents were male. Of the global participants, 16.8% reported ever using synthetic cannabinoids. Of those respondents, 40.6% of them reported synthetic cannabinoid use in the previous month. Users of synthetic cannabinoids were generally male (79.6%), with a median age of 23 and a mean age of 25.3. Two thirds of respondents reported that they were currently working, and over half reported being a current student.

Among recent users of synthetic cannabinoids, the median age of first use was 21 years old. Of recent users, 39.4% reported use within the last 30 days. Of those participants, 32.6% reported only one use, 36.8% reported use on 5 or more occasions, and 4.8% reported daily use. 99.3% of recent synthetic cannabinoid users reported a history of use of marijuana. Poly drug use was common, with most synthetic cannabinoid users reporting using alcohol, tobacco, and energy drinks within the last month. 36.2% of respondents were daily tobacco smokers and almost half of this sample reported using MDMA (ecstasy) in the past 12 months, and one third reported use of psilocybin, cocaine, LSD, and/or benzodiazepines.

An important and unique component of Winstock and Barratt's (2013) analysis was their attempt to compare user effects between synthetic cannabinoids and marijuana as well as an attempt to characterize why respondents may display a preference to synthetic cannabinoids over their natural counterpart. Marijuana was rated as having greater pleasurable effects during use and having greater sedating effects compared to synthetic cannabinoids. Interestingly though, respondents reported that they were more able to function normally after using marijuana compared to synthetic cannabinoids. Marijuana was reported to inflict more memory impairment, be more addictive, and produce a more consistent high than synthetic cannabinoids. Synthetic cannabinoids were reported though to be a better value cost wise when compared to marijuana. Synthetic cannabinoids were reported to produce more negative effects during use. Individuals that reported a preference for synthetic cannabinoids over marijuana (7.2%) were asked to identify the most important reason for their preference. The most important reason identified was their effect/high (58%), followed by synthetic cannabinoids availability (18.9%), then their ability to evade urine screening (14.5%), and last their cost (8.7%). 1.8% of respondents reported that they would like help/treatment to reduce or cease their use of synthetic cannabinoids. Some limitations were present in this study. In an attempt to maintain anonymity and prevent any potential for information tracking of respondents, no identifying information including IP addresses were retained. As a result of this, no protocol was in place to prevent multiple responses from single respondents. However, because no incentives were provided for participation in this study, it is unlikely that multiple responses would be a factor great enough to influence results in such a large sample. This study also relied on self-report data and participant's proficiency in their self-history. Participants may have reported their previous use inaccurately or characterized their current use inaccurately, however this is a concern in all self-

reported substance use screenings. This study represents one of the only large scale independent samplings of synthetic cannabinoid use and provides unique insight into both use patterns and demographics, as well as providing unique comparisons to marijuana use and validating online data collection methods for this population.

Stogner and Miller (2014) collected data to profile synthetic cannabinoid users in a sample of 2,349 United States college students between 2011 and 2012. This time point is notable as it pre-dates the majority of legal actions taken to schedule and criminalize synthetic cannabinoids for recreational use. Classes at the university were randomly selected and all students were allowed to participate regardless of enrollment status; duplicate participants had their second submission thrown out (n = 202). The researchers specifically targeted all synthetic cannabinoid use and attempted to identify a wide variety of retail names commonly used for synthetic cannabinoids to avoid confusion or misidentification of substances in self-report.

Of the students surveyed in this study, 14.3% reported lifetime use of synthetic cannabinoids with an average age of initiation of 18. Approximately 7.1% of respondents reported use of synthetic cannabinoids in the past year and 2.7% reported use in the previous month. Men were twice as likely to report lifetime use than women and almost twice as likely to report use in the past year. Lifetime use was also correlated with lower grade point averages. Lifetime use was also more prevalent in respondents with family incomes over $100,00 per year. Sexual orientation also was correlated with lifetime use of synthetic cannabinoids, with LGBT members reporting lifetime use of 26.6% versus 13.7% in heterosexual respondents. Notably, use of synthetic cannabinoids was low among those that abstained from alcohol use (0.3%) and among those that did not use marijuana (0.4%). Overall, Stogner & Miller (2014) found that males who were White or Hispanic from higher income families that identify as LGBT were

most likely to use synthetic cannabinoids as well as those that use other substances.

Stogner and Miller (2014) a detailed profile of synthetic cannabinoid use among young college students. Some limitations exist in this study, notably that the sample population is bound to individuals pursuing college education and may not be generalizable to the population of synthetic cannabinoid users as a whole. This study is one of few that investigated use patterns among LGBT individuals, however their analysis did not include comparisons of usage rates of other drugs between LGBT and heterosexual populations to investigate whether this is a phenomenon unique to synthetic cannabinoid use or a trend prevalent among multiple classes of substances. Corroborating other studies, synthetic cannabinoid users tend to use other substances with nearly all reported users also reporting use of tobacco, alcohol, or marijuana.

Vandrey, Dunn, Fry, and Girling (2012) conducted an internet based survey to characterize use of synthetic cannabinoids, with all participants reporting at least one lifetime use of a synthetic cannabinoid product. Important to note, as with Stonger and Miller (2014), the time that this survey took place pre-dates the criminalization of synthetic cannabinoid products in the United States and may not be current or generalizable to extant populations as lifetime use has likely decreased as a function of adult population due to recent declines in prevalence among young adults. This study also has a relatively low number of participants (N = 168) and comprised an international sample representing 13 different countries, which also limits the generalizability of this data as the investigators did not articulate what percentage of participants were from the United States. This study, though, was unique in that is attempted to investigate where individuals who were using synthetic cannabinoids were acquiring them from.

Similar to previously discussed studies, synthetic cannabinoids users were primarily male (83%), Caucasian (90%), had a high school education (96%), with almost half being employed

full time (46%) and one quarter being students (28%). Polydrug use was also common, with 92% of participants reporting alcohol use, 84% reporting marijuana use, and 66% reporting tobacco use. These numbers are in line with previous usage, however demographic data on prevalence of synthetic cannabinoid use among non-Caucasian groups was not presented. The majority of participants reported obtaining synthetic cannabinoids from gas stations and convenience stores (87%), from the internet (37%), and from friends and relatives (29%). Though 49% of participants reported living in an area where laws had been enacted restricting the sale of synthetic cannabinoids, only 2% of participants reported acquiring synthetic cannabinoids from an illicit drug dealer. This is of the limited evidence demonstrating that even with laws in place to curtail the sale of synthetic cannabinoids, these substances are often available through relatively accessible channels while still being illegal.

Unlike other studies of this type, average age of first use was relatively high at 26, with a large amount of participants reporting regular synthetic cannabinoid use, with 55% reporting use in the past month and 39% reporting use in the past week. Though high compared to other studies, these numbers may accurately reflect the prevalence rate of synthetic substance use at the time of survey as in 2011, synthetic cannabinoids were the most commonly used illicit substance behind marijuana (Monitoring the Future, 2016). Vandrey et al. (2012) also investigated the subjective effects of synthetic cannabinoids among users. The most frequently reported positive effects were a pleasant high (37%) and increased appetite (14%), with the most frequently reported negatives effects being xerostomia (14%) and feeling lightheaded (13%).

Considering the discussed literature that has attempted to characterize the use of synthetic cannabinoids, several consistent themes stand out that identify potential risk factors for use. Among these consistently identified are being male, aged 18-30, Caucasian or Hispanic, current

or ever use of marijuana, tobacco use, alcohol use, and having a higher household income. A subset of the discussed studies purporting to characterize synthetic cannabinoid use also examined reasons why users may choose these substances over marijuana. The most commonly identified reasons are their particular high/effect, their availability, their cost when compared to marijuana, and the ability to bypass traditional drug screening methods used in various contexts. Generally, these studies utilize self-report methods via online or phone surveys. While susceptible to the limitations inherent to self-report survey research, the relative small size of the population as well as the legal concerns of disclosing use of these substances make the anonymity provided by online survey methods to be the preferable channel for data collection.

Relevant to the current study, to date no investigation has been made into the large amount of former synthetic cannabinoid users as to why they have discontinued use of this drug class. Inferences can be made based on the changing legal landscape of these substances as well as the changing legal status of marijuana across the United States. However, acute poisonings as a result of synthetic cannabinoid use is increasing, representing a need for targeted intervention strategies that can be informed by increased understanding of not only risk factors but protective factors as well as motivation to discontinue use of these substances (Riederer at al., 2016).

Synthetic Cannabinoid Use in Specific Populations

Several previously discussed studies identified that the overwhelming majority of individuals who use synthetic cannabinoids also use some other psychoactive substances, notably marijuana but also tobacco and alcohol. With this consideration in mind, Bonar, Ashrafioun, and Ilgen (2014) worked to further advance the characterization of synthetic cannabinoid use by investigating use among individuals participating in residential substance use disorder treatment. Recruiting participants voluntarily who were participating in a large residential substance use

disorder (SUD) treatment program serving a large Midwestern United States population, Bonar et al. (2014) recruited 396 SUD treatment patients. The mean age was 34.8 years (SD=10.7) with 67% male and 75% white participants. Of those surveyed, 38% (n=150) reported ever use of synthetic cannabinoids, with 79% (n=119) endorsed use within the past-year. Similar to other motivations for use, Bonar et al. (2014) found that 91% of participants tried synthetic cannabinoids out of curiosity/experimentation, 89% reported using synthetic cannabinoids for their high, 71% reported using synthetic cannabinoids for their relaxing effect, 71% also reported that their use was motivated by the ability to get high without having a positive drug screen. While the number of individuals reporting avoidance of drug screening in this study is relatively high, these results are understandable considering the context of substance use treatment that the study was performed in. It should also be noted that a potential client pool for this treatment facility came from the department of corrections, potentially influencing the number of individuals motivated to avoid positive drug screens.

Further analysis was performed to attempted to differentiate between those with lifetime synthetic cannabinoid use and those who did not use. Lifetime users were younger, more likely to be white, and were more likely to report polysubstance use. Participants who reported lifetime use of synthetic cannabinoids also reported more severe symptoms of depression, higher levels of general psychiatric distress, more likely to report paranoid ideation, and psychosis. This information is important in characterization studies as previously discussed, studies have identified a relationship between synthetic cannabinoid use and psychiatric symptoms (Fattore, 2016; Fattore & Fratta, 2011; Cooper, 2016; Trecki et al., 2015; Debruyne & Le Boisselier, 2015; Spaderma et al., 2013; Castellanos & Gralnik, 2015; Every-Palmer, 2010). Overall, synthetic cannabinoid use among SUD treatment populations was relatively common, with over

two thirds reporting their motivation for use as avoidance of drug screening methods. Interesting, 30% of participants with synthetic cannabinoid use endorsed that they felt it was safer than other drugs. Schulenberg et al.'s (2016) data investigated perceived risk of synthetic cannabinoids, but not perceived safety; this information represents valuable insight into why individuals may continue to use these substances.

Another specific population of individuals who may have incentives to utilize synthetic cannabinoids are military personnel. Berry-Caban, Kleinschmidt, Rao, and Jenkins (2012) investigated both synthetic cannabinoid use as well as synthetic cathinone use among United States soldiers. While not discussed in this paper, synthetic cathinones represent another group of synthetic drugs of abuse that are colloquially known as "bath salts". The target population consisted of active duty soldiers that presented to a military emergency medical department and either endorsed substance use or were suspected by a provider to be using illicit substances (N=155). Of the sample, 7.7% (n=12) tested positive for synthetic cannabinoid use and 8.3% (n=13) tested positive for synthetic cathinone use. Rates of synthetic cannabinoid use were concentrated in individuals aged 19 to 24 (75%) consistent with other studies characterizing its use. Berry-Caban et al. (2012) did not do further investigation into the motivations for use of synthetic cannabinoids or cathinones in this investigation.

A similar study was performed by Heltsley et al. (2012) investigating the prevalence of synthetic cannabinoid use among athletes in the United States. Their methods involved using specific urinalysis of samples taken from participants for metabolites of the two synthetic cannabinoids JWH-018 and JWH-073. Analyzing samples from 5,946 athletes, Heltsey et al. detected metabolites of the two synthetic cannabinoids in 4.5% of the sample (n=266), with the majority being JWH-018 (99%; n=263). Though low compared to general populations numbers

in previously discussed studies, these numbers were notable as the authors articulated that 4.5% placed synthetic cannabinoids among the most detected drug class among all screened for in that particular laboratory. Limitations also were present in this study that may have limited the ability for the researchers to identify all potential cases of synthetic cannabinoid use, as JWH-018 and JWH-073 are two of hundreds of synthesized synthetic cannabinoids. However, this information is impactful as it places synthetic cannabinoids at the top of drug classes that are used by individuals who have incentive to avoid detection.

Synthetic Cannabinoids and Psychosis

An emerging line of research that has emphasized the importance of understanding use patterns as well as the need for harm reduction strategies in synthetic cannabinoid use is its relationship with psychiatric symptoms and particularly psychosis. While the relationship is complicated, much like the relationship of marijuana use and psychosis, it's frequency is being observed at a much higher rate in a much shorter period and has generated notable concern about the potential for future harm to users. At early as 2011, only three years into the widespread proliferation of synthetic cannabinoids in the United States, authors began analyzing case studies of psychosis presentations in synthetic cannabinoid users. Pierre (2011) was of the first to aggregate these case studies and examining psychosis associated with synthetic cannabinoid use in both individuals with a history of psychotic symptoms and those without. When evaluating individuals with psychosis related to synthetic cannabinoid use, Pierre (2011) observed a near 50% split between those with a history of psychosis and those without any history. The majority of the studies identified JWH-018 as the suspected synthetic cannabinoid resulting in psychosis.

In one case study discussed by Pierre (2011), though symptoms resolved in 70% of patients after 5 days, psychosis symptoms were still present at 5-month follow up for 30% of

patients. While the relatively low number of observations (N=10) in this instance limits its generalizability, it still presents the alarming possibility that chronic psychotic symptoms may be triggered by synthetic cannabinoid use. When considered together, the initial reports investigated by Pierre (2011) suggested that acute psychosis in patients with no psychiatric history was associated with synthetic cannabinoid use as well as the potential for exacerbation or triggering of psychotic symptoms in previously stable individuals with a history of psychotic symptoms.

Fattore (2016) carried on the same thread of Pierre's (2011) work continuing to interpret new case studies that have been presented to understand the relationship between synthetic cannabinoid use and psychosis. While there are no controlled clinical trials demonstrating the association to date, Fattore (2016) came to largely the same conclusion that Pierre (2011) did 5 years earlier.

Fattore (2016) generally concluded that:

> "Compelling evidence shows that SCs are able to trigger psychotic symptoms not only in vulnerable individuals, who re-experience psychosis after consumption, but also in subjects with no previous history of psychosis, who may experience prolonged psychotic episodes after smoking products containing SCs." (p. 541)

The literature on these associations is limited and most data are gathered from emergency department admissions as well as reports from poison control centers. Fattore (2016) also identified many of the issues that arise from relying on case studies for information on the association of synthetic cannabinoids and psychosis. Particularly that there is often no differentiation between new onset of psychosis and individuals with a history of psychosis. The majority of reports also do not disclose which specific compound was responsible for the incident as this relies on complex and possibly unbailable laboratory analysis with limited

accessibility. This is a major limitation in understanding of the association as the complexity of the emergence of new compounds as well as the modification of existing compounds through methods such as fluorination may impact the influence that these substances have on triggering psychiatric symptoms.

The most recent, complex, and thorough meta-analysis of current reports on the association of synthetic cannabinoid use and psychosis was performed by Deng, Verrico, Kosten and Nielsen (2018). Searching all available published literature that contained information on the association of synthetic cannabinoid use and psychosis, ultimately analyzing 42 articles. With regards to new-onset psychosis, Deng et al. (2018) identified studies discussing patients that had new-onset psychosis with both positive and negative psychiatric histories, as well as identifying onset of psychosis in individuals with strong genetic predisposition to mental illness. Deng et al. (2018) investigated relapse of psychosis instigated by synthetic cannabinoid use. While there are less cases of these documented in the literature, it should also be noted that there are instances in the literature of psychotic relapse in similar populations from multiple drugs of abuse. While this does not rule out synthetic cannabinoids as a potential for relapse in individuals with positive psychiatric histories, less emphasis has been placed on this line of research due to this being the norm rather than the exception when considering substance use disorders in psychiatric populations.

Deng et al. (2018) concluded that a causal effect in some instances of presentation of psychosis symptoms after use of synthetic cannabinoids is likely based on the literature but not conclusive. Recent studies analyzed also demonstrated that cohorts of synthetic cannabinoid users are more severely psychotic than marijuana using peers, including when controlling for sociodemographic factors and history of exposure to other substances. Another difficulty in

concluding on a causal relationship is, as previously discussed, the majority of synthetic cannabinoid users also use other drugs. It is impossible to rule out the potential impact that these drugs have on the development of psychosis, though retrospective works have suggested that there are higher rates of psychosis in populations that use synthetic cannabinoids. Previous literature has established a dose dependent relationship between prior cannabis use and the development of schizophrenia, that relationship is unclear with synthetic cannabinoids.

Considering the relevant literature, development of psychosis is a ubiquitous concern when considering negative effects of synthetic cannabinoid use. Though there are other complications that may arise from use of these substances, both physiological and psychological, the association of psychotic symptoms and the potential for these symptoms to become chronic are a top concern. The novelty of these substances, their rapidly developing chemistry, as well as their rapid progression to Schedule I status in the United States has prevented the performance of a randomly controlled study to investigate the negative effects that these drugs may have on individuals enough to establish causal relationships. Researchers must continue to rely on case reports from medical treatment facilities as well as poison control centers' data to build knowledge on the effects that these substances have.

Summary of Research Findings

Synthetic cannabinoids are complex drugs that have several subtypes and complications such as fluorination making their classification difficult and understanding the effects of individual compounds nearly impossible. With an estimated prevalence rate of less than 1%, the user base of these substances are diverse but generally consist of young white males, who are poly drug users, and have a higher than average household income. Mixed motivations for use have been identified in the literature, such as avoidance of detection through drug screening

methods, availability of synthetic cannabinoids, their cost, and a preference for their mood altering effects when compared to other drugs. New onset psychotic symptoms as well as relapse of psychotic symptoms in individuals with history has been associated with synthetic cannabinoid use. Though the relationship is complicated and not well understood, it is clear that some interaction exists with synthetic cannabinoids that may instigate the presentation of psychosis in vulnerable individuals.

Previous Research Methods

The majority of previous research methods to characterize the use of synthetic cannabinoids rely on self-report through either survey methods or live scripted interviews, with many participants being recruited or analyzed as a subset of a larger study aimed at substance use in general or at a different substance with a high level of co-occurring use. Due to the illegal nature of the use of synthetic cannabinoids as well as the current low levels of prevalence in the general population, the utilization of online survey based research to recruit from a large pool of potential participants seems appropriate when attempting to form a representative and generalizable sample population when compared to traditional survey sampling methods.

There is no consistent data collection method demonstrated in the relevant literature. Of the extant studies discussed, two relied on phone interviews to collect data, two relied on internet based surveys of international populations, one relied on a large government funded data collection program, and another sampled college students through in class participation incentives. Limitations exist in all of these methods of data collection that will attempt to be addressed in the present study. Telephone interviews, while having the ability to gain accurate survey information and curtail confusion originating from survey questions, is very labor intensive and requires a notable amount of time to collect enough participants. Online surveys,

while time and cost effective, present limitations with the global nature of the internet and limitations of who can participate to target a specific population. Online surveys can also be filled out inaccurately, rushed, or performed for monetary gain when incentives are involved. Sampling college students, while a convenient audience, limits the generalizability of substance use data as previous literature has shown that synthetic cannabinoid use is highly age correlated.

Data collected concerning the use of synthetic cannabinoids, outside of case studies on emergency department presentations, rely on self-report. Especially with consideration of estimation of use over long time periods, self-report may be inaccurate. It is difficult to accurately estimate and recall use frequency with a high level of acuity after an extended period. Self-report measures are also subject to many biases, such as social desirability, demand characteristics, and extreme responses. Social desirability bias, being of great concern for self-report surveys surrounding substance use, has been observed to account for 10%-70% of the variance explained in participant responses (Nederhof, 1985). However, even when considering these factors, no alternative method superior to self-report was identified to collect data for this type of research. This conclusion is consistent with the the relevant literature surrounding synthetic cannabinoid use.

No extant measure exists that is validated specifically for use to understand and characterize the use of synthetic cannabinoids. The surveys and measures used in the previously discussed literature aimed at characterization of use were formed by content validation methods with consideration of the relevant research questions at hand. Because of the dichotomous nature of many of these variables, analytical methods often do not extend past simple inferential statistics and analyses of variance. The current study borrows from these methods, as they are not only the most effective but also the most efficient, with some differences including the

primary recruitment source.

Summary

At present, no known study to date has attempted to provide an explanation for the changes in prevalence of synthetic cannabinoid use. Though, with this decrease in use, data shows an increase in acute poisonings as well as other negative effects associated with the recreational use of these drugs. Literature exists on the structure and function of these substances as well as the psychotomimetic of these substances. Likewise, limited literature exists on the characterization of use of synthetic cannabinoids and provides insight into risk factors associated with synthetic cannabinoid use. Unfortunately, because of the dynamic legal landscape of these drugs as well as the growing diversity of these substances, much earlier research on use of these substances is outdated and not generalizable to the current population. Still, case studies and meta-analyses are being published examining the harmful effects of these drugs, and future directions are aimed at better understanding harm reduction methods specific for this drug class.

The current study was intended to be on the cutting edge of this research, forging a new paradigm in not only collecting information on the prevalence of use, but being the first to investigate motivating factors to discontinue use and add further knowledge to the characterization of use. Little is known about intervention methods for these drugs both medically and behaviorally. The current study was poised to fill that gap in the literature as well as continue collecting corroborating information to further confirm previous research findings to establish their generalizability and confirm the current utility on the subject.

CHAPTER 3

METHODOLOGY

The purpose of the study is to develop an understanding of why individuals with a history of synthetic cannabinoid use have decided to either discontinue use of these substances or continue use. First, I was interested in acquiring knowledge as to why individuals with a history of synthetic cannabinoid use have decided to discontinue use of these substances. Second, a goal was to investigate why individuals continue to use synthetic cannabinoids while examining the role of participant demographic information. Another factor investigated was related to synthetic cannabinoid users' knowledge of the substances and what the perceived risks of synthetic cannabinoid use are. This chapter is a discussion of the methodology of the study in relation to the research questions, design of the study, sample, instruments, procedures, data collection and analysis, and limitations of the study.

Sample

The sample (n = 297) was comprised of individuals from the online survey service Mechanical Turk who respond to the request to participate. Participants were limited to those residing in the United States who identify as having a history of use of synthetic cannabinoids. Participants were provided with informed consent through Qualtrics, an online survey platform often used in social sciences research, with a digital indication of consent. All participants were over the age of 18. Demographics of the sample are included in Table 1.

Table 1. Age, Gender, Ethnicity, Race, Employment Status, Education, Synthetic Cannabinoid Use

Demographic Characteristics	Frequency (%)
Age	
18-24	41 (13.8%)
25-34	175 (59.1%)

35-44	45 (15.5%)
45-54	46 (15.5%)
55-64	11 (3.7%)
Gender	
Male	163 (55.1%)
Female	129 (43.6%)
Non-binary/third gender	2 (0.7%)
Ethnicity	
Not Hispanic / Latino/a	234 (79.1%)
Mexican, Mexican American, Chicano/a	29 (9.8%)
Puerto Rican	11 (3.7%)
Cuban	4 (1.4%)
Another Hispanic, Latino/a, or Spanish Origin	23 (7.8%)
Race	
White/Caucasian	240 (81.1%)
Black or African American	22 (7.4%)
American Indian or Alaskan Native	5 (1.7%)
Asian	31 (10.5%)
Native Hawaiian or Pacific Islander	2 (0.7%)
Other	2 (0.7%)
Employment Status	
Employed	253 (85.5%)
Unemployed	22 (7.4%)
Student	16 (5.4%)
Education	
High School Education	35 (11.8%)
Some College	55 (18.6%)
Associate's Degree	37 (12.5%)
Bachelor's Degree	139 (47.0%0
Master's Degree	25 (8.4%)
Professional Doctorate (MD, JD, etc)	2 (0.7%)
Doctorate (PhD, Ed.D, etc)	3 (1.0%)
Synthetic Cannabinoid Use History	
SC Use In Last 12 Months	148 (50.0%)
SC Use In Last 30 Days	70 (32.7%)
Alcohol Use History	
Alcohol Use in Last 12 Months	224 (75.7%)
Alcohol Use in Last 30 days	194 (65.5%)

Tobacco Use History	
Tobacco use in Last 12 Months	176 (59.5%)
Tobacco Use in Last 30 Days	153 (51.7%)
Marijuana Use History	
Marijuana Use in Last 12 Months	201 (67.9%)
Marijuana Use in Last 30 Days	165 (55.7%)
Other Illicit Drug Use History	
Other Drug Use in Last 12 Months	93 (32.1%)
Other Drug Use in Last 30 Days	73 (24.7%)

Design of the Study

The study at hand utilized data obtained through the crowd sourcing participant recruitment platform Mechanical Turk in conjunction with cross sectional survey methods. Mechanical Turk (MTurk) is an online labor market that assists researchers with recruiting and compensating participants in a variety of research tasks. All participants affiliated with MTurk are assigned a set of qualifications that can be utilized by the researchers to limit who may participate in a study, such as country of residence or age. Researchers can also define custom qualifications for eligibility to participate in a study through MTurk. All surveys placed on MTurk are labeled as Human Intelligence Tasks or a HIT, which represents a single task that participants can respond to and be compensated for. By default, participants may only perform a HIT once and researchers are given the option to approve or deny a HIT, with participants only being compensated if a HIT is approved. It is possible to also limit participation to participants who have historically demonstrated that they fill out surveys accurately and have a notable level of performance exceeding regular users.

This design allowed data to be collected from a sample to represent a larger population. Questionnaire surveys are not only a good way of measuring attitudes and behaviors, but

observation of the behaviors of interest to the current study is simply not possible on a large-scale basis through any other method. Online survey distribution methods have been chosen, as accessing the target population for the current study in a way that may be generalizable to the population is not possible through utilization of convenience sampling of university students. The utilization of online survey methods also allowed for a large amount of research participants to complete the survey in a short period of time.

MTurk is not without both advantages and limitations. In an analysis of papers evaluating the utility of MTurk in social sciences research, Cheung, Burns, Sinclair, and Sliter (2017) stated that data provided by MTurk participants had satisfactory psychometric properties as well as advantages in sampling participants from more diverse backgrounds. There were questions of the motive of participants who complete surveys and other tasks online for proportionately low compensation when compared to traditional wages. Representativeness was also a concern, with participants self-selecting themselves into online freelance work as a means of income. In studies utilizing the MTurk recruitment tool, participants tended to be younger, underemployed, more liberal, and less religious than the general population. There was also an overrepresentation of Whites and Asians. However, MTurk respondent pools are considered demographically more diverse than traditional student samples (Sheehan, 2018). In the context of the research questions in the study at hand, the benefits of having access to a nationwide sample with diverse ages outweighed the disadvantages summarized above.

Because of the economic motivation to complete surveys through MTurk, deception and misrepresentation may occur in order to qualify for a study. Sharpe-Wessling, Huber, and Netzer (2017) found that from 24% to 83% of participants passing screening questions are imposters and deceit can occur in 49% to 89% of those who are eligible to, misrepresent their responses.

However, there are steps that can be taken to minimize imposters from gaining eligibility to a study, such as disguising desired screening questions and answers and running a short, paid, pre-screen. Online communities exist that provide information by those who have completed surveys to allow other users to bypass pre-screening questions to gain access to a survey to complete for financial gain thus revealing experimental conditions. However, these communities also serve as a safeguard against deception. In another study conducted by Sharpe-Wessling et al. (2017), findings revealed that compromising information that surfaced in online communities about their study was removed by moderating staff and only 3.8% of respondents were able to "guess" a random number, reinforcing norms that participants through MTurk are reliable respondents. Four research questions were developed to help guide the study.

Research Questions

1) What factors have motivated individuals to discontinue synthetic cannabinoid use?
2) What factors contribute to the continued use of synthetic cannabinoids?
3) What knowledge do individuals who currently use or have used synthetic cannabinoids possess on the physiological effects and known consequences of synthetic cannabinoid use?
4) What are the perceived risks of using synthetic cannabinoids?

There are two qualitative independent variables in this study: any history of use of synthetic cannabinoids and current use of synthetic cannabinoids. Information regarding these variables was collected from the screener questions at the beginning of the survey. These screener questions had the dual purpose of both collecting information on these variables as well as determining participant eligibility for the study. Dependent variables included the scores from the proprietary questionnaires designed to answer the research questions. Responses on the

discontinuation and continuation questionnaires are categorized as nominal variables, scores on the knowledge questionnaire are categorized as an ordinal variable, and responses on the relative risk questionnaire are categorized as discrete variables.

Instruments

Discontinuation of Synthetic Cannabinoid Use Questionnaire

The Discontinuation of Synthetic Cannabinoid Use Questionnaire is a 20 item self-report measure that obtains information related to the attitudes, opinions, and experiences that have influenced the respondent to discontinue use of synthetic cannabinoids or considering discontinuing the use of synthetic cannabinoids. Previous literature regarding this concept was reviewed and questions were developed to encompass previously assessed domains as well as novel reasons that have potentially not yet been evaluated in research. These domains encompass personal experiences, second-hand experiences, influence of information sources, preference towards other substances, risks to physical and mental health, accessibility, and concerns about the content of synthetic cannabinoid containing drugs. All items in this instrument were comprised of yes/no questions. Due to the exploratory nature of the study and this instrument, convergent and discriminant validity was not investigated because there were no extant instruments available to make comparisons with. Also, this unidimensional approach was taken to attempt to begin identifying discrete categories which may influence decision making as no theoretical framework yet exists for more complex instrument design. Items on the discontinuation questionnaire were also validated through consultation with other experts in the field of substance use disorders. Specifically, three additional individuals with doctorates in Rehabilitation Counseling having both extensive research design experience as well as expertise in the field of substance use disorder treatment. Question content, readability, and redundancy of

questions were appraised until the experts converged on the suitability of the remaining items for the purposes of this study. The discontinuation questionnaire was administered to all participants endorsing a history of synthetic cannabinoid use as it encompassed both reasons for discontinuation as well as future considerations to engender opinions of both current and previous synthetic cannabinoid users. This questionnaire was found to have an acceptable level of internal consistency with a Cronbach's Alpha of .784.

Continuation of Synthetic Cannabinoid Use Questionnaire

The Continuation of Synthetic Cannabinoid Use Questionnaire is a 10 item self-report measure that obtained information related to the attitudes, opinions, and that have influenced the participant to continue using synthetic cannabinoids, use them in the past, or consider starting to use synthetic cannabinoids again. Previous literature regarding this concept was reviewed and questions were developed to encompass previously identified domains of interest as well as novel reasons that have potentially not yet been evaluated in research. These domains encompass drug screening, personal experiences, accessibility, legal concerns, and comparisons to other substances. Question format justification as well as content validation through expert consultation was identical to that of the discontinuation questionnaire. The continuation questionnaire was administered to all participants endorsing a history of synthetic cannabinoid use as well as current synthetic cannabinoid use as is encompasses both motivating factors for current use as well as motivating factors to begin using synthetic cannabinoids again after a period of abstinence. This questionnaire was found to have an acceptable level of internal consistency with a Cronbach's Alpha of .782.

Synthetic Cannabinoid Knowledge Questionnaire

This questionnaire was intended to measure the relative knowledge that participants

possess about synthetic cannabinoids. No known previous literature has assessed the understanding of synthetic cannabinoids and their associated side effects by individuals with a history of using these substances. The contents of this instrument were constructed with consideration of identified side effects/risks of synthetic cannabinoid use, common misconceptions of synthetic cannabinoids identified in the literature, identified issues in detection/screening methods through urinary analysis, and pharmacological effects. Individual items were also influenced by consultation with experts in the field of substance use disorders. The knowledge questionnaire was administered to all participants.

Synthetic Cannabinoid Risk Comparison Index

This instrument utilized Likert scale responses to characterize participants perceived danger of various drug classes of abuse, including synthetic cannabinoids. Rating items from 1 to 10, with 1 being "Not Dangerous at All" and 10 being "Extremely Dangerous". Comparisons can be made of the perception of danger of synthetic cannabinoids by comparison to other drugs. Utilization of data transformation methods allow this instrument to make relative risk comparisons between synthetic cannabinoids and other substance classes while controlling for baseline differences in overall perception of substance use risk between participants. The substance classes represented in this questionnaire were intended to create a comprehensive listing of commonly abused substances mimicking substances represented in Monitoring the Future survey data. The identical professional panel that assisted in content validation of previously discussed instruments also reviewed this category list and offered suggestions and inclusions. The Risk Comparison Index was administered to all participants.

Data Collection Procedure

All research-related materials were submitted to and approved by the Human Subjects

Committee at Southern Illinois University Carbondale. Several steps are taken to maintain the anonymity of participants. Inherently, as a component of the MTurk system, Amazon had the ability to link responses on survey items to the participants' identities if the study used Amazon's data collection tools. To prevent the ability to match responses with identities, MTurk was only utilized for participant recruitment and remuneration for participation. Participants were redirected to survey materials through Qualtrics where no identifying information was collected. Upon completion of the survey, participants were given a randomly generated code number that they entered in the MTurk system to confirm that they successfully completed the survey without allowing MTurk administrators access to responses. Once confirmation of successful completion of the survey was made by the researcher and the participant was compensated, participants were assigned a code number de-identifying any potential association with their MTurk profile and maintained the anonymity of provided data. Along with responses to questions listed in the survey found in the index of this proposal, demographic information including age, gender, ethnicity, level of education, and employment status was collected.

Data Analyses

All data were collected and analyzed in an ethical manner in accordance with the guidelines established by the Southern Illinois University Carbondale Human Subjects Committee. All data was kept in an appropriate and secured location in order to maintain confidentiality for all involved research participants. Descriptive, inferential, and multivariate statistics were used to organize, analyze, and evaluate the data.

Prior to data analysis, for the purpose of making inferences about the collected data, Exploratory Factor Analyses (EFA) were performed on the continuation survey, discontinuation survey, and knowledge questionnaire. An EFA is traditionally used to explore the underlying

structure of a set of interrelated variables without imposing a preconceived structure on the outcome (Child, 1990). Specifically, the EFA allows the researcher to determine the number of latent constructs underlying a set of items and quantify the dimensionality of this item set. This analysis was used in lieu of a Confirmatory Factor Analysis as this type of analysis is suited for subsequent validation studies of measures after their initial development. These analyses were performed to evaluate the dimensionality of the surveys based on participants' responding and to evaluate internal consistency of survey items. Though these questionnaires will require continued validation to be appropriate for further utilization in research, for the purpose of this exploratory study, acceptable values of Cronbach's Alpha and acceptable inflection points on scree plots were utilized to determine their suitability for this study.

1) What factors have motivated individuals to discontinue synthetic cannabinoid use?
2) What factors contribute to the continued use of synthetic cannabinoids?

To answer research questions 1 and 2, individual questions were first analyzed using descriptive statistics. Z-Tests were then performed to determine significant differences in the proportion of respondents endorsing specific motivating factors to discontinue synthetic cannabinoid use and specific motivating factors to continue synthetic cannabinoid use. Following these initial Z-Tests, Chi-Squared tests of independence were conducted comparing responses from participants who identified as current users of synthetic cannabinoids (use within the previous 30 days) and those who identify as historic users (lifetime history of use but not within previous 30 days). Chi-Squared tests were chosen over Z-Test scores as this analysis allowed for interpretation of not only significant differences between motivating factors but also interpretation of significant differences in motivating factors between current and historical users of synthetic cannabinoids. This analysis added robustness to the interpretation of results. Statistically significant results on

individual questions for the Chi Squared analysis identify motivating factors that differ significantly between these two groups and signify a potential factor that can be addressed to understand underlying motivations. This methodology was chosen over Z-Tests as it allowed for inferences to be made about not only the significance of motivating factors, but also make comparisons between current and historical synthetic cannabinoid users.

3) What knowledge do individuals who currently use or have used synthetic cannabinoids possess on the physiological effects and known consequences of synthetic cannabinoid use?

To answer research question 3, data were analyzed using descriptive statistics to represent knowledge content of the participants. Participants' correct responses on knowledge questionnaire items were coded as 1 and incorrect responses were coded as 0. This coding resulted in a final score for each participant representing their total correct responses to the knowledge questionnaire. A one-way Analysis of Variance (ANOVA) was performed to compare overall scores of individuals who identify as current users of synthetic cannabinoids and those who identify as historic users. A one-way ANOVA was chosen due to the structure of the data from this question; specifically, the dependent variables being categorical in nature and the single independent variable being ordinal. Significant results on this analysis suggested that there are notable differences in knowledge of synthetic cannabinoids between current users and those with a history of use and suggest the suitability of psychoeducation as a harm reduction strategy.

4) What are the perceived risks of using synthetic cannabinoids?

To answer research question 4, data was first transformed by utilizing each participant's rating of the danger of synthetic cannabinoids as a baseline value and subtracting this number from their danger ratings from all other substances, creating relative risk ratings for each

substance for each participant. These values were then averaged across the entire sample for each substance class. Each participant's responses comprise individual differences in risk perception of drugs suggest that simple comparisons of risk ratings would likely yield data with little utility without transformation. Utilizing each participant's rating of the danger of synthetic cannabinoids as a baseline value, this number was subtracted from their danger ratings from all other substances, creating relative risk ratings for each substance for each participant. These values were then analyzed using descriptive statistics to represent the sample's overall relative risk rating of various substances to synthetic cannabinoids. Further statistical analysis is not necessary for the interpretation of data utilized to investigate this question, as quantifying statistical differences between these ordinal or dichotomous variables is impractical

CHAPTER 4

RESULTS

Prior to any analysis being conducted, factor analyses were performed to determine the dimensionality of the scales utilized for this study as well as investigate potential redundancy in scale items. A factor analysis was run on the 20-question cessation of synthetic cannabinoid use scale and the 10-question continuation of synthetic cannabinoid use scale. There are several assumptions that must be met to perform an exploratory factor analysis. Variables should be metric in an exploratory factor analysis which is met in all cases. The sample size should be greater which is met in all three cases. The sample should also be homogenous. Reliability analyses were conducted on all three scales and their levels fells within acceptable limits; these are reported with the results from each respective factor analysis. Correlations of .3 are required between research variables, as well there should be no outliers within the data.

Factor Analysis Results

Discontinuation of Synthetic Cannabinoid Use Questionnaire Factor Analysis Results

An Exploratory Factor Analysis (EFA) was run on a 20-question questionnaire that measured attitudes towards cessation of use of synthetic cannabinoids. The suitability of EFA was assessed prior to analysis of 285 reported cases. The scale had an acceptable level of internal consistency, as determined by a Cronbach's Alpha of .784. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.802 with individual KMO measures all greater than 0.7, classifications of 'middling' to 'meritorious' according to Kaiser (1974). Bartlett's test of sphericity was statistically significant ($p < .05$), indicating that the data was likely factorizable.

EFA revealed six factors that had Eigenvalues greater than 1 and which explained 22.37%, 8.25%, 7.05%, 6.42%, 5.66%, and 5.263% of the total variance, respectively. Visual

inspection of the scree plot indicated that one component should be retained (Cattell, 1966). In addition, a one-component solution met the interpretability criterion. As such, one component was retained.

A one-component solution explained 22.371% of the total variance. Though a six-factor analysis cumulatively explained more variance, identified factors 2 through 6 possessed Eigenvalues close to 1. Though this is over the threshold necessary for inclusion as components in the factor analysis, they are difficult to distinguish from factors 7 through 19 that were rejected for being below the threshold of 1 by the same absolute value. Thus, interpretation of the Scree Plot was necessary to determine the number of factors that should be retained. A scree plot is a plot of the total variance explained by each component via its Eigenvalue against other components. It should be noted that in the scree plot there are as many components as there are variables. Components that should be retained are those before the last inflection point of the graph, which is a point that represents when the graph begins to level out and subsequent components add little to the total variance. In this analysis, visual inspection of the scree plot indicated that one component should be retained (Cattell, 1966).

The one-component solution explained 22.371% of the total variance. A Varimax orthogonal rotation was employed to aid interpretability. The rotated solution, even when limiting extracted factors, failed to exhibit 'simple structure' (Thurstone, 1947) until limited to an extraction of one factor. The interpretation of the data was consistent with the attributes of the questionnaire designed to look at the single dimension of motivations to discontinue using synthetic cannabinoids with the strongest loading of items on component 1.

Continuation of Synthetic Cannabinoid Use Questionnaire Factor Analysis Results

An Exploratory Factor Analysis (EFA) was run on a 10-question questionnaire that

measured attitudes towards continuation of use of synthetic cannabinoids. The suitability of EFA was assessed prior to analysis of 285 reported cases. The scale had an acceptable level of internal consistency, as determined by a Cronbach's Alpha of .782. The overall Kaiser-Meyer-Olkin (KMO) measure was 0.843 with individual KMO measures all greater than 0.7, classifications of 'middling' to 'meritorious' according to Kaiser (1974). Bartlett's test of sphericity was statistically significant ($p < .05$), indicating that the data was likely factorizable.

EFA revealed two factors that had Eigenvalues greater than 1 and which explained 35.547% and 12.253% of the total variance, respectively. Visual inspection of the scree plot indicated that one component should be retained (Cattell, 1966). In addition, a one-component solution met the interpretability criterion. As such, one component was retained.

A one-component solution explained 34.547% of the total variance. Though a two-factor analysis cumulatively explained more variance, identified factors 2 through 4 possessed Eigenvalues close to 1. Though this is over the threshold necessary for inclusion as components in the factor analysis, they are difficult to distinguish from factors 3 and 4 that were rejected for being below the threshold of 1 by the same absolute value. Thus, interpretation of the Scree Plot was necessary to determine the number of factors that should be retained. In this analysis, visual inspection of the scree plot indicated that one component should be retained (Cattell, 1966).

The one-component solution explained 34.547% of the total variance. A Varimax orthogonal rotation was employed to aid interpretability. The rotated solution failed to exhibit 'simple structure' (Thurstone, 1947) until limited to an extraction of one factor. The interpretation of the data was consistent with the attributes of the questionnaire designed to look at the single dimension of motivations to continue using synthetic cannabinoids with the strongest loading of items on component 1.

After the Exploratory Factor Analyses were run on these two measures, it was determined that their internal consistency was adequate and that improvements to internal consistency and component structure would be marginally improved by removal of items from the instruments. This indicates that though some questions on the measures at face value seem similar, they are divergent enough from other items that they should be retained when making inferences about the research questions in the study at hand.

Research Question 1 Results

What attitudes or opinions have motivated individuals to discontinue synthetic cannabinoid use? The purpose of this question is to explore what factors contribute to individual decision making leading to cessation of use of synthetic cannabinoids. After the factor analysis had been performed, Chi-Squared tests of independence were used to compare motivating factors between individuals who reported current use of synthetic cannabinoids and those who reported historical use of synthetic cannabinoids. Chi-square tests of independence have three assumptions that must be met: 1) There must be two variables that are measured at the categorical level, 2) There must be independence of observations, 3) All cell counts should have expected frequency measures greater than five.

A chi-square test for association was conducted between current synthetic cannabinoid use and all discontinuation questionnaire items. All expected cell frequencies were greater than five. All statistically significant associations between current use and discontinuation motivations are listed below along with their level of association (Phi, φ).

Table 2

Chi Squared Tests of Association

Discontinuing Use Items	$\chi 2(1)$	p	φ	p
I would rather use other drugs	12.177	.000	0.203	.000
K2/Spice is difficult to obtain	6.401	.011	0.148	.000
I'm unsure what K2/Spice does to my body	6.291	.012	-0.146	.000
I didn't/don't enjoy using K2/Spice	12.655	.000	-0.207	.000
I don't know where K2/Spice comes from	11.690	.001	-0.199	.000
I don't know what K2/Spice actually is	4.436	.035	-0.123	.000

Research Question 2 Results

What attitudes or opinions contribute to the continued use of synthetic cannabinoids?

The purpose of this questions is to explore what motivations contribute to individual decision making leading to continuing to use synthetic cannabinoids. A chi-square test for association was conducted between current synthetic cannabinoid use and all discontinuation questionnaire items. All expected cell frequencies were greater than five. All statistically significant associations between current use and discontinuation motivations are listed below along with their level of association (Phi, φ).

Table 3

Chi Squared Tests of Association

Continued Use Items	$\chi 2(1)$	p	φ	p
K2/Spice isn't detected in drug screening tests	14.207	.000	0.219	.000
I enjoy using K2/Spice	59.184	.000	0.449	.000
K2Spice is safer than other drugs or alcohol	48.303	.000	0.406	.000
My Friends Enjoy using K2/Spice	44.517	.000	0.389	.000
K2/Spice is affordable to me	22.951	.000	0.279	.000
K2/Spice is easy to obtain	17.464	.000	0.243	.000
K2/Spice is legal	16.063	.000	0.234	.000
I trust where K2/Spice comes from	57.911	.000	0.443	.000
I trust that K2/Spice is pure	38.466	.000	0.362	.000
K2/Spice is stronger than marijuana	6.565	.010	0.149	.010

Research Question 3 Results

What knowledge do individuals who currently use or have used synthetic cannabinoids possess on the physiological effects and known consequences of synthetic cannabinoid use?

The purpose of this question is to investigate the general knowledge about synthetic cannabinoids among current and historical users of the substance. Scores were computed for each participant based on percentage of correct responses to the knowledge questionnaire items. Item 7 (K2/Spice is detectable in drug tests/urine screens) was not considered for this analysis as it cannot be accurately answered as a true/false question. This decision was made during data analysis as it was considered that some formulations of synthetic cannabinoids do not have

available detection assays, thus the answer is ambiguous.

A one-way ANOVA was conducted to determine if general knowledge about synthetic cannabinoids was different between individuals who reported current use of synthetic cannabinoids and those with only historical lifetime use of the substance. Participants were classified into two groups: current use (n = 67) and historical use (n = 220). There were no outliers, as assessed by boxplot. Data was normally distributed for each group, as assessed by examining a histogram of the total score and obtaining kurtosis and skewness values. A conservative range of kurtosis and skewness values fall within a +1 to -1 range (Howell, 2009). The reported values (kurtosis = -.680, -.774; skewness = .429, -.619) fell within the conservative category range. The central limit theorem supports the assumption that groups with 20-30 participants will meet the normality assumption (Howell, 2009). There was homogeneity of variances, as assessed by Levene's Test of Equality of Error Variance ($F_{(1, 285)} = 1.706$, p = .193). A result greater than .05 implies that the error variance in the conditions are not significantly different. Knowledge scores were significantly different between individuals who reported current synthetic cannabinoid use and those who reported only historical use ($F(1,285) = 90.504$, p = .000). Individuals who reported currently using synthetic cannabinoids had significantly less knowledge about the substance than those who did not report current use.

Research Question 4 Results

What are the perceived risks of using synthetic cannabinoids relative to other substances? The purpose of this question is to understand how dangerous participants feel that synthetic cannabinoids are by comparing them to how they rank the dangers of other drugs. To answer this question, data transformations were made to make meaningful interpretation of the descriptive statistics of the responses. Participants were asked to rate their perceived danger of

14 different substances on a Likert scale from 0 -10, with 0 being not dangerous at all and 10 being the most dangerous. Variables were computed for each substance class by subtracting the score assigned to Synthetic Cannabinoids from the score assigned to each other drug class. These values were then averaged. Positive numbers represent perception of a substance as more dangerous than synthetic cannabinoids, and negative numbers represent perception of a substance as less dangerous than synthetic cannabinoids. Average values for all substance classes are represented below.

Table 4

Relative Risk Comparison Data

Substance Class	Average Danger Rating	Difference from SC	Total Responses (n)
Synthetic Cannabinoids	6.6294	*	286
Tobacco	6.5171	-0.1303	284
Alcohol	6.4399	-0.1555	283
Marijuana	3.1254	-3.5054	279
Inhalants	6.7057	0.1309	275
LSD	5.6272	-0.9596	272
PCP	7.1697	0.5827	266
Ecstasy	5.9386	-0.6593	276
Bath Salts	7.2288	0.6180	267
Cocaine	6.8648	0.1709	275
Crack	7.3794	0.7309	275
Heroin	7.9894	1.3297	276
Methamphetamine	7.6547	1.0696	273
Benzodiazepines	6.4258	-0.0840	250

CHAPTER 5

DISCUSSION

The purpose of the current study is to expand existing research on the characterization of synthetic substance use, perceived harm of synthetic cannabinoids, and users' knowledge about synthetic cannabinoids. Particularly, the study investigated specific contributing factors that led to the decision to quit or continue using synthetic cannabinoids. The study also investigated the knowledge about synthetic cannabinoids possessed by individuals with a history of use as well as relative perceived risk of synthetic cannabinoids. The previous chapter reflected the findings for the data analysis conducted on each reach question. In this chapter, I focused on discussion of the research findings and how these findings related to previous research, the implications of these findings, and the limitations of this study.

Factor Analysis Conclusions

Exploratory Factor Analyses (EFA) were run on both measures of motivations to continue using synthetic cannabinoids and motivations to discontinue using synthetic cannabinoids. For exploratory research, these analyses yielded favorable results suggesting acceptable internal consistency and dimensionality. While acceptable for the performed study, results should still be interpreted with caution until continued development and validation of these measures has been performed to further assess their validity, reliability, and utility.

Research Question 1 Conclusions

What attitudes or opinions have motivated individuals to discontinue synthetic cannabinoid use?

Several significant differences in motivating factors were found for the continuation of use between current and historical users of synthetic cannabinoids. Considering simple Z-Test statistics on the overall sample, many of the factors come as no surprise. However, when

considered through Chi-Squared tests between current and historical users, the results become much more interesting in the context of harm-reduction and intervention effectiveness. Access to synthetic cannabinoids was a notable factor, with current users being less likely to report difficulty in obtaining the substance. Preference and personal experience was also a significant factor, with historical users being significantly more likely to express preference for using other substances as well as negative personal experiences with synthetic cannabinoids as a reason they chose to no longer use the drug. Knowledge of the substance class, its effects on the body, and the source of the drug(s) were the remaining significant factors found in the analysis. Individuals with historical use were more likely to report concerns about the production of and physiological effects of synthetic cannabinoids than current users. Finally, knowledge about the nature of synthetic cannabinoids was a significant factor, with current users less likely to report concerns about what synthetic cannabinoids inherently are as a reason to discontinue use.

Though no study to date was found that explicitly investigated reasons that individuals discontinue use, Gunderson et al. (2015) reported that adverse effects related to synthetic cannabinoid use were common. Winstock and Barratt's (2013) analysis also yielded consistent results with the current study, identifying that availability of synthetic cannabinoids is a notable consideration when making decisions to use these substances.

Research Question 2 Conclusions

What attitudes or opinions contribute to the continued use of synthetic cannabinoids?

Compared to considerations made for discontinuation, more significant factors related to decision making around continued use were identified. These results were somewhat expected, considering that many individuals who use synthetic cannabinoids are polydrug users (Vandrey, Dunn, Fry, & Girling, 2012) and are more likely to make considerations to use synthetic

cannabinoids over other substances. Also, considering Monitoring the Future (2016) data, use prevalence has decreased at a high enough rate to suggest that discontinuation of use for most individuals is automatic or related to factors outside the scope of the current study. As with the first research question, examinations of significant differences in responding through simple Z-Tests of the entire population did yield interpretable results, however with the goal of understanding motivating factors related to use, Chi-Squared analyses between current and historical users yielded more practical data for analysis.

Consistent with previous studies, (Bonar et al., 2014, Vandrey et al., 2012), avoidance of drug screening methods was a significant factor considered when making the decision to use synthetic cannabinoids. Access was also a significant factor considered when making the decision to use, encompassing both affordability and availability as significant factors. Proportionately inverse to data collection in the discontinuation survey, positive personal experiences were the strongest significant factor for consideration to continue using. Participants also reported significant considerations on the perception that synthetic cannabinoids are safer than other substances, as well as a trust for the source and purity of the synthetic cannabinoids they are using.

While not necessarily surprising, these results can be sorted into several smaller discrete categories for consideration of major motivating factors: access, safety, and experiences. Items falling in the safety category, such as trusting the purity and source of the synthetic cannabinoids had critical values second only to personal experience. Importantly, these topics can be addressed through psychoeducational materials and targeted specifically for intervention and harm reduction campaigns. Future publications intended for harm reduction should potentially focus on information pertaining to the chemical composition and nature of these substances,

concise information on the effects of these substances especially with comparisons to marijuana, and information about the production sources, purity, and differences between the discrete formulations of synthetic cannabinoids that are distributed under ubiquitous trade names such as K2 and Spice.

Research Question 3 Conclusions

What knowledge do individuals who currently use or have used synthetic cannabinoids possess on the physiological effects and known consequences of synthetic cannabinoid use?

Though the study at hand intended to primarily investigate motivating factors that lead to decisions surrounding synthetic cannabinoids use, research question three was intended to look at the general knowledge possessed about synthetic cannabinoids by individuals with a history of their use. While originally intended to collect information about the sample population as a whole, characteristics of the sample population allowed multivariate statistical methods to be utilized to make comparisons in knowledge content between individuals reporting current use of synthetic cannabinoids and those with a history of use. To date, no known study of this type has been performed with which to make data comparisons.

Though the overall results are not necessarily surprising, the spread in knowledge questions answered correctly on average between the two groups was unexpectedly large. Individuals who reported a history of use but no current use answered 74% (σ = 24%) of questions correctly on average. Individuals who reported current use of synthetic cannabinoids answered 42% (σ = 28%) of the knowledge survey questions correctly on average. This represents a difference of 32% in average scores on the knowledge survey. While this information should be interpreted with caution as this survey was exploratory in nature and has not been further validated, favorable results on exploratory factor analysis add strength to the

usability of this information. These results suggest that not only do individuals currently using synthetic cannabinoids have statistically significantly less knowledge about the substance class, the gap in knowledge is quite large.

These results, when taken together with the results of research questions 1 and 2, suggest that psychoeducational campaigns may be particularly effective for harm reduction methods for this substance class. As explored in chapter 2, these drugs are exceptionally complicated when compared to more common substances and still complicated with regards to other designer and synthetic drugs. Additional complexity was introduced as a result of the rapid and fragmented legislative response to this drug class. These results suggest that consolidation of this type of information in accessible format and language may lead to increased cessation rates of synthetic cannabinoids.

Research Question 4 Conclusions

What are the perceived risks of using synthetic cannabinoids relative to other substances?

The purpose of this question was to investigate participant's perceived danger of synthetic cannabinoids relative to the perceived danger of other various substance classes. While multivariate analysis was not indicated for this research question, results were interesting. Participants rated Tobacco, Alcohol, Marijuana, LSD, Ecstasy, and Benzodiazepines as safer on average than synthetic cannabinoids. However, it should be noted that many of the differences were very small and caution must be taken when interpreting these results as strong conclusions cannot be drawn. Unsurprisingly, participants rated Marijuana as the least dangerous drug class of all those included on the list. This result is likely influenced by data suggesting that between 84% and 99% of individuals who use synthetic cannabinoids have a history of marijuana use

(Vandrey et al., 2012;Winstock & Barratt, 2013).

Participants rated Inhalants, PCP, Bath Salts (synthetic cathinones), Cocaine, Crack, Heroin, and Methamphetamine as more dangerous than synthetic cannabinoids. However, the risk on many substances was marginal, with Heroin and Methamphetamine as the only substances with an average risk difference of more than one point on the scale. Additional analysis outside the scope of this study is necessary to draw any meaningful conclusions from this data set beyond reporting of average values.

Summary of Findings

The primary purpose of this study was to explore motivating factors for continuation and discontinuation of synthetic cannabinoid use, with ancillary goals of understanding more about the general knowledge that users have about this substance class and their perception of its dangers. Participants reported that a preference to other drugs, difficulty to access, poor personal experience, and lack of knowledge on the source and physiological effects of synthetic cannabinoids were all reasons they consider quitting using this drug. Participants reported that avoiding drug detection screens, personal and collegial enjoyment, assumed safety, ease of access, and trust on the purity of synthetic cannabinoids were reasons they choose to continue using these drugs.

Considering the differences in knowledge of current users and historical users, the study found that individuals who report current synthetic cannabinoid use have significantly less overall knowledge about the substance class than those who report only a history of use ($F(1,285) = 90.504$, $p = .000$). Participants rated Tobacco, Alcohol, Marijuana, LSD, Ecstasy, and Benzodiazepines as less dangerous than synthetic cannabinoids on average. Participants rated INhalents, PCP, Bath Salts (synthetic cathinones), Cocaine, Crack, Heroin, and

Methamphetamine as more dangerous than synthetic cannabinoids on average.

Limitations and Delimitations

The present study was quantitative in nature but limited to non-experimental comparative design with analysis of data using Chi-Squared tests of independence and ANOVA. From the survey data, relationships between variables were be shown however no direct causation could be inferred. Another limitation of the present study emerges in regards to participant recruitment. Survey participants were recruited utilizing the online crowd sourcing data platform Mechanical Turk (MTurk) and compensated for their participation. It is possible that individuals participating in these surveys responded inaccurately to items, failed to utilize sufficient time to understand responses, or fabricated responses to questions pertaining to eligibility criteria to be remunerated for survey responses among other issues with online data collection. MTurk and the Qualtrics survey design system have tools available such as attention checks and reported time to completion of survey responses, as well as control over remuneration dispersion being given to the researcher to prevent misuse of the system. The method selected for this study, however, was the utilization of a screening "quiz" comprised of questions that individuals with a history of synthetic cannabinoid use should know. For example, asking if the substance needs to be kept in the freezer to remain viable. While this method is not without flaw, in the current study it rejected almost 50% of survey attempts. The quiz was sensitive to both correct answers as well as clicking one response through all of the options to speed through the questionnaire. While it cannot be guaranteed that no participants attempting to misrepresent themselves to gain access to the study and ultimately receive payment for completion, there were no obviously invalid responses in the data set(all identical responses, skipping sections, etc). This suggests to the author that overall, the data generated utilizing this collection method was genuine and as

reliable as any other more traditional form of data collection.

The utilization of MTurk as a crowd sourcing data platform presents some limitations in the recruitment of a truly representative sample. Sheehan (2018) discussed that MTurk participants have an overrepresentation of Whites and Asians compared to the general population as well as being underemployed. However, similar arguments can be made about convenience sampling of college students which is an acceptable practice in social sciences research. There are also concerns previously discussed of misrepresentation to gain access to surveys for monetary compensation. While this practice is not new in social research, it may be more prevalent in samples recruited from MTurk as participants self-select into a group of online workers performing tasks and surveys for compensation. An effective way of mitigating these concerns is disguising the relevant screener questions with others as well as offering a paid screener to reduce misrepresentation for monetary gain (Sharpe Wessling et al., 2017). Analysis of demographics in the sample data, however, was consistent with previous research on this topic. This information suggests that while overrepresentation of certain groups may be present in MTurk samples, it's effect was not perceptible on this data set with regards to consistency to other literature on this topic.

Though research attempting to characterize the use of SCs is not new, prevalence has notably dropped from 7.4% to less than 1% since that time (Monitoring the Future, 2016; Vandrey et al., 2012). The present study is the first of its kind to investigate motivation for discontinuation of SC use beyond the scope of preference for marijuana. While useful to inform psychoeducational campaigns aimed at substance use prevention and harm reduction, it's generalizability to other drug classes may be limited as SCs distinguish themselves as a unique case being a synthetic analogue to a widely available and popular natural substance.

Implications

Previous research had begun initial investigation into these factors as a component of their research, but data had never been collected with the specific purpose of understanding these underlying motivations for use in harm reduction strategies. Going beyond describing the differences in motivations between individuals who have made the decision to stop using synthetic cannabinoids and those that do, this study additionally quantified that there is likely a gap in general knowledge about synthetic cannabinoids among current and historical users. Importantly, addressing this gap may lead to more individuals electing to stop using this substance and result in reduced negative health outcomes associated with their use in the population.

Psychoeducational programming has been used as a harm reduction method for many years in high profile programs such as D.A.R.E. programming in primary and secondary education settings. Though their effectiveness sometimes remains unclear, the current study's data suggests that addressing this knowledge gap may be particularly effective for synthetic cannabinoids. Many factors may contribute to this somewhat unique position, including the notable complexity behind this class of designer drugs and the relative simplicity of which was advertised to the general public. Misinformation remains, including the notable amount of participants who indicated that synthetic cannabinoids are legal and utilize this assumed legal status as motivation to continue using these substances. Individuals reporting current use also demonstrated a higher trust for the purity and safety in production of synthetic cannabinoids, suggesting that information on the process of their production may be effective in persuading them to discontinue use.

While multivariate analysis was not performed on risk comparison data, differences

observed do not necessarily follow expected patterns when considering the information provided in chapter two. This could potentially be explained by the large variations observed in general knowledge about this substance class among current users versus those with a history of use. Lack of understanding and misinformation renders individuals unable to make informed decisions about the relative risk of synthetic cannabinoids when selecting a mind altering substance. Continued analysis of this data and additional comparisons may be made when interpreting these results in the context of specific groupings of users rather than the sample population as a whole. Also, these risk comparisons are limited only to those with any history of synthetic substance use, which may represent an immediate reduction in perceived danger in the sample population as a whole. Continued studies should focus on making comparisons between those with a history of use and non-users to draw inferences about the effects of risk perception.

Additional research is first necessary to validate whether the motivating factors utilized in the survey items in the current study are adequately representative. While initial factor analysis results on the continuation and discontinuation questionnaires were favorable, validation studies will be necessary to utilize them in future studies drawing more specific conclusions. Similarly, while factor analysis results were favorable for the knowledge survey, additional information should be included in future studies to increase the reliability of the questionnaire and increase the scope of knowledge areas covered to more accurately determine what knowledge areas are most important when considering harm reduction. The study at hand has provided an outline to what may be effective harm reduction methods for synthetic cannabinoid use, however additional research may increase its specificity and utility.

REFERENCES

Berry-Caban, C., Kleinschmidt, P., Rao, D., & Jenkins, J. (2012). Synthetic Cannabinoid and Cathinone Use Among US Soldiers. The Army Medical Department Journal, 19–24.

Bonar, E. E., Ashrafioun, L., & Ilgen, M. A. (2014). Synthetic cannabinoid use among patients in residential substance use disorder treatment: Prevalence, motives, and correlates. Drug and Alcohol Dependence, 143, 268–271. http://doi.org/10.1016/j.drugalcdep.2014.07.009

Castaneto, M. S., Gorelick, D. A., Desrosiers, N. A., Hartman, R. L., Pirard, S., & Huestis, M. A. (2014). Synthetic cannabinoids: Epidemiology, pharmacodynamics, and clinical implications. Drug and Alcohol Dependence, 144, 12–41. http://doi.org/10.1016/j.drugalcdep.2014.08.005

Castellanos, D., Gralnik, L. (2016). Synthetic cannabinoids 2015: An update for pediatricians in clinical practice. World Journal of Clinical Pediatrics, 5(1), 16–10. http://doi.org/10.5409/wjcp.v5.i1.16

Cattell, R. B. (1966). The scree test for the number of factors. Multivariate Behavioral Research, 1, 245-276.

Caviness, C. M., Tzilos, G., Anderson, B. J., & Stein, M. D. (2014). Synthetic Cannabinoids: Use and Predictors in a Community Sample of Young Adults. Substance Abuse, 36(3), 368–373. http://doi.org/10.1080/08897077.2014.959151

Cheung, J. H., Burns, D. K., Sinclair, R. R., & Sliter, M. (2017). Amazon Mechanical Turk in Organizational Psychology: An Evaluation and Practical Recommendations. Journal of Business and Psychology, 32(4), 347–361. http://doi.org/10.1007/s10869-016-9458-5

Child, D. (1990). The essentials of factor analysis, second edition. London: Cassel Educational Limited.

Cooper, Z. D. (2016). Adverse Effects of Synthetic Cannabinoids: Management of Acute Toxicity and Withdrawal. Current Psychiatry Reports, 18(5), 1–10. http://doi.org/10.1007/s11920-016-0694-1

Debruyne, D., & Le Boisselier, R. (2015). Emerging drugs of abuse: current perspectives on synthetic cannabinoids. Substance Abuse and Rehabilitation, 113–17. http://doi.org/10.2147/SAR.S73586

Deng, H., Verrico, C. D., Kosten, T. R., & Nielsen, D. A. (2018). Psychosis and synthetic cannabinoids. Psychiatry Research, 268, 400–412. http://doi.org/10.1016/j.psychres.2018.08.012

Every-Palmer S. Warning: legal synthetic cannabinoid-receptor agonists such as JWH-018 may precipitate psychosis in vulnerable individuals. Addiction 2010;105:1859-60

Fantegrossi, W. E., Moran, J. H., Radominska-Pandya, A., & Prather, P. L. (2014). Distinct pharmacology and metabolism of K2 synthetic cannabinoids compared to Δ9-THC: Mechanism underlying greater toxicity? Life Sciences, 97(1), 45–54. http://doi.org/10.1016/j.lfs.2013.09.017

Fattore, L. (2016). Synthetic Cannabinoids—Further Evidence Supporting the Relationship Between Cannabinoids and Psychosis. Biological Psychiatry, 79(7), 539–548. http://doi.org/10.1016/j.biopsych.2016.02.001

Fattore, L., & Fratta, W. (2011). Beyond THC: the new generation of cannabinoid designer drugs, 1–12. http://doi.org/10.3389/fnbeh.2011.00060/abstract

Gunderson, E. W., Haughey, H. M., Ait-Daoud, N., Joshi, A. S., & Hart, C. L. (2014). A Survey of Synthetic Cannabinoid Consumption by Current Cannabis Users. Substance Abuse, 35(2), 184–189. http://doi.org/10.1080/08897077.2013.846288

Howell, D. (2009). Statistical Methods for Psychology. Cengage Wadsworth: New York, NY.

Heltsley, R., Shelby, M. K., Crouch, D. J., Black, D. L., Robert, T. A., Marshall, L., et al. (2012). Prevalence of Synthetic Cannabinoids in U.S. Athletes: Initial Findings. Journal of Analytical Toxicology, 36(8), 588–593. http://doi.org/10.1093/jat/bks066

Hu, X., Primack, B. A., Barnett, T. E., & Cook, R. L. (2011). College students and use of K2: an emerging drug of abuse in young persons. Substance Abuse Treatment, Prevention, and Policy, 6(16), 1–4. http://doi.org/10.1186/1747-597X-6-16

Hudson, S., & Ramsey, J. (2011). The emergence and analysis of synthetic cannabinoids. Drug Testing and Analysis, 3(7-8), 466–478. http://doi.org/10.1002/dta.268

Hutter, M., Kneisel, S., Auwärter, V., & Neukamm, M. A. (2012). Determination of 22 synthetic cannabinoids in human hair by liquid chromatography–tandem mass spectrometry. Journal of Chromatography B, 903, 95–101. http://doi.org/10.1016/j.jchromb.2012.07.002

Kaiser, H. F. (1974). An index of factorial simplicity. Psychometrika, 39, 32-36.

Langford, A. M., & Bolton, J. R. (2018). Synthetic cannabinoids: Variety is definitely not the spice of life. Journal of Forensic and Legal Medicine, 59, 36–38. http://doi.org/10.1016/j.jflm.2018.07.012

Law, R., Schier, J., Martin, C., Chang, A., & Wolkin, A. (2018). Increase in Reported Adverse Health Effects Related to Synthetic Cannabinoid Use — United States, January–May 2015, 1–2.

Lee, M. A., & Shlain, B. (1990). Acid dreams: The CIA, LSD, and the sixties rebellion. New York: Grove Weidenfeld.

Mcdowell, D. M., & Kleber, H. D. (1994). MDMA: Its History and Pharmacology. Psychiatric

Annals, 24(3), 127-130. doi:10.3928/0048-5713-19940301-06

Nederhof, A. J. (1985). Methods of coping with social desirability bias: A review. European Journal of Social Psychology, 15(3), 263-280. doi:10.1002/ejsp.2420150303

Palamar, J. J., & Acosta, P. (2015). Synthetic cannabinoid use in a nationally representative sample of US high school seniors. Drug and Alcohol Dependence, 149, 194–202. http://doi.org/10.1016/j.drugalcdep.2015.01.044

Pierre, J. (2011). Cannabis, synthetic cannabinoids, and psychosis risk: What the evidence says. Current Psychiatry, 10(9), 49–57.

Riederer, A. M., Campleman, S. L., Carlson, R. G., Boyer, E. W., Manini, A. F., Wax, P. M., et al. (2016). Acute Poisonings from Synthetic Cannabinoids — 50 U.S. Toxicology Investigators Consortium Registry Sites, 2010–2015. MMWR. Morbidity and Mortality Weekly Report, 65(27), 692–695. http://doi.org/10.15585/mmwr.mm6527a2

Schulenberg, J. E., Johnston, L. D., O'Malley, P. M., Bachman, J. G., Miech, R. A., & Patrick, M. E. (2017). Monitoring the Future national survey results on drug use, 1975-2016: Volume II, college students and adults ages 19-55. Ann Arbor: Institute for Social Research, The University of Michigan

Seely, K. A., Lapoint, J., Moran, J. H., & Fattore, L. (2012). Spice drugs are more than harmless herbal blends: A review of the pharmacology and toxicology of synthetic cannabinoids. Progress in Neuro-Psychopharmacology and Biological Psychiatry, 39(2), 234–243. http://doi.org/10.1016/j.pnpbp.2012.04.017

Sharpe Wessling, K., Huber, J., & Netzer, O. (2017). MTurk Character Misrepresentation: Assessment and Solutions. Journal of Consumer Research, 44(1), 211–230. http://doi.org/10.1093/jcr/ucx053

Sheehan, K. B. (2018). Crowdsourcing research: Data collection with Amazon's Mechanical Turk. Communication Monographs, 85(1), 140–156. http://doi.org/10.1080/03637751.2017.1342043

Spaderna, M., Addy, P. H., & D'Souza, D. C. (2013). Spicing things up: synthetic cannabinoids. Psychopharmacology, 228(4), 525–540. http://doi.org/10.1007/s00213-013-3188-4

Stogner, J. M., & Miller, B. L. (2013). A spicy kind of high: a profile of synthetic cannabinoid users. Journal of Substance Use, 19(1-2), 199–205. http://doi.org/10.3109/14659891.2013.770571

Thurstone, L. L. (1947). Multiple factor analysis. Chicago, IL: University of Chicago Press.

Trecki, J., Gerona, R. R., & Schwartz, M. D. (2015). Synthetic Cannabinoid-Related Illnesses and Deaths. New England Journal of Medicine, 373(2), 101–106. http://doi.org/10.1056/NEJMp1504912 Understanding the "Spice" phenomenon. (2009). Understanding the "Spice" phenomenon (pp. 1–34).

United Nations Office on Drugs and Crime (UNODC) (2011), Synthetic cannabinoids in herbal products. 1-24

United Nations Office on Drugs and Crime (UNODC), World Drug Report 2018 (United Nations publication) Available at: https://www.unodc.org/wdr2018/en/topics.html

Vandrey, R., Dunn, K. E., Fry, J. A., & Girling, E. R. (2012). A survey study to characterize use of Spice products (synthetic cannabinoids). Drug and Alcohol Dependence, 120(1-3), 238–241. http://doi.org/10.1016/j.drugalcdep.2011.07.011

Winstock, A. R., & Barratt, M. J. (2013). Synthetic cannabis: A comparison of patterns of use and effect profile with natural cannabis in a large global sample. Drug and Alcohol Dependence, 131(1-2), 106–111. http://doi.org/10.1016/j.drugalcdep.2012.12.011

APPENDICES

APPENDIX A

SCREENER SURVEY

Before we begin, we would like to make sure you qualify for our study. Please respond to the following questions.

1. K2/Spice was sold in retail stores.
   True False
2. K2/Spice doesn't get you high.
   True False
3. You can smoke K2/Spice
   True False
4. I have never used K2/Spice (or other synthetic cannabinoid).
   True False
5. K2/Spice must be kept frozen.
   True False

APPENDIX B

DEMOGRAPHIC INFORMATION

1. What is your age? _____

2. What is your gender?
    a. Male
    b. Female
    c. Non-binary/third Gender
    d. Prefer not to respond

3. Are you Hispanic, Latino/a, or of Spanish origin? (one or more categories may be selected)
    a. No, not of Hispanic, Latino/a, or Spanish origin
    b. Yes, Mexican, Mexican American, Chicano/a
    c. Yes, Pureto Rican
    d. Yes, Cuban
    e. Yes, Another Hispanic, Latino/a or Spanish origin

4. What is your race? (one or more categories may be selected)
    a. White
    b. Black or African American
    c. American Indian or Alaskan Native
    d. Asian
    e. Native Hawaiian or Pacific Islander
    f. Other

5. Employment Status
    a. Employed
    b. Unemployed
    c. Student

6. What is your level of education?
    a. High School Education
    b. Some College
    c. Associate's Degree
    d. Bachelor's Degree
    e. Master's Degree
    f. Professional Doctorate (MD, JD, DDS, DPT, etc.)
    g. Doctorate (PhD, Ed.D, etc.)

7. Have you used K2/Spice in the past 12 months?
    Yes No

8. Have you used K2/Spice in the past 30 days?
   Yes No

9. Have you used alcohol in the past 12 months?
   Yes No

10. Have you used alcohol in the past 30 days?
    Yes No

11. Have you used tobacco products in the past 12 months?
    Yes No

12. Have you used tobacco products in the past 30 days?
    Yes No

13. Have you used marijuana in the past 12 months?
    Yes No

14. Have you used marijuana in the past 30 days?
    Yes No

15. Have you used any other illicit drugs in the past 12 months?
    Yes No

16. Have you used any other illicit drugs in the past 30 days?
    Yes No

APPENDIX C

DISCONTINUATION OF SYNTHETIC CANNABINOID USE QUESTIONNAIRE

On the following items, please indicate your responses as yes or no, considering why you have stopped using K2/Spice or have considered stopping using K2/Spice:

Q1. I have quit using K2/Spice or considered quitting K2/Spice because…

1. It could harm my physical health
   Yes No

2. I've seen stories in the news about K2/Spice being dangerous
   Yes No

3. I've had a bad personal experience with K2/Spice
   Yes No

4. I read online that K2/Spice is dangerous
   Yes No

5. I've seen or heard about friends have bad experiences using K2/Spice
   Yes No

6. My friends have told me that K2/Spice is dangerous
   Yes No

7. My parents have told me that K2/Spice is dangerous
   Yes No

8. I would rather use marijuana
   Yes No

9. I would rather use alcohol
   Yes No

10. I would rather use other drugs
    Yes No

11. I am worried about their impact on my mental health
    Yes No

12. K2/Spice is illegal
    Yes No

13. K2/Spice is difficult to obtain
    Yes No

14. K2/Spice in unnatural
    Yes No

15. I'm unsure what K2/Spice does to my body
    Yes No

16. I didn't/don't enjoy using K2/Spice
    Yes No

17. I think K2/Spice is addictive
    Yes No

18. I don't know where K2/Spice comes from or how its made
    Yes No

19. I don't know what K2/Spice actually is
    Yes No

20. K2/Spice could be mixed with something else that is harmful
    Yes No

APPENDIX D

CONTINUATION OF SYNTHETIC CANNABINOID USE QUESTIONNAIRE

I would consider using K2/Spice again or I continue to use K2/Spice because…

1. K2/Spice isn't detected in drug screening/urine tests
   Yes/ No

2. I enjoy using K2/Spice
   Yes/ No

3. K2/Spice is safer than other drugs or alcohol
   Yes/ No

4. My friends enjoy using K2/Spice
   Yes/ No

5. K2/Spice is affordable to me
   Yes/ No

6. K2/Spice is easy to obtain
   Yes/ No

7. K2/Spice is legal
   Yes/ No

8. I trust where K2/Spice comes from and that it is made responsibly
   Yes/ No

9. I trust that K2/Spice is pure
   Yes/ No

10. K2/Spice is stronger than marijuana
    Yes/ No

APPENDIX E

SYNTHETIC CANNABINOID KNOWLEDGE QUESTIONNAIRE

Please respond to these questions by either selecting true or false:

1. There is only one type of K2/Spice, the different brands are all the same.
   True False

2. K2/Spice is legal
   True False

3. No one has died from using K2/Spice
   True False

4. No one has been hospitalized from using K2/Spice
   True False

5. No one has had suffered permanent damage from using K2/Spice
   True False

6. No one has had mental health problems after using K2/Spice
   True False

7. K2/Spice is detectable in drug tests/urine screens
   True False

8. K2/Spice works in the same way as marijuana
   True False

9. K2/Spice is the same as marijuana, but made in a lab
   True False

APPENDIX F

SYNTHETIC CANNABINOID RISK COMPARISON INDEX

	Not At all Dangerous									Extremely Dangerous	I Don't Know
	1	2	3	4	5	6	7	8	9	10	-
Tobacco											
Alcohol											
Marijuana											
Inhalants											
LSD/Acid											
PCP											
Ecstasy											
K2/Spice											
Bath Salts											
Cocaine											
Crack											
Heroin											
Methamphetamine											
Benzodiazepines											

APPENDIX G

Table 1. Age, Gender, Ethnicity, Race, Employment Status, Education, Synthetic Cannabinoid Use

Demographic Characteristics	Frequency (%)
Age	
18-24	41 (13.8%)
25-34	175 (59.1%)
35-44	45 (15.5%)
45-54	46 (15.5%)
55-64	11 (3.7%)
Gender	
Male	163 (55.1%)
Female	129 (43.6%)
Non-binary/third gender	2 (0.7%)
Ethnicity	
Not Hispanic / Latino/a	234 (79.1%)
Mexican, Mexican American, Chicano/a	29 (9.8%)
Puerto Rican	11 (3.7%)
Cuban	4 (1.4%)
Another Hispanic, Latino/a, or Spanish Origin	23 (7.8%)
Race	
White/Caucasian	240 (81.1%)
Black or African American	22 (7.4%)
American Indian or Alaskan Native	5 (1.7%)
Asian	31 (10.5%)
Native Hawaiian or Pacific Islander	2 (0.7%)
Other	2 (0.7%)
Employment Status	
Employed	253 (85.5%)
Unemployed	22 (7.4%)
Student	16 (5.4%)
Education	
High School Education	35 (11.8%)
Some College	55 (18.6%)
Associate's Degree	37 (12.5%)
Bachelor's Degree	139 (47.0%0
Master's Degree	25 (8.4%)

Professional Doctorate (MD, JD, etc)	2 (0.7%)
Doctorate (PhD, Ed.D, etc)	3 (1.0%)
Synthetic Cannabinoid Use History	
SC Use In Last 12 Months	148 (50.0%)
SC Use In Last 30 Days	70 (32.7%)
Alcohol Use History	
Alcohol Use in Last 12 Months	224 (75.7%)
Alcohol Use in Last 30 days	194 (65.5%)
Tobacco Use History	
Tobacco use in Last 12 Months	176 (59.5%)
Tobacco Use in Last 30 Days	153 (51.7%)
Marijuana Use History	
Marijuana Use in Last 12 Months	201 (67.9%)
Marijuana Use in Last 30 Days	165 (55.7%)
Other Illicit Drug Use History	
Other Drug Use in Last 12 Months	93 (32.1%)
Other Drug Use in Last 30 Days	73 (24.7%)

APPENDIX H

Table 2

Chi Squared Tests of Association

Discontinuing Use Items	$\chi 2(1)$	p	φ	p
I would rather use other drugs	12.177	.000	0.203	.000
K2/Spice is difficult to obtain	6.401	.011	0.148	.000
I'm unsure what K2/Spice does to my body	6.291	.012	-0.146	.000
I didn't/don't enjoy using K2/Spice	12.655	.000	-0.207	.000
I don't know where K2/Spice comes from	11.690	.001	-0.199	.000
I don't know what K2/Spice actually is	4.436	.035	-0.123	.000

APPENDIX I

Table 3

Chi Squared Tests of Association

Continued Use Items	$\chi 2(1)$	p	φ	p
K2/Spice isn't detected in drug screening tests	14.207	.000	0.219	.000
I enjoy using K2/Spice	59.184	.000	0.449	.000
K2Spice is safer than other drugs or alcohol	48.303	.000	0.406	.000
My Friends Enjoy using K2/Spice	44.517	.000	0.389	.000
K2/Spice is affordable to me	22.951	.000	0.279	.000
K2/Spice is easy to obtain	17.464	.000	0.243	.000
K2/Spice is legal	16.063	.000	0.234	.000
I trust where K2/Spice comes from	57.911	.000	0.443	.000
I trust that K2/Spice is pure	38.466	.000	0.362	.000
K2/Spice is stronger than marijuana	6.565	.010	0.149	.010

APPENDIX J

Table 4

Relative Risk Comparison Data

Substance Class	Average Danger Rating	Difference from SC	Total Responses (n)
Synthetic Cannabinoids	6.6294	*	286
Tobacco	6.5171	-0.1303	284
Alcohol	6.4399	-0.1555	283
Marijuana	3.1254	-3.5054	279
Inhalants	6.7057	0.1309	275
LSD	5.6272	-0.9596	272
PCP	7.1697	0.5827	266
Ecstasy	5.9386	-0.6593	276
Bath Salts	7.2288	0.6180	267
Cocaine	6.8648	0.1709	275
Crack	7.3794	0.7309	275
Heroin	7.9894	1.3297	276
Methamphetamine	7.6547	1.0696	273
Benzodiazepines	6.4258	-0.0840	250

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