Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

UNIVERSITY *of the*
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Dirk Albertus Smit

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Supervisor

Prof Sudeshni Naidoo, PhD, DSc

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DEDICATION

To my wife, Maré, children and parents for their unconditional love, patience and support in making it all possible

KEY WORDS

Substance use disorder
Oral health-related quality of life
Oral health status
Dental treatment needs
Oral health behaviour
Dental caries
Periodontal disease
Dental status
Oral health behaviour
Methamphetamine
Cannbis
Alcohol
Heroin
Opioids
Cocaine
Mandrax
Xerostomia
Fluoride
Saliva
Trismus
Bruxism
Hyposalivation

ABSTRACT

Introduction: Substance use disorder (SUD) remains a growing health problem globally with the 2021 prevalence of 5.8% representing 296 million people who used drugs. The oral health impact of substance use disorder has been comprehensively described outside South Africa, but not as yet been investigated for its effect on oral health-related quality of life (OHRQoL) especially within the South African context. The present study investigated the oral health status, dental treatment needs, oral health behaviour (OHB) and impact on OHRQoL of patients who were enrolled in a substance use treatment programme in the Western Cape, South Africa. Furthermore, the study investigated the extent to which oral health interventions were offered for patients being treated for substance use disorder. **Aim:** The aim of the present study was to investigate the oral health impact of substance use disorder (SUD), as well as to document the oral health interventions offered to patients enrolled in a treatment programme for a SUD. **Methods:** A cross-sectional study design with a mixed methods approach was used to collect data, together with standardized instruments, to measure severity of dental caries and presence of periodontal disease. A validated questionnaire was used to determine oral health-related quality of life (OHRQoL). The dental treatment needs of patients was described from the both the perspective of the patient (using clinical examinations) as well as staff (using focus group discussions) who were working at substance use treatment centres. A qualitative approach was utilized to determine the extent to which oral health interventions were incorporated into the general treatment programme for SUD. **Results:** The majority of participants were male, unemployed and the mean age of the sample was 33.87 years. Just over half used methamphetamine (51.39%) as the primary drug of choice. Most smoked the drug and used it on a daily basis. With regards to oral health behavior, daily sugar intake from juice, smoothies/drinking yogurt, soft drinks, coffee consumption, and energy drinks was 123.33g. Alcohol consumption and cigretettes smoking was very common and more than 60% were brushing teeth less than twice a day. The prevalence of dental caries was 98% and the mean DMFT score was 13.2. The severity of dental caries was significantly associated with age, duration of addiction, daily added sugar and brushing frequency. The prevalence of periodontits was 47% and 25% had gingivitis. A multivariate regression analysis for the OHIP-14 overall score found that 19% of the variability in the OHIP score could be explained by the combined effect of the risk predictors cigarette smoking, DMFT-score, poly-drug use, level of education, number of extractions needed, active caries and having a medical condition or not.

Conclusion: The present study highlighted the drug-specific oral health impact of SUD. The study reaffirmed oral health-related quality of life, dental status and oral health behaviours are poor among SUD patients, therefore oral health professionals can play a significant part in the early detection and provision of care. Furthermore, the study found a lack of dedicated oral health interventions for patients enrolled in SUD treatment programmes. This underscores the need for incorporating a comprehensive oral care strategy at treatment centres to improve OHRQoL of these patients. This will require a collaborative effort between oral health professionals and the health care workers and carers at SUD treatment facilities. Such collaborations will not only improve treatment packages, but more importantly, will improve the quality of life of the patients and contribute to a healthier society.

DECLARATION

I, Dirk Albertus Smit, hereby declare that *Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder* is my own work, that it has not been submitted for any degree or examination in other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Dirk Albertus Smit

1 March 2025
Date

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ACRONYMS AND ABBREVIATIONS

AUD: Alcohol Use Disorders

BPE: Basic Periodontal Examination

DMFT: Decayed Missing and Filled Teeth

ECC: Early Childhood Caries

EMCDDA: European Monitoring Centre for Drugs and Drug Addiction

FDI: Fédération Dentaire Internationale (World Dental Federation)

FDA: Food and Drug Administration

HED: Heavy Episodic Drinking

ICD: International Classification of Disease

NDSHS: National Drug Strategy Household Survey

NHANES: National Health and Nutrition Examination Survey

NIDA: National Institute on Drug Abuse

NSDUH: National Survey on Drug Use and Health

OECD: Organisation for Economic Cooperation and Development

OHIP-14: Oral Health Impact Profile-14

OHRQoL: Oral Health-Related Quality of Life

OTC drugs: Over-The-Counter drugs

RACC: Reference Amount Customarily Consumed

SACENDU: South African Community Epidemiology Network on Drug Use

SAMRC: South African Medical Research Council

SUD: Substance Use Disorder

THC: Delta-9-tetrahydrocannabinol

UNODC: United Nations Office on Drugs and Crime

WHO: World Health Organization

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CHAPTER 1: INTRODUCTION

Substance use disorder (SUD) remains a growing health problem globally with more than 38 million people estimated to be suffering from this disease accounting for 13.6% of people who used drugs in the past year. Moreover, in 2019 more than 500 000 deaths and 31 million years of "healthy" life were lost as a consequent of drug use (UNODC, 2022) The oral health impact of substance use disorder has been comprehensively described outside South Africa, but not as yet been investigated for its effect on oral health-related quality of life (OHRQoL) especially within the South African context. Moreover, the relationtion between SUD and oral health-related quality of life (OHRQoL) in poly-drug users remains unclear. Aspects such as oral health and dental status and history of substance use have been investigated in previous studies, but there is a paucity of information on the oral health effects of different various drug types.

SUD is comprehensively described in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM–5). The manual states that "The essential feature of substance use disorder is a cluster of cognitive, behavioural, and physiological symptoms indicating that the individual continues using the substance despite significant substance-related problems." Furthermore, it explains that "diagnosis of SUD is based on evidence of impaired control, social impairment, risky use, and pharmacological criteria" (American Psychiatric Association, 2013). The International Classification of Disease (ICD) system, ICD-11, is a collection of human disorders and health conditions that is used globally and reviewed periodically by the WHO (Matone *et al*., 2022). Chapter six (mental, behavioural, or neurodevelopmental disorders) of the ICD-11 describes substance use disorders as the problematic use of alcohol, cannabinoids, opioids, cocaine, sedative hypnotics, hallucinogens, tobacco and other stimulants (Cuberos *et al*., 2020).

In South Africa, SUD hampers the operational activities of among others, law enforcement, teachers and health care workers (Smit and Naidoo, 2015). Cannabis remains the most widely used substance in the world with an estimated prevalence of 3.8% (188 million) of those who are aged, between 15 and– 64 years, while opioid use accounted for most Drug Use Disorder (DUD) related deaths (66% = 110 000 in 2017) being recorded (UNODC, 2019).

South African Epidemiology on Drug Use (SACENDU) is an alcohol and other drug (AOD) sentinel surveillance system, which has been operational in 9 provinces in South Africa since 1996. According to the latest SACENDU report, alcohol is the dominant substance of use among patients in treatment in South Africa while methamphetamine (also known as 'Tik') is is used more commonly than alcohol within the Western Cape (SAMRC, 2023).

Oral health inequities in South Africa are intertwined with the country's socio-economic disparities, and together with the lack of access to basic oral health care, impact on the complex interaction between substance use disorder, the high prevalence of oral diseases, maxilla-facial trauma and poor oral health-related quality of life.

The present study investigated the oral health status, dental treatment needs, oral health behaviour (OHB) and impact on OHRQoL of patients who were enrolled in a substance use treatment programme in the Western Cape, South Africa. Furthermore, the study investigated the extent to which oral health interventions were offered for patients being treated for substance use disorder.

CHAPTER 2: LITERATURE REVIEW

2.1 Epidemiology of substance use

In 2015 the global prevalence of substance use was around 5.6% (UNODC, 2019). Substance use disorder remains a growing health problem worldwide with the 2021 prevalence of 5.8% representing 296 million people who used drugs (UNODC, 2023). According to the 2019 World Drug Report it was estimated that drug use is directly and indirectly responsible for the death of about half a million people per year (UNODC, 2020). Estimates show that 21.5 million American adults suffer from substance use disorder and about 8% of adults in England and Wales use illicit substances (NIDA, 2017; NHS, 2018). Substance use disorder remains a growing health problem in South Africa and it affects the operational activities of law enforcement, teachers and health care workers (Smit *et al*., 2015).

Cannabis remains the most widely used psychoactive substance in the world with an estimated prevalence of 4% (209 million) of those who are aged, 15 – 64 (UNODC, 2022). This was also confirmed by the 2024 European Drug report which showed that 22.6 million adults were using it over the past 12 months (EMCDDA, 2024). Opioid use, accounts for most Drug Use Disorder (DUD) related deaths (66% = 110 000 in 2017) (UNODC, 2019). Alcohol use is also a major problem with about 140 million people in the US, who reported drinking alcohol in the past month and 58 million people who used a form of tobacco in the past month. According to the Substance Abuse and Mental Health Services Administration (SAMHSA), 35.8 million people used an illicit drug in 2019 in the United States (SAMHSA, 2020). In more recent data from the National Survey on Drug Use and Health (NSDUH), it was reported that among people, aged 12 years and older, 59.8% used a substance in the preceding month (SAMHSA, 2023).

The European Drug Report is based on information provided to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) by the EU Member States, the candidate country Türkiye, and Norway, in an annual reporting process. According to the 2024 report, the estimated use of cannabis and cocaine over the preceding year was 8% (22.8 million) and 1.4% (4 million) respectively. 3,4-Methylenedioxymethamphetamine (MDMA), commonly known as ecstasy, and amphetamine use was less prevalent with 2.9 million and 2.3 million people using it respectively over the past 12 months (EMCDDA, 2024).

In the UK, an estimated 9.5% of people aged 16 to 59 years (about 3 million people) reported using a drug in the last 12 months. Cannabis use, over the past 12 months, was reported by 7% (about 777 000) of people who were frequent drug users (ONS, 2023). Between April 2022 and March 2023, 137 749 people entered drug and alcohol treatment services within the United Kingdom (UK) with almost 50% for opiate addiction and 30% for exclusive alcohol addiction (UK Government, 2023). According to the Office for National Statistics (ONS) in England and Wales, the prevalence of drug use among people aged 16 to 24 years, is estimated at 17.6% (around one million people) (ONS, 2023). According to the European Drug Report of 2024, the prevalence among the EU population, aged 15 to 34 is estimated at 15.0 % (15.1 million) (EMCDDA, 2024).

The National Drug Strategy Household Survey (NDSHS) in Australia estimated that 10.2 million (47%) people, aged 14 and older, used illicit drugs at some point in their lifetime and 3.9 million (18%) had used an illicit drug in the preceding 12 months. From 2022 – 2023, among people aged 14 and over, the most common illicit drug used (over the preceding 12 months) remained cannabis with 11.5%, followed by cocaine (4.5%) and hallucinogens (2.4%) (AIHW, 2024).

Data from 13 Latin American and the Caribbean (LAC) countries showed a prevalence of 6.3% of the population reported using cannabis regularly. The prevalence of cannabis use is significantly higher in Jamaica (18%), followed by Uruguay (14.6%), and Chile (12.1%). Prevalence of cocaine use is 0.91% with Uruguay showing the highest rate of (2.1%) in the region, followed by Ecuador and Argentina both at 1.7% and then Costa Rica (1.2%) (OECD/The World Bank, 2023).

In South Africa, SACENDU consists of a group of practitioners, researchers and policy makers. Findings are presented in geographic regions that are described below and the data is collected from specialist substance use disorder (SUD) treatment centres, community-based harm reduction and health research centres as well as from service quality measures (SQM) findings (SAMRC, 2023). According to the 2019 SACENDU report, alcohol was the dominant substance of use among patients in treatment, while methamphetamine (also known commonly as ‘Tik’) is most frequently used in the Western Cape (SAMRC, 2019). According to the 2023 SACENDU Update Report, 11 563 patients were admitted during the first half of 2023 at specialized substance use treatment centres in South Africa.

These included 82 treatment centres that contribute to data collection of SACENU. Data is collected from the following regions of South Africa: Western Cape, Kwa-Zulu Natal, Eastern Cape, Gauteng, Northern- (Limpopo- and Mpumalanga) and Central Region (Free State, North West and Northern Cape) (SAMRC, 2023). The SACENDU research brief contains data on drug use trends from July 1996 - December 2022. During this period, methamphetamine (32%) and cannabis (22%) were the most prevalent primary substance used in the Western Cape, followed by alcohol (19%) and heroin/opiates (19%). During the six months reporting time, about 1 900 patients were admitted in a substance treatment programme (SAMRC, 2023). When the most recent report was considered, the SACENDU Research Update of February 2024, similar trends were reported with methamphetamine (31%) remaining the most common primary substance used in the Western Cape. This was followed by cannabis (23%) and alcohol (19%). Other drug groups that were included in the analysis were heroin/opiates (17%), the combination substances, cannabis and mandrax (methaqualone) (6%) and least commonly crack/cocaine (2%) (SAMRC, 2024).

2.2 Substance specific use and effects on oral health

Substance use disorder and its impact on oral health had been widely reported on. People who use drugs, including those who use alcohol and tobacco, present with increased levels of oral diseases especially dental caries and periodontal disease (Mateos-Moreno *et al*., 2013; Shekarchizadeh *et al*., 2013; Arora *et al*., 2019). Mateos-Moreno *et al*., (2013) assessed dental status and found a mean Decayed Missing and Filled Teeth (DMFT) score of 22.9, composed of mean number of decayed (10.1), missing (12.1) and filled (0.7) respectively (Mateos-Moreno *et al*., 2013). Substance users also suffer from other oral diseases such as mucosal dysplasia, xerostomia (dry mouth), bruxism (grinding of teeth), tooth wear, and eventually tooth loss (Shekarchizadeh *et al*., 2013).

There are not many studies of the oral microbia among people who use drugs, despite the role of microbia in key oral diseases such as dental caries and periodontal disease. Regarding dental caries Mateos-Morento *et al* (2013) found that two thirds of users had over 105 CFU/ml (colony-forming units per millilitre) of *Streptococcus Mutans* and 81% had over 105 CFU/ml of Lactobacillus contained in their saliva. The study reported that presence of *Streptococcus Mutans* and *Lactobacilli* were significantly higher among drug users compared to nonusers (Mateos-Moreno *et al*., 2013).

The importance of normal saliva flow and composition cannot be emphasized enough when considering the maintenance of oral health. Saliva plays an important role in maintaining a favourable oral pH, reducing oral bacterial growth and acting as a reservoir and transporter for essential minerals for the remineralization of teeth (Brosky, 2007; Griffith *et al*., 2012). Many drugs cause a dry mouth and this significantly increases the risk of dental caries and oral infections (Selwitz *et al*., 2007).

2.2.1 Methamphetamine

According to the United Nation Office of Drugs and Crimes (UNODC), methamphetamine is categorized as a stimulant and falls in the same group as amphetamines, cocaine and crack-cocaine (UNODC, 2019). It gained popularity in the 1990's and was first synthesized from ephedrine by the Japanese chemist, Nagai (Grobler *et al*., 2011).

The number of methamphetamine users is estimated at 35 million worldwide (Hamamoto and Rhodus, 2009). From 1992 to 2002 admissions for treatment of methamphetamine use increased more than 500% in the US (Lineberry and Bostwick, 2006). Hegazi *et al*., (2021) reported on the National Health and Nutrition Examination Survey (NHANES) data from 2009 and 2013 was analysed for past methamphetamine users and those who were currently using it. From the selected pool, 7.8% of adults within the age group (30 – 64 years) self-reported having used methamphetamine at least once before, and 0.9% were current users (Hegazi *et al*., 2021). According to the 2017 US National Survey on Drug Use and Health (NSDUH), it was estimated that about 964 000 people within the age group 12 years and older, had a methamphetamine use disorder in the United States (SAMHSA, 2019). This figure increased to 1.6 million in 2023 (SAMHSA, 2024).

In Cape Town, the largest city in the Western Cape Province of South Africa, approximately 200,000 (7% of the population) people are estimated to use methamphetamine (Morris and Parry, 2006). The proportion of people in treatment reporting methamphetamine as the most common primary drug of addiction has dropped since 2009 (41% to 34%) (Pluddeman and Parry, 2010). A third of all patients in treatment rehabilitation centres, in the Western Cape, reported using methamphetamine as the primary substance of use (SAMRC, 2013). More recent figures confirmed that methamphetamine remains the most common primary substance with 31% being used by all patients who are enrolled in treatment programme (SAMRC, 2024).

Its pharmacological mechanism of action can be described by alternating the central nervous system (CNS) neurotransmitter levels by stimulation of the release of dopamine, norepinephrine and serotonin and blocking the reuptake thereof. Subsequently, this leads to neurodegeneration and neurotoxicity (Cadet *et al*., 2003; Baumgarten *et al.*, 2004; Itzhak *et al*., 2004; Sulzer *et al.*, 2005; Klasser and Epstein, 2005). Methamphetamine use can have both a long- and short-term effect on the body. The most common short-term effects are hyperactivity, talkativeness, grinding of teeth, euphoria, insomnia and a loss of appetite (Beebe and Walley, 1995). It also leads to increase physical activity which may produce effects such as cardiac dysrhythmias, hypertension, violent behaviour, as well as hallucinations (Westfall and Westfall, 2006; US DHHS NIDA, 2007). Furthermore, it may lead to increased risky sexual activity (Frosch *et al*. 1996; Scheim *et al*., 2018). At similar doses of amphetamine, it is more potent with its effects lasting longer and may cause more harm to central nervous system functioning. It is a highly addictive stimulant and increases wakefulness, decreases appetite and may lead to euphoria (NIDA, 2018).

The use of methamphetamine results in serious physiological and psychological effects that are pertinent to the dental profession. The drug acts as a stimulant for the central nervous system and leads to serious health effects such as premature labour, birth defects, memory loss, aggression, psychotic behaviour and potential heart and brain damage. It also has devastating effects on oral health (Donaldson and Goodchild, 2006). It can be snorted, smoked, swallowed or injected and the drug's effects can be experienced within 20 minutes (Schepers *et al*., 2003).

There is much literature showing rampant dental caries and tooth destruction among methamphetamine users (Walter *et al*., 2012; Smit and Naidoo., 2015; Mukerjee *et al*., 2018). The destructive effect on dental hard tissue can be explained by a multifactorial cascade of poor oral hygiene, high sugar diet, increased wearing of teeth via grinding and severe xerostomia (Shaner, 2007; Shetty *et al*., 2010; Smit, 2014). Moreover, the chemical composition of the drug itself and direct interaction during smoking of it should also be considered. Grobler *et al*., (2011) investigated 29 different samples of methamphetamine, from Cape Town, and found a mean pH of 5 (Grobler *et al*., 2011). In a healthy mouth the pH level of saliva is close to 7 (neutral) to protect enamel against acidic attack from bacteria which eventually lead to dental caries. Saliva pH has a major effect on solubility of enamel, with a lower pH (more acidic) leading to a higher enamel solubility.

When methamphetamine is used, the most common oral health effect is a dry mouth (xerostomia) which leads to a more acidic oral environment. This creates a favourable setting for enamel destruction and explains the higher prevalence of dental caries among methamphetamine users compared to non-users. Grobler *et al*., (2011) showed that methamphetamine is also acidic and should be viewed as a co-factor that contribute towards an acidic oral environment which in return leads towards higher dissolution effect of enamel and dentine (Grobler *et al*., 2011). Smit and Naidoo (2016) found that it takes less than an hour for a methamphetamine user to experience a dry mouth from the moment they start using the drug. The duration it took for the mouth to return to 'normal' saliva secretion was about 24 hours (Smit and Naidoo, 2016).

Ravenel *et al*., (2012) compared a sample of 28 methamphetamine users with controls and a thorough oral examination was done to determine number of decayed surfaces, missing teeth, presence of plaque and calculus and teeth wear. History on substance use, oral hygiene and diet was also reported on. The study found significant lower pH levels in saliva, significant higher caries rates, missing teeth and presence of plaque and calculus among methamphetamine users (Ravenel *et al*., 2012). Similar findings were reported by Smit and Naidoo in 2015. This study found a prevalence of 98% dental caries among a sample 308 methamphetamine users in the Western Cape province in South Africa. The mean scores for decayed teeth was five, for missing teeth was five and for filled teeth was one. An association was found between number of years of substance use and mean DMFT. Another interesting finding was that for every filled tooth, four teeth were missing. The mean DMFT score of all participants was 10 (Smit and Naidoo, 2015). Higher prevalence of dental caries and periodontal disease was also found by Hegazi *et al*., in 2020 when people who ever used methamphetamine were compared to those who never used it. The study used the NHANES survey data from 2009 and 2014 (Hegazi *et al*., 2021). The found a prevalence of 60% untreated caries and 65% periodontitis compared to 24% dental caries and 38.6% of periodontitis among the general public (Hegazi *et al*., 2021)

Bruxism is caused when muscles of mastication become hyperactive and this accelerate wearing down of teeth (Goodchild and Donaldson, 2007). Smit and Naidoo reported grinding of teeth was experienced by more than half of participants, while 73% had stiff facial muscles during methamphetamine use. Less common symptoms were sore gums, a burning mouth and only 15% experienced tooth ache when using the drug (Smit and Naidoo, 2016). Grinding of teeth or clenching was also reported by a qualitative study done by Robinson *et al*., (2005).

McGrath and colleagues (2005) and Saini and colleagues (2005) reported that people who use methamphetamine usually give little attention to oral hygiene or simply do not brush their teeth at all (McGrath and Chan, 2005; Saini *et al.*, 2005). Drug users are also not eager to seek care when their craving for drug use is prioritized above dental treatment as reported by Robinson *et al*., (2005). Poor oral health habits such as irregular brushing of teeth is common among methamphetamine users (Smit and Naidoo, 2015). Ravenel *et al*., (2012) found no significant difference in the proportion of users vs controls who were brushing their teeth often (Ravenel *et al*., 2012), however in the Smit and Naidoo study participants were assessed on brushing frequency during times of drug use vs non-use. About 50% of the sample were only brushing teeth once a day or less frequent when they were using methamphetamine. An association was found between tooth brushing frequency and using or not using the drug. Brushing teeth twice or more per day was regarding as "frequent" and an odds ratio of 3.25 indicated that odds of adequate tooth brushing frequency was 3.25 times higher when they were not using the drug ("off meth") compared to when they were ("on meth") (Smit and Naidoo, 2015).

The diet among people who use methamphetamine is commonly unhealthy, infrequent and in most cases high in sugar content (Scheutz, 1984; Morio *et al*., 2008; Ravenel *et al*., 2012; Smit and Naidoo, 2016). Studies had shown that the diet of people who use methamphetamine is high refined carbohydrates, it also includes increased consumption of soft drinks which eventually led to an increased severity of dental caries (Shaner, 2002; Klasser and Epstein, 2005; McGrath and Chan, 2005; Robinsen *et al.*, 2005, ADA, 2014; Smit and Naidoo, 2015).

2.2.2 Cannabis

Cannabis (also commonly known as marijuana or hashish) is of plant origin and has been used, grown and cultivated since the beginning of civilization for both medicinal and fabric purposes. Its mind-altering use was mostly practiced in India until 500 AD, but since the 20th century there was increased use for its recreational and religious application (Iversen, 2000). Preparations are mostly derived from the female plant of C*annabis Sativa* and the primary active ingredient is Delta-9-tetrahydrocannabinol (THC) (Adams and Martin, 1996). There are mainly three forms of cannabis namely marijuana, hash and hash oil. Smoking of marijuana, in a "joint", is the most common route of using cannabis and it is also easy to prepare and has rapid effects (Iversen, 2000; Cho, 2005).

A joint is about the size of a cigarette and contains 0.5g – 1g of cannabis with the THC delivered varying from 20% - 70% with as little as 3 mg that will produce a "high" (Hall *et al*., 1994). The flowering tops of the plant, has the highest contents of Delta-9-tetrahydrocannabinol (THC) followed by the leaves, lower leaves, stem and its seeds (Adams and Martin, 1996). Smoking cannabis is the easiest method to achieve psychoactive effects, however the adverse effects can be both chronic and acute (Hall *et al*., 1994).

Globally, cannabis is commonly used as both a recreational and therapeutic drug depending on applicable legislation that may allow using it for a particular purpose. In South Africa using and cultivating cannabis by adults in a private space has been granted by the SA Constitutional Court in 2018. This court instructed the South African government to amend legislation and this led to the formulation of the "Cannabis for Private Purposes Bill, 2020" (Parliament of the Republic of South Africa, 2018) which is still in parliamentary process. The bill decriminalized the possession, use, and cultivation of cannabis for private use by adults (Bantjes *et al*., 2022).

According to the most recent SACENDU "Full report", cannabis remained the leading primary substance of use nationally (31%) (SAMRC, 2024). Cannabis use among individuals younger than 20 years old, remains very high at 74% of all admissions for this age group (SACENDU, 2023). This is a serious concern considering that research done on regular cannabis use, among adolescents, suggest an association with more severe and negative outcomes compared to usage during adulthood (Lubman *et al*., 2015; Dhein, 2020). This age group should be considered as vulnerable group similar to pregnant women; therefore, legislation which allow cannabis use, should be formulated on best available evidence and therefore use among adolescents should be discouraged (OSD Department of Health and Human Services, 2019).

Another potential vulnerable group can be older people (65-year-old and older) who also use cannabis long-term. Le and Palamar (2019) argued that this will have an economic burden on the US healthcare system considering the growth the older population. They further argued that oral health is an essential component of general health and that older people suffer more from oral diseases such as dental caries, edentulism, periodontal diseases and oral cancer. In the US, cannabis is the third most used drug by older people after tobacco and alcohol. Due to the oral health risk factors and association between cannabis use and oral disease the rising trend should be taken seriously (Le and Palamar, 2019).

The National Survey on Drug Use and Health (NSDUH) showed a 336% increase in prevalence in cannabis use among older people in the US from 2006 to 2015 (Centre for Behavioural Health Statistics and Quality, 2015).

Chronic cannabis use may be carcinogenic (Leachtenberger, 1983). It has been shown that cannabinoids affecting cell-mediated and humoral immunity, leading to decreased resistance to infections (Rosenkrantz, 1999). Nahas and Latour (1992) reported on the presence of THC in the brain even a day after using cannabis. It has a direct effect on the activity of cellular immunity via the immunosuppression of macrophages, T- and B lymphocytes which leads to a decreased resistance to bacterial- and viral infections (Friedman *et al*., 2003; Pacifici *et al*., 2003). Caplan *et al*. (1989) as well as Sridhar *et al*. (1994) reported an increased prevalence of aerodigestive tract cancer in young adults with a history of heavy cannabis use. Long-term use is also associated with cognitive impairment of attention, memory and the organization of information (Fletcher *et al*., 1996; Pope and Yurgelun-Todd, 1996; Solowij, 1998).

Cannabis dependence occurs with heavy chronic use and is regarded at similar prevalence levels as observed among people who suffer from alcohol dependence. About 10% of those who ever used cannabis become dependent on it during their 4 years of heaviest use and this risk is about the same as for alcohol dependence (15%) (Anthony *et al*., 1994). Mental adverse effects include confusion, amnesia, delusions, hallucinations agitation and anxiety (Chopra and Smith, 1974). The mental effects of large doses of THC and chronic cannabis use is also important because it may lead to behavioural problems such as ability to maintain good oral hygiene. The acute effect of cannabis use includes the creation of a “high” or a pleasant, dreamy state of mind that the user experience. This is accompanied by cognitive and attention impairment with reduced psychomotor performance (Darling, 2003; Cho *et al*., 2005).

In a review conducted by Abidi *et al*., (2022) it was reported that health professionals should be cautious regarding the effects of cannabis use because it affects many health conditions. It had been shown that smoking of cannabis leading to a chronic inflammatory oral mucosa (Baddour *et al*., 1986). This could be explained by the high temperature of cannabis smoke containing chemical compounds (Silverstein *et al*., 1978). When considering oral health, it has been shown that cannabis users have more tooth decay, poorer oral hygiene and higher plaque indices when compared to non-users (Silverstein *et al*., 1978; Abidi *et al*., 2022).

Intraoral soft tissue lesions that are found among chronic cannabis users, include gingival hyperplasia, fiery red gingivitis, gingival leukoplakia and gingival inflammation (Baddour *et al.*, 1984; Versteeg *et al.*, 2008). Other oral health conditions related to cannabis use include tongue carcinoma and xerostomia (Almadori *et al*., 1990; Darling and Arendorf, 1992; Versteeg *et al*., 2008). Guarisco *et al*., (1988) reported on oral uvulitis secondary to inhalation of cannabis smoke while Colon (1980) reported on multiple cases of oral papilloma in heavy cannabis users. Scully (2007) investigated the oral side effects of oro-mucosal cannabis spray in multiple sclerosis (MS) with patients reporting a stinging sensation on using the spray, and had visible oral mucosal white lesions in the floor of the mouth (Scully, 2007).

Increased plaque accumulation and gingivitis is associated with cannabis use. In a study by Silverstein *et al*. (1978), a group of 206 heavy cannabis users, were compared to non-users for presence of dental plaque, Decaysed Missing and Filled Surfaces (DMFS) scores and gingival health. On all measures, the cannabis users presented with substantial higher DMFS scores, unhealthy gingiva and higher plaque scores. It was further suggested that the poor oral health status among cannabis users could be attributable to their lifestyle of health neglect (Silverstein *et al*., 1978).

Xerostomia and cannabis use was investigated by Darling and Arendorf in 1992 who showed a significant difference of a dry mouth in cannabis users, after smoking, compared to non-users (Darling and Arendorf, 1992). The drug has a parasympatholytic effect which leads towards a dry mouth and thus may lead to increased prevalence of dental caries and periodontal disease (Darling and Arendorf, 1992). Weller and Halikas (1992) investigated xerostomia among cannabis users, and reported on oral health changes that occur during the acute and "hang-over" stages experienced by cannabis users. The study showed that the desired pleasurable effect as well as the undesirable effects decreased over time. Users reported that their degree of having a dry mouth after using cannabis was slightly less after 5 year of regular use which may indicate some form of tolerance that developed over time (Weller and Halikas, 1982).

Darling and Arendorf (1992) found that leukoedema occurred more frequently in cannabis users than in non-smokers ($p < 0.001$). It is the developmental abnormality of the oral mucosa which presents as a simple variation of the normal anatomy. It can be described as a whitish to slate grey filmy opaque discoloured mucosal lesion which mostly appear on the buccal mucosa. It may also appear wrinkled or folded and when the mucosa is stretched, it partially disappears.

The latter can be used to differentiate it from other similar premalignant lesions such as leukoplakia (Versteeg *et al*., 2008). On risk factors of leukoedema, widespread research is available such as associating it with repeating low-grade irritation (Axell and Hendricsson, 1981). Further studies, also fund the presence of it among individuals with habits such smoking (Pindborg, *et al*., 1968; Hammer *et al*., 1971; Tyldesley, 1971; Van Wyk *et al*., 1979; Axell and Hendricsson, 1981; Versteeg *et al*., 2008), cheek sucking (Van Wyk *et al*., 1979), betel nut chewing (Pindborg *et al*., 1986) and chewing of cocoa leaves (Borghelli *et al*., 1975).

It is understood that the mechanism of action of the aromatic hydrocarbons, benzopyrene and nitrosamines in cannabis smoke act as carcinogenic (Almadori *et al*., 1990; Firth, 1997) and could lead to oral cancer when consuming amounts of 50% greater than the same amount of tobacco smoke (Zhang *et al*., 1999). However, two studies selected by the Versteeg review, concluded that no significant risk of squamous cell carcinoma was found among cannabis users (Lewellyn *et al*. 2004; Rosenblatt *et al*., 2004).

Increased prevalence of oral *Candida albicans* among cannabis users were observed by Darling and Arendorf (1994) using an imprint culture technique. In this study, cannabis users were compared to tobacco-smoking and non-tobacco smoking controls. The cannabis users were either using the cannabis alone, or in combination with either methaqualone or tobacco (Darling *et al*., 1992). In an oral medicine review done of the Versteeg and colleagues, the main conclusion was an increased prevalence of oral *Candida albicans* among cannabis users (Versteeg *et al*., 2008). It could be explained by the direct effect of the drug as well as by the lifestyle problems of the drug user (Veitz-Keenan and Spivakovsky, 2011).

The lifestyle of cannabis users and behavioural effects should also be considered when explaining impact that the drug has on oral health. Cannabis users brush their teeth less frequently than individuals who only use tobacco and this behaviour is worsened by poor adherence to dental visits (Schulz-Katterbach *et al*., 2009).

2.2.3 Alcohol

2.2.3.1 General description

Alcohol is a psychoactive substance and affects multiple neural pathways of the brain depending on the dosage, genetic factors, learned experience and different aspects of the setting (Oscar-Berman and Marinkovic, 2007; Giancola *et al*., 2010). Among most people in the world, alcohol is enjoyed in moderation for its relaxant effect and in many cultures as being part of life. However, when a person uses it in excess and subsequently loses control over, it leads to impaired social and occupational functioning, legal challenges, or developing an associated medical disease, the situation evolves to be a psychiatric condition (Friedlander *et al*., 2003).

Alcohol Use Disorders are divided into two categories by the American Psychiatric Association namely alcohol use and alcohol dependence (American Psychiatric Association, 1994). Alcohol use is distinguished by the harmful consequences if repetitive use and this occurs early in the disease process. Usually during alcohol use the individual is not able to perform daily obligations and thus may lead to school or job underperformance as well as associated neglect of child and household responsibilities.

2.2.3.2 Epidemiology of alcohol use

According to the WHO global status report on alcohol and health, worldwide, 2.3 billion people (43% of total population) of age 15 years and older consumed alcohol in the in the previous 12 months. It is estimated that 32.2% of the total population of the African WHO region, is current alcohol drinkers. It is further estimated that total alcohol per capita consumption (APC) by all people worldwide, older than 15 years, is at 6.4 litres of pure alcohol per capita per year for 2016. In 2016 the highest alcohol consumption per capita (APC) was observed in the WHO European Region at 9.8 litres per capita vs 6.3 litres per capita for the African region. When alcohol consumption exclusively among current drinkers is considered the statistics are significantly higher. APC (litres) among drinkers for the African WHO region is 18.4 vs 15.1 for the global figure. APC (g/day) for the African regions is estimated at 40g/day vs 32.8 for the global figure (WHO, 2018).

The global prevalence of heavy episodic drinking (HED) (60 or more grams of pure alcohol on at least one occasion in the past month) among all people is 18.2% and 17.4 for the African regions. The prevalence of HED among drinkers globally is 39.5% vs 50.2% for the sub-Saharan African countries. For South Africa, it is estimated prevalence is 59%, 70.8% for males vs 33.7% for females. What is more concerning, is a higher prevalence of HED for younger people within the age group of 15 – 19 years namely 74.4% among males vs 38.4% among females (WHO, 2018).

In 2003, it was reported that about 14 million Americans meet the criteria of alcoholism making it the third most common psychiatric condition. Its estimated that about 10% of women and 20% of men meet the criteria of alcohol use during their lifetime an additional 5% of women and 10% of men meet the criteria of alcohol dependence during their lifetimes (Grant, 1997; National Institute on Drug Abuse (NIDA), 1998). In 2023, among people aged 12 or older, 10.2% (or 28.9 million people) had a past year alcohol use disorder in the USA (SAMHSA, 2024).

In South Africa, alcohol accounts for about 7% of all deaths and 5.6% of all disability-adjusted life years (DALYs). The WHO define Disability-adjusted life years (DALYs) as: "representation of a time-based measure of overall burden of disease for a given population. DALYs are the sum of years of life lost due to premature mortality as well as years of life lost due to time lived in less than full health". Alcohol-attributable deaths are defined as the number of deaths attributable to alcohol consumption. They assume a counterfactual scenario of no alcohol consumption. Thus, alcohol-attributable deaths are those deaths that would not have happened without the presence of alcohol (WHO, 2018). Its attribution to death is evenly subdivided across major disease categories namely infectious diseases (36%), non-communicable diseases (32%) and injuries (31%). Alcohol is also regarded as the fifth highest contributor in terms of deaths and DALYs (Matzopoulos *et al*., 2022). The prevalence of Alcohol Use Disorders (AUD) for South Africa is 12.4% which is almost four times higher than that of the WHO African region (3.7%) (WHO, 2018).

2.2.3.3 Pathophysiological effects of alcohol use

Alcohol dependence occurs during the advanced stage of the disease and is when there is a physiological dependence of alcohol that leads to evolving tolerance or withdrawal symptoms.

In most cases the person who suffer of alcohol dependence attempt to maintain the same level of intoxication or try to avoid withdrawal symptoms such as insomnia, sweating, rapid pulse, anxiety, nausea, vomiting and xerostomia (Friedlander *et al*., 2003). People who suffer from Alcohol Use Disorder (AUD) may become depressed and struggle with chronic anxiety which leads to them use substances to alleviated these adverse mental symptoms.

Long-term, high dose alcohol use adversely affects nearly every organ system. A common effect is development of low-grade hypertension and can lead to dire consequences of most organ systems especially muscular changes in the heart and blood vessels. This may lead to congestive heart failure secondary to cardiomyopathy. When hypertension is combined with triglycerides and low-density lipoproteins an increased risk develops for coronary artery and cerebrovascular diseases (Friedlander *et al*., 2003).

Alcohol also irritates the gastrointestinal tract and during excessive use may lead to gastritis, stomach- or/and duodenal ulcers in cases of long-term use, leading to liver cirrhosis and pancreatitis. Long-term use of alcohol has also been associated with different types of cancer including carcinomas of the oral cavity, pharynx, hypopharynx, larynx, oesophagus and the stomach (Falck-Ytter and McCullough, 2000; Bagnardi *et al*., 2015).

Effects on the central nervous system (CNS) include neuronal cell death, neural cell atrophy in multiple regions in the brain, mostly in the frontal lobes, limbic centre, hippocampus and cerebellum. This results in poor judgement, impaired attention span and short-term memory as well as ataxia and emotional lability (Bleich *et al*., 2000; Pfefferbaum *et al*., 2000, Sullivan *et al*., 2000). Consumption of alcohol influences the interaction of various neurotransmitter systems in the CNS. Ingestion is associated with the release of endogenous opioid peptides, such as endorphins and enkephalins, that is leading the consumer experiencing a pleasurable sensation (Froelich *et al*., 1998). Subsequently, opioid peptides lead to the release of dopamine in the brain's nucleus accumbens which is the reinforcement/reward centre (Koob and Nestler, 1997; DuPont, 1999; Gianoulakis, 2001; Tizabi *et al*., 2002).

2.2.3.4 Oral health manifestations of alcohol use

Nutrition is also severely affected by alcohol use because its ingestion often accounts for half of the daily caloric intake (Boffetta and Hashibe, 2006). This leads to displacement of daily

essential diet proteins, minerals and trace elements such as vitamins and folic acid. Moreover, alcohol use also leads to poor absorption of essential nutrients such as folate and vitamins B, D and K as well as enhanced secretion of magnesium and zinc (Markowitz *et al*., 2000). Oral manifestations of alcohol-induced nutritional deficiencies include angular cheilosis, glossitis and gingivitis (Dreizen, 1989; Friedlander *et al*., 2003).

Long-term alcohol use oral effects may include salivary gland enlargement, especially the parotid gland and is known as sialadenosis (Friedlander *et al.,* 2003). This condition is the result of an ethanol-produced peripheral autonomic neuropathy that leads to abnormal salivary metabolism and secretion (Mandel and Hamele-Bena, 1997; Kastin and Mandel 2000). Impaired saliva production by the parotic gland leads to a dry mouth which is characterised by a reduced saliva-buffering capacity to neutralize intra-oral acidic environment. This combined with a high sugar and cariogenic diet, as well as poor oral hygiene habits, explains the increased prevalence of dental caries and advanced periodontal disease (Dutta *et al*., 1989; Duta *et al*., 1992; Novacek *et al*., 1995; Kampov-Polevoy *et al*., 2001). Another related adverse effect of reduced saliva flow is the reduction in epidermal growth factor (EGF) which is produced by the salivary glands. It has been shown that EGF can protect oral mucosal tissue from sustained damage from acidic fluids. Considering lowered mucosal tissue protection, the person who use alcohol may experience an increased prevalence of oral ulceration (Sarosiek *et al*., 2000).

Reduced salivary flow lead towards a reduction of saliva buffering capacity and a lower intra oral pH. This is combined with a high consumption of cariogenic non-alcoholic beverages and poor oral health habits leading to high prevalence of dental caries and periodontal disease (Dutta *et al.,* 1992; Novacek *et al.,* 1995; Kampov-Polevoy *et al.,* 2001). Signs of dental erosion may also occur due to acidic nature of beverages consumed as well as gastroesophageal reflux. This condition is typically seen among long-term heavy drinkers due to the relaxant effect that alcohol has on the lower oesophageal sphincter and subsequently leads to regurgitation of acidic stomach contents (Robb and Smith, 1990; Lazarchik and Filler, 2000; Ali *et al*., 2002, Valena and Young, 2002).

Soft tissue oral conditions such as glossitis, angular cheilosis and gingivitis have also been reported among heavy drinkers. Glossitis in the early phases, can be described as a painful tongue, with swollen fungiform papillae, flattened and mushroom-shaped.

As the condition progresses, the tongue becomes intensely red accompanied by atrophy of the filiform and fungiform papillae. A classical picture of ulceration at the corners of the mouth resembles angular cheilosis. Increased prevalence of gingivitis seen in people who suffer from alcohol use disorder can be explained by the dry mouth that is typical, oral health neglect and nutritional deficiencies. Gingivitis manifests with necrotic areas at the tips of the interdental papillae (Dreizen, 1989; Pantalon and Scottenfeld, 1999).

Studies have found an association between oropharyngeal cancer and alcohol consumption coupled with tobacco smoking (Christen, 1983; Craig and Triedman, 1986; McMichael and Puzio, 1988;). Squamous-cell carcinoma of the oral cavity especially on the tongue and floor of the mouth is seen among people who use alcohol and tobacco products concurrently. It is known that the oral concentration of acetaldehyde is high in and long-lasting in heavy drinkers who also have poor oral hygiene. Acetaldehyde is ethanol metabolite which promotes tobacco-initiated tumours through alteration of DNA and oncogene expression in oral keratocytes. After the consumption of alcohol, ethanol is absorbed in the gut distributed though the blood and tissue fluids such its concentration in the blood is the same as in saliva. When ethanol-rich saliva comes in contact with lingual and gingival mucosal cells, oral bacteria and yeast that contain ADH, the ethanol is then oxidized to acetaldehyde (Homann *et al*., 2000; Homann *et al*., 2001; Forastiere *et al.,* 2002; Timmons *et al*., 2002).

Inflammatory oral changes accompanied with xerostomia lead to oral candidiasis (Rees, 1980; Shellow, 1983). Long-term alcohol use has also been linked to dental caries, periodontal disease, and tooth loss (Christen, 1983; Friedlander *et al.,* 1987; Kranzler *et al.,* 1990; Van der Weijden *et al*., 2001). Kranzler found an association between alcohol consumption and oral hygiene effectiveness. Other oral symptoms observed include dental attrition and an increased tendency to bruxism, especially during sleep (Christen, 1983; Friedlander *et al.,* 1987).

2.2.3.5 Impact on dental treatment

Patients involved with alcohol use have reduced responsiveness to local anaesthetics and increased tolerance to certain drugs (Friedlander *et al*., 2003). The hepatological and haematological adverse effects of alcohol use are important on account of its clinical significance to dental treatment and defence mechanism to infections including oral infections.

Long-term alcohol use leads to impaired function of the liver related to the production of coagulation factors and metabolism of medications. It also leads to abnormal functioning of white blood cells and reduced chemotactic abilities, eventually resulting in reduced production of platelets by bone marrow (Friedlander *et al*., 2003). Chronic alcohol use leads to suppression of megakaryocyte maturation which is not only leading to a decreased platelet count but also inhibits the release of thromboxanes A and B which adversely impacts platelet aggregation. Friedlander *et al*., (2003) also reported on people who used alcohol who developed bleeding abnormalities that pose surgical challenges as mentioned above. During oral surgical procedures, excessive bleeding can occur.

Impaired liver function can also affect the metabolism and utilization of vitamin K which is necessary for the synthesis of several clotting factors. In patients with advanced liver disease, a low hepatocyte count is unable to synthesize fibrinogen, prothrombin and clotting factors V, VII, IX, and X. Poor nutrition, with inadequate Vitamin K intake, and impaired liver function is shown by an alteration in the prothrombin time and thus deficiency in functional coagulation (Rubin and Rand, 1994; McGarry *et al*., 1995).

Lowered serum osteocalcin levels lead to poor skeletal homeostasis with subsequent delayed fracture repair and bone formation which is also common among patients with impaired liver function. Ethanol consumption is associated with a low osteoblast count and function and this will lead to lower bone volume and strength (Bikle *et al*., 1993; Mathog *et al*., 2000; Elmali et al., 2002).

2.2.3.6 Alcohol use and maxilla-facial injuries

It is important to emphasize the adverse effects substances (especially alcohol) have on the oral cavity and normal physiological functioning, and to mention the behavioural effects of alcohol use and its contribution to maxillo-facial trauma (Bowley *et al*., 2004). Alcohol-related craniofacial trauma is a major public health problem in the Western Cape (Ranchod *et al.* 2014). Its use leads to behavioural changes that increases interpersonal violence, falls (Passeri *et al*., 1993; Smith *et al*., 1998) and irresponsible driving under the influence. Violence and injuries are commonly associated with intoxication and Eggensperger *et al*. (2007) found that almost a 25% of assault-related facial fractures were caused by intoxicated people under the influence of alcohol, illicit drugs or a combination thereof (Eggenberger *et al.*, 2007).

Another study done among 4000 patients from six different trauma centres found a positive blood alcohol concentration (BAC) level in 40.2% of the patients on admission and 60% who tested positive for poly-substance use (Soderstrom *et al*., 1992). Similar findings were reported by McAllister who analysed urine samples from 93 patients who sustained facial injuries. Again, 40% had positive BAC and 50% used illicit drugs in combination with alcohol (McAllister *et al*., 2013).

Bowley *et al*., (2004) conducted a study in Johannesburg (South Africa), and found an average blood alcohol (BAC) level of 37mmol/l (0.17g/dl) in trauma patients which is three times the legal limit of 10.9mmol/l (0.05 g/dl), allowed in South Africa. About 60% of all trauma patients, tested positive for presence of blood alcohol and half tested positive for cannabis and other drugs such as mandrax and amphetamines (Bowley *et al*., 2004). Another interesting finding was that a third of pedestrian trauma patients also had presence of blood or/and cannabis (Bowley *et al*., 2004). This leads to a massive burden on the South African health care system, with 70 000 trauma-related deaths and 3.5 million trauma incidents per year (Crisp *et al*., 1999).

2.2.3.7 Role of the dentist when suspecting alcohol use

The dentist can play an integral role once untreated alcohol use is suspected or confirmed by a patient in terms of referring the patient to professional treatment. The most important components of treatment include confrontation, detoxification and rehabilitation (Friedlander *et al*., 2003). This require the referral to appropriate treatment facilities and professional care.

2.2.4 Mandrax (methaqualone)

Methaqualone, known as mandrax, is a synthetic sedative-hypnotic that has a long history of illicit recreational use in South Africa (Gerald *et al*., 1973; Bhana *et al*., 2002; Harker *et al*., 2020). It is mostly used in a tablet form, crushed and then smoked with either tobacco or cannbis being called “white pipe”. Effects of using it include a euphoric high accompanied by drowsiness, temporary unconsciousness with potential sedation that can last up to 5 hours (McCarthy *et al*, 2005). According to the SACENDU Brief, mandrax use is the fifth most frequently primary substance being used in the Western Cape at 6%. More importantly to note was that it was most commonly used as secondary drug at 36% (SAMRC, 2024).

2.2.5 Crack/Cocaine

The association between crack use and changes in the oral mucosa could be related to the extreme heat of the smoke, the harmful effects of the chemical contents and friction over the gingival tissue. Applying cocaine to the oral mucosa causes vasoconstriction that leads insufficient blood supply that can lead to tissue necrosis. It also may lead a reduced salivary flow (Pellergrino *et al.* 1998). Crack use was found to be associated with clinical and cellular changes in the oral mucosa (Antoniazzi *et al.* 2018).

2.2.6 Heroin and other opiates

Heroin, also called dimorphine, is an opioid and among the most frequently used recreational drugs used worldwide, estimated around 34 million users globally (UNODC, 2018). It is mostly used for its euphoric effects and can be snorted, smoked and injected. The mechanism of action is to activate the opioid neuroreceptors to stimulate release of high-level dopamine (NCBI, 2018). The use of heroin leads to physical and psychological dependence and chronic use is associated with adverse effects affecting the cardiovascular, respiratory, central nervous, gastrointestinal and genitourinary systems (BMA, 2013). Personal neglect is common among heroin users associated with psychosis and malnutrition. In many cases uncontrolled overdose leads to respiratory distress and death (Akerele and Olupona, 2017). Heroin withdrawal is characterized with severe unpleasant symptoms such as nausea, vomiting, abdominal pain, tremor, body shaking, myalgia, and tachycardia. This requires a multi-disciplinary treatment approach of behavioural, social, and pharmacological management (Akerele and Olupona, 2017).

Oral methadone, which is a μ receptor agonist, is widely used to treat dependence of the drug, not only because it reduces heroin use but also lowers injecting practice. Subsequently it also improves social functioning, physical symptoms experienced among users and the quality of life (Teoh *et al*., 2016). However, the formulation of methadone is high in sugar and may lead to increased risk for dental caries if the patient is receiving it over long periods. One suggestion is to offer methodone that is sugar-free (Nathwani & Galagher, 2008).

It has been reported that a higher prevalence of dental caries and periodontal disease has been evident among heroin users mainly due to inadequate diet, hyposalivation, personal hygiene neglect, poor oral hygiene practice, and an abnormal oral microbiome (Shen and Fu, 1998; Brondani and Park, 2011; Ma *et al*., 2012; Raymond and Maloney, 2015; Aukštakalnis and Jurgelevičius, 2018). Protka *et al*., (2013) conducted a study to determine the prevalence of dental caries among heroin users. The sample consisted of 100 participants diagnosed with heroin addiction and these were compared to controls who took no addictive substance. The mean DMFT score was higher in the test group (mean 18.78) compared to 5.32 in the control group. This was significantly different ($p < 0.0005$). The highest caries prevalence in both groups was recorded on occlusal dental surfaces (44.70% in the test group and 16.20% in the control group). Prevalence of dental caries on vestibular surface was also higher among heroin users (9.4%) vs controls (2.34%). An interesting finding from the study was also a lower saliva pH in the test group with a concurrent statistically correlation between heroin addiction and reduced production of stimulated saliva ($p < 0.002$) (Protrka *et al*., 2013).

In 2019, Van Kempen and Brand reported on a drug called, krokodil, which is a semi-synthetic narcotic drug used as a cheap alternative to heroin. Although it is not well known in the South African context, it is important to take note of. Its highly addictive and mostly used in eastern Europe and in Russia. According to the review, the majority of studies reported osteonecrosis of the jaw, after dental extractions, and other oral health adverse effects such as poor oral hygiene, severe gingival recession, bleeding on probing, destruction of interdental septum, mobile teeth, partial edentulousness, high prevalence of dental caries and presence of plaque and calculus (Van Kempen and Brand, 2019). Oral treatment of these patients is complex and mainly involve surgical intervention which include necrectomies, complete or partial resection of the mandible, maxilla and maxillofacial bones and segmental jaw resection with further implantation. The drug-related osteonecrosis of the jaw, is comparable with phosphorus and bisphosphonate-induced necrosis of the jaws with the clinical picture similar to ‘phossy jaw’ and medication-related osteonecrosis of the jaw (MRONJ) (Van Kempen and Brand, 2019).

Opiate use results in xerostomia due to suppression of salivary secretion that is caused by disordered peripheral signalling at parasympathetic muscarinic receptors (Titsas, 2002; Farnsworth, 2009). Plaque accumulation from poor oral health habits among opiate users further contribute to dental caries (Scheutz *et al.,* 1984; Bigwood and Coelho, 1990). Research found that methadone users favoured intake of sugars and low intake of fibre.

This led to a high prevalence of plaque and dental caries (Zador *et al,* 1996; Nathwani and Gallagher, 2008). This was supported by another study conducted in China that found the oral health status among former heroin users in Chengdu was poorer than the general population (Ma *et al.*, 2012). A study in Australia found that dental problems among injecting drug users were common. It was also found that socio-economic problems such as poor housing, hygiene and poor nutrition further place these people at risk (Laslette *et al.*, 2008).

Research done by Robinson *et al*. (2005) found that among Opiate users, they experienced an altered sense of taste making regular meals taste like 'cardboard', and not enjoying food as before. Users also reported that their mouths and sense of smell were constantly numbed by drug use (Robinson *et al*., 2005).

Providing proper dental care for heroin users might be challenging considering the negative attitude towards oral health care, mental health disorders, common anxiety and fear among heroin users and associated drug interactions in combination with associated medical co-morbidities (Abed and Hassona, 2019). The treatment plan of a heroin user was structured into a disease control phase, rehabilitation phase and maintenance programme. The initial phase included dietary analysis and advice, oral hygiene instructions and education, developing a smoking cessation programme, prescribing a high Fl tooth paste (Colgate Duraphat toothpaste 5,000 PPM), removal of unrestorable teeth, scaling and root surface debridement and performing dental restorations on decayed teeth. An essential part of dietary advice was encouraging the patient to drink plenty of water and to use sugar-free chewing gum to increase oral hydration. During the rehabilitation phase, missing teeth were replaced of with an acrylic partial denture. Lastly, the patient was scheduled for a six-monthly dental maintenance programme. In the overall management of heroin addicts, they should be encouraged to lead a healthy lifestyle and improving the patient's attitude towards health care services (Abed and Hassona, 2019).

2.3 Oral health behaviour of drug users

Oral health behaviour refers to tooth brushing frequency, usage of fluoride toothpaste, flossing, consumption of sugary products between the main meals, smoking and attendance of dental visits (Chen *et al.,* 1997; Bourgeois and Llodra, 2004; Tseveenjav *et al.,* 2004; Khami *et al.*, 2007).

Research found poor oral health behaviour among drug addicts while enrolled in a withdrawal treatment programme. Patients who were less educated and those addicted to crystalline heroin as being at greatest risk for oral diseases (Shekarchizadeh *et al.,* 2013). This was supported by a study by Smit and Naidoo (2015) where an association between tooth brushing frequencies was found when drug users were using methamphetamine compared to when they were not use the drug (Smit and Naidoo, 2015).

A high sugar diet followed by drug users is also important to consider when explaining the high prevalence of dental caries that is commonly reported on in studies. A qualitative study done by Robinson utilized focus group discussions and individual semi-structured interviews with drug users. Participants reported on having an unhealthy diet and also that they drugs led to a decreased apatite (Robinson *et al*., 2005).

Cigarette smoking is often seen among heavy drinkers and this can exacerbate the imminent loss of teeth due to chronic periodontal disease (Van der Weijden *et al*., 2001).

2.4 Oral health-related quality of life and substance use disorder

The Oral Health Impact Profile (OHIP-49) questionnaire was designed to measure quality of life, which relates to oral health (Slade and Spencer, 1994). A shorter version, OHIP-14, has shown good reliability, validity and precision (Slade, 1997).

A limited number of studies have investigated oral health-related quality of life (OHRQoL) of drug users. A study in Australia compared OHIP-14 summary indicators among injecting drug users with the general population. The study found poorer OHRQoL than the general population especially among those with longer injecting careers (Truong *et al.,* 2015). Oral health status of substance users does have a substantial effect on their quality of life, which can be greatly improved by dental treatment (Van Wijk *et al.*, 2016). In 2017, Antoniazzi et al. (2017) found that crack users and other drug users exerted a negative impact on oral health-related quality of life (OHRQoL) and had a poorer OHRQoL than the controls independently of socio-demographic characteristics and tobacco use (Antoniazzi *et al.,* 2017).

Mukerjee *et al.* (2018) focused on methamphetamine use and oral health-related quality of life on cohort of 545 methamphetamine users in the Los Angelas County of California (US).

The study found that methamphetamine users had worse oral health-related quality of life when a comparison was made to the findings from data of the US general population (Mukerjee *et al*., 2018). The study used the self-reported shortened version of the OHIP-14 questionnaire by only using seven key questions to report on the seven impact areas of the OHIP-14 questionnaire to asses oral health related quality of life (Mukerjee *et al*., 2018). Findings from the Mukerjee study indicated that the sense of taste was more affected among moderate/heavy methamphetamine users compared to light users. The study further found that participants who were 45years and older were 1.57 times more likely to report an unfavourable response towards sense of taste compared to younger participants. Participants who experienced a painful tooth/sores over the past month were 3.11 times more likely reporting affected sense of taste when compared to those who did not experienced tooth ache/sores (Mukerjee *et al*., 2018). This is also in line with findings from Murphy *et al*. (2106) that found that methamphetamine users were 3.5 times more likely to experience recurrent painful toothaches compared to the general population (Murphy *et al*., 2016). The study also applied the short form of OHIP-14 that included methamphetamine users compared to the general population from the NHANES surveys. Methamphetamine users were 4.5 times more likely to feel embarrassed because of problems with their teeth, mouth or dentures. Furthermore, the study also shown that drug users were 2.5 times more likely to experience life as less satisfying, and 9.4 times more likely to experience difficulty doing their job or attending school. Drug users also were 6 times more likely to experiencing difficulty when eating compared to the general population (Murphy *et al*., 2016).

A cross-sectional study from Australia was done on 194 individuals from Victoria who used methamphetamine at least monthly and again the OHIP-14 was utilised. The aim of the study was to investigate potential correlations between sociodemographic details, behavioural factors, psychosocial elements and dental service utilisation with methamphetamine use. It also had a secondary aim of checking if smoking of methamphetamine was associated with a reduced OHRQL. No significant association was found between route of administration of the drug and three main OHIP-14 elements that were investigated i.e. OHIP-14 prevalence, OHIP-14 extent and OHIP-14 severity. Participants from rural areas, had significant worse OHRQoL levels than those who lived in the metro areas (Abdelsalam *et al*., 2023).

CHAPTER 3: AIM AND OBJECTIVES

3.1 AIM

The aim of the present study was to investigate the oral health impact of substance use disorder (SUD), as well as the oral health interventions that are offered to patients while enrolled in a treatment programme for substance use disorder (SUD)

3.2 OBJECTIVES

The objectives of the study were as follows:

1. To measure the dental caries experience and severity of the participants
2. To determine presence or absence of periodontal disease
3. To investigate oral health behaviour of patients with substance use disorder
4. To determine the dental treatment needs of the participants based on the history of substance use
5. To ascertain the oral health interventions that are included in current drug use programmes from the perspective of facilitators at treatment centres
6. To assess Oral Health related Quality of Life (OHQoL) of drug users admitted to a treatment centre

3.3 PROBLEM STATEMENT

Substance use disorder (SUD), oral diseases including dental caries, periodontal disease and maxilla facial trauma are serious public health problems in the Western Cape. The oral health persons with SUD is severely compromised due to complex risk factors which have direct and indirect effects depending on the substance of choice and socio-economic environment of the patient. Detailed data and reporting of dental status, oral health behaviour, dental treatment needs, oral health related quality of life (OHRQoL) and whether oral health interventions are included in the general treatment programme for substance use disorder (SUD), in South Africa, remains extremely limited.

3.4 RATIONALE FOR RESEARCH

Substance use disorder is associated with poor oral health but it is unknown if differences exist between specific drugs being used and if so, to what degree it affects oral health related quality of life. There are only a few South African studies that have investigated the oral health effects of drug use. The present study was done after careful consideration of research recommendations from previous research. These included the need for an in-depth study with a detailed clinical focus combined with an extensive questionnaire, incorporating a large sample, to investigate all potential risk predictors to increase the knowledge on this research topic.

3.5 CONCEPTUAL FRAMEWORK OF THE RESEARCH PROJECT

The conceptual framework of the present study was formulated with the main focus on substance use disorder and its impact on oral health. As described by Varpio *et al*. (2020) it was developed through a synthesis of the literature, identifying the gaps in understanding of a phenomenon or problem and outlining the methodological foundations of the research project (Varpio *et al*., 2020). Professional insight and experience were also incorporated in compiling the conceptual framework.

The framework provided the connections between the main variables linked to the research objectives. It is a guide to explain the research study process as well as describe how particular variables were measured. The conceptual framework was used to ensure a focus on the research aim throughout the research process. The main components (in bold) refer to the research objectives and their applicable variable being investigated.

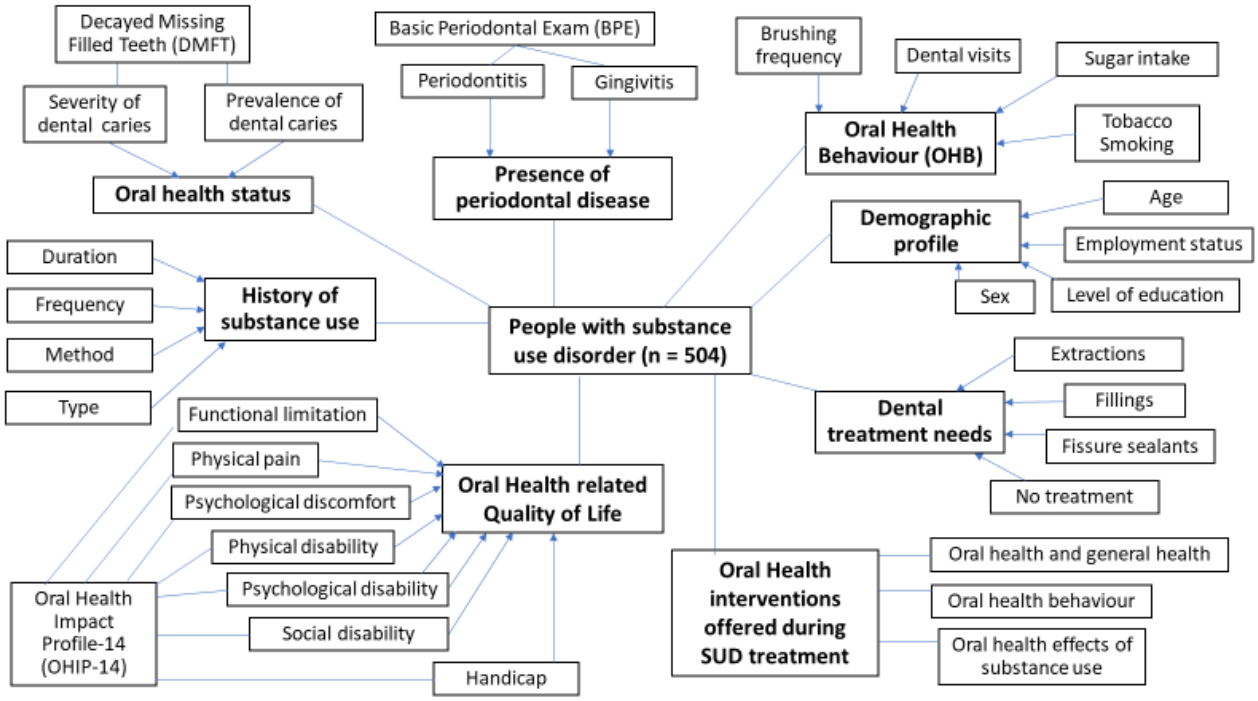

Figure 1: Conceptual framework of the research project

CHAPTER 4: METHODOLOGY

4.1 Study design

The present study used a cross-sectional study design with a mixed methods approach. Firstly, a descriptive quantitative component was used to answer the first research question that focused on oral health status, oral health behaviour, dental treatment needs and oral health-related quality of life (OHRQoL) of people who suffer from substance use disorder (Phase 1). This was achieved by performing a clinical oral examination and completing a structured researcher-administered questionnaire for all patients enrolled for the study (n = 504). The descriptive nature of the study allowed reporting on prevalence of dental caries, periodontal disease and specific oral health symptoms being experienced among substance users.

Secondly, a qualitative approach was applied by using four focus group discussions assisted by a semi-structured interview guide for staff who were working at different substance use treatment centres in the Western Cape (Phase 2). It answered the second research question that attempted to establish to which extent oral health care is available for patients during the period of being enrolled in a treatment programme of substance use disorder (SUD).

4.2 Introduction to methodology

Standardized instruments, to measure severity of dental caries and presence of periodontal disease were used. A validated questionnaire was used to determine oral health-related quality of life (OHRQoL) of participants. The dental treatment needs of patients was described from the both the perspective of the patient (using clinical examinations) as well as from the perspective staff (using focus group discussions) who were working at substance use treatment centres. A qualitative approach was utilized to determine the extent to which oral health interventions were incorporated into the general treatment programme for SUD.

This study investigated different factors that could impact dental status and OHQoL among patients who suffer from SUD. The selected study design was based on previous research that was done as well as finding the best fit, through a mixed methods approach, to answer the research questions. These methodological considerations were discussed in this chapter.

4.3 Study sites

All the treatment centres that participated in the research project were also reporting data to the sentinel surveillance of South Africa Community Network on Drug Use (SACENDU) managed by the South African Medical Research Council (SAMRC).

A total of eight treatment centres were included in the study.

4.4 Study population

Phase 1: The population for the quantitative part of the study was identified as the on-point number of patients who were enrolled in a treatment programme at any point in time in the Western Cape province. Using the latest SACENDU reports, this estimated study population was approximately 1500 after considering that 6000 patients were included over a 12-month reporting period and that the average duration of treatment cycle was about 6 to 8 weeks.

Phase 2: Population: For the second part (qualitative) of the study the target population was staff at treatment centres for SUD who are directly involved with therapeutic and nursing services for patients. Professionals such as councillors, psychologists, occupational therapists, social workers and nursing staff were included.

4.5 Study sample and recruitment

Phase 1: Study participants were patients who were enrolled for a treatment programme for substance use disorder (SUD) at registered centres in Cape Town, the Cape Winelands-(Stellenbosch) and the Breede Valley (Worcester) districts in the Western Cape, South Africa. The participants were selected from SACENDU reporting treatment centres. A convenience sample selection was applied. Patients who participated in the study were recruited with assistance from the applicable centre manager and administrator.

Phase 2: Staff members who were directly involved with SUD treatment programmes at the centres from where the patient participants were selected from. Staff member who participated in the study were recruited with the assistance from the applicable centre manager and administrator.

4.6 Sample size

Phase 1: The prevalence of substance use disorder in the Western Cape was estimated at 7.1% (Peltzer, 2018). According to the latest SACENDU report, about 6 000 patients were enrolled in a treatment programme within the Western Cape Centres from July 2017 – June 2018. The Duration of treatment varied from 5 – 16 weeks and this suggested that at any point in time, there were about 1 500 patients enrolled in a treatment programme which present the on-point study population. Taking into consideration the time needed to complete each participant's oral examination and questionnaire, and after consultation with a statistician, a sample of 475 was calculated to be a true presentation of the on-point population of 1 500. The sample size was estimated with an 80% power and 5% level of significance and a delta of -0.129.

$n = 2\ \{Z\alpha/ES\}^2 = 2*\{1.96/(-0.129)\}^2 = 457.00$

The estimated sample size was also deemed acceptable considering the study by Van Wijk et al. (2016) that also investigated OHRQoL in a sample of alcohol and drug users in Amsterdam (The Netherlands). This study had a sample size of 392 (Van Wijk *et al*., 2016). Finally, 504 (n = 504) patients were included to ensure a robust sample size and to safeguard a decent buffer for data analysis.

Phase 2: A total of five focus groups were conducted, representing different geographic areas in the Western Cape, however data saturation was reached after four focus group sessions were concluded. Focus groups were compiled of staff such as occupational therapists, social workers, counsellors, nurses and psychologists who were actively involved with SUD patient treatment programme. Focus group 1 consisted of eight participants, focus groups 2 and 3 consisted of six participants each while focus group 4 consisted of two participants, making a total of 22 participants.

4.7 Selection criteria

4.7.1 Inclusion Criteria

Phase 1: SUD patients older than 18 years enrolled in a substance use treatment programme in Cape Town, Cape Winelands- (Stellenbosch) and the Breede Valley (Worcester).

All participants were allocated to the following drug categories according to primary drug of choice:

- Alcohol
- Cannabis (exclusive cannabis use)
- Mandrax (Methquinolone)
- CAT (Methcathinone)
- Crack Cocaine
- Heroin or other Opiates
- Methamphetamine
- Over the Counter (OTC) or Prescription drugs (PRE)

Phase 2: Only participants (staff members from the applicable treatment centres) who provided informed consent were included in the focus group discussions.

4.7.2 Exclusion criteria

- Individuals who refused to participate in the study or who did not consent to participate
- Users who were re-entering a treatment programme and who had participatedin the study previously.
- Users who were younger than 18 years old.

4.8 Instruments

A structured researcher administered questionnaire was used to collect data on demographic information, history of drug use, diet and dental history (Appendix 5). Questions on the demographic profile and history of drug use were similar to the SACENDU enrolment questionnaires that are used by the majority of treatment centres over the past 20 years. Questions that focused on oral health behaviour were adapted from a questionnaire designed and used for Master's thesis with a sample of 308 methamphetamine users. (Smit, 2014).

A validated questionnaire, the Oral Health Impact Profile-14 developed by Slade (1997) was used to investigate Oral Health-Related Quality of Life (OHRQoL). This questionnaire had 14 questions and was administered by the researcher.

An oral examination, using international guidelines (WHO, 2013), were carried out on 504 participants to determine dental status using the decayed, missing and filled (DMFT) score. The oral examination included a basic periodontal examination (BPE) (British Society of Periodontology and Implant Dentistry, 2012) to determine periodontal pocket bleeding percentage, as well as presence of periodontal disease. All oral examinations were done by the calibrated principal investigator.

To investigate what oral health interventions were offered to patients while enrolled in a treatment programme for SUD, a qualitative research approach with focus group discussion was used.

4.8.1 Developing the questionnaires

The questionnaire used for the collection of demographic details, history of substance use and oral health behaviour was evaluated for face validity by two clinical examiners (dentists) in a pilot study to test the questionnaire in terms of comprehension, practicability and relevance. The pilot study was done to:

- test the suitability of the data collection method
- calculate the time needed to complete each questionnaire
- check the adequacy of the data collection form
- check that all the questions and response options were clear and unambiguous
- ensure that no major items from the research aim and objectives were omitted

4.9 Data collection

All questionnaires were administered by the lead researcher and conducted as a one-on-one session with closed as well as open ended questions. Information was retrieved from the completed paper-based questionnaires and transferred to a data capture document namely RedCap. The captured data was exported to a data spread sheet in Microsoft Excel 2019 and to the selected statistics software packages namely Epi Info version 7 (CDC) and Sata (Stata Corp., College Station, TX).

4.9.1 Phase 1: Data collection (quantitative component)

a. **Demographic information** (questionnaire): included age, gender, marital status, level of education, employment status, etc.

b. **Substance use history** (questionnaire): included the primary drug of choice as well as the secondary drug, if applicable. It also included duration of addition, preferred method of us, frequency of use

c. **Oral health behaviour** (OHB): history of tooth brushing frequency, dental visits, flossing teeth, in-between snacking, degree of a high sugar diet, diet preference during substance use and cigarette smoking.

Tooth brushing frequency was determined using a Likert scale: brushing more frequently, brushing twice a day, brushing once a day or brushing less frequently. Diet that was followed during times of substance was investigated to determine the association with dental status, oral health symptoms or oral health related quality of life. Questions related to diet determined the daily sugar intake, daily alcohol intake and appetite during times of drug use. Questions that focused on solid food, distinguished between ordinary meals and in-between snacking while questions that focused on drinks included non-alcohol and alcohol drinks.

Questions related to consumption of alcoholic drinks was completed by the entire sample including those who used alcohol as a primary drug. Participants were asked to select alcoholic drinks that they would prefer during time of drug use, and to indicate how many drinks per day and per week they consumed. The measuring unit to quantify alcoholic consumption, was the number of glasses (250ml) per day/week. Thereafter, the number of glasses of each alcohol type was converted to alcohol units in order to have a standardized generic unit for the main types of alcoholic drinks. Self-reported food consumption which included the type and quantity of food consumed during breakfast, lunch, dinner as well as in-between snacking of salt- and sweet snacks were included. Structured questions on snacking frequency, type, and quantity was used. Self-reported information on in-between snacking provided from participants were then according to main types for sweet and salt snacking. Quantities of snacks were then further using the Reference Amount Customarily Consumed (RACC) which is an amount of a food for use in nutrition labelling and is regulated by the Food and Drug Administration (FDA).

d. **Oral health status** (clinical oral examination)

An intra-oral clinical examination was performed to measure the dental status (DMFT), to determine dental treatment needs and to do the basic periodontal examination (BPE). The WHO Oral Health Survey guidelines and criteria for determining DMFT was used (WHO, 2013). The Basic Periodontal Exam (BPE) was conducted as a screening tool of periodontal health status according to guidelines from the British Society of Periodontology. The oral examination was done using a plane mirror and WHO probe, no radiographic examinations was performed. The researcher, who is a qualified dentist and who have been calibrated, performed an oral examination on each all 504 participants at the various treatment centres. The same conditions as prescribed by the WHO was adhered to with each examination.

Information on the Decayed, Missing and Filled Teeth Index (DMFT) was captured on a data capture sheet. The D-component included all teeth with codes 1 or 2. The M-component included teeth coded 4 in patients under 30 years of age and the teeth coded 4 or 5 for patients who are 30 years and older, i.e. missing due to caries or for any other reason. The F-component included only teeth with 3. Teeth coded 6 (fissure sealants) or 7 (bridge abutment, special crown or veneer/implant) will not be included in calculation of the DMFT. DMFT index ratio will be calculated by dividing the total number of decayed, missing and filled teeth by 28 (Appendix 7a).

Information on treatment needs was captured for each teach except third molars. A code “0” was indicating no treatment needed (none), code 1 was for caries arrest treatment or sealant care, code 2 was for 1-surface filling while code 3 was for 2-and-more- surface restorations. Code 4 was for a crown or bridge abutment needed while code 5 for a bridge element. Code 6 was indicating that a tooth needed pulpal care and code 7 was for extraction needed. Code 8 was given for other care needed (Appendix 7a).

The Basic Periodontal Exam (BPE) was conducted to determine periodontal health status and provided information on further treatment that a patient may require (The British Society of Periodontology, 2011).

The dentition of a patient was divided into six section or "sextants" that were scored separately. For a section of the mouth to be considered a sextant, there must have been at least two teeth present (Appendix 7b). The third molars were not recorded in a BPE but every other tooth present in a sextant was subject to a BPE. If there was a sextant with only a single tooth present, that tooth was measured as part of the adjacent sextant. The hand instrument of choice was a WHO BPE probe was used (World Health Organisation probe). This has a "ball end" 0.5 mm in diameter, and a black band from 3.5 to 5.5 mm and another at 8.5 to 11.5mm. Light probing force was used (approximately 10 to 20 grams). The probe was "walked around" the sulcus/pockets in each sextant, and the highest score was then recorded. As soon as a code 4 was identified in a sextant, the research moved on directly on to the next sextant, though it was better to continue to examine all sites in the sextant. If a code 4 is not detected, then all sites were examined to ensure that the highest score in the sextant was recorded before moving on to the next sextant (Table 1).

BPE code	**Probing depth and black band on probe**	**Unique clinical observation**	**Treatment required**
0	< 3.5mm First black band completely visible	Healthy periodontal tissue No calculus/overhangs No BOP	No need for periodontal treatment BPE recorded at every routine examination
1		No calculus/overhangs BOP present	Oral health instructions; BPE recorded at every routine examination
2		Supra or subgingival calculus or plaque	As for code 1, removal of plaque retentive factors (supra and subgingival calculus). BPE recorded at every routine examination
3	3.5mm – 5.5mm Black band partially visible indicating pocket depth of 4 – 5mm		As for code 2, and root surface debridement (RSD) if required. A 6-point pocket chart (6PPC) should be carried out in the sextants scoring 3
4	> 5.5mm Black band entirely within the pocket indicating a pocket depth > 6mm		As for code 3. Referral to a specialist may be indicated and more complex treatment needed. A 6-point pocket chart (6PPC) should be carried out in all the sextants.
*****	Furcation involvement	Detection of a furcation	

Table 1: Scoring criteria for the BPE

e. **Medical history** (Questionnaire): Self-reported information on chronic conditions and medication was also included in the questionnaire.

f. **Dental treatment needs** (Clinical oral examination and focus group discussions)

Dental treatment needs were determined during oral examinations by measuring the DMFT of each patient applying WHO protocols. A specific code was awarded to each tooth (excluding third molars) during data collection. The results on treatment needs will be presented in mean scores for the common treatment needs cross-tabulated to history of substance use as well as investigating for potential association between proportion of certain treatment needs and different variables.

Dental treatment needs were determined in two sections of the research study. Firstly, during oral examinations by measuring the DMFT of each patient. A specific code was awarded to each tooth (excluding third molars) during data collection. The results on treatment needs were presented in mean scores for the common treatment needs and cross-tabulated to history of substance use as well as investigating for potential association between proportion of certain treatment needs and different variables.

Secondly, during qualitative data analysis, the treatment needs of the programme offered for SUD, at treatment centres, were investigated during the focus group discussion. Broader themes, sub-themes and categories were identified during data analysis.

g. **Oral health related quality of life** (Oral health impact profile (OHIP-14) questionnaire created by Slade and Spencer (1997)

To determine the severity and prevalence of the impact on OHRQoL, the Oral Health Impact Profile (OHIP-14), a validated questionnaire created by Slade (1997), was used to measure oral health related-quality of life (Appendix 6). The 14 questions were grouped into seven dimensions namely functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap.

The total OHIP-14 score measured the ***severity*** negative impact on OHRQoL. For each of the 14 questions, a 5-point Likert scale response format (0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, 4= very often) was given to measure oral functional limitation, discomfort, and disability. The sum of the scores for each question (ordinal responses) was used to calculate a total score (maximum of 56) as well as the sum for each of the 7 dimensions. Higher scores (OHIP-scores) indicated a poorer OHRQoL and thus a greater negative impact on OHRQoL. Those who answered with one or more "fairly often" and "very often" (categorical outcomes on the OHIP-14 instrument) were used as a ***prevalence*** of negative impact on OHRQoL and subsequently used to investigate potential associations with the main primary drug groups and other variables.

4.9.2 Phase 2: Data collection (qualitative component)

Focus group discussions using a semi-structured interview guide (Appendix 9) with facilitators/managers of substance use treatment centres were conducted to ascertain what the oral health needs of patients were when they enrolled for SUD treatment, but more importantly to determine the extent to which oral health interventions (oral health education, promotion and treatment) were offered as an adjunct to existing treatment programmes. The following themes were covered in the focus group discussions:

- The importance of oral health and dental hygiene habits for general health and life
- Appropriate diet to promote oral health and prevent tooth decay and gum disease
- The effects of substance use on oral health
- Oral health behaviours (tooth brushing, dental visits, rinsing, diet)

As suggested by Creswell (2013) attentive listening and interview skills during the focus group discussion were applied. Further clarification and summary were applied to ensure that researcher was clear about the responses of the participants.

4.10 Data capturing

A data capture form was compiled on a password-protected on the RedCap platform that was managed by the registered institution and safeguarded by the required licencing. From the RedCap platform, the data file was exported to Microsoft Office Excel 2020, and then imported to the statistical package for data analysis.

4.11 Data analysis

4.11.1 Phase 1: Data analysis

Data from the Microsoft Excel version 2020 was exported to Epi Info V7 and Stata, which was used to perform statistical analysis. The analysis was conducted using Stata version 17 by an independent bio-statistician. Basic statistics were used to describe the demographics, dental history, DMFT (Decayed, Missing, and Filled Teeth) total, OHIP-14 overall score, and primary and secondary drug use.

Statistics including frequencies, means and standard deviation were used. Statistical significance tests were performed with chi-square test of significance for categorical variables and correlation coefficients. The relationship between participants' response on risk factors for dental fluorosis, reported fluoride level of sampled water and the severity of dental fluorosis were investigated using analysis of variance (ANOVA), and independent sample t-test

Student's t-test and Chi square analysis will used to investigate differences between group means and proportions respectively and Spearman's rank correlation for associations between variables. Test of association will be done using Chi Square (χ^2) and Fisher's exact test (FET) when assumptions for Chi Squire Test are not met. P-value for statistical significance will be set at 5%.

Mean DMFT total scores across different risk groups were compared using t-tests and one-way ANOVA. Post hoc analyses, including Bonferroni, Sidak, and Scheffé tests, were performed to identify differences between groups after a significant ANOVA result.

Cronbach's alpha coefficient was calculated to assess the internal consistency of the OHQOL (Oral Health-Related Quality of Life) survey. Both univariate and multivariate Poisson regression analyses were conducted to examine the relationship between various variables and the OHIP-14 overall score. Logistic regression was utilized to evaluate the severity of OHQOL, with odds ratios and their 95% confidence intervals reported.

All risk factors that were significantly associated with the OHQOL overall score and severity of OHQOL in the univariate analysis were included in the multivariate analysis. A *p-value* of <0.05 was considered statistically significant.

4.11.2 Phase 2: Data analysis

Audio recordings were transcribed verbatim and codes were assigned to each of the participants using the focus group number and an individual number. An inductive data analysis to ensure experiences of participants were properly recorded and described using themes, sub-themes and categories. An independent coder was used for the data analysis.

Thematic analysis was done as described by Braun and Clarke's six-step approach of reflexive analysis (Braun & Clarke, 2019). The steps that were followed in the thematic analysis included (1) reading and familiarisation with the transcribed data; (2) coding; (3) searching for themes; (4) reviewing themes; (5) defining and naming themes and (6) writing up the report.

4.12 Validity

Potential confounding variables such as age, gender, poly-drug use, cigarette smoking and diet preferences of participants were controlled in the multivariate regression analysis models. The lead investigator performed all oral examinations and questionnaires as well as lead the focus group discussion staff at treatment centres. The lead investigator and an independent external statistician interpreted data and statistical analysis, and conducting the thematic analysis for the qualitative data that was collected during focus group discussion. Questions the on demographic profile and history of drug use were similar to the SACENDU enrolment questionnaires that are used by the majority of treatment centres over the past 20 years. Questions that focused on oral health behaviour were adopted from a questionnaire used for Master's thesis with 308 methamphetamine users (Smit, 2014).

A validated questionnaire (Oral Health Impact Profile-14) developed by Slade and Spencer was used to investigate Oral Health Related Quality of Life (OHRQoL).

The clinical oral examination, using WHO guidelines, was done by the calibrated principal investigator (WHO, 2013).

4.13 Reliability

Prior to measurement, the lead investigator was calibrated by two independent researchers to ensure uniformity of the oral examination and interview procedure. A kappa statistic of 0.87 was obtained prior to commencement of the study to ensure intra- and inter-researcher reliability.

4.14 Ethical considerations

4.14.1 Obtaining research ethics approval from relevant committees

Ethical approval to conduct the study was obtained from the University of the Western Cape (UWC) Bio-Medical Research Ethics Committee (BMREC) (Reference no: BM19/8/4) (Appendix 10). Further research ethical clearance was obtained from the City of Cape Town (Reference no: 24714) (Appendix 11), Provincial Government of the Western Cape, Department of Health (Reference no: WC_201910_035) (Appendix 12) as well as from the Department of Social Development (Reference no: 12/1/2/4) (Appendix 13). The proposal was also registered on the National Health Research Database (NHRD).

4.14.2 Establishing contact

Access to the participants of the study was made initially by a letter to each treatment facility manager (Appendix 1). An introduction of the researcher, the basic aims and objectives of the study, what participating in the study would involve and how long the long the examination and questionnaire would take were explained. This process was also followed for staff members who participated in the focus group discussions. It was emphasized that that strict confidentiality would be maintained at all times and that the results of the study would be presented in a manner that ensured anonymity. Once signed informed consent (Appendix 3a and 3b) was received from each participant, appointments were made and the patients interviewed and examined.

4.14.3 Collaborative partnerships

In order to obtain access to selected participants, a good relationship was established between the lead investigator and the managers of various treatment centres. Meetings with the manager of each treatment centre prior to the study was arranged to ensure a level of trust and consideration. During the meetings, the study was explained in detail regarding the objectives, aim and other methods. Further clarification was provided in terms of what participating in the study would involve and how long the examination and questionnaire would take. Particular emphasis was placed on ensuring that participation will be strictly confidential and that the results of the study will be presented in a manner that ensured anonymity.

4.14.4 Informed consent, confidentiality, voluntary participation or withdrawal

Participation in the study was voluntary and participants were not disadvantaged or penalised in any was if they decided not to participate or withdraw from the study at any time. Informed consent from all participants was obtained before data collection. A separate consent form was signed if clinical photographs were to be taken. Interviews, oral examinations and focus group discussions took place in a private room at the treatment centre. Participants were informed of the purpose of the study both verbally and in writing through the study information sheet (Appendix 2a and 2b). No participant names were captured on the data collections forms to maintain anonymity. All information collected was handled confidentially, secured in a locked office and password protected computer. Anonymity was further secured by using only a reference code on all data collection forms. Completed questionnaires and all notes taken during data collection was stored in a secure, locked office.

4.14.5 Social value

A benefit for the patient participants of the study was firstly to receive free dental consultation by a qualified dentist which included essential oral health- education and instructions; and secondly, any participant that required further dental treatment was provided with a referral letter or with information on the closest clinic or private dental practice. Staff members at the treatment centres received an oral health education presented by the researcher scheduled at date after the focus group discussions. During these sessions a brief overview was also given to potential dental referral pathways and suspected oral health impact of SUD.

CHAPTER 5: RESULTS

5.1 INTRODUCTION OF THE RESULTS

The main theme of the present study was to investigate the oral health impact of SUD with a specific focus oral health related quality of life (OHRQoL). This chapter presents the results in a systematic manner following the objectives of the present study. Special emphasis was placed on the following themes: socio-demographic profile, history of substance use, oral health behaviour, oral health status, dental treatment needs, oral health intervention during SUD programmes and oral health related quality of life.

5.2 DESCRIPTION OF THE SAMPLE

5.2.1 Demographic information

A total of 504 persons who were enrolled in a treatment programme for substance use disorder (SUD), participated in the study (n = 504). The majority (76%) was 39 years and younger, while only 7.7% was 50 year and older. Almost three quarters 72%) were males, 15% of participants were married and 10% living as married. Just over half were living in a rural (53%) district and 47% in a metro district (Table 2).

Variable		**n**	**%**
Age	18 – 29	181	35.91
	30 – 39	198	39.29
	40 – 49	86	17.06
	50 and older	39	7.74
Gender	Males	365	72.42
	Females	139	27.58
Marital status	Single	344	68.25
	Married	74	14.68
	Living as married	48	9.52
	Separated	13	2.58
	Divorced	21	4.17
	Widowed	4	0.79
Total		**504**	**100.00**

Table 2: Demographic information (gender, marital status and residence)

About 42% reported being employed, either on a full-time or part-time basis (Table 3) while more than half said that they are unemployed (55%)

Variable		n	%
Employment status			
	Employed (full-time/self-employed)	163	32.34
	Employed (part-time/contract/temp/casual	49	9.72
	Unemployed	278	55.16
	Student with job/apprentice/intern	7	1.39
	Pensioner/retired	3	0.6
	Medically unfit/disable	2	0.4
	Did not answer	2	0.4
Residence (Metro vs rural)			
	Metro (within City of Cape Town)	237	47.02
	Rural (rural districts of the Western Cape)	267	52.98
Total		**504**	**100.00**

Table 3: Employment status of sample (n = 504)

Almost three quarters of the sample reached high school but only about half of the sample (47%) completing grade 12. Only 18% reached tertiary education (Table 4).

Variable		n	%
Highest level of education			
	No school	2	0.4
	Primary school	41	8.13
	Secondary	364	72.22
	Tertiary	94	18.65
	Postgraduate	3	0.6
Highest school graded completed			
	Grade 0 – 7	40	7.94
	Grade 9 – 11	227	45.04
	Grade 12	237	47.02
Total		**504**	**100.00**

Table 4: Level of education (n = 504)

The mean age of the sample was 33.87 years (median = 32, SD = 9.4; IQR: 27 – 39). There was no significant difference in the mean age between males and females. However, a significant difference in age was found for different categories of employment and level of education. Those who indicated that they were employed (mean age of 35) were slightly older than those who said that they are unemployed (mean = 33) ($p < 0.05$). There was also a significant difference in the mean age between those who were married vs being single as well as between the different categories for highest level of education that was reached ($p < 0.05$) (Table 5).

		Age							
Variables		**n**	**%**	**mean**	**median**	**range**	**SD**	**IQR**	***p-value***
Gender	Males	365	72.42	34.02	33	18 – 70	9.49	27 – 39	*> 0.05*
	Females	139	27.58	33.46	32	18 – 65	9.33	27 – 39	
Marital status	Single	382	75.79	32.75	31	18 – 70	9.35	26 – 37	*< 0.05*
	Married	122	24.20	37.37	36	21 – 60	8.88	30 – 44	
Employment status	Employed	219	43.45	35.1	34	19 – 65	9.43	28 – 41	*< 0.05*
	Unemployed	285	56.55	32.92	31	18 – 70	9.43	26 – 37	
Level of Education	No school and primary	43	8.53	32.35	30	18 – 57	10.77	24 – 39	*< 0.05*
	Secondary	364	72.22	33.48	32	18 – 70	9.30	27 – 38	
	Tertiary and Postgrad	97	19.25	36	35	20 – 65	8.90	30 – 41	
Total		**504**	**100**	**33.87**	**32**	**18 – 70**	**9.44**	**27 – 39**	

Table 5: Age according to different demographic characteristics

Those who used alcohol as a primary drug, were the oldest among all participants and had a mean age of 40 years (median = 40; SD = 10.5; IQR = 33 – 49). The mean age of those who used alcohol was significant higher compared to the rest of the sample ($p < 0.005$) (Table 6). Those who were using cannabis, were the youngest among all participants and had a mean age of 30 years (median = 28; SD = 8.7; IQR = 23 – 35). This was significantly different from the rest of the sample ($p < 0.005$). The mean age of those who used methamphetamine of 31 was also found to be significantly different to the rest of the sample ($p < 0.05$) (Table 6).

Primary drugs	Age							
	n	%	mean	median	range	SD	IQR	*p-value*
Alcohol	103	20.43	40.17	40	20 – 65	10.5	33 – 49	*< 0.005*
Cannabis	45	8.93	30.04	28	19 – 50	8.7	23 – 35	*< 0.005*
Mandrax	52	10.32	35	32.5	18 – 70	11.02	27.5 – 40.5	*> 0.05*
Crack Cocaine[#]	10	1.98	35.4	33.5	23 – 48	8.49	30 – 44	*> 0.05*
Heroin and Opiates	25	4.96	35.32	34	23 – 56	7.5	30 – 40	*> 0.05*
Methamphetamine	259	51.39	31.45	31	18 – 55	7.54	26 – 36	*< 0.005*
OTC and Prescriptions[#]	9	1.79	38.33	38	20 – 51	9.8	32 – 45	*> 0.05*
Total sample	**504**	**100.00**	**33.87**					

Table 6: Age according the primary drug use

[#] Small number of participants in this group

**** All individual drugs were compared against all other drugs combined**

Demographic variables were analysed according to the main primary drug groups namely, alcohol, cannabis, mandrax, opiates and methamphetamine and categories for different drugs are shown in Table 7.

An association was found between age and methamphetamine use ($p < 0.005$) with the odds of using methamphetamine 2.6 times more among younger participants (18 – 35 years) compared to older participants (OR = 2.6; 95%CI: 1.8 – 3.7). Those who were 18 – 35 were 1.6 times more likely to be using alcohol as a primary drug than those who were 36 and older (RR = 1.6; 95%CI: 1.3 – 1.99) (Table 7).

An association was found between gender and cannabis use ($p < 0.005$) with the odds of using cannabis among males being 3.3 times more compared to females (OR = 3.3; 95%CI: 1.3 – 8.5). Males were 3 times more likely to be using cannabis as a primary drug compared to females (RR = 3.0; 95%CI: 1.23 – 7.6) (Table 7). An association was found between gender and methamphetamine use ($p < 0.05$) with the odds of those who used methamphetamine being 1.7 times more among females compared to the odds of being meth users among males (OR = 1.65; 95%CI: 1.11 – 2.47). Females were 1.2 times more likely to be using methamphetamine as a primary drug compared to males (RR = 1.2; 95%CI: 1.1 – 1.5) (Table 7).

An association was found between age and alcohol use (OR = 3.1; 95%CI: 2.6 – 6.5) p <0.005) with the odds of alcohol use to be 3 times more among older participants (36 and older) compared to younger participants (18 – 35). Those who were 35 and older were 4.1 times more likely to be using alcohol as a primary drug than the rest of the sample (RR = 4.1; 95%CI: 2.1 – 4.4) (Table 7).

	Alcohol		Cannabis		Mandrax		Opiates		Meth.	
Age	n (%)	*p*	n (%)	*p*	n (%)	*p*	n (%)	*p*	n (%)	*p*
18 – 35	36 (35)	***	34 (76)		32 (62)		13 (52)		187 (72)	***
36 and older	67 (65)		11 (24)		20 (38)		12 (48)		72 (28)	
Gender										
Males	72 (70)		40 (89)	*	40 (77)		22 (88)		175 (68)	*
Females	31 (30)		5 (11)		12 (23)		3 (12)		84 (32)	
Employment										
Employed	72 (70)	***	22 (49)		24 (46)		12 (48)		73 (28)	***
Unemployed	31 (30)		23 (51)		28 (54)		13 (52)		186 (72)	
Marital status										
Single	74 (72)		34 (76)		41 (79)		19 (76)		199 (76)	
Married	29 (28)		11 (24)		11 (21)		6 (24)		60 (23)	
Education										
No school and primary	8 (8)		3 (7)		9 (17)		1 (4)		22 (8)	
Secondary	67 (65)		30 (67)		39 (75)		16 (64)		202 (78)	
Tertiary and PG	28 (27)		12 (27)		4 (8)		8 (32)		35 (14)	
Total	**103 (100)**		**45 (100)**		**52 (100)**		**25 (100)**		**259 (100)**	

Table 7: Demographical profile according to the main primary drug groups

*** p < 0.05**
**** p < 0.005**
***** p < 0.0005**

5.3 MEDICAL HISTORY

Only 27 (5%) disclosed that they were HIV positive (Table 8), while almost a third (32.5%) declined to answer. Two thirds of the sample indicated that they were tested for HIV in the past 12 months while 10.9% were not tested and 12% declined to answer. Ten per cent said that they were tested for HIV previously, but not in the past 12 months.

Almost a third (166/504 = 32.94%) reported suffering from some kind of medical condition and a quarter (25.6%) reported that they were on chronic medication. Many participants reported that they have not taken chronic medication during drug use, and being diagnosed with a chronic condition for the first time during their enrolment into the SUD programme.

Most (12%) reported suffering from a mental disorder and that they struggled with depression and anxiety (Table 8). The second most common (8%) medical condition was hypertension followed by HIV (5%), respiratory conditions (4%) and diabetes (2%) (Table 8).

COMMON MEDICAL CONDITION	N	%
Mental conditions	62	12%
Hypertension	40	8%
Respiratory	22	4%
HIV positive	27	5%
Diabetes	10	2%

Table 8: Common medical conditions

There was an association between age and diabetes among participants with those who were 36 years and older being 16 times more likely to have diabetes compared to those who were in the 18 – 35-year age group (RR = 16; $p < 0.0005$).

A higher proportion of females (16.5%) suffered from mental disorder compared to males (10.68%), however there was no association found between gender and mental disorder ($p > 0.05$).

An association was found between age groups and mental disorders with those who were 36 and older being 1.8 times more likely to be suffering from a mental condition compared to those who were 35 and younger (RR = 1.8; 95%CI: 1.1 – 2.9; $p < 0.05$). The odds of having a mental disorder were 2 time greater among patients who were 36 and older compared to patients who were 35 and younger (OR = 2; 95%CI: 1.2 – 4).

5.4 HISTORY OF SUBSTANCE USE

5.4.1 Type of primary drug of choice

All participants were allocated to the following drug categories according to primary drug of choice:

- Alcohol
- Cannabis (exclusive cannabis use)
- Mandrax (Methquinolone mixed with either cannabis or tobacco)
- CAT (Methcathinone)
- Crack Cocaine
- Heroin or other Opiates
- Methamphetamine
- Over the Counter (OTC) or Prescription drugs (PRE)

The majority of participants used methamphetamine (51.39%) as the primary drug of choice with a fifth (20.44%) those using alcohol (20.44%). Those using cannabis and cannabis combined with mandrax, as a primary drug, contributed 8.93% and 10.32% of the sample respectively. Only about 5% used heroin opiates, about 2% used crack cocaine and about 2% used OTC drugs as their primary choice (Table 9).

Primary drug of choice	**n**	**%**
Alcohol	103	20.44
Cannabis	45	8.93
Mandrax	52	10.32
CAT **	1	0.20
Crack Cocaine	10	1.98
Opiates including heroine	25	4.96
Methamphetamine	259	51.39
OTC and PRE *	9	1.79
Total	**504**	**100.00**

Table 9: Sample distribution according to primary drug use

*** OTC (Over-the-counter) and PRE (Prescription) drugs**

**** CAT (Methcathinone)**

Mandrax was used either in combination with tobacco or with cannabis. Those who used cannabis exclusively were grouped and labelled, "Cannabis", while those who used mandrax with either tobacco or with cannabis were labelled, "Mandrax". About 10% (n=51) used mandrax as a primary drug with an even split between those who used it with tobacco vs those who used it with cannabis (Table 10).

Mandrax used as a primary drug		**n**	**%**	**Proportion of sample**
	Mandrax used with cannabis	23	45.10	4.56
	Mandrax used with tobacco	28	54.90	5.56
Total		51	100.00	10.12

Table 10: Use of mandrax mixed with cannabis vs tobacco

5.4.2 Age at initial use

The mean age of initial use the primary drug was 19.37 years (6.8: 16 – 21 years). Earliest use of 15 years old was reported among participants who used cannabis alone as a primary drug. The mean age for initial alcohol use was 18 years with those who used other drugs. Those who used "Over the Counter (OTC)" drugs were older at an age of 27 years at initial use. An association was found between the age of initial drug use and primary cannabis use ($p < 0.005$). Those who were using cannabis as a primary drug had a mean age of initial drug use of 15 compared to 20 for the rest of the sample. This age difference was significant (Table 11).

Primary drugs	**Age (years) at first use of primary drug**							
	n	**%**	**mean**	**median**	**range**	**SD**	**IQR**	***p-value***
Alcohol	103	20.43	18.83	17	10 – 54	6.91	16 – 20	*> 0.05*
Cannabis	45	8.93	15.37	15	10 – 24	3.05	13 – 17	*< 0.005*
Mandrax	52	10.32	19.23	18	11 – 50	7.20	15 – 21	*> 0.05*
Crack Cocaine[#]	10	1.98	20.30	19	12 – 34	7.11	14 – 25	*n/a*
Heroin and Opiates	25	4.96	19.96	20	14 – 29	4.29	17 – 23	*> 0.05*
Methamphetamine	259	51.39	19.83	17	11 – 54	6.75	16 – 23	*> 0.05*
OTC and Prescriptions[#]	9	1.79	27.66	28	13 – 43	9.06	25 – 33	*n/a*
Total sample	**504**	**100.0**						

Table 11: Age at first use of primary drug
[#] **very small sample numbers to determine association**

5.4.3 Duration of last primary drug use

The mean duration (days) since last use of the primary drug was 38.26 days (63.61: 14 – 30). This was similar across the different drug categories (Table 12) Participants were either seen at week two, three, four, five or six of their respective programmes.

	Duration since last use of primary drug			
Primary drug category	**n**	**mean (days)**	**SD**	**IOR**
Alcohol	103	36,62	76,67	14 – 28
Cannabis	45	29,55	19,57	17 – 35
Cannabis/Mandrax	52	46,71	80,78	13 – 32
Crack Cocaine	10	36,30	47,07	20 – 25
Heroin/Opiates	25	41,12	78,30	16 – 35
Methamphetamine	259	38,84	59,21	14 – 31
OTC (PRE)	9	30,44	34,31	14 – 30

Table 12: Duration since last of primary drug

5.4.4 Duration of drug addiction

The mean duration (years) of primary drug use among all participants was 13.58 years (8.55: 7 – 18) (Figure 2).

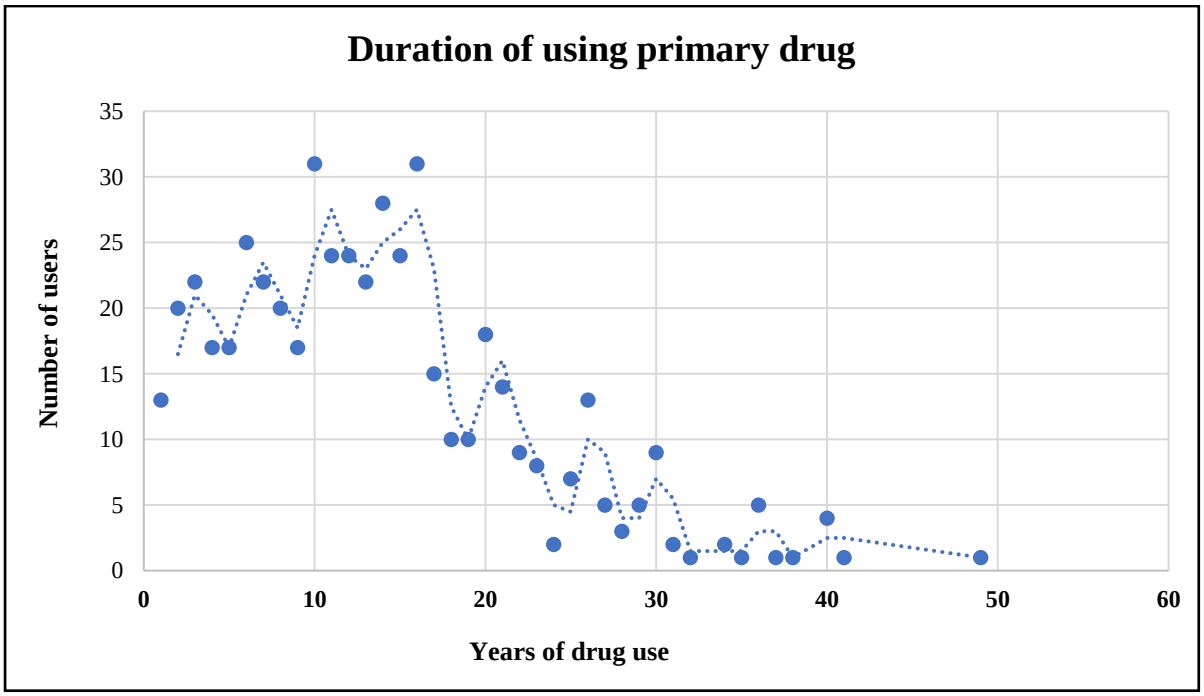

Figure 2: Scatter plot to present the frequencies of mean duration of drug use

People who use alcohol reported a longer duration of use compared to the other primary drugs. The mean duration of use was 19.25 years (11.03: 14 – 28), while those who used methamphetamine as a primary drug were using it for 11.26 years (5.77: 14 – 31). Those who used either cannabis or mandrax, were using it for 14 years. Those who used either crack cocaine or heroin were using it for a similar duration of use of about 13 years (Table 13).

There were significant differences in duration of addiction between the sample mean (13.58 years) and primary alcohol- and methamphetamine use. Those who were using alcohol as a primary drug were using it for 19 years which was significantly higher than the sample mean ($p < 0.0005$). Those who were using methamphetamine were using it for 11 years which was significantly lower than the sample mean ($p < 0.0005$) (Table 13).

Primary drugs	**Duration of primary drug use**							
	n	**%**	**mean**	**median**	**range**	**SD**	**IQR**	***p-value***
Alcohol	103	20.43	19.25	19	1 – 49	11.03	14 – 28	*< 0.0005*
Cannabis	45	8.93	14.44	13	1 – 36	9.19	17 – 35	*> 0.05*
Mandrax	52	10.32	14.19	12.5	2 – 40	9.51	13 – 32	*> 0.05*
Crack Cocaine[#]	10	1.98	13.1	13	2 – 30	9.53	20 – 25	*> 0.05*
Heroin and Opiates	25	4.96	13.2	15	1 – 23	6.55	16 – 35	*> 0.05*
Methamphetamine	259	51.39	11.26	11	1 – 29	5.77	14 – 31	*< 0.0005*
OTC and Prescriptions[#]	9	1.79	10.33	7	1 – 20	8.25	14 – 30	[#]
Total sample	**504**	**100.00**	**13.58**	**12.5**	**1 – 49**	**8.55**	**7 – 18**	

Table 13: Duration of primary drug use
[#] very small sample numbers to determine association

When the duration of addition was grouped into categories it was clear that half of the sample were using their primary drug of choice for more than 12 years 9 (Table 14) with higher proportions of alcohol (71%) users and opiate (68%) users using for more than 12 years (Table 15).

Duration or primary drug use	**n**	**%**
1 - 4 years	70	13.89
5 - 8 years	83	16.47
9 - 12 years	97	19.25
>12 years	254	50.40
Total	504	100.00

Table 14: Categorical distribution of primary drug duration of use

	Duration or primary drug use				
Primary drug groups	**1 - 4 years n (%)**	**5 - 8 years n (%)**	**9 - 12 years n (%)**	**>12 years n (%)**	**Total**
Alcohol	12 (12)	6 (6)	12 (12)	73 (71)	103 (100)
Cannabis	4 (9)	10 (22)	7 (16)	24 (53)	45 (100)
Mandrax	6 (12)	13 (25)	7 (13)	26 (50)	52 (100)
Crack Cocaine	3 (30)	1 (10)	1 (10)	5 (50)	10 (100)
Heroin/Opiates	5 (20)	1 (4)	2 (8)	17 (68)	25 (100)
Methamphetamine	36 (14)	50 (19)	68 (27)	105 (41)	259 (100)
OTC/PRE	3 (33)	2 (22)	0 (0)	4 (44)	9 (100)

Table 15: Primary drug duration of use

5.4.5 Frequency of primary drug use

Almost two thirds (62.9%) of the sample used their primary drug of addiction everyday while just more than a quarter used it two to six days per week. A minority used it less frequently once a week (6.94%), once or twice a month (2.38%) or less frequently (0.99%) (Table 16).

Drug use frequency	**n**	**%**
1_Daily	317	62.90
2_Two to six days per week	135	26.79
3_Once a week	35	6.94
4_Once or twice a month	12	2.38.
5_Less frequently	5	0.99
Total	504	100.00

Table 16: Primary drug use for entire sample

Frequency of primary drug use was cross-tabulated with the different drug categories. The most participants used their primary drug of choice on a daily basis except for people who use alcohol who reported similar frequencies for either using it daily (40.78%) vs two to six days per week (46.6%). Almost all (96%) heroin users used it daily with the other groups except for alcohol, who used it daily (60 – 70%) and two to six days per week (20 – 25%) (Table 17).

	Frequency of use					
Primary drug	**Daily**	**2 – 6 days/week**	**Once per week**	**Once/twice per month**	**Less frequently**	**Total**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Alcohol	42 (41)	48 (47)	10 (10)	2 (2)	1 (1)	103 (100)
Cannabis	30 (67)	5 (11)	6 (13)	2 (4)	2 (4)	45 (100)
Mandrax	37 (71)	13 (25)	1 (1)	1 (2)	0 (0)	52 (100)
Crack Cocaine	6 (60)	2 (20)	1 (10)	1 (10)	0 (0)	10 (100)
Heroin/Opiates	24 (96)	1 (4)	0 (0)	0 (0)	0 (0)	25 (100)
Methamphetamine	172 (66)	64 (25)	15 (6)	6 (2)	2 (1)	259 (100)
OTC/PRE	5 (56)	2 (22)	2 (22)	0 (0)	0 (0)	9 (100)
TOTAL	**317**	**135**	**35**	**12**	**5**	**504**

Table 17: Primary drug frequency of use according to drug types

There was an association found between frequency of substance use and using alcohol or opiate as a primary substance. Those who used alcohol as a primary substance were less likely using it daily than those who used other substances (Table 18).

		Frequency of use					
Main primary drug		**Daily**	**Weekly and less frequent**	**Total**	**OR**	**RR**	***p-value***
		n (%)	**n (%)**	**n (%)**			
Alcohol	Yes	42 (41)	61 (59)	103 (100)	0.32	0.59	*< 0.0005*
	No	275 (69)	126 (31)	401 (100)			
Cannabis	Yes	30 (67)	15 (33)	45 (100)	1.20	1.07	*> 0.05*
	No	287 (63)	172 (37)	459 (100)			
Mandrax	Yes	37 (71)	15 (29)	52 (100)	1.51	1.15	*> 0.05*
	No	280 (62)	172 (38)	452 (100)			
Heroin/Opiates	Yes	24 (96)	1 (4)	25 (100)	15.2	1.57	*< 0.0005*
	No	293 (61)	186 (39)	479 (100)			
Methamphetamine	Yes	172 (66)	87 (34)	259 (100)	1.36	1.12	*> 0.05*
	No	145 (59)	100 (41)	245 (100)			

Table 18: Main primary drug groups and combined frequency of use

5.4.6 Method of using primary drug

The majority (70.44%) of participants were exclusively *smoking* their primary drug of choice while 22.42% were exclusively *swallowing* it. A few were exclusively using injections (2.78%) or snorting (1.98%) the drug. However, there were a few participants who indicated multiple methods of use (Table 19). When considering of the main method being used, 72% smoked, 2.38% snorted, 22.42% swallowed and 2.98% injected.

	Method of use		Most preferred method of use	
Primary drug method of use	**n**	**%**	**n**	**%**
Injecting	14	2.78	15	2.98
Injecting and Snorting	1	0.20		
Injecting and Snorting and Swallow and Smoke	1	0.20		
Injecting and Snorting and Smoke	3	0.60		
Injecting and Smoke	1	0.20		
Snorting	10	1.98	12	2.38
Snorting and Swallow and Smoke	1	0.20		
Snorting and Smoke	4	0.79		
Swallow	113	22.42	113	22.42
Swallow and Smoke	1	0.20		
Smoke	355	70.44	364	72.22
Total	**504**	**100.00**	**504**	**100.00**

Table 19: Primary drug method of use

The majority (70%) of crack/cocaine users were snorting it with only 30% smoking it. The majority (94.2%) of methamphetamine users were smoking it, while about 3% injected it, 2% snorted it and 1% who were drinking it. The majority (88.9%) of OTC users were drinking it while 11.11% injected it (Table 20) (Figure 3).

All participants who were using alcohol as a primary substance were swallowing (drinking) it while all cannabis users except for one person, were smoking it. Those who were using cannabis and mandrax together as a primary drug were also smoking it except for one person who preferred snorting it (Table 19).

	Method of use				
	Injecting n (%)	**Snorting n (%)**	**Swallow n (%)**	**Smoke n (%)**	**Total n (%)**
Alcohol			103 (100)		103 (100)
Cannabis			1 (2)	44 (98)	45 (100)
Mandrax		1 (2)		51 (98)	52 (100)
Crack Cocaine		7 (70)		3 (30)	10 (100)
Heroin/Opiates	9 (36)	1 (4)	1 (4)	14 (56)	25 (100)
Methamphetamine	7 (3)	5 (2)	3 (1)	244 (94)	259 (100)
OTC/PRE	1 (11)			8 (89)	9 (100)

Table 20: Most preferred method of use for main drug categories

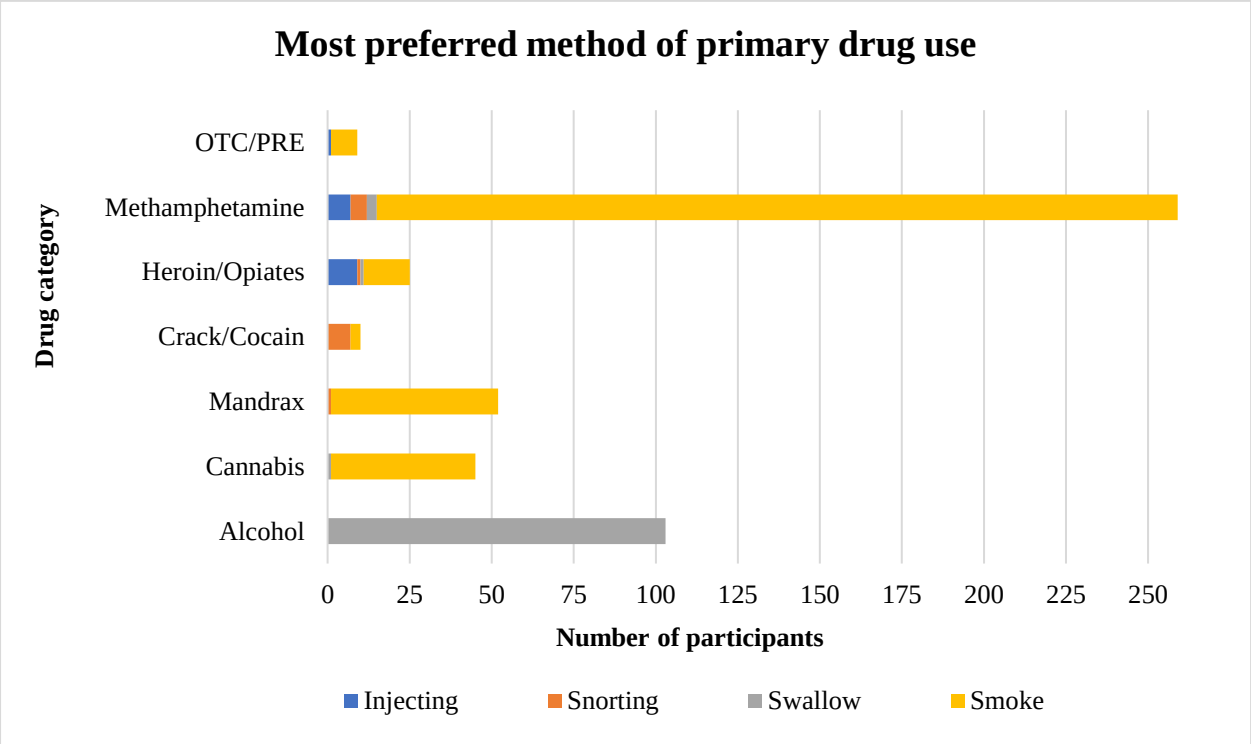

Figure 3: Primary drug most preferred method of use

5.4.7 Daily cost spent on the primary drug

The response rate of the question that dealt with self-reported daily cost that was spent on the primary drug was 87% (436/504). The mean expenditure (ZAR) on the primary drug per day was R 188.69 (299: 50 – 200). This response was cross-tabulated for the different drug categories.

Those who used crack/cocaine as primary drug spent the most per day (R 1 119.89) while those who used exclusively cannabis as primary drug, spent the least per day (R 96.43). Total daily expenditure on primary drug was also calculated by multiplying the mean daily cost with the number of participants in that specific drug category cohort. Given that the most participants were using methamphetamine or alcohol or cannabis or cannabis with mandrax, they spent the most.

Those who used methamphetamine as a primary drug, collectively spent about R40 000 per day, while those who used alcohol, spent about R 14 000. The cannabis and mandrax primary users, spent about R 11 000 collectively per day. When assuming that the majority of the sample used their primary drug on a daily basis, further cost estimates were done to determine total cost spent on primary drugs per day, per week, per month and per year respectively. Total expenditure per day was estimated at around R 80 000, while the weekly total cost was estimated at almost R 600 000. The monthly cost spent on the primary drug was estimated at R 2.4 million and annual cost at around R 30 million (Table 21).

Primary drug groups	**n**	**Total (ZAR)**	**Mean (ZAR)**	**Std Dev**	**IQR**
Alcohol	77	R 14 086.00	R 182.93	184.65	70 – 200
Cannabis	42	R 4 050.00	R 96.43	122.73	20 – 150
Mandrax	48	R 6 950.00	R 144.79	189.55	40 – 160
Crack Cocaine	9	R 10 070.00	R 1 118.89	1 325.50	100 – 1000
Heroin/Opiates	23	R 4 560.00	R 198.26	220.93	35 – 200
Methamphetamine	230	R 40 303.00	R 175.23	208.18	50 – 200
OTC/PRE	6	R 1 250.00	R 208.33	177.24	100 – 350
Total cost per day		R 81 269.00			
Total cost per week		R 568 883.00			
Total cost per month		R 2 438 070.00			
Total cost per year		**R 29 663 185.00**			

Table 21: Expenditure on primary drug use

5.4.8 Amount (weight in grams) of primary drug used on a typical day

The self-perceived amount of primary drug for a day's usage was recorded for all participants except those who were using alcohol as a primary drug. Among this group (n = 401), 380 participants provided an estimated amount (grams) of primary drug that was used on a typical day. Almost half of the sample (45%) used less than 1g per day of their primary drug, while 27% used more than 1g but less than 2g. Those who used cannabis or cannabis combined with mandrax as a primary drug, used less than 2g per day. Those who used crack/cocaine as a primary drug, used between 4 and 5g per day. More than half of all the primary methamphetamine users, used less than a gram per day (Table 22).

	Amount (g) of primary drug used per day						
	< 1g	**1 > 2g**	**2 > 3g**	**3 > 4g**	**4 > 5g**	**> 5g**	**Tot**
Primary drug groups	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Cannabis	15 (36)	11 (26)	5 (12)	1 (2)	3 (7)	7 (17)	42 (100)
Mandrax	17 (35)	18 (37)	5 (10)	3 (6)	1 (2)	5 (10)	49 (100)
Crack Cocaine	2 (20)	1 (10)	1 (10)	1 (10)	3 (30)	2 (20)	10 (100)
Heroin/Opiates	4 (19)	9 (43)	3 (14)	2 (10)	1 (5)	2 (10)	21 (100)
Methamphetamine	130 (52)	65 (26)	21 (8)	8 (3)	7 (3)	17 (7)	248 (100)
OTC/PRE	3 (33)	0 (0)	0 (0)	2 (22)	1 (1)	3 (33)	9 (100)

Table 22: Amount (g) of primary drug used per day

5.4.9 Did you use the above-mentioned amount all by yourself?

Almost half (47.42%) were using their primary drug alone while 52.58% were sharing with others. Cross-tabulation with the different drug categories, showed that among those who used alcohol as primary drug, it was distributed evenly by themselves (53%) compared to those we were drinking with others (47%). A similar finding was observed among those who used cannabis exclusively as a primary drug 51.11% vs 48.89% respectively. However, among those who used cannabis in combination with mandrax, almost two thirds (65%) indicated that they are using with others. The majority of those who used crack/cocaine, heroin/opiates and OTC drug, reported that they were using it alone. The majority (59%) of those who used methamphetamine as a primary drug, used it with other people (Table 23).

	Using the primary drug by oneself (not sharing)		
Primary drug groups	**Yes**	**No**	**Total**
	n (%)	**n (%)**	**n (%)**
Alcohol	55 (53)	48 (47)	103 (100)
Cannabis	23 (51)	22 (49)	45 (100)
Mandrax	18 (35)	34 (65)	52 (100)
Crack Cocaine	7 (70)	3 (30)	10 (100)
Heroin/Opiates	22 (88)	3 (12)	25 (100)
Methamphetamine	105 (41)	154 (59)	259 (100)
OTC/PRE	9 (100)	0 (0)	9 (100)

Table 23: Using the primary drug by oneself

When those who preferred using the primary drug together with others, the majority (74%) reported sharing their primary drug of choice with 2 – 5 persons. Only 17% preferred using with only one other person and about 9% preferred using with larger groups of more than 5 persons.

5.4.10 Number of days since the last drug usage

Participants were asked when they had last used drugs. Most in-patient programmes lasted for about six weeks and during this period patients had to stay at the treatment centre and were tested for drug use regularly. Those who were following an out-patient programme, visited the treatment centre once or twice a week and also had regular tests for drug use. The mean number of days since last drug use, as reported by participants, was 38.17 days (63.5: 14 – 30). When this was cross-tabulated for the different drug categories, no significant difference was found ($p>0.5$). Those who used mandrax reported 46.71 (80: 13.5 – 32.5) days since last drug use compared to 30 days among those who used cannabis alone as a primary drug. Those who used methamphetamine, alcohol and crack cocaine had similar mean days since last drug use (36 to 38 days). Those who used heroin opiates reported 41 days vs 30 days for OTC drug users. There was no significant difference in the mean number of days since last use when all drug groups were compared ($p > 0.05$) (Table 24).

Primary drug groups	n	mean	SD	IQR	*p-value*
Alcohol	103	36.24	75.97	14 – 28	
Cannabis	45	29.56	19.58	17 – 35	
Mandrax	52	46.71	80.78	13.5 – 32.5	
Crack cocaine	10	36.3	47.08	20 – 25	
Heroin/Opiates	25	41.12	78.31	16 – 35	
Methamphetamine	259	38.84	59.22	14 – 31	
OTC/PRE	9	30.44	34.31	14 – 30	*> 0.05*

Table 24: Number of days since last drug use

5.4.11 Secondary substance use history

There were 322 participants who used a secondary drug of choice, known as poly-drug users. They represented almost two thirds of the study sample (322/504 = 63.89%). The majority of those who used a secondary drug used mandrax combined with either tobacco or cannabis (46.58% of 322) with just less than a quarter (23.91%) using methamphetamine as secondary drug, 13.04% were using cannabis alone as secondary drug and8.39% of poly-drug users were using alcohol as a second drug of choice (Table 25).

Secondary drug groups	n	%
Alcohol	27	8.39
Cannabis	44	13.66
Mandrax	150	46.58
CAT	1	0.31
Crack Cocaine	14	4.35
Hallucinogens	2	0.62
Heroin/Opiates	3	0.93
Methamphetamine	77	23.91
OTC/PRE	4	1.24
Total	**322**	**100.00**

Table 25: Secondary drug use according to drug type

Mandrax was used either in combination with tobacco or with cannabis. Those who used cannabis exclusively were grouped and labelled, “Cannabis”, while those who used mandrax with either tobacco or with cannabis were labelled, “Mandrax”. About 30% (148 participants) of the sample, used mandrax as a secondary drug, with most people using it with tobacco (104/148 = 70.29%) vs those who used it with cannabis 44/148 = 29.73% (Table 26).

Mandrax used as a secondary drug	**Secondary mandrax users**	**% of secondary mandrax users**	**% of secondary drug users**	**% of entire sample**
Mandrax used with cannabis	44	29.73	13.67	8.73
Mandrax used with tobacco	104	70.27	32.03	20.63
Total	148	100.00	45.70	29.36

Table 26: Distribution of participants using mandrax as a secondary drug of choice

The total cost spent on primary drugs was added to the cost spent on secondary drug in order to calculate total cost spent on both primary and secondary drugs for the entire study sample. The cumulative expenditure for both primary and secondary drugs was about R120 000 per day, R850 000 per week, R3.5million per month and about R45million per year (Table 27).

Drug groups	**Primary drugs**	**Secondary drugs**	**Primary plus secondary drugs**
	daily cost	**daily cost**	**Tot daily cost**
Alcohol	R 14 086	R 4 520	R 18 606
Cannabis	R 4 050	R 3 610	R7 660
Mandrax	R 6 950	R 13 984	R 20 934
Crack Cocaine	R 10 070	R 7 973	R18 043
Hallucinogens		R 320	R 320
Heroin/Opiates	R 4 560	R 235	R 4 795
Methamphetamine	R 40 303	R 10 030	R 50 333
OTC/PRE	R 1 250	R 50	R 1 300
			R 121 991
Tot cost per day	R 81 269	R 40 722	**R 121 991**
Tot cost per week	R 568 883	R 285 054	**R 853 937**
Tot cost per month	R 2 438 070	R 1 221 660	**R 3 659 730**
Tot cost per year	R 29 663 185	R 14 863 530	**R 44 526 715**

Table 27: Expenditure on primary plus secondary drug use

5.4.12 Substance use treatment history

Participants were asked whether they had ever been to a drug treatment (rehabilitation) centre or treatment programme as in- or outpatient. Slightly more than a third (37.38%) reported previous treatment received for substance use while 62.62% indicated that this was their first time in a treatment programme. Among those who received substance use treatment before, most (42.55%) were only admitted once, with 27% twice before and 11% three times previously. Almost a fifth of the sample (19.15%) reported being admitted more than three times.

Previous substance use treatment history was cross-tabulated with being a polydrug users or not and an association was found ($p < 0.004$). Those who were polydrug users were 1.8 times more likely to be treated for substance use compared to those who were not polydrug users.

Previous history and frequency of treatment for substance use was also cross-tabulated with the main drug categories which represented 96% of the study sample. Almost three quarters (72%) of those who used alcohol or cannabis (73%) as their primary drug did not receive previous treatment for substance use disorder. The opposite was true for those who used heroin/opiates with almost three quarters (72%) who were admitted to a treatment centre in the past. The majority of those who used methamphetamine (62%) or mandrax (62%) as a primary drug, had not received substance use treatment before (Table 28).

	Previous treatment for substance use		
Primary drugs main groups	**Yes n (%)**	**No n (%)**	**Total n (%)**
Alcohol	29 (28)	73 (42)	102 (100)
Cannabis	12 (27)	33 (73)	45 (100)
Mandrax	20 (38)	32 (62)	52 (100)
Heroin/Opiates	18 (72)	7 (28)	25 (100)
Methamphetamine	98 (38)	161 (62)	259 (100
TOTAL	**177**	**306**	**483**

Table 28: Previous treatment received for SUD according to <u>main</u> drug groups

The frequency of previous treatment admissions was cross-tabulated with the main primary drug groups. The majority of those who were previously treated in the most main group was either treated once or twice, while half of those in heroine/opiate group was treated more the three times in the past (Table 29).

	Frequency of previous treatment for substance use				
Primary drug main groups	**Once n (%)**	**Twice n (%)**	**Thrice n (%)**	**More n (%)**	**Total n (%)**
Alcohol	14 (48)	11 (38)	3 (10)	1 (3)	29 (100)
Cannabis	10 (83)	0 (0)	0 (0)	2 (17)	12 (100)
Mandrax	9 (45)	6 (30)	2 (10)	3 (15)	20 (100)
Heroin/Opiates	6 (33)	3 (17)	0 (0)	9 (50)	18 (100)
Methamphetamine	40 (41)	28 (29)	14 (14)	16 (16)	98 (100)
TOTAL	79 (45)	48 (27)	19 (11)	31 (18)	177 (100)

Table 29: Frequency of previous treatment for SUD according to main drug groups

5.4.13 Polydrug use

Almost two thirds (64%) of the sample were poly-drug users meaning that they had at least a primary and secondary drug of choice. Almost half (46%) of those who were poly-drug users, were using mandrax as a secondary drug, followed by methamphetamine at 24%.

An association was found between age groups and poly-drug use ($p < 0.005$) with the odds of poly-drug users being 2.7 times more likely to be within the ag group of 18 – 35 compared to 36 and older (OR = 2.7: 95% CI: 1.84 – 3.92). Those who were 18 – 35 were 1.5 times more likely to be poly-drug users compared to those who were 36 years and older (RR = 1.5; 95%CI: 1.2 – 1.7) (Table 30).

		Poly-drug use			
Age category	**Yes**	**No**	**OR**	**RR**	***p-value***
18 - 35	226	84	2.69	1.45	*< 0.0005*
36 and older	97	97			

Table 30: 2 x 2 table for Age category and poly-drug use

5.5 ORAL HEALTH BEHAVIOUR AND SUBSTANCE USE

Oral health behaviour includes history of dietary habits, tooth brushing frequency, dental visits, in-between snacking and high sugar diet and smoking.

5.5.1 Dietary habits

The diet that was consumed during times of substance was investigated to determine an association with dental status, oral health symptoms and oral health related quality of life. This was done through diet assessment, daily sugar intake, daily alcohol intake and level of appetite. Questions that focused on solid food intake, distinguished between ordinary meals and in-between snacking, while questions that focused on drinks included non-alcohol and alcohol drinks.

5.5.1.1 Non-alcoholic liquids

Participants were asked what non-alcoholic drinks they mostly drink during drug usage, from the following list: water, juice, smoothies/drinking yogurt, fizzy drinks (soft drinks), hot drinks (coffee or tea) and other. Glasses (250ml) per day and per week were used as measuring units.

About two thirds (64.29%) indicated that they drank a mean number of glasses of water daily of 5. Those who were brushing teeth frequently (twice or more often per day) were consuming more water than those who were brushing teeth infrequently (once a day of less often) ($p = 0.02$).

Water consumption among the main primary drug groups was also described (Figure). The highest consumption of water among the main primary drug groups was among alcohol (70.87%) and cannabis (80%) users. Only half of mandrax and opiate users indicated that they drink water during times of drug use (Figure 4).

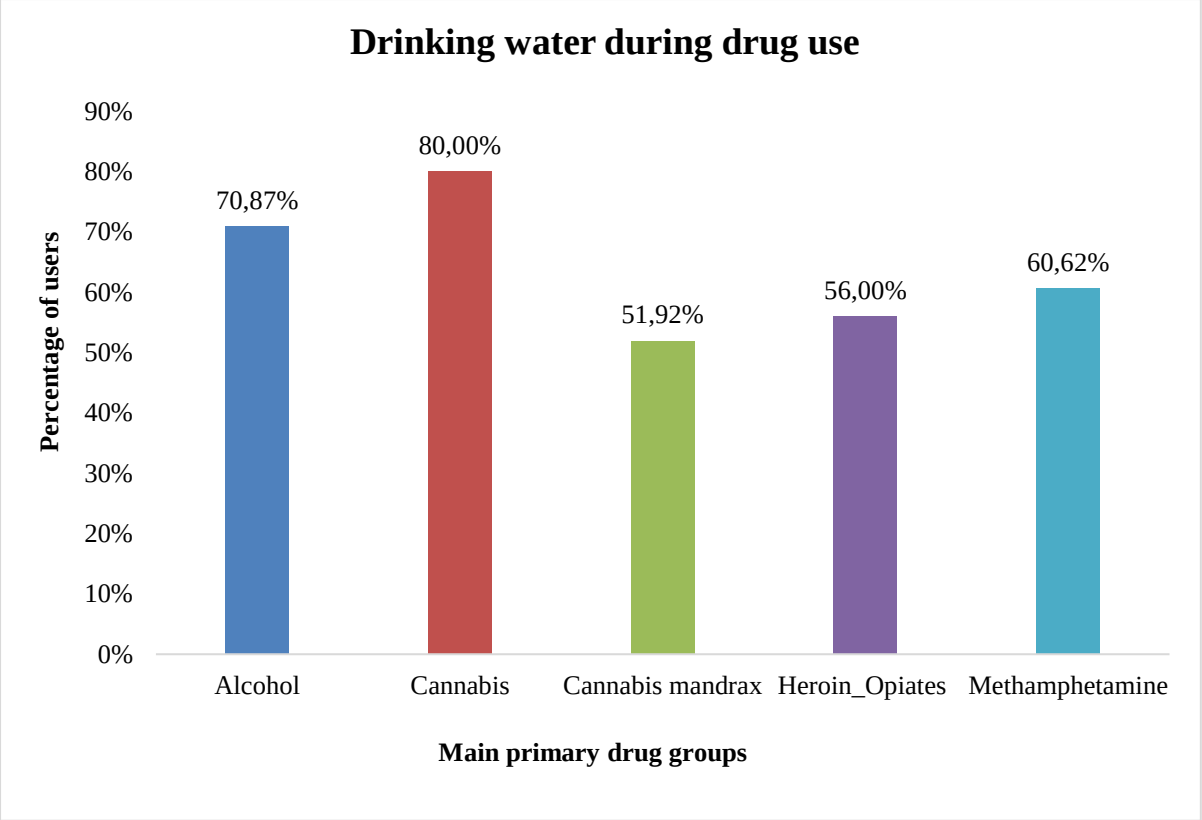

Figure 4: Water consumption during drug use according to the main primary drug groups

An association was found between gender and drinking water. Men were 1.69 times more likely to drink water during times of drug use compared to women ($p < 0.05$). This was also support by comparing mean water intake per day between men and women with men drinking 3.5 glasses per day compared to 2.5 consumed by women ($p < 0.05$).

An interesting finding was that those who used alcohol (4 glasses of water per day) and cannabis (4 glasses of water per day) (Table 31) as a primary drug respectively, were drinking more glasses of water per day when compared to the other (2 glasses of water per day) drug groups ($p = 0.0008$). These two groups had also shown the lowest mean DMFT score that was significantly lower when compared to other main primary drug groups ($p = 0001$).

Main primary drug groups	n	mean	median	SD	IQR
Alcohol	103	4.39	4	4,3	0 – 8
Cannabis	45	4.13	3	4	1 – 6
Cannabis mandrax	52	2.58	0.5	3,4	0 – 5.5
Heroin Opiates	25	2.44	1	3,8	0 – 4
Methamphetamine	259	2.67	2	3,0	0 – 5

Table 31: Mean number of glasses (250ml) water consumed per day

About a third (29.56%) of the sample indicated that they drank juice when they were using drugs. The most common juice brands preferred by users had a sugar contend of 2.4g – 11.6g sugar per 100ml. In order to calculate mean sugar intake via juice consumption, the average of six common labels were calculated at 8.25g sugar per 100ml juice (Table 32), 20.63g sugar per 250ml juice and 5.08 teaspoons of sugar per glass of juice

Product	Sugar (g) per 100ml	Sugar (g) per 250ml (glass)	Teaspoons (4g) per 250ml (glass)
Henties 6% mango	4.1g	10.25g	2.56
Quali Apple	11.6g	27.5g	6.88
Fruitree Guava	8.7g	21.75g	5.44
Rhodes Pineapple	11.3g	28.25g	7.06
Oros Ready to Drink Mango	2.4g	5.76g	1.43
Clover Krush Uht Fruit Juice 100% Mango	11.4g	28.5g	7.13
Average	**8.25g**	**20.34g**	**5.09**

Table 32: Sugar contends of common juices

The mean juice consumption for the entire sample was 0.76 glasses per day (SD = 1.57; median = 0; IQR = 0 – 1). This equated to 15.46g (20.34g x 3.86) added sugar intake per day only from drinking juice.

Only 13.29% were drinking smoothies or drinking yogurt. The mean score of smoothies or drinking yogurt consumption for the entire sample was 0.25 glasses per day (SD = 1.02; median = 0; IQR = 0 – 0). This amount equated to 4.77g (19.08g x 0.25) (Table 33) added sugar intake per day only from drinking juice.

Product	Sugar (g) per 100ml	Sugar (g) per 250ml	Teaspoons (4g) per 250ml
Clover Sip Up Granadilla	10g	25g	6.5
Yogofun Pineapple	7.9g	19.75g	4.94
First Choice Low Fat Granadilla	5g	12.5g	3.13
Average	**7.63g**	**19.08g**	**4.86**

Table 33: Sugar contents of common smoothies and drinking yogurts

Exactly a quarter (126/504 = 25%) drank energy drinks. Users preferred the least expensive energy drinks brands that had a sugar content of between 6mg – 11mg sugar per 100ml. The mean score of energy drink consumption for the entire sample was 0.76 glasses per day (SD = 1.9; median = 0; IQR = 0 – 0.33). In order to calculated mean sugar intake via energy drinks, the average of the three most common preferred name labels were taken (Table 34). When the average sugar content is considered it equated to 17.7g sugar per day from only drinking energy drinks.

Product	Sugar (g) per 100ml	Sugar (g) per 250ml (glass)	Teaspoons (4g) per 250ml (glass)
Score	6g	15g	3.75
Monster	11g	27.5g	6.88
Red Bull	11g	27.5g	6.88
Average	**9.3g**	**23.3g**	**5.84**

Table 34: Sugar contents of common energy drinks

More than half (290/504 = 57.54%) drank fizzy drink (soft drinks) when using primary drugs. Users preferred the least expensive soft drinks available in stores. The most common soft drink brands preferred by users had a sugar content of between 4mg – 12mg sugar per 100ml. In order to calculated mean sugar intake via soft drinks, the average of the three most common name labels were taken (Table 35).

Product	Sugar (g) per 100ml	Sugar (g) per 250ml (glass)	Teaspoons (4g) per 250ml (glass)
Coca-Cola	10.6g	26.52g	6.63
Jive	4g	10g	2.5
Fanta	12.42g	31.05g	7.76
Average	**9g**	**22.43g**	**5.63**

Table 35: Sugar contents of common soft drinks

The overall mean score of soft drink consumption for the entire sample was 2.47 glasses per day (SD = 3.55; median = 1; IQR = 0 – 4). This amount equated to 55.40g (22.43g x 2.47) added sugar intake per day only from drinking soft drinks and was similar for men (59.45%) vs women (52.52%). Those who used mandrax as a primary drug were drinking the most, while people who used alcohol were drinking the least soft drinks (Table 36).

Main primary drug groups	n	mean	median	SD	IQR
Alcohol	103	1,65	0	2,40	0 – 3
Cannabis	45	2,69	1	3,06	0 – 4
Mandrax	52	3,1	2	3,14	0 – 5
Heroin/Opiates	25	2,68	2	2,78	0 – 4
Methamphetamine	259	2,67	1	4,08	0 – 4

Table 36: Soft drink consumption (glasses per day) among main primary drug groups

Those who used both a primary and secondary drug (poly-drug users) were consuming 3 glasses per day vs 1.7 glasses among those who only used a primary drug ($p < 0.001$). The majority (419/504 = 83.13%) drank hot drinks such as coffee or tea. The mean number of coffees consumed for the entire sample was 2.3 cups (250ml) per day (SD = 2.05; median = 2; IQR = 1 – 3). The mean number of teaspoons of sugar per cup of coffee was 3.26. When calculating sugar addition to the diet through coffee consumption with added sugar, the mean intake among the entire sample was 7.5 (2.3 cups x 3.26) teaspoons of sugar per day. This equated to 30g (4g x 7.5) of added sugar per day only from drinking coffee. The daily sugar intake from juice, smoothies/drinking yogurt, soft drinks, coffee consumption, and energy drinks was **123.33g** (15.46g + 4.77g + 55.40g + 30g + 17.7). This was the added sugar consumed per participant per day drinking non-alcoholic beverages.

5.5.1.2 Alcoholic drinks consumption

Users from all drug groups including those who used alcohol as a primary drug, were asked to select alcoholic drinks that they preferred during time of drug use. The list included beers, ciders, wine, spirits, shots and other. Just more than half of the sample indicated that there drank beer, followed by spirits (whiskey, brandy, rum and vodka) mixers at 25% and wine at 18%. A tenth (10%) of the sample reported drinking ciders (Figure 5).

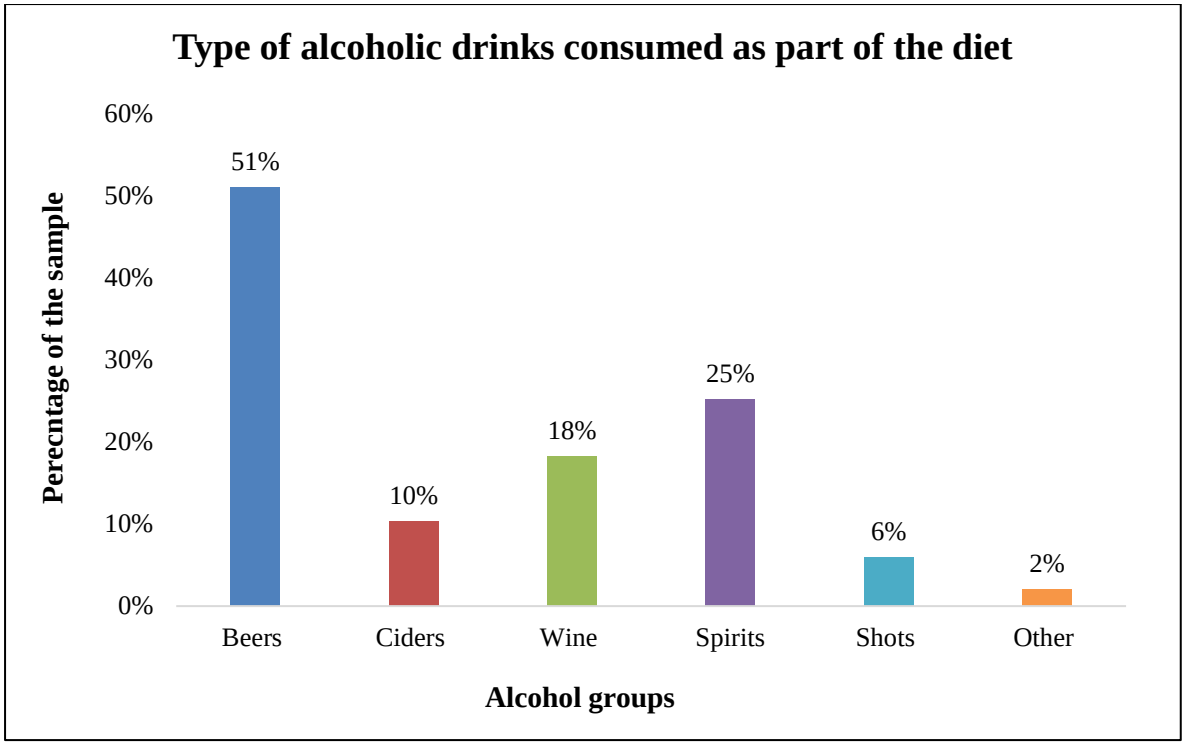

Figure 5: Preferential alcohol drinks consumed by the sample

Almost two thirds (72.02%) consumed alcoholic drinks, however there was no association between gender and alcohol consumption (p = 0.44). Also, no association was found between poly-drug users and alcohol consumption.

Except for people who used alcohol, among most of the main primary drug groups, prevalence of alcohol consumption was roughly between 63% - 68%. About half (48%) of those who used opiates consumed alcohol.

Participants indicated how many drinks per day and per week they would have. The measuring unit to quantify alcoholic consumption, was the number of glasses (250ml) per day/week. Thereafter, the number of glasses of each alcohol type was converted to alcohol units in order to have a standardized generic unit for all alcohol type. The mean number of alcoholic drinks (glasses = 250ml) consumed per day among the entire sample was 5.06. Participants reported mostly drinking 750ml of beer and this had to be converted into glasses consumed per day and per week. A mean of 3 glasses of beer was consumed per day among the entire sample while the mean wine consumption was 0.63 glassed per day (Table 37).

Type of alcohol	glasses per day	Units calculation	units per day
Beers (ABV 5.2%)	3.06	1.3 per 250ml	3.98
Ciders (ABV 5.5%)	0.27	1.36 per 250ml	0.37
Wine (ABV 12%)	0.63	3 per 250ml	1.89
Spirits (ABV 40%)	0.88	2 per double shot 250ml mix	1.76
Overall alcohol consumption	5.06	1.23 per 250ml	6.23

Table 37: Mean alcohol consumption among all participants

Alcohol consumption among those who used alcohol as a primary drug was also investigated. When the mean sample alcohol consumption was compared with those who used alcohol as a primary drug, the mean number of glasses for all alcohol types were about double as high except for ciders (Table 38).

Type of alcohol	Mean glasses (250ml) per day	Units per glass (250ml)	units per day
Beers (ABV 5.2%)	7.96	1.3 per 250ml	10.35
Ciders (ABV 5.5%)	0.17	1.36 per 250ml	0.23
Wine (ABV 12%)	2.22	3 per 250ml	6.66
Spirits (ABV 40%)	2.25	2 per double shot 250ml mix	4.5
Overall alcohol consumption	13.02	1.32 per 250ml	17.24

Table 38: Mean alcohol consumption among those who used alcohol as a primary drug

5.5.1.3 Alcohol drinks consumed by people who used alcohol

Those who used alcohol as a primary drug, mostly (29%) preferred beer exclusively. Almost a quarter (22%) of people who used alcohol used wine exclusively. Most preferred a combination of drinks, alternating between beer and wine consumption (Table 39).

Alcohol type	n	%
Beer only	30	29,13%
Beer and brandy	1	0,97%
Beer and ciders	1	0,97%
Beer and gin	6	5,82%
Beer antrum	2	1,94%
Beer and vodka	3	2,91%
Beer and whiskey	8	7,77%
Beer and whiskey and gin	1	0,97%
Beer and wine	17	16,50%
Brandy only	4	3,88%
Gin only	1	0,97%
Vodka only	2	1,94%
Wine only	23	22,33%
Wine and brandy	2	1,94%
Wine and vodka	1	0,97%
Wine and whiskey	1	0,97%
Total	103	100,00%

Table 39: Preferential alcohol type consumed among people who uswd alcohol

Almost three quarters were consuming alcoholic drink (Table 40).

		n	%
Regular drinking of water	Yes	324	64
	No	180	36
Regular drinking of soft drinks	Yes	289	57
	No	215	43
Drinking alcoholic drinks	Yes	363	72
	No	141	28
In-between snacking (sweet)	Yes	407	81
	No	97	19
In-between snacking (salt)	Yes	405	80
	No	99	20
Appetite during primary drug use	Good and normal	193	38
	Poor	311	62

Table 40: Frequency diagram on diet questions

5.5.1.4 Meals and in-between snacking

Most participants did not have three meals per day. Breakfast, usually included high amounts of sugar, most patients skipped lunch and some having a cooked meal for supper. In-between snacking consisted of confectionaries such as low-cost crisps, sweets, ice cream, cake or biscuits. In-between snacking was very common with 81% indicating having in-between sweet snacks and 80% having in-between salty snacks (Table 40).

5.5.1.5 Appetite during primary drug use

Participants were asked to indicate how their appetite was during times of drug use, both for primary and secondary drug use, if applicable. Almost two thirds said that their appetite was poor during drug use (Table 40). About two thirds of the sample (62%) reported a very poor or poor appetite during primary drug use. Only 17.37% reported a normal appetite with about 9% having a good appetite and 11% having a very good appetite (Figure 6).

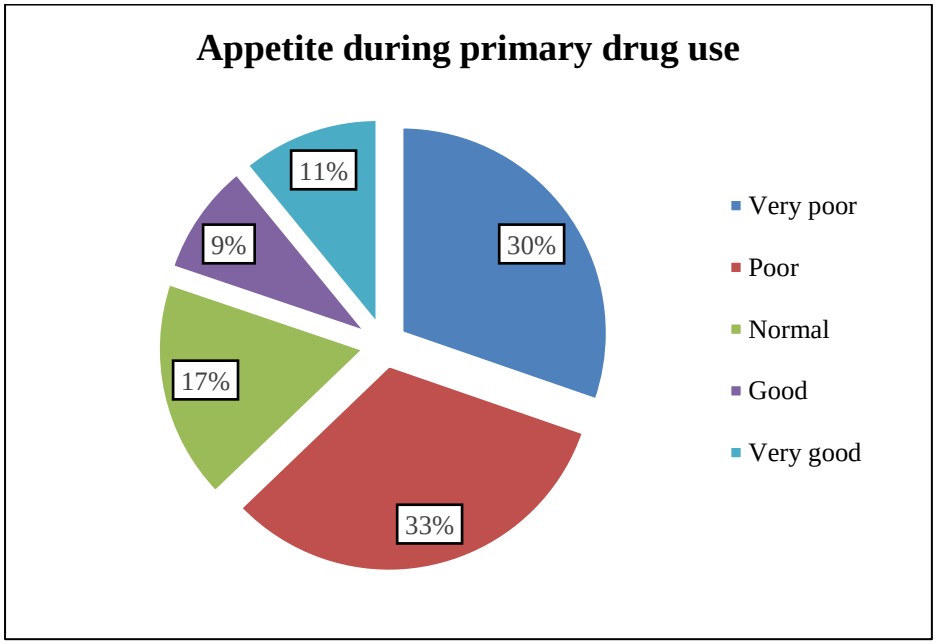

Figure 6: Appetite during primary drug use for entire sample

Appetite during drug use was also according to the main drug categories. Those who used cannabis as a primary drug had the best appetite among all participants (42%) reporting a very good or a good appetite during drug use.

Mandrax users (28%) reported having a very good or good appetite. Heroin (opiate) users and methamphetamine reported the worst appetite during drug use (16%) (Figure 7).

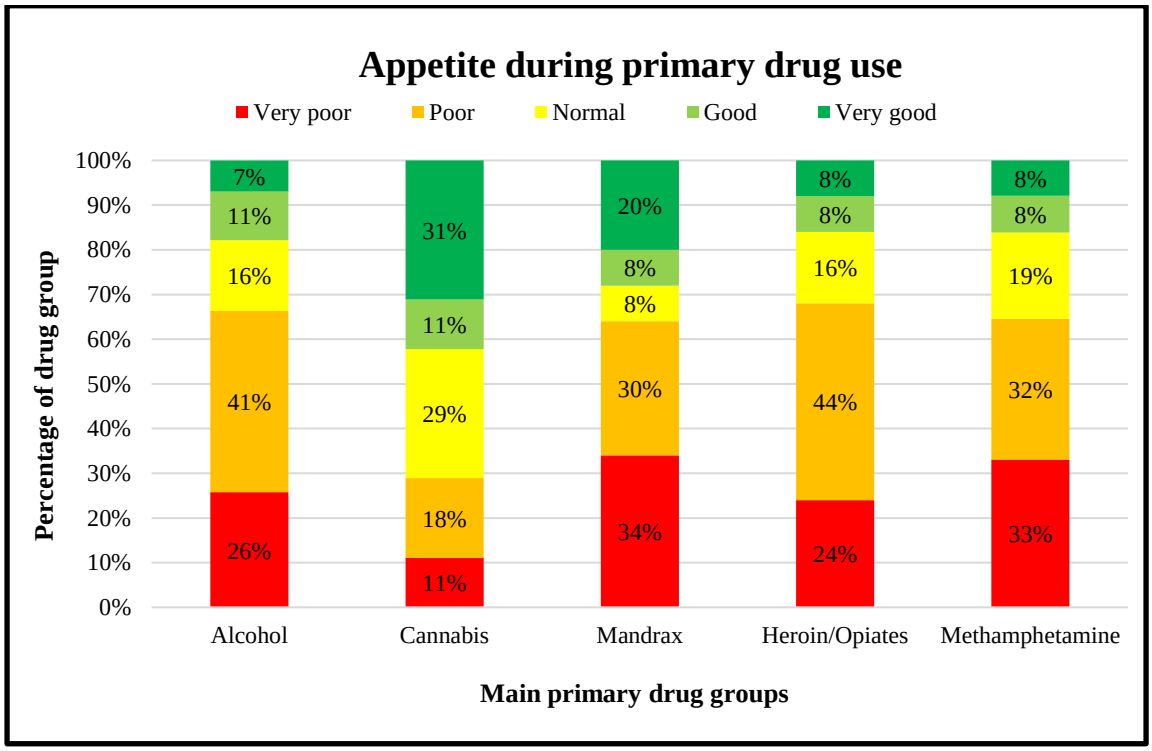

Figure 7: Appetite during primary drug use for main drug groups

An association was found between appetite and main drug groups. The odds of having a good or a normal appetite, during drug use, were 4.8 times more likely among cannabis users compared to the rest of the sample ($p < 0.0005$; OR = 4.82; RR = 2.1) (Table 41).

	Appetite during drug use				
Cannabis used as primary drug	**Good and normal**	**Poor**	**OR**	**RR**	***p-value***
Yes	32	13	4.82	2.10	*< 0.0005*
No	152	298			

Table 41: Appetite during cannabis use

The mean DMFT score and appetite participants was analyzed to whether appetite and severity of dental caries is related, but mean DMFT scores (13.2 vs 13. 3) for those who had a good and normal appetite with primary drug was very similar to those who had a poor appetite ($p = 0.96$).

Sugar consumption via non-alcoholic beverages and added sugar with tea and coffee, was very high among participants. According to self-reported number of drinks consumed per day and week, the mean number of teaspoons of sugar per participant per day was 22.24.

5.5.2 Tooth brushing frequency

5.5.2.1 Brushing frequency during times when not using drugs (during treatment)

More than half of the sample reported brushing their teeth once a day or less frequently during the period of receiving treatment for substance use, or when not using drugs. For the same period (while off drugs), about 31% were brushing teeth twice a day and 6.6% were brushing more frequently (Table 42).

Tooth brushing frequency	n	%
Never	16	3,17%
Less often	78	15,48%
Once a day	221	43,85%
Twice a day	156	30,95%
More often	33	6,55%
Total	504	100,00%

Table 42: Tooth brushing frequency when not using drugs

5.5.2.2 Brushing frequency during drug use

Almost two thirds of the sample reported brushing teeth once a day or less frequent when using their primary drug of choice (Table 43).

Tooth brushing frequency	n	%
Never	17	3,37%
Less often	86	17,06%
Once a day	218	43,25%
Twice a day	142	28,17%
More often	41	8,13%
Total	504	100,00%

Table 43: Tooth brushing frequency during primary drug use (“on drugs”)

5.5.2.3 Tooth brushing frequency according to dug types

Primary drug	Never n (%)	Less often n (%)	Once a day n %	Twice a day n %	More often n %	Total n %
Alcohol	2 (2%)	5 (5%)	54 (52%)	38 (37%)	4 (4%)	103 (100%)
Cannabis	2 (4%)	8 (18%)	19 (42%)	13 (29%)	3 (7%)	45 (100%)
Mandrax	3 (6%)	14 (27%)	18 (35%)	10 (19%)	7 (13%)	52 (100%)
CAT	0 (0%)	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1 (100%)
Crack Cocaine	0 (0%)	0 (0%)	5 (50%)	5 (50%)	0 (0%)	10 (100%)
Opiates	1 (4%)	5 (20%)	11 (44%)	8 (32%)	0 (0%)	25 (100%)
Methamphetamine	9 (3%)	52 (20%)	108 (42%)	65 (25%)	25 (10%)	259 (100%)
OTC_PRE	0 (0%)	2 (22%)	2 (22%)	3 (33%)	2 (22%)	9 (100%)
TOTAL	**17 (3%)**	**86 (17%)**	**218 (43%)**	**142 (28%)**	**41 (8%)**	**504 (100%)**

Table 44: Brushing frequency according to the different drug groups

Brushing frequency was further analysed combining "never", "less frequent" and "once a day" as "infrequent". "Twice a day" and "more often" was combined and labelled as "frequent". Tooth brushing frequency was also cross-tabulated with the main drug groups to determine if there is a tendency among users of a specific drug to brush less of more frequent than other drug groups, but no association was found ($p > 0.5$). Infrequent brushing among the main primary drug groups ranged between 59% to 68% (Table 44 and 45) (Figure 8).

		Brushing frequency				
Main primary drugs		**Frequent n (%)**	**Infrequent n (%)**	**OR**	**RR**	***p-value***
Alcohol	Yes	**42 (41)**	61 (59)	1.27	1.16	*> 0.05*
	No	141 (35)	260 (65)			
Cannabis	Yes	**16 (36)**	29 (64)	0.96	0.98	*> 0.05*
	No	167 (36)	292 (64)			
Mandrax	Yes	**17 (33)**	35 (67)	0.84	0.89	*> 0.05*
	No	166 (37)	286 (63)			
Heroin/Opiates	Yes	**8 (32)**	17 (68)	0.82	0.88	*> 0.05*
	No	175 (37)	304 (63)			
Methamphetamine	Yes	**90 (35)**	169 (65)	0.87	0.92	*> 0.05*
	No	93 (38)	152 (62)			

Table 45: Tooth brushing frequency according to main primary drug groups

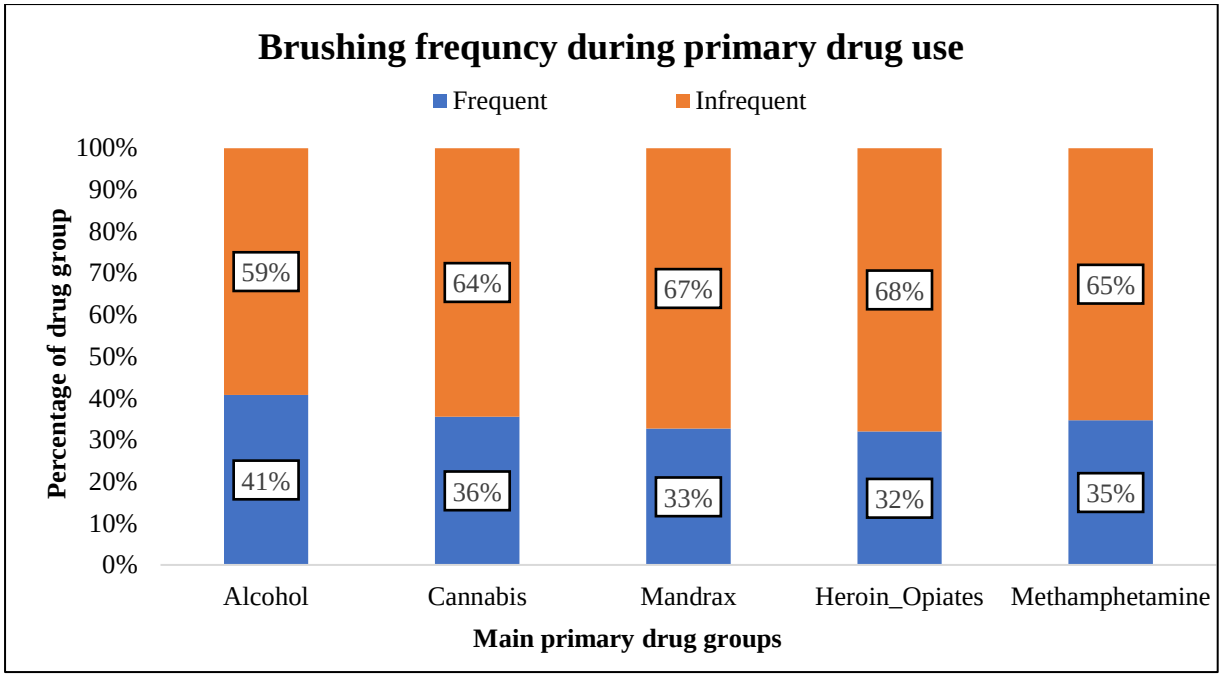

Figure 8: Tooth brushing frequency according to main primary drug groups

5.5.2.4 Tooth brushing frequency according to severity of dental caries

An analysis of tooth brushing frequency according to severity of dental caries should a significant difference for mean M-score (missing teeth), S-Score (sound teeth) and DMFT-score. Those who were brushing teeth frequently (twice and more frequent per day) had a mean DMFT-score of 10.72 vs 14.65 for those who brushed less frequent ($p < 0.0005$) (Table 46).

		n	Mean	Median	IQR	SD	*p*
Decayed teeth	**Frequent**	183	5.28	5	2 – 8	4.18	*< 0.05*
	Infrequent	321	6.85	6	2 – 10	5.72	
Missing teeth	**Frequent**	183	5.29	3	1 – 7	7.53	*< 0.05*
	Infrequent	321	7.63	5	2 – 10	7.76	
Filled teeth	**Frequent**	183	0.77	0	0 – 1	1.82	*> 0.05*
	Infrequent	321	0.89	0	0 – 0	1.50	
Sound teeth	**Frequent**	183	17.49	18	14 – 22	6.24	*< 0.005*
	Infrequent	321	13.96	14	8 – 20	7.02	
DMFT	**Frequent**	183	10.72	10	6 – 15	6.80	*< 0.0005*
	Infrequent	321	14.65	14	8 – 21	7.88	

Table 46: Mean decayed-, missing-, filled- and sound teeth for frequent vs infrequent tooth brushing during primary drug use

5.5.2.5 Tooth brushing frequency and OHRQoL

Tooth brushing frequency was also associated with the mean OHIP-14 score. Participants who were brushing twice a day or more had a mean OHIP-14 score of 17 while those who were brushing teeth less frequent, had a mean OHIP-14 score of more than 20. This difference was significant ($p < 0.0005$) (Table 47).

	OHIP-14 score				
	n	**mean**	**SD**	**IQR**	***p-value***
Never	17	30	15.7	24 – 41	*< 0.0005*
Less often	86	24	15.4	11 – 37	
Once a day	218	17.5	15.1	4 – 27	
Twice a day	142	17.6	14.6	5 – 26	
More often	41	15.7	16.7	2 – 23	

Table 47: Mean OHIP-14 score for brushing frequency during primary drug use

5.5.2.6 Brushing frequency and periodontal health

Bleeding percentage was associated with tooth brushing frequency ($p < 0.005$). Those who were brushing less frequent have shown higher bleeding percentages suggesting a higher prevalence of periodontal disease. Those who reported brushing never and less often, had a bleeding percentage of 42% and 46% respectively while those who were brushing teeth twice a day or more often, had a bleeding percentage of 31% and 26% respectively (Table 48).

	n	**mean**	**SD**	**IQR**	***p***
Never	14	49.29	39.08	14 – 85	*< 0.005*
Less often	75	45.69	32.33	19 – 75	
Once a day	199	43.75	34.36	11 – 70	
Twice a day	135	31.24	29.48	0 – 54	
More often	39	26.23	34.94	0 – 63	

Table 48: Mean bleeding percentage and tooth brushing frequency during primary drug use

When bleeding percentages were compared with the collapsed tooth brushing frequency of primary drug users, similar findings were observed. Those who were brushing teeth infrequently had a mean bleeding percentage of 45% while those who were brushing frequently had a bleeding percentage of 33%. This difference was significant ($p < 0.0005$).

5.5.2.7 Brushing frequency and substance use history

Duration of drug use was also associated with tooth brushing frequency. Participants who were brushing frequently had a mean duration of addiction of 12 years while those who were brushing infrequently was drug for a longer period (14 years). This difference was significant ($p < 0.005$). Comparison between duration of addiction and the more detailed brushing frequencies had shown the same association (Table 49).

Brushing frequency		**Duration (years) of drug use**				
	n	**mean**	**median**	**SD**	**IQR**	***p***
Frequent	183	12.22	10	8.5	5 – 17	*< 0.005*
Infrequent	321	14.35	13	8.5	9 – 19	

Table 49: Duration (years) of primary drug use and brushing frequency

5.5.3 History of dental visits

5.5.3.1 Last dental visit

More than half (52%) reported having visited a dentist in the past five years. About 8% reported never being to dentist (Table 50).

Last dental visit	**n**	**%**
Within the last year	162	32,14%
More than a year ago but less than 5 years ago	152	30,16%
More than 5 years ago	150	29,76%
Never have been at the dentist	40	7,94%
Total	504	100,00%

Dental treatment received at last visit	n	%
Restorations	46	9,13%
Restorations, Extractions and Scale and Polish (S&P)	1	0,20%
Restorations and S&P	21	4,17%
Extractions	244	48,41%
Extractions and S&P	8	1,59%
S&P	36	7,14%
Just a check-up	43	8,53%
Never been at the dentist	40	7,94%
No response	65	12,90%
Total	504	100,00%

5.5.4 Tobacco use history

5.5.4.1 Cigarette smoking

Tobacco use among the sample was extremely common with 432/504 = 85.7% reporting that they were using some form of tobacco. The majority of the sample were cigarette smokers (418/504 = 82.94%). The mean number of cigarettes being smoked per day among all participants was 13 (SD = 9; median = 10; IQR = 6 – 20) while the most cigarettes being smoked per day, was observed among those who use heroin/opiates as a primary drug (Table 52).

Main primary drug groups	n	mean	median	SD	IQR
Alcohol	68	14	20	8,9	6 – 20
Cannabis	38	13	12	8,1	7 – 20
Cannabis mandrax	49	12	10	9,1	5 – 20
Heroin Opiates	25	18	20	12,0	10 – 20
Methamphetamine	222	13	10	8,8	5 – 20
All primary drugs		13			

Table 52: Mean cigarette use according to the main primary drug groups

All those who used heroin/opiates as a primary drug were also cigarettes smokers, while the second most prevalent smoking group was among those who used mandrax (94.23%). Cigarette smoking was the lowest (66%) among those who used alcohol as a primary drug (Figure 9).

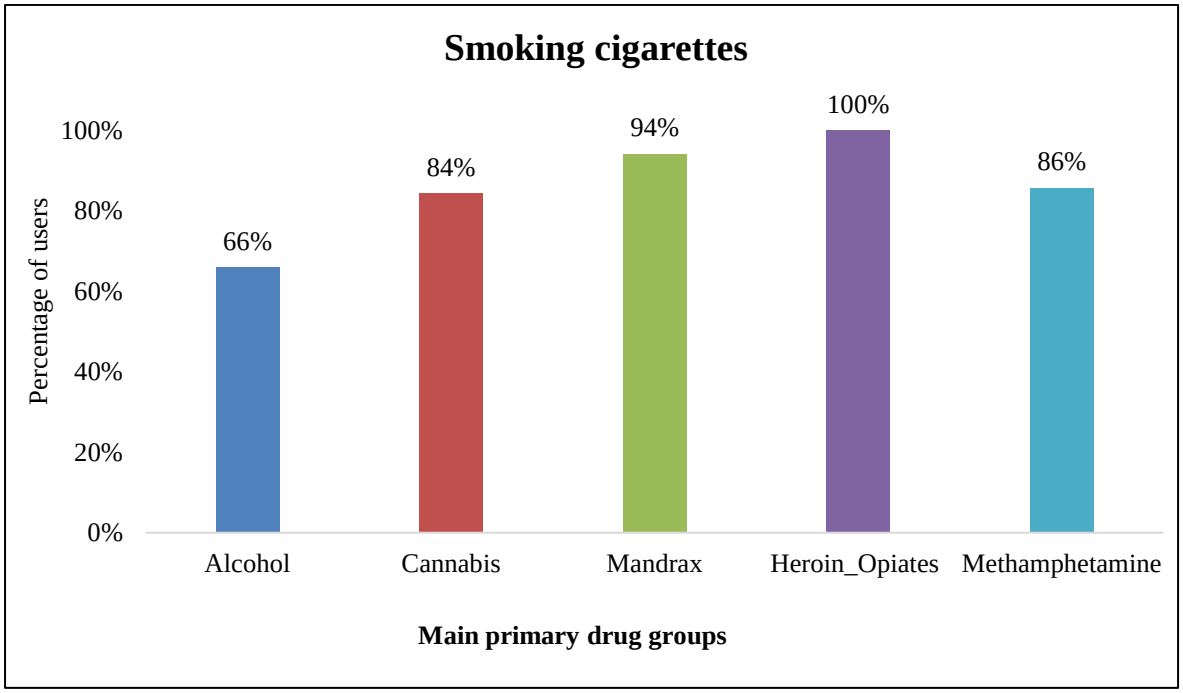

Figure 9: Percentage of cigarettes use according to main primary drug groups

Almost all (91.64%) of those who used both a primary and secondary drug (poly-drug users) were smoking cigarettes. An association was found between cigarette smoking and poly-drug use. Those who were polydrug users were 5 times more likely to be smoking cigarettes ($p < 0.0001$). There was no significant difference in daily cigarettes smoked between the main primary drug groups ($p > 0.15$), nor in daily cigarettes smoked between men and woman ($p > 0.12$). There was no significant difference in daily cigarettes smoked between those who reported a dry mouth compared to those who did not experience a dry mouth when using the primary drug ($p > 0.721$). There was no significant difference in number of daily cigarettes smoking between poly-drug users vs those who only used a primary drug ($p = 0.9$). Participants who were brushing their teeth twice a day or more often, were smoking 12 cigarettes per day compared to 15 being smoking daily by those who were brushing teeth once a day or less often ($p < 0.014$).

5.6 DENTAL HEALTH STATUS

5.6.1 Dental caries prevalence

The prevalence of dental caries (caries experience) was 97.62% while active caries (untreated tooth decay) was 87.1% among the entire sample. There was no association between a specific drug group and prevalence of dental caries (caries experience) ($p > 0.05$), because all of the main drug groups showed very high prevalence ranging from 93.33% - 100%. However, an association was found between methamphetamine use and untreated tooth decay ($p < 0.05$). The odds of untreated tooth decay were 1.97 times more among methamphetamine users compared to those who did not use methamphetamine. Those who used methamphetamine as a primary drug were 1.1 times more likely to have active caries (untreated tooth decay) than those we were not using methamphetamine (RR = 1.1) (Table 53).

	Having untreated tooth decay				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	235	24	1.97	1.1	*< 0.05*
No	204	41			

Table 53: 2 x 2 table for using methamphetamine as primary drug and having untreated tooth decay

5.6.2 Dental caries severity

5.6.2.1 General description

Dental caries severity was determined by measuring the number of decayed, missing and filled teeth (DMFT) and analyzed according to demographic information, drug use history, brushing frequency, oral health symptoms and OHRQoL.

The graph of the DMFT score showed multiple peaks with the highest point, being the mode, at DMFT score of 7. The mean DMFT score was 13.2 and the IQR was 7 – 19. The mode of 7 and median of 12 was less than the mean of 13.2 (Figure 10).

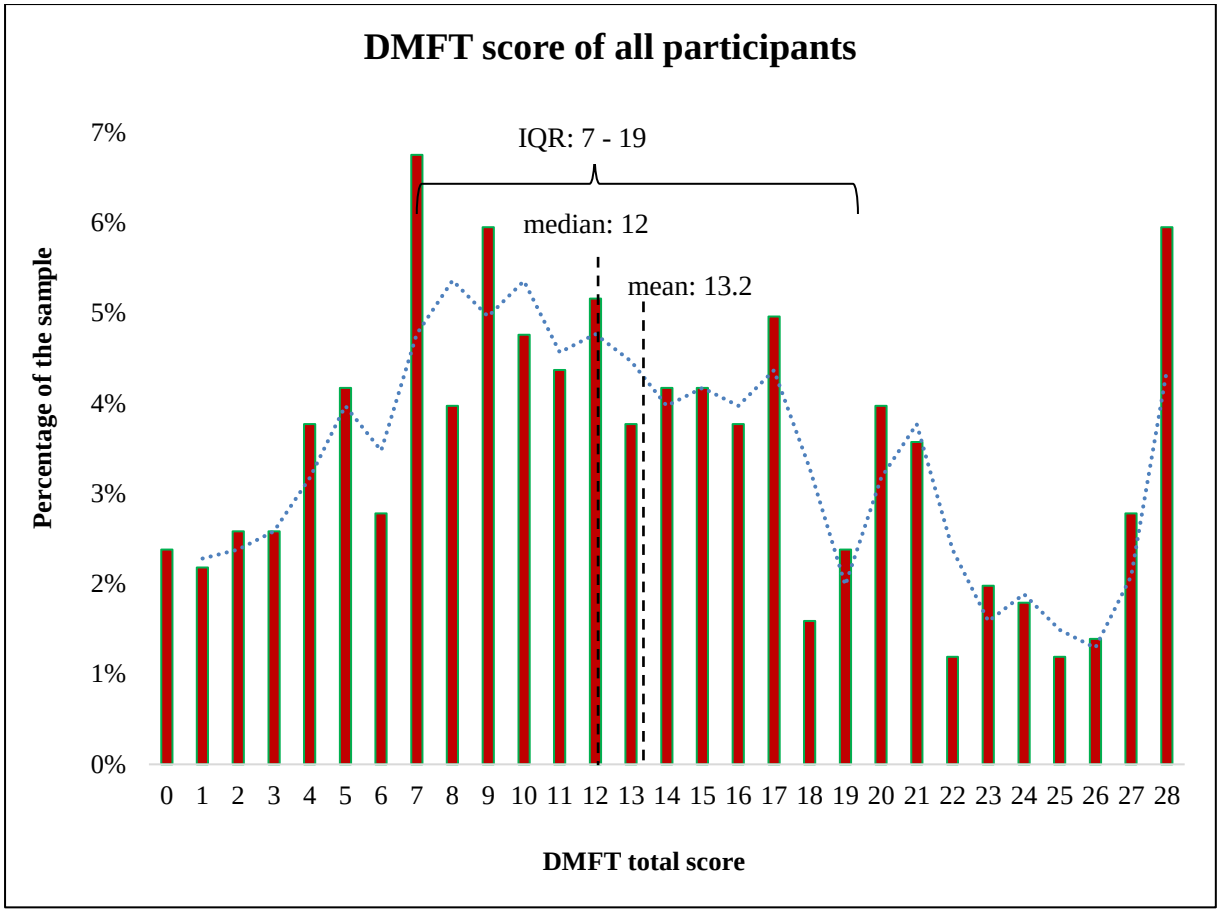

Figure 10: DMFT score frequencies of all participants

DMFT data was categorized into four groups namely, 0 – 7, 8 – 14, 15 – 21 and more than 21. More than a quarter (28%) of the sample had a DMFT of 0 – 7 while almost a third (32%) of the sample had a DMFT of 8 – 14. About a quarter had a DMFT of 15 – 21 and only 16% had a DMFT of more than 21 (Table 54).

DMFT	n	%	95% CI
0 – 7	138	27.38%	27.62% - 38.39%
8 – 14	161	31.94%	37.61% - 48.93%
15 – 21	123	24.40%	15.59% - 24.79%
>21	82	16.27%	15.59% - 24.49%
Total	**504**	**100.00%**	

Table 54: DMFT-scores (categorical) of all users

5.6.2.2 Dental status of individual teeth

Almost half (42% – 45%) of all upper 2nd molars were decayed compared to slightly more than a third (34% – 37%) of lower 2nd molars. More of the lower 2nd molars (29% - 34%) were

missing compared to the upper 2nd molars (23% – 27%). A very low percentage of 2nd molars were filled with the distribution, according to location in the mouth, very similar (5% – 8%). About a quarter of all 2nd molars were sound with a similar distribution according to location (25% - 26%) (Table 55).

	Decayed	Missing	Filled	Sound	Other
R upper 2nd molar	210 (42%)	135 (27%)	27 (5%)	127 (25%)	5 (1%)
R lower 2nd molar	173 (34%)	169 (34%)	31 (6%)	127 (25%)	4 (1%)
L upper 2nd molar	226 (45%)	118 (23%)	28 (5%)	129 (26%)	3 (1%)
L lower 2nd molar	185 (37%)	148 (29%)	38 (8%)	130 (26%)	3 (1%)

Table 55: Specific dental status for 2nd molars

About a third (31% – 36%) of all upper 1st molars were decayed compared to slightly less (32% - 29) of lower 1nd molars molar appearing decayed. More of the lower 1st molars (37% - 38%) were missing compared to the upper 1st molars (29% – 31%). A very low percentage of 1st molars were filled (7% - 8%) while. The proportion for sound 1st molar was very similar to 2nd molars with about a quarter being sound (Table 56).

	Decayed	Missing	Filled	Sound	Other
R upper 1st molar	180 (36%)	156 (31%)	35 (7%)	131 (26%)	2 (0%)
R lower 1st molar	146 (29%)	192 (38%)	38 (8%)	124 (25%)	4 (1%)
L upper 1st molar	169 (34%)	148 (29%)	42 (8%)	143 (28%)	2 (0%)
L lower 1st molar	156 (31%)	186 (37%)	38 (7%)	120 (24%)	4 (1%)

Table 56: Specific dental status of 1st molars

The dental status of 2nd premolars was different to molars. Half (48% – 53%) of all the 2nd premolar was sound with no distinction between upper and lower teeth. The distribution of decayed 2nd premolars were similar (21%) except for left lower 2nd premolars which were slightly higher at 25%. Similar to molars, there was a discrepancy between upper and lower teeth with regards to the missing component.

However, the higher percentages of missing being among the upper 2nd premolar teeth compared to the higher percentages being among the lower molars. A very low percentage of 2nd premolars were filled (2% - 3%) (Table 57).

	Decayed	Missing	Filled	Sound	Other
R upper 2nd premolar	108 (21%)	135 (27%)	16 (3%)	243 (48%)	2 (0%)
R lower 2nd premolar	106 (21%)	94 (19%)	11 (2%)	293 (58%)	0 (0%)
L upper 2nd premolar	108 (21%)	130 (26%)	9 (2%)	255 (51%)	2 (0%)
L lower 2nd premolar	128 (25%)	93 (18%)	16 (3%)	267 (53%)	0 (0%)

Table 57: Specific dental status of 2nd premolars

Similar to 2nd premolars, the majority of 1st premolars were sound, however the discrepancy between upper and lower sound 1st premolars were bigger than in the case with 2nd premolars. Almost a quarter of lower 1st premolars were sound compared to half of upper 1st premolars. With regards to being decayed, 1st premolars followed the same trend as in the case of molars and 2nd premolars with upper teeth being more decayed than lower teeth. With regards to being missing a similar trend was observed as for 2nd premolar with upper teeth being more missing than lower teeth, but this was the complete opposite for missing molars. More lower molars were missing than upper molars while more upper premolars were missing than lower premolars (Table 58).

	Decayed	Missing	Filled	Sound	Other
R upper 1st premolar	113 (22%)	116 (23%)	11 (2%)	263 (52%)	1 (0%)
R lower 1st premolar	78 (15%)	58 (12%)	5 (1%)	362 (72%)	1 (0%)
L upper 1st premolar	117 (23%)	119 (24%)	11 (2%)	256 (51%)	1 (0%)
L lower 1st premolar	91 (18%)	57 (11%)	3 (1%)	352 (70%)	1 (0%)

Table 58: Specific dental status of 1st premolars

The dental status of canine teeth followed a similar trend as premolars except with higher percentages of being sound and lower percentages of being decayed and missing. Lower canine teeth (81%) being more sound than upper canines (64%).

This tendency was observed among 1st premolars, with the canines having higher percentages of sound and lower percentages of decayed and missing teeth. More than three quarters (81%) of lower canines were sound while almost two thirds (65%) of upper canines were sound. This difference was incorporated in more upper canines being decayed (15%) and missing (19%) than lower canines (12% and 8% respectively) (Table 59).

	Decayed	Missing	Filled	Sound	Other
R upper canine	76 (15%)	95 (19%)	10 (2%)	321 (64%)	2 (0%)
R lower canine	60 (12%)	37 (7%)	1 (0%)	406 (81%)	0 (0%)
L upper canine	74 (15%)	92 (18%)	6 (1%)	328 (65%)	4 (1%)
L lower canine	56 (11%)	39 (8%)	1 (0%)	407 (81%)	0 (0%)

Table 59: Specific dental status of canines

Dental status of lateral incisors followed a similar trend to the canine teeth except with higher percentages of being missing. More than three quarters (82%) of lower lateral incisors were sound while only half (50%) of upper lateral incisors were sound. This difference was incorporated in more upper lateral incisors being decayed (14%) and missing (33%) than lower lateral incisors (10% and 10% respectively) (Table 60).

	Decayed	Missing	Filled	Sound	Other
R upper lateral incisor	72 (14%)	167 (33%)	11 (2%)	251 (50%)	3 (1%)
R lower lateral incisor	51 (10%)	46 (9%)	0 (0%)	407 (81%)	0 (0%)
L upper lateral incisor	69 (14%)	167 (33%)	12 (2%)	253 (50%)	3 (1%)
L lower lateral incisor	40 (8%)	50 (10%)	0 (0%)	414 (82%)	0 (0%)

Table 60: Specific dental status of lateral incisors

Dental status of central incisors followed a similar trend as canines and lateral incisors except with higher percentages of being decayed. Lower central incisors (80%) were more sound than upper central incisors (64%). More than three quarters (82%) of lower central incisors were sound while less than half (45%) of upper central incisors were sound. More upper central incisors were decayed (19%) and missing (33%) compared to lower central incisors (9% and 11% respectively) (Table 61).

	Decayed	Missing	Filled	Sound	Other
R upper central incisor	96 (19%)	168 (33%)	14 (3%)	219 (43%)	7 (1%)
R lower central incisor	46 (9%)	54 (11%)	1 (0%)	403 (80%)	0 (%)
L upper central incisor	80 (16%)	168 (33%)	21 (4%)	228 (45%)	7 (1%)
L lower central incisor	43 (9%)	56 (11%)	0 (0%)	405 (80%)	0 (0%)

Table 61: Specific dental status of central incisors

5.6.2.3 Severity of dental caries (DMFT) according to demographic information

The mean DMFT total scores were analyzed according to the demographic information of the sample. Those who were 18 – 35 years old had a mean DMFT of 11.85 compared to 15.54 for people aged 36 and older. This age difference was significantly different ($p < 0.0005$). There was no significant difference in the mean DMFT scores for males and females, for single vs married people as well as employed vs unemployed people. However, level of education was associated with DMFT. Those who only reached primary school, had a DMFT of 17.05, while those who reached secondary school (high school) had a DMFT of 13.39 vs 10.93 for those who reached tertiary education and postgraduate studies. These differences were statistically significant ($p < 0.0005$) (Table 62).

				DMFT score				
Variables		**n**	**(%)**	**Mean**	**Median**	**SD**	**IQR**	***p-value***
Age group	18 – 35	310	62	11.85	11	7.1	7 – 17	*< 0.0005*
	36 and older	194	38	15.42	15	8.2	9 – 23	
Gender	Males	365	72	13.02	12	7.8	7 – 19	*> 0.05*
	Females	139	28	13.76	13	7.5	9 – 19	
Marriage	Single	382	76	12.92	12	7.6	7 – 18	*> 0.05*
	Married	122	24	14.19	14	7.1	8 – 21	
Employment	Employed	219	43	12.90	12	7.83	7 – 19	*> 0.05*
	Unemployed	285	57	13.47	12	7.67	7 – 19	
Education	No school and primary	43	9	17.05	17	7.63	12 – 24	*< 0.0005*
	Secondary	364	72	13.39	12	7.67	8 – 19	
	Tertiary and Postgraduate	97	19	10.93	9	7.32	5 – 15	

Table 62: DMFT cross-tabulated by demographic information

5.6.2.4 Dental caries severity according to history of substance use

DMFT categories were analyzed according to the main primary drug groups. Those who used mandrax as a primary drug, had had a fairly similar distribution of DMFT groups (21% - 27) (Figure 11).

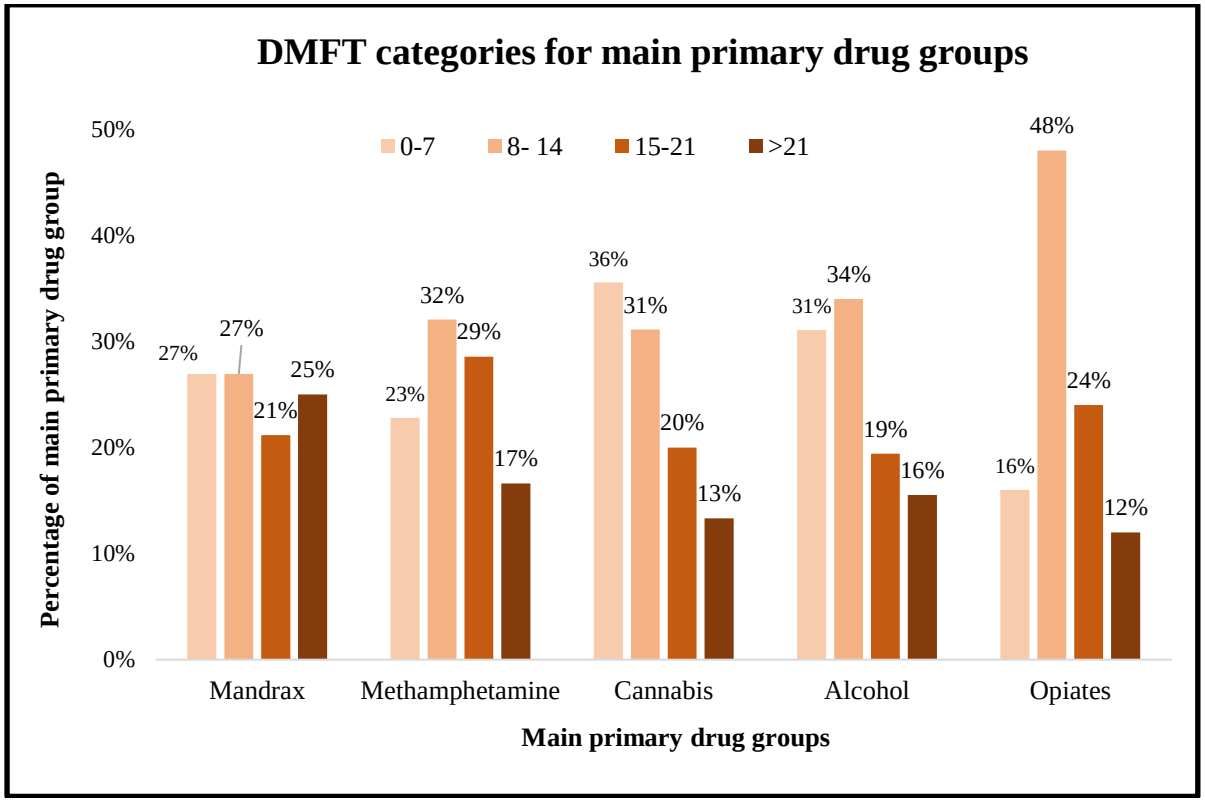

Figure 11: DMFT categorical distribution according to main primary drug groups

The majority (61%) of methamphetamine users had a DMFT score of 8 – 21, while 17% had a DMFT of more than 21. The graph of cannabis users was skewed to the right with the majority (67%) having a DMFT of 0 – 14, and only a third having a DMFT of 15 and more. The graph for DMFT categories for alcoholic was similar to the cannabis graph, being skewed to the right (positively skewed) (Figure 11). Two thirds had a DMFT of 0 – 14 and 35% had a DMFT of 15 and more. The graph for opiate users had a very tall middle section which revealed the majority (72%) have a DMFT of 8 – 21 and only 16% and 12% having a DMFT of 0 – 7 and more than 21 respectively (Figure 11).

Those who were using methamphetamine had the highest number of decayed teeth (mean = 7.54; median = 6, IQR: 3 – 10) with opiates users also very high (mean = 6.96; median = 7; IQR: 5 – 9). This was significantly different to the mean number of decayed teeth for the rest

of the sample ($p < 0.005$). Those who were using crack cocaine and OTC drugs had the lowest number of decayed teeth. Those who used alcohol as a primary drug, had only 4.86 teeth that was decayed (median = 4; IQR: 1 – 7). This was significantly different compared to the rest of the sample ($p < 0.005$) (Table 63).

Drug group	**Decayed teeth (D)**							
	n	**mean**	**median**	**range**	**IQR**	**SD**	**variance**	***p-value***
Alcohol	103	4.86	4	0 – 23	1 – 7	4.5	20.36	*< 0.005*
Cannabis	45	5.22	3	0 – 20	1 – 8	5.6	31.54	*> 0.05*
Mandrax	52	5.87	5	0 – 28	2 – 8	5.6	31.10	*> 0.05*
Crack Cocaine	10	3.10	2.5	0 – 9	0 – 5	3.14	9.88	*< 0.05*
Heroin and Opiates	25	6.96	7	0 – 14	5 – 9	3.66	13.37	*> 0.05*
Methamphetamine	259	7.24	6	0 – 28	3 – 10	5.42	29.38	*< 0.005*
OTC & Prescriptions	9	4.67	2	0 – 17	2 – 4	5.61	31.5	*< 0.05*
Total sample	**504**	**6.28**	**5**	**0 – 28**	**2 – 9**	**5.27**	**27.72**	

Table 63: Dental status: Decayed teeth (D) for primary drug groups

Those who were using mandrax had the highest number of missing teeth (mean = 8.44; median = 5.5; IQR: 1 – 12) among the sample. However, this was not significantly different to the mean number of missing teeth for the rest of the sample ($p > 0.05$) (Table 64).

Drug group	**Missing teeth (M)**							
	n	**mean**	**median**	**range**	**IQR**	**SD**	**variance**	***p-value***
Alcohol	103	6.61	4	0 – 28	1 – 9	7.48	55.91	*> 0.05*
Cannabis	45	6.51	4	0 – 28	1 – 7	8.14	66.30	*> 0.05*
Mandrax	52	8.44	5.5	0 – 28	1 – 12	9.27	86.02	*> 0.05*
Crack Cocaine	10	0.90	0	0 – 3	0 – 2	1.29	1.66	*< 0.005*
Heroin and Opiates	25	5.84	3	0 – 21	2 – 8	5.58	31.06	*> 0.05*
Methamphetamine	259	6.52	5	0 – 28	1 – 9	6.70	44.94	*> 0.05*
OTC & Prescriptions	9	6.78	2	0 – 18	0 – 12	7.58	57.44	*> 0.05*
Total sample	**504**	**6.58**	**4**	**0 – 28**	**1 – 9**	**7.24**	**52.45**	

Table 64: Dental status: Missing teeth (M) for primary drug groups

Those who were using alcohol, crack cocaine and OTC drugs had the highest number of filled teeth. However only the mean score of only those using alcohol and crack cocaine were significantly higher the rest of the sample ($p < 0.05$). Those who used mandrax and methamphetamine has the lowest mean number of filled teeth. Methamphetamine users had 0.38 teeth filled (median = 0; IQR: 0 – 7) and this was significantly different to the rest of the sample ($p < 0.005$) (Table 65).

Drug group	**Filled teeth (F)**							
	n	**mean**	**median**	**range**	**IQR**	**SD**	**variance**	***p-value***
Alcohol	103	1.31	0	0 – 14	0 – 1	2.69	7.25	*< 0.05*
Cannabis	45	0.47	0	0 – 4	0 – 0	0.99	0.98	*> 0.05*
Mandrax	52	0.35	0	0 – 3	0 – 0	0.86	0.74	*> 0.05*
Crack Cocaine	10	1.20	1	0 – 3	0 – 2	1.23	1.51	*< 0.0005*
Heroin and Opiates	25	0.80	0	0 – 7	0 – 1	1.80	3.25	*> 0.05*
Methamphetamine	259	0.38	0	0 – 7	0 – 0	0.98	0.96	*< 0.005*
OTC and Prescriptions	9	2.33	2	0 – 7	0 – 3	2.69	7.25	*> 0.05*
Total sample	**504**	**0.65**	**0**	**0 – 14**	**0 - 0**	**1.63**	**2.64**	

Table 65: Dental status: Filled teeth (F) for primary drug groups

Those who used crack cocaine (22.4), alcohol (15.99) and cannabis as a primary drug had the highest number of sound teeth. Cocaine users had a significant higher number of sound teeth ($p < 0.005$); methamphetamine users had a significant lower number ($p < 0.05$) (Table 66).

Drug group	**Sound teeth (S)**							
	n	**mean**	**median**	**range**	**IQR**	**SD**	**variance**	***p-value***
Alcohol	103	16.01	16	3 – 28	11 – 21	6.8	46.31	*> 0.05*
Cannabis	45	16.93	18	4 – 28	11 – 22	7.25	52.52	*> 0.05*
Mandrax	52	14.17	15	2 – 27	7 – 20.5	7.44	55.28	*> 0.05*
Crack Cocaine	10	22.4	23	15 – 28	21 – 26	3.98	15.82	*< 0.005*
Heroin and Opiates	25	14.76	16	3 – 27	11 – 19	6.34	40.19	*> 0.05*
Methamphetamine	259	14.58	15	1 – 28	9 – 20	6.84	46.78	*< 0.05*
OTC and Prescriptions	9	15.67	19	5 – 23	10 – 22	6.9	47.67	> 0.05
Total sample	**504**	**15.24**	**16**	**1 – 28**	**9.5 – 21**	**6.95**	**48.33**	

Table 66: Dental status: Sound teeth for primary drug groups

Those who used mandrax as a primary drug, showed the highest mean DMFT score of 14.65, while those who used methamphetamine and opiates showed DMFT scores of 13.86 and 13.56 respectively. Crack cocaine and OTC users showed a DMFT score of 5.2 and 12, but these groups were very small group compared to other groups and therefore could not be considered for further analysis for significance (Table 67).

Drug group	**Decayed, Missing and Filled teeth (DMFT) total score**							
	n	**mean**	**median**	**range**	**IQR**	**SD**	**variance**	***p-value***
Alcohol	103	12.40	12	0 – 28	7 – 17	7.63	58.20	*> 0.05*
Cannabis	45	11.82	10	0 – 28	6 – 17	8.27	68.42	*> 0.05*
Mandrax	52	14.65	13.5	1 – 28	7 – 22	8.65	74.90	*> 0.05*
Crack Cocaine	10	5.20	5.5	0 – 13	2 – 5	4.02	16.18	*< 0.005*
Heroin and Opiates	25	13.56	12	1 – 27	9 – 17	6.80	46.26	*> 0.05*
Methamphetamine	259	13.86	13	0 – 28	8 – 20	7.52	56.53	*< 0.05*
OTC and Prescriptions	9	12	9	5 – 23	6 – 18	7.16	51.25	*> 0.05*
Total sample	**504**	**13.23**	**12**	**0 – 28**	**7 – 19**	**7.74**	**59.88**	

Table 67: Dental status: DMFT (tot) for primary drug groups

An analysis of variance (ANOVA) was done on the DMFT of the main primary drugs groups to determine if there is a significant difference in mean DMFT. The main primary groups were representing the major drugs being used and represented 96% of sample. Cannabis and alcohol users had the lowest mean DMFT scores while mandrax and methamphetamine users had the highest mean DMFT score. There was no significant difference in mean DMFT score when all the main groups were compared to each other ($p > 0.05$) (Table 68).

Main primary drugs	**n (%)**	**mean**	***p-value***
Alcohol	103 (21)	12.40	*> 0.05*
Cannabis	45 (9)	11.82	
Mandrax	52 (11)	14.65	
Heroin and Opiates	25 (5)	13.56	
Methamphetamine	259 (54)	13.86	

Table 68: ANOVA of mean DMFT scores for main primary drug groups

DMFT categories and mean duration of addiction (years) are shown in Figure 12. Just over half (51%) reported using the primary drug of choice for more than 12 years. Among this group, a third (81/254 = 33%) had a DMFT of 9 – 14, while 67 had a DMFT of 15 – 21 and 59 had a DMFT of 7 or less. Forty-seven participants had a DMFT of more than 21 (Figure 12).

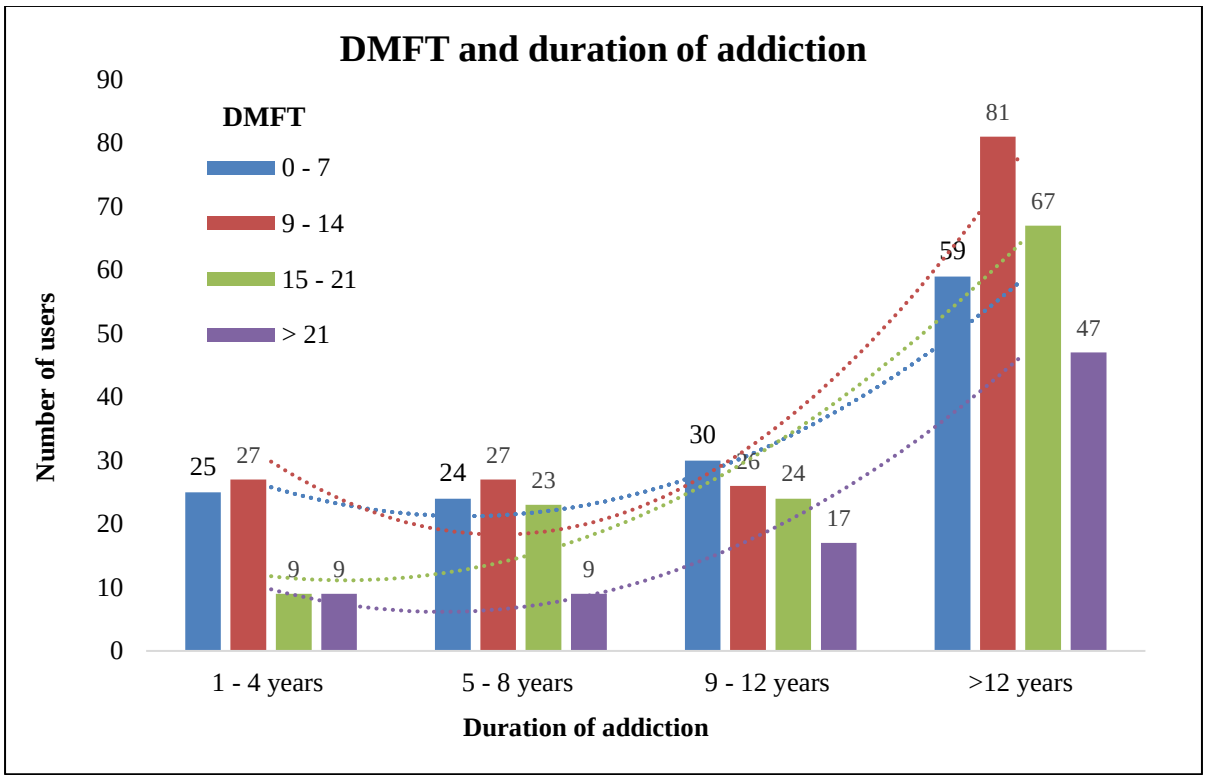

Figure 12: DMFT and duration of addiction

Mean DMFT score was also cross-tubulated with poly-drug use, but no significant difference ($p > 0.05$) was detected between those who used a primary and secondary drug (mean DMFT = 13.16) and those who only used a primary drug (mean DMFT = 13.36).

Duration of addiction was analyzed according to mean DMFT score and a significant difference was detected ($p < 0.05$). Those who had a duration of addiction of 1 to 4 years had a mean DMFT of 11 which was significantly different to those who used drugs for 9 years and longer (mean DMFT = 14) ($p < 0.05$). There was a significant difference between the duration of drug use categories and mean DMFT. The post-hoc test was used to identify were the difference was between the 1-4 years group and the more than 9 years group ($p < 0.05$; $R^2 = 0.02$). The coefficient of 0.127 confirmed that with an increase in primary drug duration use the DMFT score also increased (Table 69).

		DMFT total score						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Poly-drug use	Yes	323	64	13.15	12	7.8	7 – 19	*> 0.05*
	No	181	36	13.36	12	7.7	8 – 19	
Most preferred method of use	Injecting	15	3	14.87	13	8.4	9 – 21	*< 0.005*
	Snorting	12	2	5.83	5	5.1	3.5 – 6	
	Swallow	113	22	12.30	12	7.5	7 – 17	
	Smoke	364	72	13.53	13	7.7	8 – 20	
Duration of addiction	1 – 4 years	70	14	11.00	9	7.7	5 – 15	*< 0.05*
	5 – 8 years	83	16	11.95	12	7.3	7 – 17	
	9 – 12 years	97	19	14.00	12	7.8	7 – 20	
	> 12 years	254	50	13.96	13.5	7.8	8 – 20	
Frequency of primary drug use	Daily	317	63	13.36	12	7.5	7 – 19	*> 0.05*
	Weekly and less	187	37	13.00	12	8.1	7 – 19	
Cigarette smoking	Yes	418	83	13.1	12	7.7	7 – 19	*> 0.05*
	No	86	17	13.8	13	7.8	8 – 20	

Table 69: History of primary drug use and cigarette smoking according to DMFT score

5.6.2.5 Dental caries severity and tooth brushing frequency

DMFT score and tooth brushing frequency was also cross-tabulated. Those who were brushing teeth frequently (twice or more frequently per day) had a mean DMFT score of 10.72 while those who were brushing teeth infrequently (once a day and less) had mean DMFT score of 14.65. This was significantly different ($p < 0.0005$) (Table 70).

Brushing frequency	**Decayed, Missing and Filled teeth (DMFT) total score**							
	n	**mean**	**median**	**range**	**IQR**	**SD**	**variance**	***p-value***
Frequent	183	10.72	10	0 – 28	6 – 15	6.8	46.27	*< 0.0005*
Infrequent	321	14.65	14	0 – 28	8 – 21	7.9	62.17	
Total	**504**	**13.23**	**12**	**0 – 28**	**7 – 19**	**7.7**	**59.88**	

Table 70: DMFT score for frequent vs infrequent tooth brushing during primary drug use

5.6.3 Risk predictors for dental caries

A multivariate regression analysis for DMFT score as the outcome variable was done with the following predictor variables: age, gender, daily sugar intake through drinks, highest school grade completed, duration of addiction, cigarette smoking, having a dry mouth during drug use, frequency of drug use, poly-drug use and tooth brushing frequency. Eighteen per cent of the variability in the DMFT score was explained by the combined effect of the predictors. Age, daily sugar intake through drinks, highest school grade completed, gender and brushing frequency were significant predictor variables ($p < 0.05$) (Table 71).

Variable	**Coefficient**	**95% CI**	***p-value***	**R^2**
Age	0.257	0.167 – 0.348	*< 0.0005*	0.182
Sex	1.510	0.093 – 2.927	*< 0.05*	
Sugar intake per day (teaspoons)	0.031	0.001 – 0.061	*< 0.05*	
Level of education	-0.828	-1.146 – -0.510	*< 0.0005*	
Duration of addiction	-0.064	-0.161 – 0.033	*> 0.05*	
Cigarette smoking	-0.336	-2.091 – 1.419	*> 0.05*	
Have a dry mouth during drug use	-0.714	-0.793 – 2.220	*> 0.05*	
Frequency of drug use	-0.319	-1.650 – 1.011	*> 0.05*	
Poly-drug use	-0.262	-1.216 – 1.739	*> 0.05*	
Tooth brushing frequency	3.529	2.199 – 4.858	*< 0.0005*	
CONSTANT	10.799	5.448 – 15.092	*< 0.0005*	

Table 71: Multivariate regression analysis for DMFT score and predictor variables

5.6.4 Dental caries and OHRQoL

Mean DMFT score was analyzed according the prevalence (presence) of the 14 questions of the OHIP-14 questionnaire. OHIP-14 responses were categorized and classified to signify the presence of impact on OHRQoL if there was at least one response of “fairly often” or “often” with a question or absence of impact in the case of answering “never”, “hardly ever”, and “occasionally”. The percentage of an oral health impact of “fairly often” and “very often” responses were added to determine prevalence. All the questions, where a negative impact was felt by the participants on their OHRQoL in the preceding 12 months, had a significant higher (< 0.005) mean DMFT except for the question of a worsened sense of taste (Table 72).

Presence of negative impact on OHRQoL over the preceding 12 months			DMFT total score						
			n	%	mean	median	SD	IQR	*p-value*
Functional limitation	1. **Trouble pronouncing any words** because of problems with your teeth, mouth or dentures?	Yes	57	11	17.61	17	7.2	13 – 23	*< 0.0005*
		No	447	89	12.67	12	7.6	7 – 18	
	2. **Sense of taste has worsened** because of problems with your teeth, mouth or dentures?	Yes	91	18	14.62	14	7.8	8 – 20	*> 0.05*
		No	413	82	12.92	12	7.7	7 – 18	
Physical pain	3. Had **painful aching in your mouth?**	Yes	155	31	15.15	15	7.2	9 – 20	*< 0.0005*
		No	349	69	12.37	11	7.8	7 – 17	
	4. Found it **uncomfortable to eat any foods** because of problems with your teeth, mouth or dentures?	Yes	167	33	15.78	16	7.5	10 – 21	*< 0.0005*
		No	337	67	11.96	11	7.6	6 – 17	
Psychological discomfort	5. **Been self-conscious** because of your teeth, mouth or dentures?	Yes	184	37	15.05	15	7.5	9 – 21	*< 0.0005*
		No	320	63	12.18	11	7.7	6 – 17	
	6. **Felt tense** because of problems with your teeth, mouth or dentures?	Yes	154	31	15.15	15	7.4	9 – 21	*< 0.0005*
		No	350	69	12.38	11	7.8	7 – 17	
Physical disability	7. **Diet been unsatisfactory** because of problems with your teeth, mouth or dentures?	Yes	103	20	16.44	16	7.6	10 – 23	*< 0.0005*
		No	401	80	12.40	11	7.6	7 – 17	
	8. **Had to interrupt meals** because of problems with your teeth, mouth or dentures?	Yes	119	24	16.60	16	7.4	10 – 23	*< 0.0005*
		No	385	76	12.18	11	7.6	7 – 17	
Psychological disability	9. **Found it difficult to relax** because of problems with your teeth, mouth or dentures?	Yes	126	25	15.69	16	7.6	9 – 21	*< 0.0005*
		No	378	75	12.40	11	7.6	7 – 17	
	10. **Been a bit embarrassed** because of problems with your teeth, mouth or dentures?	Yes	181	36	15.58	15	7.4	10 – 21	*< 0.0005*
		No	323	64	11.76	11	7.6	6 – 17	
Social disability	11. **Been a bit irritable with other people** because of problems with your teeth, mouth or dentures?	Yes	137	27	16.06	15	7.4	10 – 21	*< 0.0005*
		No	367	73	12.17	11	7.6	6 – 17	
	12. **Life in general was less satisfying** because of problems with your teeth, mouth or dentures?	Yes	91	18	15.96	15	7.4	10 – 22	*< 0.0005*
		No	413	82	12.62	12	7.7	7 – 17	
Handicap	13. **Felt that life in general was less satisfying** because of problems with your teeth, mouth or dentures?	Yes	112	22	16.01	16	7.8	9 – 22	*< 0.0005*
		No	392	78	12.43	12	7.6	7 – 17	
	14. **Been totally unable to function** because of problems with your teeth, mouth or dentures?	Yes	60	12	15.88	16	6.9	11 – 21	*< 0.005*
		No	444	88	12.87	12	7.8	7 – 18	

Table 72: DMFT score according to presence of negative impact on OHRQoL

5.6.5 Oral health symptoms during drug use

5.6.5.1 General description oral health symptoms being experienced during drug use

Another section of the study that was linked to the dental status and impact that substance use had on oral health was determining oral health symptoms were present during substance use.

This was asked for both during primary drug use and secondary drug use, if applicable. Each of the oral health symptoms were then cross-tabulated with the main drug groups and a number of other variables to check for potential associations. The most common oral health symptom experienced during drug use, was a dry mouth (76%). Having a bad taste in the mouth while using the primary drug was experienced by 69%, while tooth sensitivity and having dental pain were reported by 61%. Gum problems, especially bleeding gums, were experienced by more than half (54%). Less frequent symptoms included grinding of teeth (45%), having stiff facial muscles (37%) and a burning sensation in the mouth (24%) (Figure 13).

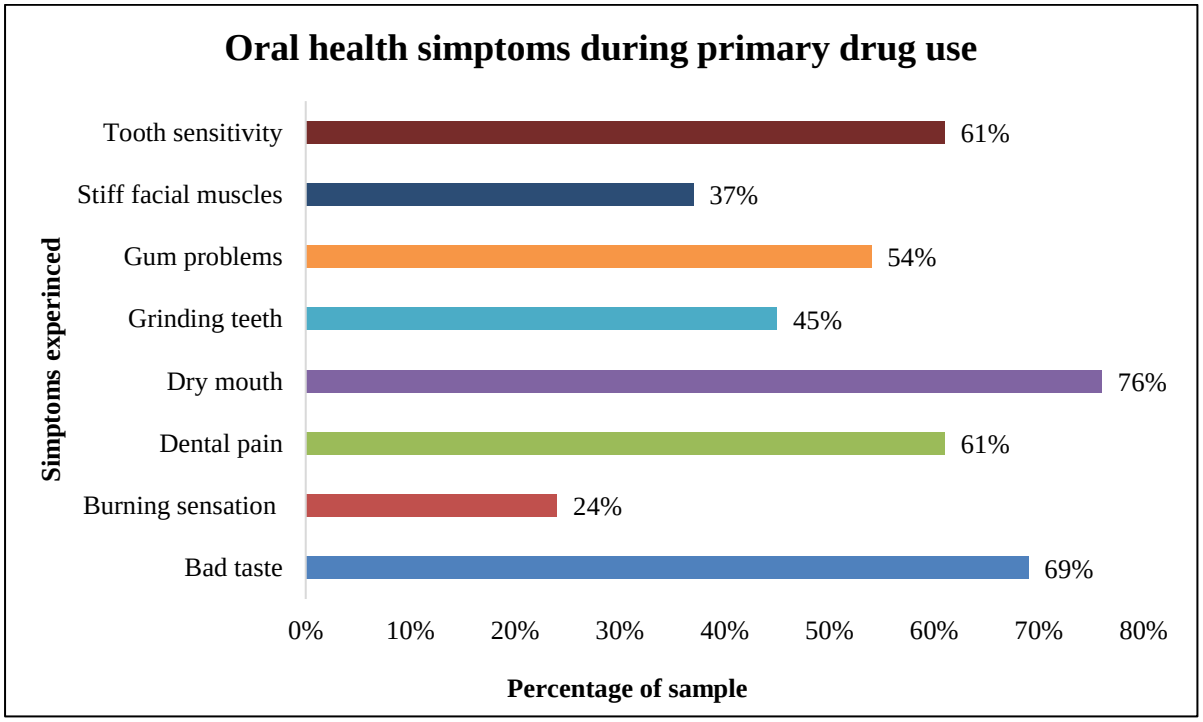

Figure 13: Oral health symptoms that were experienced during primary drug use.

5.6.5.2 Grinding of teeth when using primary drug of choice

Slightly under half (44.73%) of the sample reported grinding of teeth during drug use (Figure 14). Those who were using methamphetamine as a primary drug, had to highest prevalence (53%) of grinding teeth during drug use.

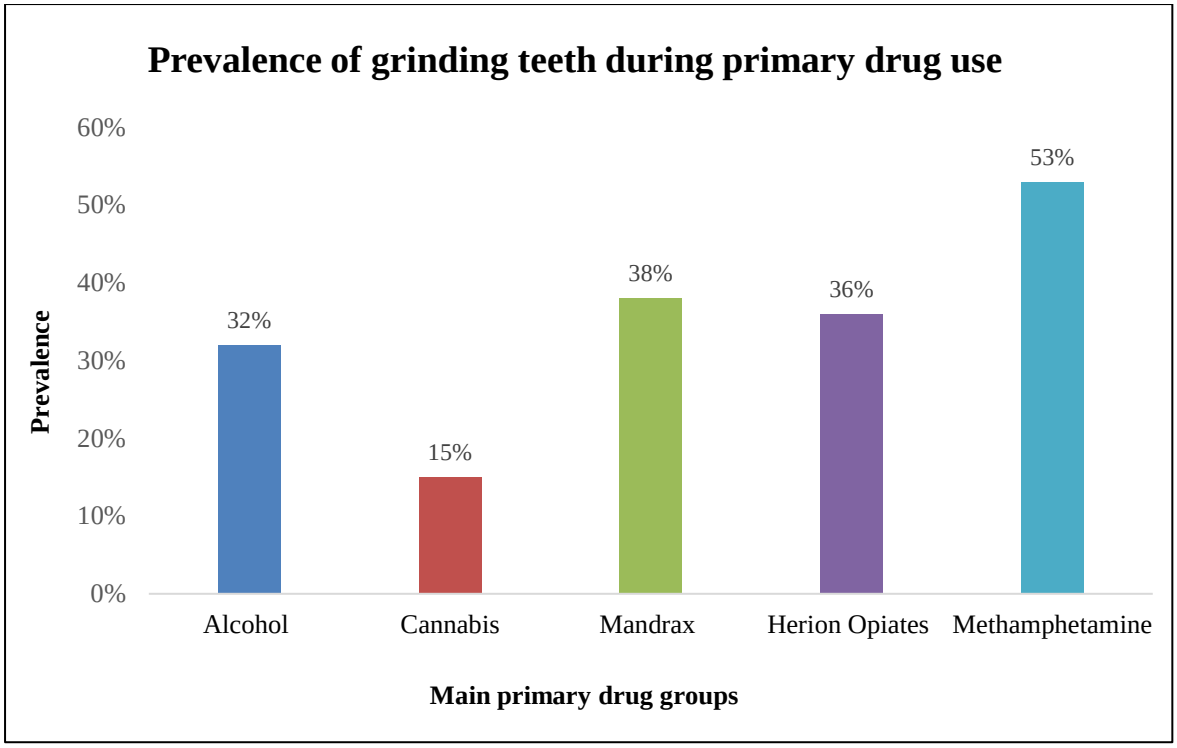

Figure 14: Prevalence of tooth grinding during drug use among main drug groups

An association was found between tooth grinding and methamphetamine use ($p < 0.0005$). The odds of those who reported grinding of teeth during drug use were 2.1 times more likely to be methamphetamine users compared to those who did not grind their teeth during drug use (OR = 2.1; 95%CI: 1.4 – 2.9). The probably of grind teeth among methamphetamine users were 1.5 times more likely than those who did not use methamphetamine (RR = 1.5; 95% CI: 1.2 – 1.8) (Table 73).

	Grinding teeth during drug use				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	138	121	2.06	1.49	*< 0.0005*
No	87	157			

Table 73: 2 x 2 table for methamphetamine use and grinding teeth

No other associations were found between other drug groups and grinding teeth during drug use.

5.6.5.3 Experiencing dental pain (toothache) when using drug of choice

The prevalence of dental pain that was experienced during drug use was 61% (Figure 15). The majority of mandrax, opiate and methamphetamine users experienced dental pain during drug use. About half of people who used alcohol and only 36% of cannabis users had dental pain (tooth ache) when they were using their primary drug of choice.

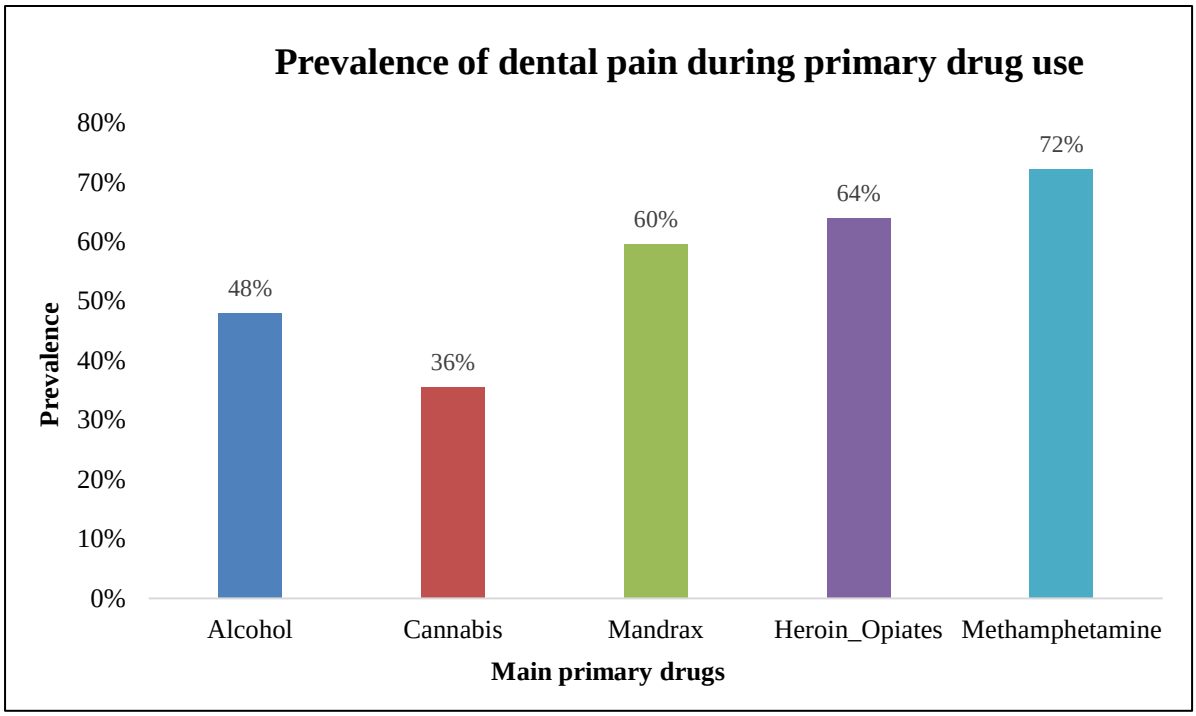

Figure 15: Prevalence of dental pain during drug use among the main drug groups

An association was found between using alcohol as a primary drug and dental pain ($p < 0.05$) with those who used alcohol being 24% less likely to experience dental pain during drinking than those who were not using alcohol as a primary drug (RR = 0.75; 95%CI: 0.61 – 0.94) (Table 74).

	Dental pain during drug use				
Using alcohol as primary drug of choice	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	49	52	0.52	0.75	*< 0.005*
No	257	145			

Table 74: 2 x 2 table for dental pain and using alcohol as a primary drug

An association was also found between using cannabis as primary drug and dental pain during drug use ($p < 0.005$). Those who were using cannabis as a primary drug were 44% less likely to also experience dental pain during drug use than those when did not use cannabis (RR = 0.56; 95%CI: 0.38 – 0.84) (Table 75).

	Dental pain during drug use				
Using cannabis primary drug of choice	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	16	29	0.32	0.56	*< 0.0005*
No	290	168			

Table 75: Dental pain and cannabis use

Cigarette smoking and poly-drug use were also investigated for potential associations with dental pain during drug use, but neither of the two variables showed an association, statistically. However, mean OHIP-14 score, mean DMFT score and mean bleeding percentage were significantly different ($p <0.0005$) when those with dental pain during drug use were compared with those without dental pain.

Participants who experienced dental pain during use of their primary drug, had an OHIP-14 score of 22.8 compared to 13 for those who did not had dental pain when using drugs. The mean DMFT-score of those who experienced dental pain during drug use was 14 (median = 13) compared to 12 (median = 11) for those without dental pain during drug use. This different was significant ($p < 0.0052$).

The mean bleeding percentage among those who experience dental pain was 43% compared to 35% among those without dental pain during drug use. This was significantly different ($p < 0.0073$).

5.6.5.4 Self-perceived gum problems during drug use

Just over half (54%) experienced gum problems when they were using the primary drug of choice (Figure 16) with most indicating “bleeding gums” as the most common problem.

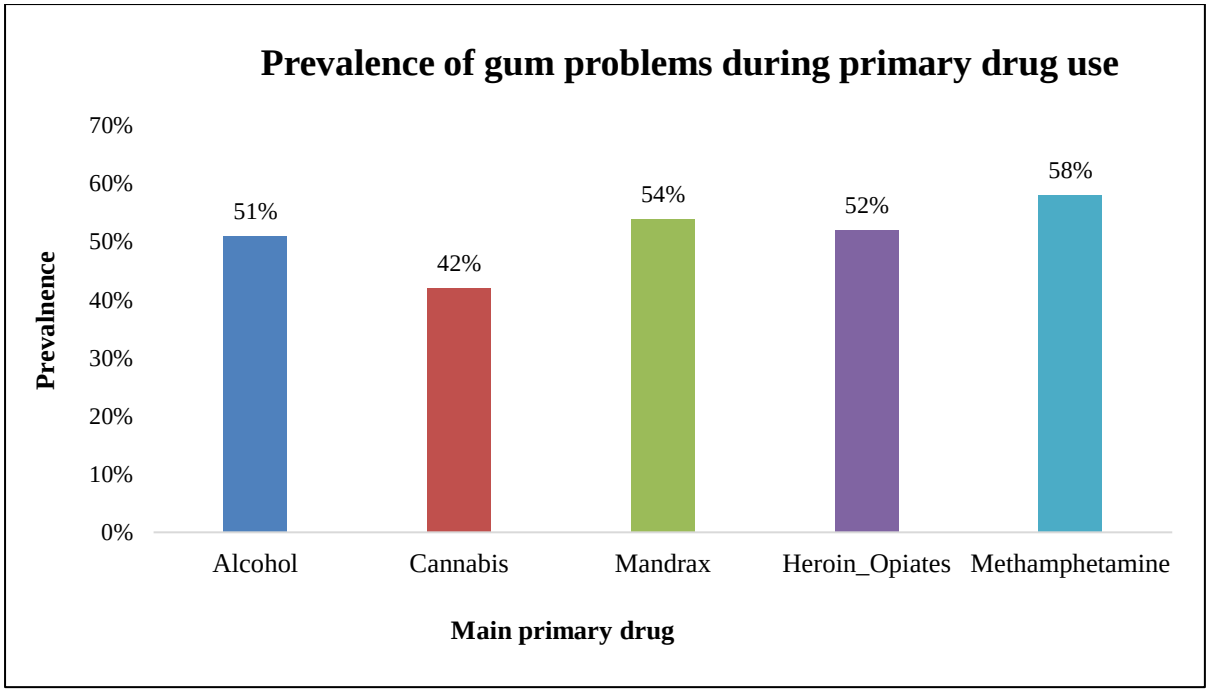

Figure 16: Self-perceived gum problems during primary drug use

Of the main drug use groups, just more than half reported gum problems, except for cannabis users who had a prevalence of 42%. There was no association between the different drug groups and experiencing gum problems during drug use. There was also no association between poly-drug use and gum problems during drug use.

An association between cigarette smoking and gum problems was found ($p < 0.05$). The odds of smokers having gum problems were 1.8 times more likely non-smokers (OR = 1.75; 95%CI: 1.1 – 2.8) (Table 76).

	Cigarette smoking				
Gum problems during drug use	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	234	36	1.76	1.10	*< 0.05*
No	181	49			

Table 76: 2 x 2 table for gum problems during drug use cross-tabulated with cigarettes smoking

The mean OHIP-14 score among those who did have gum problems, during drug use, was 23.1 compared to those not having it (14). This difference was significant ($p < 0.0005$).

Among those who experienced gum problems during drug use, the mean bleeding percentage was 44% (median: 43%; IQR: 10.5% - 73%) while among those without gum problems, the mean bleeding percentage score was 35% (median: 29%; IQR: 0% - 61%). This difference was significant ($p < 0.005$). There was no significant difference in mean DMFT between those with and without gum problems during drug use.

5.6.5.5 Stiff facial muscles during drug

Only 37% of the sample indicated that they experienced stiff facial muscles during using the primary drug of choice (Figure). Methamphetamine users had the highest prevalence of stiff facial muscles during drug use at 44%, followed by mandrax users at 37%. Only about quarter of people who used alcoholic experienced stiff facial muscles during heavy drinking episodes (Figure 17). Opiate and cannabis users were quite similar with 29% and 32% respectively.

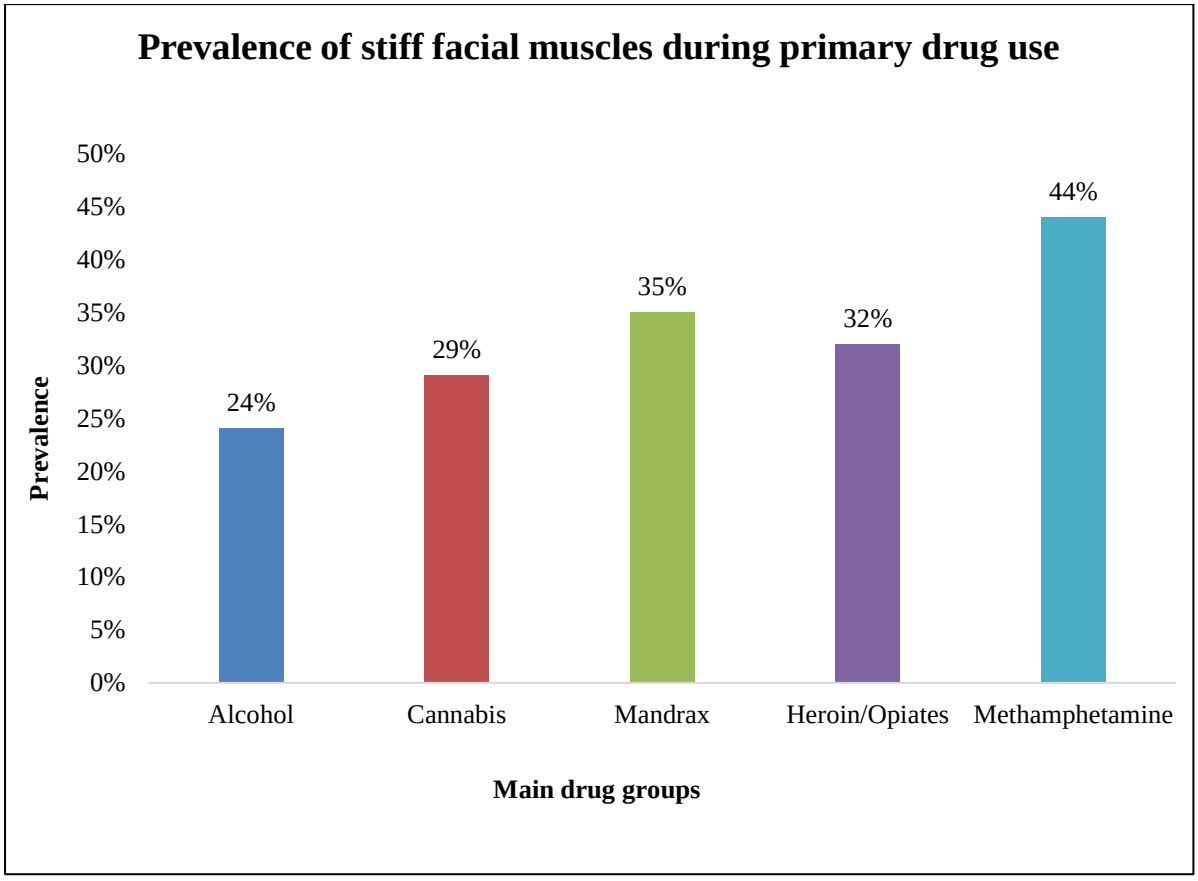

Figure 17: Prevalence of stiff facial muscles when using primary drug of choice

When all the main drug groups and experiencing stiff facial muscles were, an association was found ($p < 0.005$). Using alcohol as a primary drug and experiencing stiff facial muscles during use was associated ($p < 0.005$). Those who were using alcohol as a primary drug were 31% less likely to have stiff facial muscles during alcohol use, compared to those not using alcohol as a primary drug of choice (RR = 0.61; 95%CI: 0.42 – 0.88) (Table 77).

	Having stiff facial muscles during drug use				
Using alcohol as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	24	75	0.48	0.60	*< 0.005*
No	157	238			

Table 77: 2 x 2 table for using alcohol as primary drug and having stiff facial muscles during alcohol use

The other main drugs were not associated with having stiff facial muscles except for those who used methamphetamine as primary drug ($p < 0.0005$). Methamphetamine users were 1.6 times more likely to be have stiff facial muscles during drug use compared to those who did not use methamphetamine as a primary drug (RR = 1.56; 95%CI: 1.22 – 1.99) (Table 78).

	Having stiff facial muscles during drug use				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	112	140	2.01	1.56	*< 0.0005*
No	69	173			

Table 78: 2 x 2 table for using methamphetamine as primary drug and having stiff facial muscles during drug use

Poly-drug use and stiff facial muscles during drug use was associated ($p < 0.009$). The odds of those who experienced stiff facial muscles during drug use were 1.7 times more likely to be poly-drug users compared to those who did not have stiff facial muscles during drug use (OR = 1.7; 95%CI: 1.1 – 2.5). The mean OHIP-14 score of those who had stiff facial muscles during drug use, was 24.25 (median: 24; IQR: 9 – 38) compared to 15.85 median: 14; IQR: 2 – 24) of those not having stiff facial muscles during drug use. This difference was significant ($p < 0.0005$).

No association was found for other variables such as mean DMFT score or cigarettes smoking and having stiff facial muscles during drug use.

5.6.5.6 Experiencing a dry mouth (xerostomia) during drug use

Dry mouth during drug use, was the most common (76%) oral health symptom among all symptoms that were investigated in this study. Among all the main drug groups, those who used cannabis (87%), methamphetamine (83%) and mandrax (79%) had the highest prevalence of a dry mouth (xerostomia) when using the primary drug of choice (Figure 18).

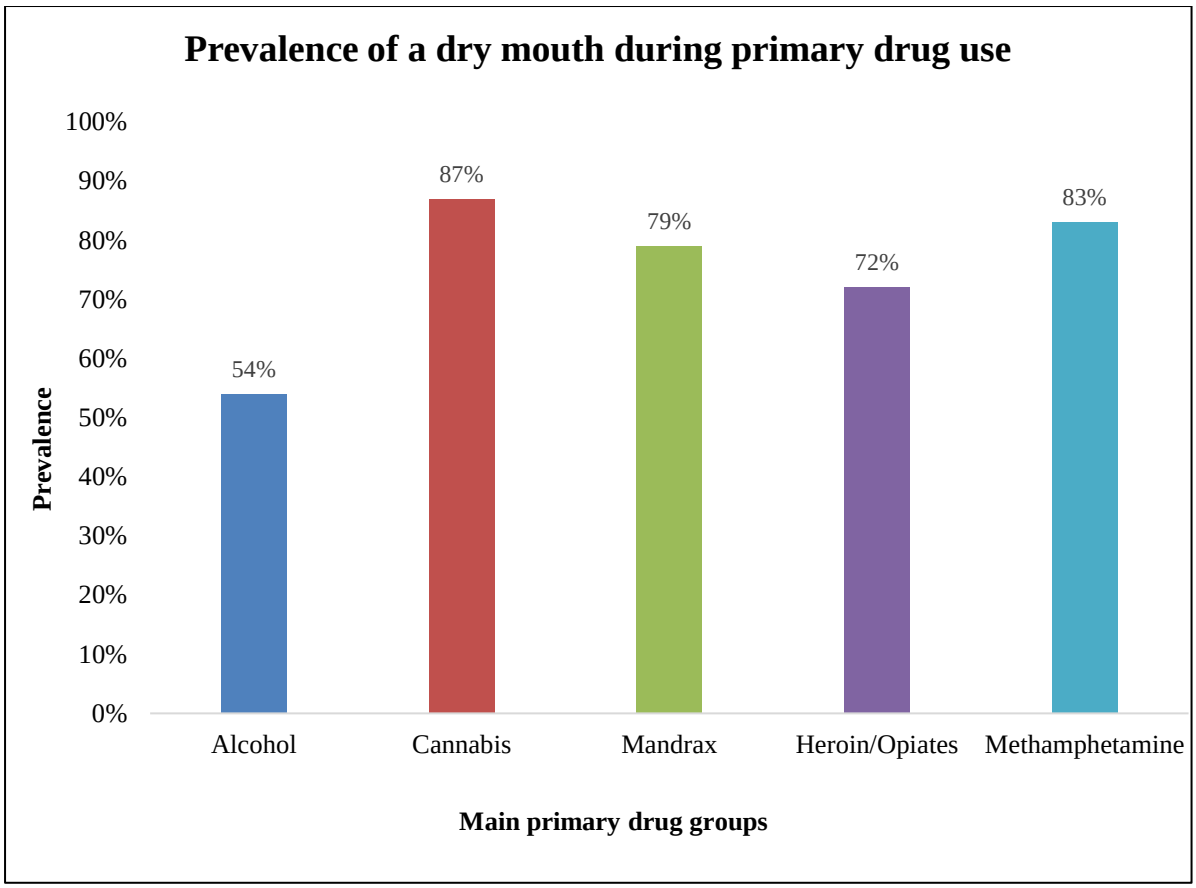

Figure 18: Prevalence of dry mouth when using primary drug of choice

None of the main drug groups were associated with a dry mouth during drug use, except for methamphetamine ($p < 0.0005$). The odds of those who had a dry mouth during drug use were 2.3 times more likely to be methamphetamine users than those who did not had a dry mouth during drug use (OR = 2.29; 95%CI: 1.49 – 3.5) (Table 79).

	Having a dry mouth during drug use				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	216	43	2.29	1.21	*< 0.0005*
No	167	76			

Table 79: 2 x 2 table for using methamphetamine as primary drug and having a dry mouth during drug use

Poly-drug use was an associated with having a dry mouth during drug use ($p < 0.0005$). The odds of those who had a dry mouth during drug use, were 2.6 times more likely to be poly-drug users compared to those who did not experience a dry mouth (OR = 2.6; 95%CI: 1.7 – 3.9).

Cigarette smoking was also associated with experiencing a dry mouth during using the primary drug of choice ($p < 0.05$). The odds of those who experienced a dry mouth during drug use, were 1.8 times more likely to be cigarettes smokers compared to those who did not experience a dry mouth during drug use (OR = 1.8; 95%CI: 1.06 – 2.92).

Brushing frequency and xerostomia was associated ($p < 0.05$). Those who were brushing their teeth frequently (twice and more often per day) were 11% less likely to be experiencing a dry mouth when using the primary drug of choice (RR = 0.89; 95%CI: 0.8 – 0.99).

Mean DMFT score was not associating with having a dry mouth during drug use. However, the mean OHIP-14 score for those who had a dry mouth during drug use was 20.5 (median = 18; IQR: 18 – 31) compared to 14 (median = 11; IQR: 1 – 22) for those not having a dry mouth.

About 50% of the sample reported that their mouth became dry in less than 5 minutes, while 42% said that their mouth became dry between 5 min and 60min after they started using the primary drug of choice. Only 11% said that it took between 1 and 6 hours, while 7% said that it took longer than 6 hours when their mouth became dry (Figure 19).

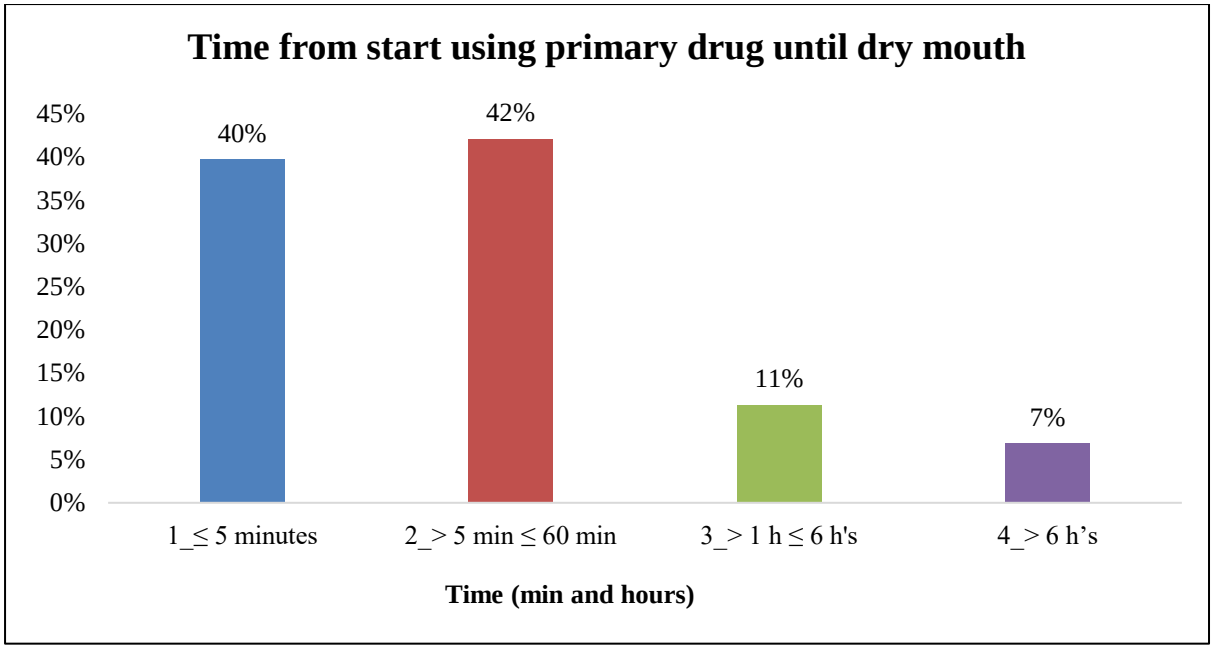

Figure 19: Duration of onset of dry mouth since starting drug use

The time from after drug use until the dry mouth felt "normal" again in terms of saliva presence was also recorded. Slightly more than 41% said their mouth felt normal within an hour after drug use, while 40% said that it took more than an hour but less than 24hours to become "normal" again. Just more than 12% said that it took longer than a day but less than 7 day and just less than 7% said that it took more than 7 days to become "normal" again (Figure 20).

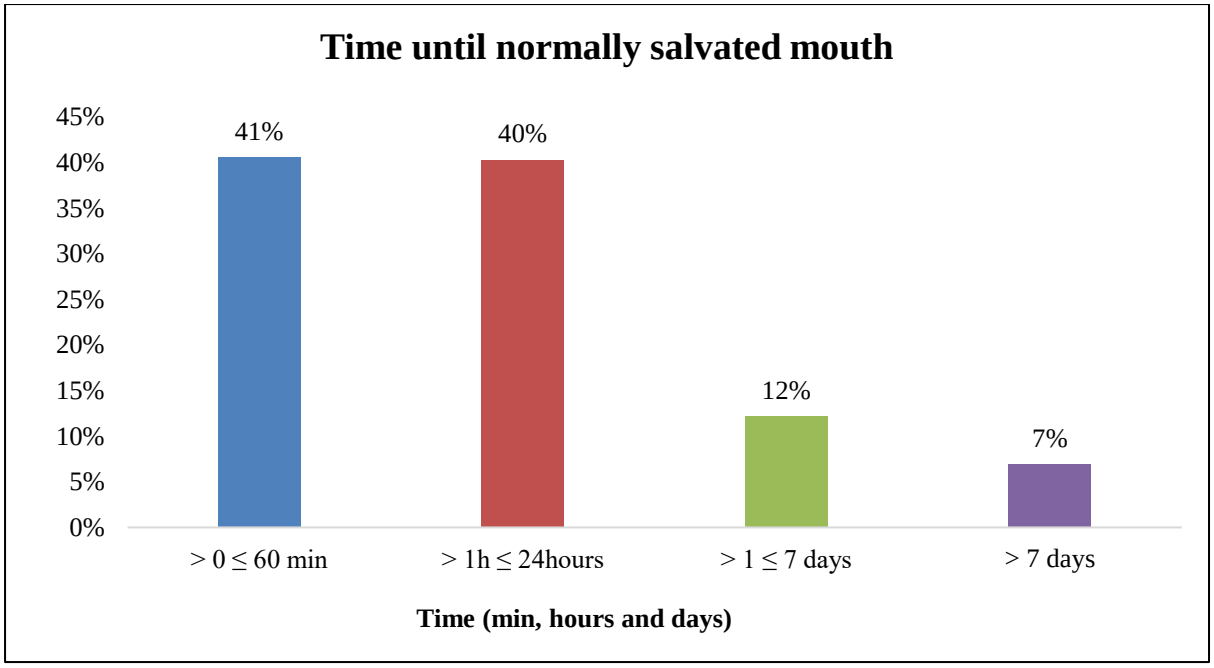

Figure 20: Time from stopping primary drug usage until experiencing normally salivated mouth

An association was found between a dry mouth (xerostomia), during drug use, and cigarette smoking ($p < 0.05$). The odds of experiencing a dry mouth, during drug use, were 1.8 times more among cigarette smokers compared to those who did smoke cigarettes (OR = 1.8; 95%CI: 1.1 – 2.9). Cigarette smokers were 1.2 times more likely to be having a dry mouth than those who not smoke cigarettes (RR = 1.2; 95%CI: 1 – 1.4).

5.6.5.7 Experiencing a bad taste in the mouth during primary drug use

Just over two thirds of the sample reported having a bad taste in the mouth when using their primary drug of choice (Figure 21). An association was observed when the main drug groups were cross-tabulated with presence a or absence of a bad taste during drug use ($p < 0.005$).

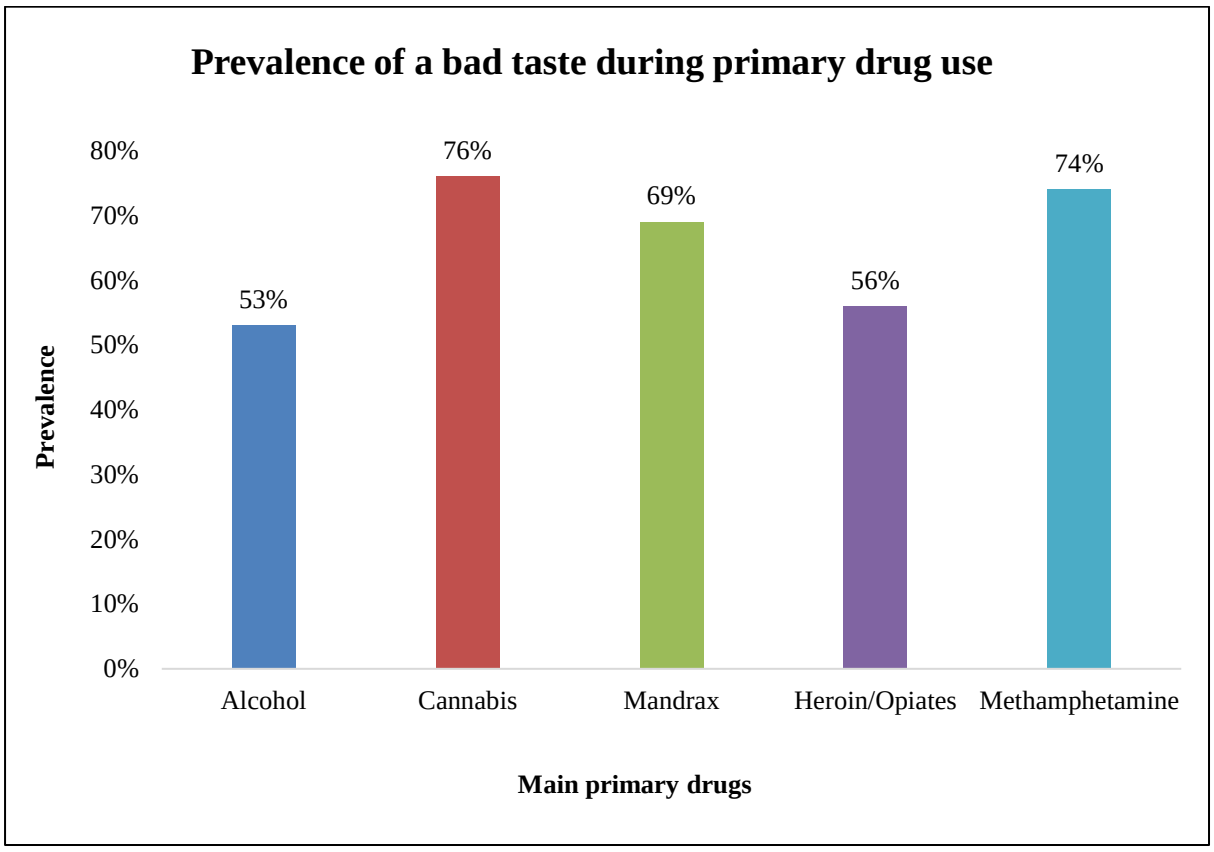

Figure 21: Prevalence of experiencing a bad taste when using primary drug of choice

Those who used cannabis (76%), methamphetamine (74%) and mandrax (69%) had the highest prevalence of a bad taste in the mouth when using the primary drug of choice (Figure). Just over half of those using opiates (56%) and alcohol (53%) had a bad taste during drug use.

Poly-drug use was an associated with having a bad taste in the mouth during drug use ($p < 0.005$). The odds of experiencing a bad taste in the mouth during drug use, were 2 times more among poly-drug users compared to those who were not poly-drug users (OR = 2; 95%CI: 1.37 – 2.97).

None of the main drug group were associated with having a bad taste while using drugs except for methamphetamine ($p < 0.005$). The odds of experiencing a bad taste in the mouth, during drug use, were 1.8 times more among methamphetamine users compared to those who did use methamphetamine (OR = 1.76; 95%CI: 1.2 – 2.5) (Table 80).

	Having a bad taste in the mouth during drug use				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	192	66	1.76	1.20	*< 0.005*
No	150	91			

Table 80: 2 x 2 table for using methamphetamine as primary drug and having a bad taste in the mouth during drug use

Mean bleeding percentage, DMFT, daily cigarettes smoked, alcoholic drinks consumed or brushing frequency was not associated with a bad taste during drug use. However, the mean OHIP-14 score among those who did experience a bad taste during drug use was 21.96 (IQR: 9 – 34) compared to 12.68 (1 – 21) for those who did not have a bad taste while using the primary drug of choice. The difference was significant ($p < 0.0005$).

5.6.5.8 Experiencing a burning sensation in the mouth during primary drug use

Slightly less than a quarter (23.7%) of the sample had a burning sensation in the mouth when using their primary drug of choice (Figure 22). An association was observed when the main drug groups were cross-tabulated with presence a or absence of a burning sensation during drug use ($p < 0.05$).

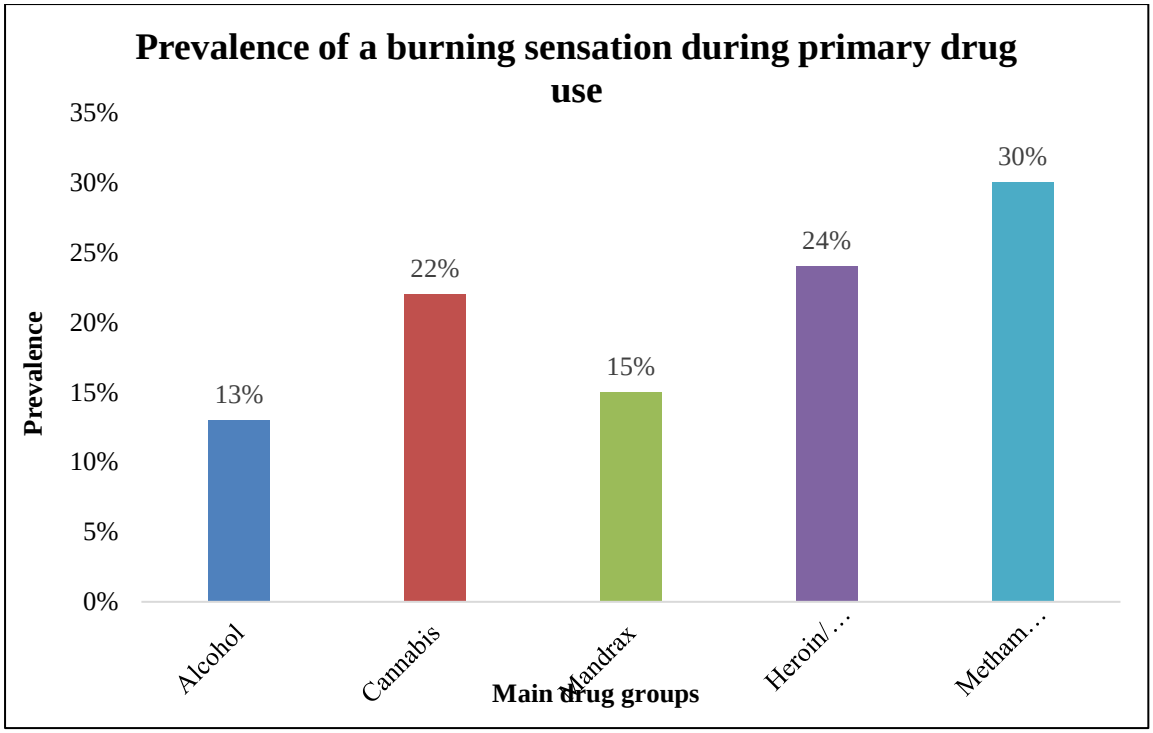

Figure 22: Prevalence of experiencing a burning sensation in mouth when using primary drug of choice

None of the main drug group were associated with having a burning sensation in the mouth when using drugs except for alcohol ($p < 0.005$) and methamphetamine ($p < 0.0005$). Those who were using alcohol were 50% less likely to experience a burning sensation in the mouth during episodes of heavy drinking (RR = 0.5; 95%CI: 0.29 – 0.84) (Table 81).

	Having a burning sensation in the mouth during drug use				
Using alcohol as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	13	88	0.41	0.49	*< 0.005*
No	105	292			

Table 81: 2 x 2 table for using alcohol as primary drug and having a burning sensation in the mouth during drug use

Those odds of those who were experience a burning sensation in the mouth during drug use were 2.1 times more likely to be methamphetamine users compared to those who did not use methamphetamine (OR = 2.1; 95%CI: 1.3 – 3.3). Methamphetamine users were 1.8 times more likely to experience a burning feeling in the mouth during drug use compared to those who were not primary methamphetamine users (RR = 1.79; 95%CI: 1.3 – 2.5) (Table 82).

	Having a burning sensation in the mouth during drug use				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	77	178	2.13	1.79	*< 0.0005*
No	41	202			

Table 82: 2 x 2 table for using methamphetamine as primary drug and having a burning sensation in the mouth during drug use

Poly-drug use was an associated with having a dry mouth during drug use ($p < 0.05$). The odds of having burning sensation in the mouth during drug use, were 1.9 times more among poly-drug users compared to those who were not poly-drug users (OR = 1.85; 95%CI: 1.2 – 2.9). Poly-drug were 1.6 times more likely to have a burning sensation in the mouth during drug use compare to those who were not poly-drug users (RR = 1.6; 95% CI: 1.1 – 2.3).

The DMFT score and OHIP-14 score was significantly different between those with and those without a burning sensation in the mouth during drug use ($p < 0.05$).

The mean OHIP-14 score among those who did experience a burning sensation during drug use was 26.42 (IQR: 14 – 41) compared to 16.73 (3 – 26) for those who did not have a burning feeling while using the primary drug of choice. The difference was significant ($p < 0.0005$).

The mean DMFT score among those who did experience a burning sensation during drug use was 15.19 (IQR: 8 – 22) compared to 12.63 (IQR: 7 – 17) for those who did not have a burning feeling while using the primary drug of choice. The difference was significant ($p < 0.005$).

5.6.5.9 Experiencing tooth sensitivity during drug use

Almost two thirds of the sample (61.28%) were experiencing tooth sensitivity when using their primary drug of choice. The prevalence of tooth sensitivity was the highest among methamphetamine and opiate users with 68% and 67% respectively (Figure 23). For the other main drug groups, slightly more than half of the users experienced it during drug is.

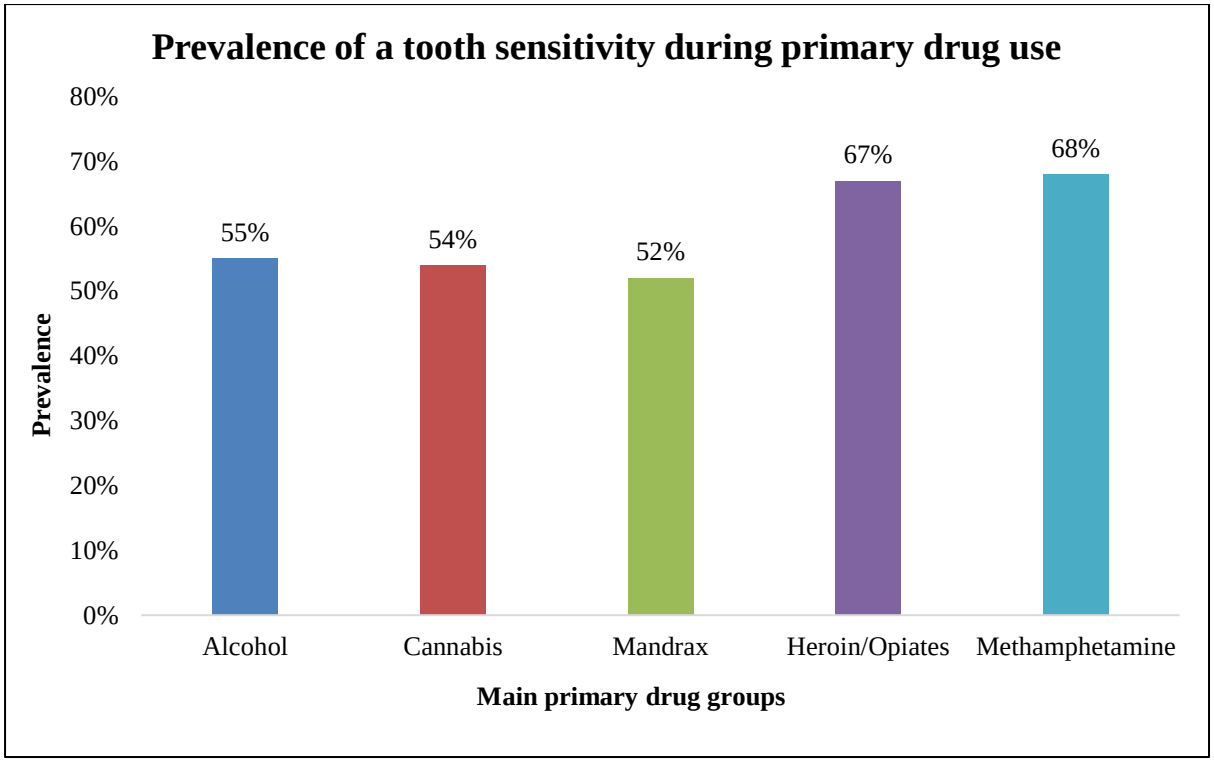

Figure 23: Prevalence of tooth sensitivity when using primary drug of choice

None of the main drug group were associated with experiencing tooth sensitivity when using drugs except for methamphetamine ($p < 0.005$). The odds of experiencing tooth sensitivity, during drugs use, were 1.8 times more among methamphetamine primary users than those who did not use methamphetamine (OR = 1.8; 95%CI: 1.2 – 2.5). Those who were using methamphetamine as a primary drug were 1.2 times more likely to have tooth sensitivity during drug use compared to those who did not use methamphetamine as a primary drug (RR = 1.2; 95%CI: 1.1 – 1.4) (Table 83).

	Having a tooth sensitivity during drug use				
Using methamphetamine as primary drug	**Yes**	**No**	**OR**	**RR**	***p-value***
Yes	168	80	1.76	1.24	*< 0.005*
No	128	107			

Table 83: 2 x 2 table for using methamphetamine as primary drug and having a tooth sensitivity during drug use

Poly-drug use was also associated with tooth sensitivity being experienced during drug use ($p < 0.05$). The odds of those who experienced tooth sensitivity during drug use were 1.7 times greater among poly-drug users compared to those who were not poly-drug users (OR = 1.7, 95%CI: 1.1 – 2.5).

Brushing frequency was not associated with tooth sensitivity during drug use, however an association was found between gender and experiencing tooth sensitivity during drug use ($p < 0.0005$).

Females were 1.34 times more likely to experience tooth sensitivity when using drugs compared to males (RR = 1.33; 95%CI: 1.17 – 1.53) (Table 84).

	Having a tooth sensitivity during drug use				
Gender	**Yes**	**No**	**OR**	**RR**	***p-value***
Females	99	33	2.35	1.34	*< 0.0005*
Males	197	154			

Table 84: 2 x 2 table for tooth sensitivity during drug use cross-tabulated with gender

The mean OHIP-14 score among those who did experience tooth sensitivity during drug use was 23.38 (IQR: 11 – 35) compared to 12.3 (0 – 20) for those who did not have tooth sensitivity while using the primary drug of choice. The difference was significant ($p < 0.0005$).

5.7 PERIODONTAL DISEASE

5.7.1 General description

Periodontal health and presence of periodontal disease was determined using the Basic Periodontal Examination (BPE). This screening tool scored each sextant of the oral cavity on a scale from 0 to 4, with higher scores indicative of more severe periodontal conditions. Its design was used to identify the highest score in each sextant. During examinations one-point (buccal) bleeding on probing was also collected to measure bleeding percentage and to grade gingivitis.

5.7.2 Bleeding on probing (BOP) percentage

The mean BOP percentage was 40.58 (median = 36; SD = 33.44; IQR: 7 – 67).

5.7.2.1 BOP and demographic variables

The mean BOP score was analysed according to demographic profile. Significant different measurements were detected for employment status and level of education (Table 85).

				BOP percentage (n = 463) [$]				
Demographic variables		**n**	**(%)**	**Mean**	**Median**	**SD**	**IQR**	***p-value***
Age group	18 – 29	176	38	44.29	43.5	33.9	9 – 71.5	*> 0.05*
	30 – 39	181	39	40.35	37	32.9	10 – 67	
	40 – 49	74	16	35.24	26.5	32.6	5 – 59	
	50 and older	32	7	33.84	24	34.8	0 – 60	
Gender	Males	335	72	41.15	36	33.6	7 – 68	*> 0.05*
	Females	128	28	39.10	35.5	33.1	5.5 – 65	
Marriage	Single	352	76	40.84	36	33.5	7 – 68	*> 0.05*
	Married	111	24	39.77	34	33.5	6 – 67	
Employment	Employed	200	43	35.24	29	32.3	2 – 58	*< 0.005*
	Unemployed	263	57	44.65	44	33.7	11 – 73	
Education	No school and primary	38	8	54.08	61.5	32.8	30 – 75	*< 0.0005*
	Secondary	333	66	43.90	42	33.5	12 – 70	
	Tertiary and Postgrad	92	18	22.99	14	26.8	0 – 39	

Table 85: Bleeding percentage (BOP) cross-tabulated by demographic information
[$]: n = 463 because BOP was only measured on patients who were dentate or with teeth that could be probed

5.7.2.2 BOP and history of substance use

The mean bleeding on probing percentage (BOP) was compared to different categories of variables related to drug use history. Poly-drug users had a mean BOP score of 43%, significantly higher than the 36% non-poly drug users ($p < 0.05$). The mean BOP score was also significantly different in those who smoked and injected their drug of choice being higher than those who swallowed or snorted it ($p < 0.0005$). A significant difference was also found for frequency of drug use. Those who were daily users had a BOP score of 44% while those who used on a weekly or less frequent basis had a BOP score of 34% ($p < 0.005$) (Table 86).

		BOP (Bleeding percentage)						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Poly-drug use	Yes	296	64	43.13	39.5	33.6	11 – 69	*< 0.05*
	No	167	36	36.07	29	32.8	0 – 63	
Most preferred method of use	Injecting	14	3	45.36	36	36.8	15 – 71	*< 0.0005*
	Snorting	12	3	10.42	0	17.1	0 – 17.5	
	Swallow	105	23	33.41	25	32.7	4 – 54	
	Smoke	332	72	43.74	43	33.8	12 – 70	
Duration of addiction	1 – 10 years	193	42	40.74	36	33.5	7 – 68	*> 0.05*
	11 – 20 years	190	41	42.72	40	33.1	11 – 68	
	21 years and more	80	17	35.14	26	34.1	4 – 57	
Frequency of primary drug use	Daily	293	63	44.13	43	32.7	13 – 69	*< 0.005*
	Weekly and less	170	37	34.47	25	33.9	0 – 61	
Cigarette smoking	Yes	384	83	41.39	38	33.1	9 – 67	*> 0.05*
	No	79	17	36.68	25	36.0	0 – 70	

Table 86: History of primary drug use and cigarettes smoking according to bleeding percentage (BOP)

The mean bleeding percentage for the sample (n = 504) was 39.95% (median = 35%; SD = 33.3; IQR: 7% – 67%). The mean bleeding percentage for each of the drug groups was calculated and also investigated for significant differences. Among the main primary drug groups, those who were using opiates and methamphetamine, as a primary drug, had the highest bleeding percentage at 45% while those who were using alcohol and cannabis shown the lowest mean bleeding percentages of 34% and 32% respectively. Significant differences in mean bleeding percentages for a specific drug group and the rest of the sample were observed among primary alcohol and methamphetamine users (Table 87). People who used alcohol had a significant lower bleeding percentage (34% vs 42%; $p < 0.05$) then the rest of the sample while methamphetamine users had a significant higher bleeding percentage (45% vs 35%; $p < 0.005$) when compared to the rest of the sample (Table 87).

Primary drug group	Bleeding percentage (%)							
	N	mean	median	range	IQR	SD	variance	*p-value*
Alcohol (main)	94	33.98	25	0 – 100	0 – 56	33.3	1108.9	*< 0.05*
Cannabis (main)	40	32.05	27	0 – 100	2 – 54	30.9	953.7	*> 0.05*
Mandrax (main)	43	41.47	43	0 – 100	11 – 65	32	1025.1	*> 0.05*
Crack Cocaine	10	7.7*	0	0 – 52	0 – 4	16.9	285.3	*
Heroin and Opiates (main)	23	44.78	42	0 – 100	21 – 68	28.9	836.4	*> 0.05*
Methamphetamine (main)	242	44.76	44	0 – 100	12 – 73	33.7	1134.8	*<0.005*
OTC and Prescriptions	9	28.33*	25	0 – 89	0 – 46	31.8	1010	*
Total sample	**504**	**40.58**	**36**	**0 – 100**	**7 – 67**	**33.4**	**1118.2**	

Table 87: Bleeding percentage according to primary drug of choice
* Too small sub-sample to calculate significant difference, (main) Main primary drug groups

No association was detected between mean bleeding percentage and the following variables: polydrug use, gender, age, duration of drug addiction and cigarette smoking. However, an association was found between mean bleeding percentage and the following variable: water consumption (as a part of the diet), BPE-score, tooth brushing frequency, OHIP-14 score and mean DMFT score.

5.7.2.3 BOP percentage according to BPE score

The mean bleeding percentage for those who had a higher BPE score (3 to 4) was 52.92% compared to those with a lower BPE score of 0 to 2, was 26.70%. This difference was significant ($p < 0.0005$) (Table 88).

		Bleeding percentage (BOP)				
BPE score	**n**	**Mean**	**Median**	**IQR**	**SD**	***p-value***
BPE 3 – 4	243	52.92	54	30 – 78	30.93	*< 0.0005*
BPE 0 – 2	222	26.70	18.5	0 – 48	30.45	
No Score	39					
Total	**504**	**40.6**	**36**	**7 – 67**	**33.44**	

Table 88: Bleeding percentage (BOP) for BPE score categories (High vs Low)

5.7.2.4 BOP percentage according to presence of periodontitis

The mean bleeding percentage for those who had suspected periodontitis (BPE score of 3 to 4 and with at least 10 remaining teeth) was 52.37% compared to those with a lower BPE score of 0 to 2, was 26.7%. This difference was significant ($p < 0.0005$) (Table 89).

		Bleeding percentage (BOP)				
Periodontitis	**n**	**Mean**	**Median**	**IQR**	**SD**	***p-value***
Yes	238	52.37	54	29 – 77	30.79	*< 0.0005*
No	225	28.12	19	0 – 50	31.61	
Total	**504**	**40.6**	**36**	**7 – 67**	**33.44**	

Table 89: Bleeding percentage (BOP) according to presence of periodontitis

There was no significant difference in mean bleeding percentage for the different categories of demographic variables except for employment status and level of education. Those who were employed had a significant lower bleeding percentage compared to those who were unemployed ($p < 0.005$). Participants who reach tertiary education and postgraduate studies also had a significant lower bleeding percentage than the rest of the sample ($p < 0.0005$).

5.7.3 BPE sores of the sample

Categories for BPE score was established at a "Low BPE score" for those who had a BPE score or 0, 1 or 2 (n = 215; 43% of the sample), those who had a BPE score of 3 or 4 (n = 243; 48% of the sample) and those who had no score (n = 46; 9% of the sample). About 43% of the sample had a BPE score of not more than 2 which was further according to bleeding on probing (BOP) percentage (Table 90).

BPE score	**n**	**%**	**95% CI**
Low BPE score (0 – 2)	215	42.66%	38.41 – 47.02
High BPE score (3 – 4)	243	48.21%	43.88 – 52.57
No score	46	9.13%	6.91 – 11.96
Total	**504**	**100.00%**	

Table 90: BPE score frequency diagram

A BPE score of maximum 2 with less than 10% BOP, was regarded as periodontal health. Just less than a fifth (n = 94; 19%) of the sample fell into this category (Table). A BPE score of maximum 2 was with a BPO of more than 10% were categorized as having "gingivitis". Almost a quarter of the sample was in this group (n = 117; 23.2%) (Table 91).

	Periodontal health	**Gingivitis**
BPE score 0 – 2	BOP < 10%	BOP 10% and more
Yes	94 (19%)	117 (23.2%)
No	410 (81%)	387 (76.8%)
Total	**504 (100%)**	**504 (100%)**

Table 91: Periodontal health vs Gingivitis

5.7.4 Gingivitis

Those who had gingivitis who had a BPO of 10% to 30%, were regarded as having localized gingivitis. Almost 10% (n = 47; 9.33%) were in this group. Those who had gingivitis with a BOP of more than 30% were regarded as having generalized gingivitis. Just over 14% (n = 71; 17.09%) of the sample were in this group (Table 92).

	Localized gingivitis	**Generalized gingivitis**
BPE score 0 – 2	**BOP 10% - 30%**	**BOP > 30%**
Yes	47 (9.33%)	71 (14.09%)
No	457 (90.67%)	433 (85.91%)
Total	**504 (100%)**	**504 (100%)**

Table 92: Localized vs generalized gingivitis

The presence of gingivitis was associated with age groups and marriage status ($p < 0.05$). The prevalence of gingivitis was 26% vs 18% among those who were 36 and older. The odds of having gingivitis among younger patients (18 – 35) was 1.63 timed greater compared to older participants (36 and older) (OR = 1.63) (Table 93). There was no association between prevalence of gingivitis and gender, employment status or level of education.

Demographic variables		Gingivitis				*p-value*
		Yes n (%)	No n	OR	RR	
Age group	18 – 35	82 (16)	228	1.63	1.5	*< 0.05*
	36 and older	35 (7)	159			
Gender	Males	84 (17)	281	0.96	0.97	*> 0.05*
	Females	33 (7)	106			
Marriage	Single	97 (19)	285	1.74	1.55	*< 0.05*
	Married	20 (4)	102			
Employment	Employed	51 (10)	168	1.01	1.01	*> 0.05*
	Unemployed	66 (13)	219			
Education	No school and primary	10 (2)	33	n/a	*n/a*	*> 0.05*
	Secondary	82 (16)	282			
	Tertiary and Postgrad	25 (5)	72			

Table 93: Prevalence of gingivitis cross-tabulated by demographic profile

The presence of gingivitis was analysed according to the main primary drug groups (Figure 24). Opiate and methamphetamine users showed the higest prevalence of gingivitis.

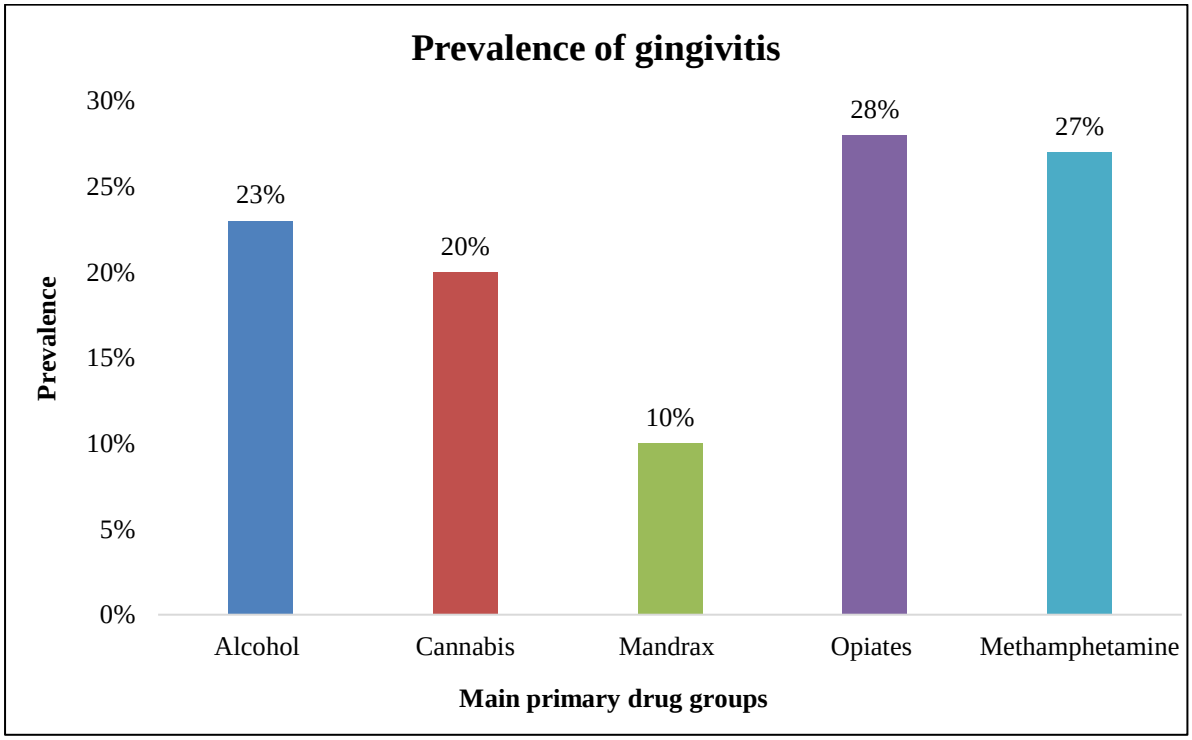

Figure 24: Prevalence of gingivitis more among the main primary drug groups

5.7.5 Periodontitis

Almost half of the sample had a BPE score of 3 or 4, and had at least 10 remaining teeth in the mouth, which indicated that 47% of the sample had suspected periodontitis. Almost a 10th of the sample had "no score" recorded for BPE due to being edentulous or having multiple gross carious teeth association with soft tissue proliferation. Almost a quarter had gingivitis (23%) (Table 94).

Periodontal status	**N**	**prevalence**
Periodontal health	94	19%
Gingivitis	117	23%
Periodontitis	239	47%
No score	54	9%
Total	**504**	**100%**

Table 94: Frequency distribution of periodontal status of the sample

The presence of periodontitis was not associated with any of the demographic variables (Table 95).

Demographic variables		**Periodontitis**		**OR**	**RR**	***p-value***
		Yes n (%)	No n (%)			
Age group	18 – 35	147 (29)	163	1	1	*> 0.05*
	36 and older	92 (18)	102			
Gender	Males	176 (35)	189	1.1	1.1	*> 0.05*
	Females	63 (13)	76			
Marriage	Single	175 (35)	207	0.77	0.87	*> 0.05*
	Married	64 (13)	58			
Employment	Employed	93 (18)	126	0.7	0.8	*> 0.05*
	Unemployed	146 (29)	139			
Education	No school and primary school	24 (5)	19	n/a	n/a	*n/a*
	Secondary	184 (37)	180			
	Tertiary and postgrad	31 (6)	66			

Table 95: Prevalence of periodontitis cross-tabulated by demographic profile

The only association that was found was with mandrax use with the odds of having gingivitis among mandrax users being 0.3 times less (70%) less than the rest of the sample ($p < 0.05$). Heroin or opiate users had the highest prevalence of gingivitis among all the main primary drug groups while as described above, mandrax had the lowest (Table 96).

Main Primary drug groups *484/504 = 96%*	**Gingivitis**					
	Yes	**No**	**Total n (%)**	**OR**	**RR**	***p***
	n (%)	**n (%)**				
Alcohol	23 (23)	79 (77)	103 (100)	0.95	0.96	*> 0.05*
Cannabis	9 (20)	36 (80)	45 (100)	0.81	0.85	*> 0.05*
Mandrax	5 (10)	47 (90)	53 (100)	0.32	0.39	*< 0.05*
Heroin and Opiates	7 (**28**)	18 (72)	25 (100)	1.30	1.22	*> 0.05*
Methamphetamine	69 (27)	190 (73)	259 (100)	1.49	1.36	*> 0.05*
TOTAL	**117 (23)**	**387 (77)**	**484 (100)**			

Table 96: Frequency table for periodontitis among main groups

Prevalence of periodontitis among the main primary drug groups was quite similar with 56% being the highest among mandrax users (56) and lowest among people who used alcohol (44%). For the rest of the main groups it ranged between 44% and 51% (Figure 25).

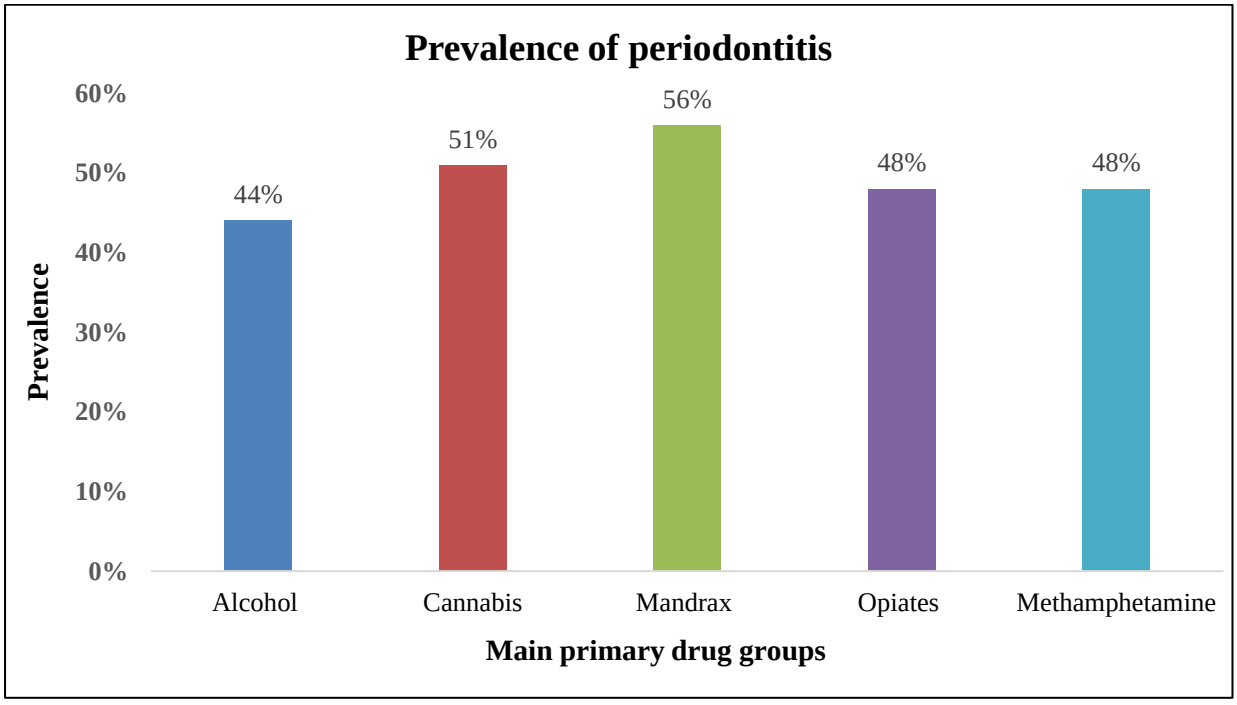

Figure 25: Prevalence of periodontitis among the main primary drug groups

There was no association found between presence of periodontitis and the different main primary drug groups (p > 0.05) (Table 97).

Main Primary drug groups *484/504 = 96%*	**Periodontitis**					
	Yes	**No**	**Total n (%)**	**OR**	**RR**	***p-value***
	n (%)	**n (%)**				
Alcohol	45 (44)	58 (56)	103 (100)	0.85	0.91	*> 0.05*
Cannabis	23 (51)	22 (49)	45 (100)	1.18	1.09	*> 0.05*
Mandrax	30 **(56)**	23 (44)	53 (100)	1.45	1.20	*> 0.05*
Heroin and Opiates	12 (48)	13 (52)	25 (100)	1.02	1.01	*> 0.05*
Methamphetamine	124 (48)	133 (52)	259 (100)	1.04	1.02	*> 0.05*
TOTAL	**233 (48)**	**247 (51)**	**484 (100)**			

Table 97: Frequency table for periodontitis among main groups

There was no association between BPE score and gender, age, duration of addiction. However, there was an association between BPE score and cigarette smoking (p < 0.005), OHIP-14 score (p < 0.05), BOP (bleeding percentage). The odds of having periodontitis were 2.3 times more among smokers compared to those who did not smoke (OR = 2.25; 95%CI: 1.38 – 3.69). Smokers were 1.6 times more likely to have periodontitis compared to non-smokers (RR = 1.6) (p < 0.005) (Table 98).

	Periodontitis		
Smoking	Yes	No	**Total**
Yes	221	206	418
No	27	59	86
TOTAL	239	265	504

Table 98: 2 x 2 table for smoking and periodontitis

5.8 DENTAL TREATMENT NEEDS BASED ON HISTORY OF SUBSTANCE USE

5.8.1 Overall findings

Figure 26 presents the results on dental treatment needs. More than three quarters required fillings while more then halp of participants required dental extractions. (Figure 26).

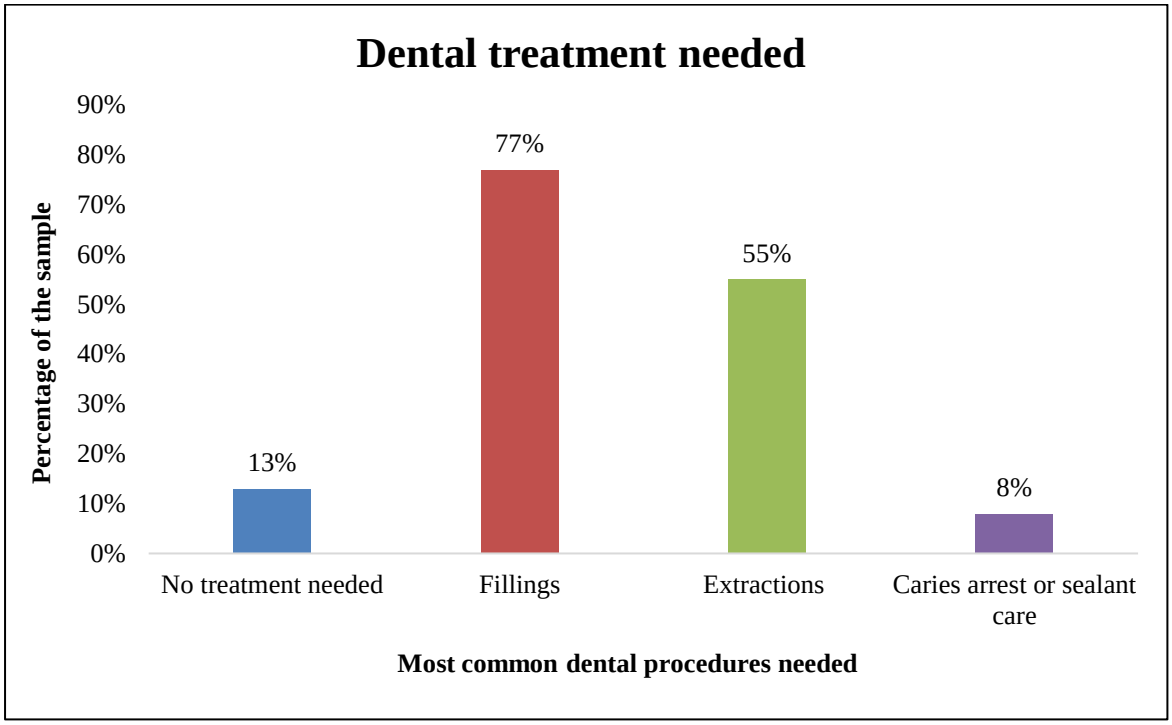

Figure 26: Most common dental treatment needed among the sample

5.8.2 Dental treatment needs according to history of substance use

Among all the main primary drug groups, those who were using heroin or other opiates had the highest need for fillings (88%), extractions (76%) and fissure sealants (20%). Methamphetamine users has the second highest treatment need of fillings (82%) and for extractions (64%). For each of the main primary drug groups, dental fillings, was the highest needof all dental procedures. An association between opiate use and needing extractions was found (OR = 2.8; RR = 1.4; $p < 0.05$). A similar association was found between methamphetamine use and needing extractions (OR = 2.3; RR = 1.5; $p < 0.0005$). Another association was found between methamphetamine use and needing dental fillings (OR = 1.7; RR = 1.1; $p < 0.05$) (Table 99).

		Dental treatment needed					
		Fillings		Extractions		Caries arrest or F/S	
Main primary drug		Yes	No	Yes	No	Yes	No
Alcohol (n = 103)	Yes	77 (75%)	26	34 (33%)	68	9 (9%)	94
	No	314	88	241	161	29	373
Cannabis (n = 45)	Yes	30 (67%)	15	16 (36%)	29	3 (7%)	42
	No	361	98	259	200	35	424
Opiates (n = 25)	Yes	**22 (88%)**	3	**19 (76%)** *	6	**5 (20%)**	20
	No	369	110	256	223	33	446
Mandrax (n = 52)	Yes	35 (67%)	17	31 (60%)	21	5 (10%)	47
	No	356	96	244	208	33	419
Methamphetamine (n = 259)	Yes	213 (82%) *	46	167 (64%) *	92	15 (6%)	244
	No	178	67	108	137	23	222

Table 99: Dental treatment needs according to main primary drug use
***: p < 0.05**

When the code "0" was given no treatment was needed. The mean number of teeth, per participant, given this code was 21 (SD = 5.3; median = 23, IQR: 19 – 26). This meant that on average each participant required some form of dental procedure on 7 teeth.

The mean number of fillings needed per patient was 3.5 (SD = 3.3; median = 3, IQR: 1 – 5) with no significant difference ($p > 0.05$) between males and females but a significant difference was detected between age groups. Those who were 18 to 35 needed 4 fillings compared to those who were 36 and older, only needing 2.7 fillings ($p < 0.0005$).

The mean number of extractions needed per patient was 2.7 (SD = 4.1; median = 1; IQR: 0 – 4) with no significant difference for both gender and age variables ($p > 0.05$). There was a significant difference in number of dental extractions needed between employed (2.3) vs unemployed people (3) ($p < 0.05$). A significant difference was also detected for number of extractions needed according to level of education. Those who only reached primary school needed 4.1 extractions, while those who reached secondary school, needed 2.47 extractions compared to 1.6 extractions needed for those who reached tertiary education or postgraduate studies (0.005).

The mean number of fillings and extractions needed, were also analysed according to the main primary drug groups as well as for other factors pertaining to history of drug use. Methamphetamine users had the highest demand (mean = 3.9) for dental fillings as well as for dental extractions (mean = 3.4). There was no significant difference for mean fillings needed for the main primary drug groups except for methamphetamine users compared to the rest of the sample. On the other hand, a significant difference in the mean number of extractions needed was detected between the different drug groups. Alcohol users needed significant less (1.16) dental extractions compared to those who did not use alcohol as a primary drug ($p < 0.05$). Cannabis users (mean = 2) also needed significant less extractions than the rest of the sample. However, those who used opiates (mean = 3.28) and methamphetamine (mean = 3.41) needed significant more dental extractions then the rest of the sample (Table 100).

		Number of dental procedures needed			
		Fillings		**Extractions**	
Primary drug		**mean**	***p-value***	**mean**	***p-value***
Alcohol	Yes	3.33	*> 0.05*	1.16	*< 0.0005*
	No	3.59		3.06	
Cannabis	Yes	2.98	*> 0.05*	2.00	*< 0.05*
	No	3.60		2.74	
Mandrax	Yes	3.06	*> 0.05*	2.83	*> 0.05*
	No	3.60		2.66	
Heroin/Opiates	Yes	3.72	*> 0.05*	3.28	*< 0.05*
	No	3.53		2.65	
Methamphetamine	Yes	**3.90**	*< 0.05*	**3.41**	*< 0.0005*
	No	3.17		1.90	

Table 100: Number of fillings and extractions needed for main primary drugs groups

The number of dental fillings needed per participant according to their history of substance use was analysed in order to answer the 4th objective of the study. Those who were poly-drug users and those who were not, both required about 3.5 dental fillings ($p > 0.05$). Snorting drug users had less fillings needed compared to those who were injecting, swallowing and smoking their drug of choice ($p > 0.05$). For duration of drug use (addiction), it showed that those who were using the drug for 21 years and longer, needed 2.57 dental fillings compared to 4.34 fillings needed for those who used the primary drug shorter. This difference was significant ($p < 0.05$). There was no significant difference in mean number of fillings needed for cigarettes smokers (mean = 3.54) compared to non-smokers (mean = 3.57; $p > 0.05$) (Table 101).

		Number of dental fillings needed						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Poly-drug use	Yes	323	64	3.59	3	3.8	1 – 5	*> 0.05*
	No	181	36	3.45	3	3.4	1 – 5	
Most preferred method of use	Injecting	15	3	3.53	3	4.0	1 – 4	*> 0.05*
	Snorting	12	2	2.75	2	2.9	0.5 – 4	
	Swallow	113	22	3.27	2	3.3	0 – 5	
	Smoke	364	72	3.65	3	3.3	1 – 5	
Duration of addiction	1 – 10 years	204	40	4.34	4	3.6	1 – 7	*< 0.0005*
	11 – 20 years	206	41	3.19	3	3.0	1 – 5	
	21 years and more	94	19	2.57	2	3.0	0 – 4	
Frequency of primary drug use	Daily	317	63	3.67	3	3.3	1 – 5	*> 0.05*
	Weekly and less	187	37	3.34	3	3.3	0 – 5	
Cigarette smoking	Yes	418	83	3.54	3	3.3	1 – 5	*> 0.05*
	No	86	17	3.57	3	3.5	1 – 5	

Table 101: Number of fillings needed based on history of substance use

A similar finding to number of fillings need, there was no significant difference in the number of dental extractions needed for poly-drug users (mean = 2.88) compared to non-poly-drug users (mean = 2.32). Method of use showed a significant difference in mean dental extractions needed for those who were snorting (mean = 0.67) and swallowing (mean = 1.31) the drug being much lower than for those who were injecting (2.73) and smoking (3.16) their primary drug of choice ($p < 0.0005$). No difference in mean number of dental extractions was found for duration of addiction and for cigarette smoking ($p > 0.05$). However, for frequency of drug use, those who used the drug daily, needed a mean of 3 extractions while those who used the drug weekly or less frequently, needed 2 extractions. This difference was significant ($p < 0.005$) (Table 102).

		Number of dental extractions needed						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Poly-drug use	Yes	323	64	2.88	1	4.3	0 – 4	*> 0.05*
	No	181	36	2.32	0	3.5	0 – 3	
Most preferred method of use	Injecting	15	3	2.73	1	3.8	0 – 4	*< 0.0005*
	Snorting	12	2	0.67	0	1.7	0 – 0.5	
	Swallow	113	22	1.31	0	2.8	0 – 1	
	Smoke	364	72	3.16	2	4.4	0 – 4.5	
Duration of addiction	1 – 10 years	204	40	2.72	1	4.2	0 – 3.5	*> 0.05*
	11 – 20 years	206	41	2.94	1	4.2	0 – 4	
	21 years and more	94	19	2.01	0	3.6	0 – 3	
Frequency of primary drug use	Daily	317	63	3.03	1	4.4	0 – 4	*< 0.005*
	Weekly and less	187	37	2.09	0	3.8	0 – 3	
Cigarette smoking	Yes	418	83	2.74	1	4.0	0 – 4	*> 0.05*
	No	86	17	2.36	0	4.5	0 – 3	

Table 102: Number of extractions needed based on history of substance use

5.8.3 Dental treatment needs and oral health behaviour (OHB)

Oral health habits such as tooth brushing frequency was also analysed according to dental treatments needs. Those who were brushing once a day or less (infrequent) needed 3.6 fillings compared to 3.4 for those who were brushing teeth twice a day or more frequent (frequent). This difference was not significant ($p > 0.05$) (Table 103).

		Number of dental fillings needed						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Tooth brushing frequency during drug use	Frequent	183	36	3.43	3	2.9	1 – 5	*> 0.05*
	Infrequent	321	66	3.60	3	3.5	1 – 5	

Table 103: Number of dental fillings needed according to brushing frequency

Those who were brushing once a day or less (infrequent) needed 3.23 extractions compared to 1.7 for those who were brushing teeth twice a day or more frequent (frequent). This difference was significant ($p < 0.0005$) (Table 104).

		Number of dental extractions needed						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Tooth brushing frequency during drug use	Frequent	183	36	1.70	0	2.78	0 – 3	*< 0.0005*
	Infrequent	321	66	3.23	1	4.56	0 – 4	

Table 104: Number of dental extractions needed according to brushing frequency

5.9 INCLUSION OF ORAL HEALTH INTERVENTIONS IN SUD PROGRAMMES

The following section of results were from Phase 2 focus group discussions with staff members from treatment centres. A qualitative approach was used to determine oral health interventions included in current drug use programmes from the perspective of the facilitators. Focus group discussions with staff from each of selected treatment centred were used to collect data. A semi-structured interview guide was developed to facilitate the focus group discussions (Appendix 9). A semi-structured interview guide was developed and used by the principal investigator to facilitate each focus group and the following questions were posed (Table 105).

No	Question
1.	Do you offer any oral health programmes, oral health education, oral health promotion for your clients/patients while they are in a programme for substance use disorder?
1.1	If yes, what services are offered and how frequent are they offered.
2.	What are your views on the effects of substance use on Oral Health (dental health / state of their teeth)?
3.	Do you think oral health is important for your patients' general health?
4.	Why do you think a person needs good oral health including health gums and teeth?
5.	Do you find oral health problems in your patients? Yes or No
5.1	If yes, what kinds of problems
5.2	What do you do to address these?
5.3	Do you refer them for oral health problems (dental problems)
6.	Do you think that there should be oral health education, promotion for these patients while they are enrolled for treatment at your facility?
7.	What information do you think may be relevant for this group of patients?
8.	Who should provide the oral health education and promotion for patients who are in a substance addiction programme?
9.	In your opinion, which practical things can be done by a patient to maintain good oral health?
10.	What might be the benefits of incorporating an oral health programme into the current general programme for substance us disorder?

Table 105: Semi-structured interview guide used for focus group discussions

Five overarching themes emerged data analysis which included oral health assessments, oral health interventions, health promotion, barriers to oral health treatment and interrelated patient and oral health factors. For each of the themes, sub-themes and related categories emerged from the analysis (Table 106). The five main themes were: oral health assessments, oral health interventions, health promotion, barriers to health and interrelated patient and oral health factors and they will be discussed below.

No.	Themes	Sub-themes	Categories
1.	**ORAL HEALTH ASSESSMENTS**	**General health assessment during admission**	
		Observation to assess dental health	
		Assessment based on patient information	
2.	**ORAL HEALTH INTERVENTIONS**	**Referral for dental treatment**	Governmental health facilities
			Community facilities (e.g. CHC's)
			Private facilities
3.	**HEALTH PROMOTION**	**General health promotion**	
		Oral Health promotion	Benefits to include oral health promotion
			Topics to include in oral health promotion
			Persons responsible for dental health promotion
4.	**BARRIERS TO ORAL HEALTH**	**Limited inclusion of oral health programmes**	
		External systemic barriers to oral health treatment	
		Patient barriers to treatment of oral health	
5.	**INTERRELATED PATIENT AND ORAL HEALTH FACTORS**	**Correlation between oral health and substance use/use**	Substance use contribute to poor dental health
			Poor dental health contributes to substance use
		Patient dental health behaviour	Lack of knowledge on dental health

Table 106: Themes, sub-themes and categories that emerged from focus group discussions

5.9.1 THEME 1: ORAL HEALTH ASSESSMENTS

The focus group participants reported that dedicated assessments were not done when patients were enrolled into a programme for SUD. Oral health information and complaints mostly became known during general medical assessments at intake or when a patient presented at the health department of the centre with a specific dental complaint.

5.9.1.1 General health assessment during admission

The majority of participants reported that no formal oral health programmes are offered during admission, and that the focus is primarily on general health education and self-care talks. Only symptomatic treatment for dental pain is provided in some cases.

"When they first start with the social worker assessment there's a medical part, the social workers will ask them questions about their medical health, mental health, ***physical health, and obviously, part of that is oral*** *and then they get to sister, she has little bit of background as to why the client is with her… the rest of the medical stuff happens."* **(FGD1, P1)**

"They don't go too much into detail… medical section ***… I also usually ask. When last, you went to the doctor or the dentist?*** *So, it's also just a part of, you know, a list of checks."* **(FGDP2, P3)**

Most participants acknowledged that not enough information regarding oral health was available at the various treatment centres.

"I think, in terms of what we do offer, we make an assessment using a ***questionnaire****, … an assessment of which we speak of health. And under* ***health assessment, we would then look at dental hygiene****. It's based on the questions that lead us in certain areas, but it's mainly open ended, and the therapist would primarily lead the conversation, as opposed to the questionnaire.* ***And then part of I mean in terms of most clients, dental hygiene will be something that as a therapist, we will be picking up, because the form or the assessment include dental hygiene****…. It's primarily speaks about health, a one pager of which we look at family planning for females, medical history, hospitalization and its really up to the therapist to speak about dental health in the regard"* **(FGD4, P2)**

5.9.1.2 Observation to assess dental health

When staff observe or identify oral health problems, they sometimes discuss it with patients and refer to a dentist or clinic if available. From the present study, staff also shared that due to dental pain, some patients had great difficulty during counselling sessions to focus and fully participate. This delayed their progress significantly.

*"I **also have an observation**. I distinctly remember had a client in Athlone and with her presentation, I observed that there are issues… that hardly could engage because of our mouth… we didn't tap into the substance issue. So, I think observation is very keen when the patient sits in front of you."* **(FGD1, P3)**

*"Then, sometimes, **based on observation**, we will answer more about dental history."* ***(FGD4, P1)***

5.9.1.3 Assessment based on patient information

Social workers refer clients to medical staff to follow up on complaints about tooth ache or other tooth problems. When problems are reported at the intake, some centres give priority to address it considering that it could be an obstruction to the recovering process.

*"I mean, **it does come up in discussion, quite a lot, 'tooth pain'**."* **(FGD1, P4)**

*"Yes, **sometimes it's not a specific session, but it comes up often. Tooth ache. Tooth pain is very bad one, having their wisdom teeth out, the medication.**"* **(FGD3, P3)**

*"And **sometimes clients will request to be referred** …that oral problems, challenges that I need to take care of… Sometimes clients will elaborate on the care they had including extractions they had this year, and teeth that is paining here and there. We then put it down on the assessment form."* **(FGD4, P1)**

*"……. **we determine based on the client's perception of how the dental health is.** We determine what they would think of it and then in treatment plan, which is another tool associated with assessment when we make the necessary referral"* ***(FGD4, P2)***

5.9.2 THEME 2: ORAL HEALTH INTERVENTIONS

5.9.2.1 Referral for dental treatment

5.9.2.1.1 Governmental health facilities

In the event when a patient has an oral health complaint, the patient usually reports to the nurse or medical unit of the centre, and in most cases only pain relief with paracetamol is offered. In extreme cases, patients are referred to the nearest community health centre when needed, but this is not the norm or routinely done.

"tooth ache…. I then ***normally refer them to Tygerberg****."* (FGD1, P2)

*"****We refer to the dental clinic in Strand****… I think it's a full day clinic… they have an oral hygienist.* ***There is a centre close, in Broadlands Park, and they having an oral hygienist****, is part of the service. Important, so kids can come there for free, and have their teeth checked."* **(FGD2, P2)**

"…when the client comes in and we can see that the oral health is really bad … we will ***emphasize that they need to go to the dentist. So, we obviously will refer to the clinic****."* **(FGD2, P3)**

In most cases, the patient does not have primate health care insurance and is reliable on public dental services. This is part of the challenge, given that not all centres are close to a dental clinic and the waiting list for a dental extraction at most clinics is several months.

"I often transport patients around, and in the past year and a half, ***I have never driven patients to the state dental clinic.*** *There is a medical doctor coming in once a week and she will also see those patients who complain about tooth ache. She will then also make a recommendation or prescribe antibiotics."* **(FGD3, P1)**
"…we try to determine ***who can afford it to go to the dentist, in order then to refer them there...*** *We also provide them with transport."* **(FGD3, P3)**

"Many of the clients I've worked with ***have also presented Tygerberg hospital as the solution…they are aware of the sites, Mitchell's Plain and Tygerberg****… they know as far as accessing it."* **(FGD4, P2)**

5.9.2.1.2 Community facilities

*"****The other facility, matrix facility in town****. They have* ***access to the dentist within the City of Cape Town, who works at the Lentegeur clinic****. So how they have access to all the dentists, he or she they are able to phone and make an appointment for their clients, their direct appointment, which in our case, we wouldn't have, because we are not within the area, so we have to. They have direct access."* **(FGD4, P2)**

5.9.2.1.3 Private facilities

Given the poor access the population have to basic oral health care services, some patients are forced, at a high cost, to seek care at private dentists. One private dentist offered a free service for one patient per month, but unfortunately passed away and nobody followed his pro bono, voluntary service.

"We ***had a dentist once who had a practice in town****. And he was good to us, he took one patient, once a month, treating the patient free of charge. It usually entailed extracting the painful tooth of the patient. Unfortunately, he passed away during the COVID-19 period****. The colleagues thereafter said that they are not able to further assist with this service****. This is unfortune, but this was one way on assisting one out of the patients who complained of tooth ache."* **(FGD3, P3)**

5.9.3 THEME 3: HEALTH PROMOTION

5.9.3.1 General health promotion

Some participants mentioned that they provide educational information regarding the importance of oral health, especially the influence on mental health and appearance a person. There was also mention of oral health being a part of general health and its importance in the recovery process as well a patient's self-esteem and performance in a future job interview.

*"It's **a big part of the overall healthy lifestyle. A big part of our programme is teaching them a healthy lifestyle**, as we all know, drug use, do exercise, sleep while eat well …But then we have different topics. We have like triggers and cravings. Those are all topics, but healthy lifestyle is one of the topics we have to do. So sometimes it will just be mentioned in the session, and sometimes the whole session will be healthy lifestyle. Let's talk about what you're eating every day. What should you eat every day? How should you care for your skin? Ho w much hygiene all of that? We focus more on just hygiene in general."* **(FGD1, P1)**

*"There is a **handout that's called "taking care of yourself"** that's cover briefly the importance of oral health, having your teeth checked, new opportunities"* **(FGD2, P1)**

*"It's just in terms of **taking care of yourself as part of the recovery programme**… just **prevention**."* **(FGD2, P2)**

*"**We do healthy eating habits … It's the balanced diet.** Sugar comes up, because it's the number one drug in the world."* **(FGD3, P1)**

*"In occupational therapy, we **have a group on balanced lifestyle**, these four areas that we focus on, and one of them is care, self-care and how the substances affected that. And then the big amount of sugar that they take. Then that is again the dagga (cannabis) patients."* **(FGD3, P2)**

*"In general, we will also supply the clients with a **water bottle and encourage them the take in water more water during the day**, every day."* (FGD3, P3)

5.9.3.1.1 Benefits to include oral health promotion

Most participants acknowledged the importance of good oral health and its contribution towards general health and wellness. They acknowledged that good oral health results in people feeling good, minimized the risk of developing other oral health issues, such as bad breath, tooth decay, difficulty eating food, and gum diseases and losing teeth. Other general health impact that good oral health can have includes better sleeping patterns, better self-esteem, improving self-confidence and progress with the recovery process.

*"… **dental health is such an important part in all of that**, because if they have tooth ache they're not going to sleep well, or they're not going to eat well. If they're not sleeping well and not eating well, the chances of relapse are higher. So, every time that the oral health impacts another part of the healthy lifestyle negatively, the risk for relapse is bigger…"* (FGD1, P1)

*"… so, I also think **that is also a very good thing we should learn to save our teeth**."* (FGD1, P6*)*

*"Health session as part of the assessment while they are on road of treatment……**there should be oral health education promotion** Yes… Taking care of yourself, maybe just expanding on it, giving more information."* (FGD2, P1)

*"We should … like a component of the of the program or just like additional sessions … I suppose part of it is just it makes the whole treatment more comprehensive, because **it can include oral health… enables them also to understand the damage, but also then how to look after themselves results, to manage that…** Part of the recovery process and becoming independent and ability to take care of myself and provide. So, certainly, **if it helps to have good oral health, because it means my teeth are better than they do better, and it gives a bit impression that… how they think of themselves.**"* **(FGD2, P2)**

A major benefit of improved oral health was the value it extends to supporting family members. Some participants mentioned that it could prevent a relapse and enhance the chances of getting a job after treatment. It will also enable patients to understand oral damage and how to manage it and taking better care in future. This will lead towards better confidence, encouraging patients to observe regular oral health care.

*"…but definitely could…It could be incorporated into another… **A whole hour on dental health… I think it's important… Taking better care of themselves…when they walk and leave here, they're in better shape than hey been before**… I suppose its preparation for them, **if you go into functioning in the world, the way you look, that thing of first impressions is important, and people look at your face first thing, and the mouth, the teeth, that's part of the face. It's lifelong benefits. You know, if you can have good teeth for rest of your life, that will help a lot You can chew better, and you decrease your chances of developing cavities and therefore pain and discomfort and money."* **(FGD2, P3)**

"It's ***important for the patients to develop insight in the importance to main good oral health****."* **(FGD3, P2)**

"I think ***90% of the clients*** *that I have seen since I've been here, they all* ***have dental challenges*** *…because most of them, they come here and they have dental problems and I think we need to pay attention to…* ***it would help them in terms of taking care …it does link into the program in terms of boosting their self-confidence and taking care of themselves****."* **(FGD4, P1)**

"… yeah, ***given the extent to which oral health is affected by substance use and in strong correlation****. I think It should be prioritized within treatment services, one of the one of the requirements by inpatient, especially subsidized facilities, is for us to first determine the extent to which oral health has been affected, and those needs first needs to be serviced on an outpatient basis before clients can be admitted.* ***It highlights the challenges associated with it, but also the need for us to perhaps formally have an aspect designated to oral health during the assessment process, as well as the treatment plan, and it's something that we follow up on the review throughout the program… with proper collaboration, something can be prioritized.****"* **(FGD4, P2*)***

5.9.3.1.2 Topics to include in oral health promotion

Participants agreed that the most important components to include in a dedicated oral health programme for SUD patients, should include basic oral health education and instructions on brushing, flossing, rinsing, and a low sugar diet. There should also be follow-up information sessions that focus on oral health education and promotion to support patients regarding their oral health.

"It is also important that we need to ***know how we should brush our teeth****"* **(FGD1, P6)**

"The education part is important. That's where oral hygienist is coming in…. I have a few clients ***that just don't know about brushing****. I said, you have to brush twice a day. And he said to me, I brush at night, and that's enough. They don't actually know."* **(FGD2, P2)**

*"**Not eating the food with too much sweet stuff …, and the acidic stuff**…I suppose, because of the damage done to the teeth already, it is important to be extra careful in the first few months, or whatever time it takes. I think it also just speaks to **making sure that you know what the condition of your teeth in your whole oral cavity. Getting information and having the proper toothbrush and toothpaste understanding how to brush. So those are the practical things to be done for and then the patient."*** **(FGD2, P2)**

The importance of explaining to patients how the plaque and dental caries process works, was also highlighted in the focus group discussions.

*"Maybe one can **explain to the patients how dental plaque accumulate in the mouth and lead to dental caries… Flossing** is also very important. I have a friend who is a dentist, and he tell me you only floss those teeth that you want to keep. I only started floss at the age of 30. I also used "tik" (meth) in the past and when I was on the street, there was one thing that I always had on me and that was floss… It's a miracle that I still have my teeth. It's very abrasive."* **(FGD3, P1)**

*"They should **understand why it is important to brush**. Also, to get rid of bacteria"* **(FGD3, P2)**

*"Also, maybe if we **can teach the patients who have this cheap gold on the teeth.**"* **(FGD3, P5)**

***Basic oral health education.** That's what they need. We have to start with the basics. I**f you brush your teeth two times a day**, then we can prevent a lot of other things.* **(FGD4, P1)**

*"For me. Is twofold. Number one**, information about treatment, symptoms, the channels to access, but also the other component about self-care and practices associated with self-care**, going forward. I think that could be the two main components. The other component about self-care and practices associated with self-care, I think that would be the two main components, and maybe also some features associated with the potential challenges associated with such as bleeding gums, or what to look for symptoms associated with it."* **(FGD4, P2)**

5.9.3.1.3 Persons responsible for oral health promotion

The initial response in this regard, was that a health professional such as a nurse, doctor or oral hygienist should provide that information on good oral health and maintenance of oral health. However, following focus group discussion, there was consensus that any educated or trained staff can be used to provide information on oral health promotion and oral disease prevention. It was further mentioned that the clinics have the potential to play an important role especially if they were more accessible. A suggestion was made that the use of previous patients as volunteers to motivate for prevention could motivate patients.

"… start with basics and will start with the counsellor, the social worker, most of the medical information in the session with nurse," **(FGD1, P1)**

A ***medical person****, a person who know what they are talking about and someone who have the necessary* ***training****. I think the* ***sister****…* **(FGD1, P4)**

I think preferably if there is ***a nurse*** *to do that…I think then it's a question of if it's, if it's a non-medical person, they need to get the right information from a dentist, or nurse to know what to cover and what not to say and all of that, maybe so* ***it needs to be informed by a medical person who has got the necessary knowledge...*** **(FGD2, P2)**

"If we have a health person, maybe a ***nurse, or therapist combination...****"* **(FGD2, P1)**

"You don't necessary require a doctor (dentist) to host the programme, therefore ***some else at the centre could also present it. Anyone can do it.****"* **(FGD3, P1)**

"Similar to how we incorporate with the OT students, if we can have dental students that can come here, will be very helpful if they can host programmes" **(FGD3, P6)**

"I think ideally it would be ***therapists or oral hygienists*** *to come to us… certain information we are able to give, but these people specialize in the form of medical practitioners to who we refer if it come out from the questions…. those who structure the programme can provide training of the staff. Then are able to give information and able to answer some questions."* **(FGD4, P2)**

5.9.4 THEME FOUR: BARRIERS TO ORAL HEALTH TREATMENT

5.9.4.1 Limited inclusion of oral health in programmes

Although many participants mentioned that oral health features in some general health screenings and discussions, it was not a standalone or dedicated topic for staff training. Occasionally patients report oral health complaints at admission, but there are no clear protocols available to manage the patient accordingly.

*"**It's not specific to oral health, it's just medical. So, any questions regarding medical, any complaints that the client has they will give to the sister**…If they don't mention it at all. Then we won't offer the information…I think it depends on also, the first question on the medical assessment is: what problems does the client have that will impact negatively on the program? If they don't mention it at all. Then we won't offer the information... **but we don't focus a lot on just kind of mention and if we see there's a problem, then sister can refer the patient, but I think if we use that information as part of our lifestyle session, we can give a lot more information**…"* **(FGD1, P1)**

*"**Oral health …. No, not too much**…"* **(FGD1, P2)**

*"There is a handout that's called "taking care of yourself" that's **cover briefly the importance of oral health, having your teeth checked**,"* **(FGD2, P1)**

*"**No, it's no specific, e.g. one of the points, is going to the dentist**."* **(FGD2, P2)**

*I don't think so…I don't think we should be doing it, I think there is cause for referring to… **but oral health No, no, nothing… It's just the basics of brushing, not biting, bottles**…* **(FGD2, P3)**

*"We do healthy eating habits. **Not much on brush**… It's the balanced diet. Sugar comes up, because it's the number one drug in the world. It does come up in the conversation. **But not necessarily what it does to your teeth**."* **(FGD3, P1)**

*"In most of the groups, there is a session on the importance of a healthy body. **But I'm not sure if there is a lecture on the importance of healthy teeth.** If its somewhere on a lecture, it might be only one bullet on a slide."* **(FGD3, P2)**

"I think we accept that everyone knows the importance of brushing teeth. ***We assume that all clients show know that they should be brushing teeth regularly.****"* **(FGD3, P4)**

"… we do have sessions where we talk about taking care of yourself, and sometimes oral health like brushing will come up from those sessions. But ***we don't really have sessions when we say we're going to talk about brushing or taking care of oral health*** *… it will come up."* **(FGD3, P1)**

"I think ***it's the area that is lacking****. We talk about health, we talk about psychiatric, general health, psychological wellbeing, you know,* ***and very little emphasis put on oral health.*** *We even talk about spirituality…* ***but in terms of education, awareness or any other form of dental hygiene or dentistry information is quite limited, and what is shared with clients is quite limited. In that regard….*** *there will be no questions on last consultation (last dental visit) or for their awareness of dental hygiene…And this is probably something that we need to think of, it's really a limitation because it's really dependent on the specific therapist doing the assessment who would pose some questions, and in certain sessions provide some feedback, because our program is limited in terms of that yes, we prioritize other things …* ***some of the things that is prioritized is associated with health, but very seldom dentistry or oral health****."* **(FGD4, P2)**

5.9.4.2 External systemic barriers to oral health treatment

According to participants, a major barrier to oral health care is the extensive waiting time to get basic oral care services such as dental extractions. In some cases, patients need to travel across health districts to seek urgent dental treatment.

"…a lot of the time we have to apply for inpatient and then you have to send them with a dental form to the dentist. Sometimes ***they wait four months to go to the dentist. I****f they go to the Paarl dental clinic, you go,* ***but you can't see the dentist, you're going to get an appointment. You have to sit in line the whole day, then you get an appointment for four months from now, so if you can travel here and sleep on the street, then its better.****"* **(FGD1, P1)**

"…easy access as well, because ***sometimes the days when sister is not here****, you know, what do I tell my client****? They have to now wait another week before they can go without seeing Sister****, you know? I think having that here, even if it was just once a week, so we know, okay, every Friday, whatever's going to be, just to check can be easily from the dentist referral, whatever the case may be…"* **(FGD1, P6)**

"We refer to Strand clinic. They could go to the clinic, ***wait for an appointment, and they only get on specific days, and they take a specific amount of people*** *… just making it more accessible… practical, in that sense, for them, because they do have substance use disorders, and there are symptoms that come with that in the behaviours. And* ***they are not treated always really nicely at the clinic of the fact that they are users, values****, still using. Whatever the case might be. So, they just stay away."* **(FGD2, P1)**

"There is a long waiting period. So, it's not happening while they stay at the centre." **(FGD3, P5) (FGD3, P5)**

Another challenge among the public dental clinics is also the overburdened work load and loss being "community centred".

*"Because not so much the user …****you will discover that they're also say to me, the doctors don't want to give any attention to the healthy teeth****… doctors and dentists needs to be more community centred."* **(FGD1, P5)**

"It's very difficult…. ***Referrals for dentistry in our area. T****here is a form for referrals,* ***the systems are a challenge.*** *So,* ***they need to be there before a certain time, because only a certain number of people are seen a day.****, I know there was a* ***telephone appointment protocol, but that hasn't served our clients well because the*** *telephone numbers do not work."* **(FGD4, P2)**

"…they will go to the clinic. Sometimes they will get an appointment. Sometimes they will be told that ***you must wake up at 03:00 and then come her. Because they will only take a certain number. So, it's they don't really get a response that is one, who to go to or who the dentists were on the day. It depends on whom they spoke to or whose attendance was on the day****."* **(FGD4, P2)**

5.9.4.3 Patient barriers to treatment of oral health

"...some clients are ***from the Paarl*** *office ...* ***they come the night before, and then sleep on the street, so that they can be there, at Tygerberg****."* **(FGD1, P1)**

"I think just having access in a lot of the clients, when you do refer them, ***when they hear Tygerberg, when they hear day clinic, that's when the switches off, because they know this a day that they can't use. Which means I can't use and they don't want to do that. They're not willing to sit for two to three hours…they take the referral note, they end up not going****, so going to use more so you can follow up. But they end up not going because they know how long it's going to take for them to sit there and then not even get the proper treatment."* ***(FGD1, P6)***

*"...****they'll extract one or two at the time without funds …still, that sense of needs and gratification. If they are not going to get it quick, they will just leave it altogether. If it's, why should I go over twice? So, we're going to take two teeth now and then my next appointment, and they don't want to go through all of that again.****"* **(FGD2, P1)**

*"...****our client's ability to access*** *... they need to be there before a certain time, because only a certain number of people are seen a day, that's one, so they* ***need to leave early. And the crime stats and challenges with crime in the area prohibit them leaving certain areas early****... I think there's an aspect that also* ***deters clients is their own levels of anxiety, (around a dentist) and especially from what they've heard in terms of dentist practice at these facilities*** *unfortunately deters them from really being open and willing to go because they are aware that that they have to wait long... And then they also* ***question the levels of compassion at these facilities and dental practice****."* **(FGD4, P2)**

5.9.5 THEME FIVE: INTERRELATED PATIENT AND ORAL HEALTH FACTORS

5.9.5.1 Correlation between oral health and substance use

5.9.5.1.1 Substance use contribute to poor dental health

Staff working at treatment centres were aware of the high prevalence of dental and oral problems. Oral diseases were not only limited to teeth but also affected patient's gums and their

ability to brush their teeth. Poor oral health resulted in pain, dental abscess formation, broken teeth, loose teeth and poor nutrition.

"I think we especially observed in ***methamphetamine users where they have no teeth in the front, or all the teeth are already rotten or broken****. So, it's very obvious the* ***damage that has been caused by the years of Meth use****. I think we had a client the other day where you said her teeth were looking very, very bad because of Meth. And you couldn't believe that she was using the amount that she was saying."* **(FGD1, P1)**

"…she told me that she was using once or twice a week. However, ***the teeth do not reflect once or twice a week. So, we can add, just to see that there's one sister also confirmed that it can't be once this is like a chronic user****. As you can see the damage that has made …"* **(FGD1, P4)**
"…if one look at the spectrum initially, there will still be some looking after myself, but when ***all goes into it becomes from abuse to dependency, certainly, then the decrease in time spent focusing… …the use it leads to deterioration in practice, like oral hygiene*** *practices, decreasing. In the priority of taking care of themselves, or taking care of their teeth. They might only take care of their teeth, once in three days, not every day…* ***the prominence of discoloration and the wearing away of the teeth, so this is not full tooth, it half, but it's usually discoloration, brownish, yellowish kind of thing and with some the spaced, the lack of teeth …just no teeth. This duly is an indication this use is a long time.*** *It's not just been for the last month. There has been* ***progressive use for quite a while to have this level of deteriorating****."* **(FGD2, P2)**

"Brittle teeth, I mean meth mouth. ***People who are known for substance use, their teeth short, and it fall out. Their favourite thing is, they just pull teeth****."* **(FGD2, P3)**

"Well, we know that ***some drugs make your mouth dry, then the saliva cannot take the bacteria away and they grind on the teeth, especially the tik (meth).*** *They don't brush to get bacteria out of the mouth."* **(FGD3, P2)**

"So, I think then, then oral hygiene, or taking care of their ***oral health is the last thing on their minds when they're using*** *because they always share when we are in the group…, the first thing is to get their effects, and everything else comes after…"* **(FGD4, P1)**

"I do believe that ***there's a correlation between those who use substances and poor oral health you know, and whether it's a result of the substances they ingest or a result of poor practices, you know, that part I am uncertain*** *of. But I am aware that many people* ***who use for some time suffer from poor oral health or decay or broken teeth****. You know, candidates quite frequently. And so, I think my limited understanding is just really, is it the result of poor hygiene practices or the smoke that they, you know, or the combination of the two."* **(FGD4, P2)**

5.9.5.1.2 Poor dental health contributes to substance use

Having poor access to basic oral health care, especially in the public sector was a major issue and challenge for patients, but it was clear from the feedback from staff that this was not the only concern. Untreated tooth decay was highly prevalent among SUD patients, and it was conjectured that following discharge from the treatment centre, toothache could be a trigger for a relapse with a return to substance use to address the pain.

"I had a client that came to me last year, he was clean. He just wanted extra support. She was already in recovery…Something interesting that he mentioned, when he was using Tik (Meth), he never got sick, never ever. Through COVID, he never got sick. And then ***while he was with me, he started experiencing toothache and the thought that came to his mind, maybe if could take one more hit, this toothache will go away……how his toothache or how his oral health, actually put that thought in his mind, maybe just one more hit, you know? Then I'm not going to experience that pain anymore.*** *But he didn't think of maybe I should go see a dentist or maybe you can refer me to sister to talk about it. So, it was just quite interesting for me…He didn't go to the dentist, he then eventually started changing his shifts. So, I didn't see him again. I didn't see like him. But that just that the thought that he had that came to his mind, you know, because of the toothache that he was experiencing."* **(FGD1, P3)**

"… if I have pain, look at the ability to endure pain is also versus when you're not drugs … that would also now lead to an excuse to use. The patient relapse when the have pain." **(FGD2, P2)**

"We always ask. Remember ***pain is also a trigger…"*** **(FGD2, P3)**

"What we also see here is ***when they quit or stopped using the substances, then they started the tooth ache. That's sometimes when they keep on using****."* **(FGD3, P2)**

"…the other challenge is because it's often perpetuated in that they ***self-medicate to treat the symptoms associated with a broken tooth, pain,*** *instead of accessing dental care, they use on it and then therefore becomes worse, and the* ***drugs is therefore used to manage pain****, as opposed to accessing treatment or intervention… Some* ***often relapse, whether it's on the drug of choice, be it meth (methamphetamine) or over the counter medication to manage pain.*** *… a few years ago, I had a client overdose while treating pain as a result of oral health, and she was subsequently admitted at hospital for suicide attempt, but it was not suicide, it was just dealing with the pain associated with oral health, poor oral health. So, it's something that we need to think of and look at and correct far as possible." (FGD4, P2)*

5.9.5.2 Patient dental health behaviour

5.9.5.2.1 Lack of knowledge on dental health

"I think also… brushing twice a day… That's general information, that our clients obviously forget or people, they don't do it." **(FGD1, P3)**
"Normally they ask for the type of toothpaste you need to use for bleeding gums, severe bleeding gums." **(FGD1, P5)**

"When they come to us, they are adults, then it's too little too late. At the age of 4 or 5, you need to teach the child about brushing teeth." **(FGD3, P1)**

"I think many patients did not received the necessary oral health education from childhood." **(FGD3, P2)**

"I also think that many of them don't know that they should be brushing teeth twice a day. Or to brush after a meal. Many of think that it's OK to only brush in the mornings and then it's enough… They also don't know that they should be brushing their tongue. Or how to hold the toothbrush in terms of angulation." **(FGD3, P3)**

5.9.5.2.2 Methods implemented for dental health

Despite the contributing factors to poor oral health and challenges that patients experienced accessing basic oral health care, it was reported that some patients used innovative ways to improve their oral health status. For example, ash from charcoal after making a fire, was used as an alternative to toothpaste. From the staff perspective, this was very effective as a medicament to remove dental plaque and contribute to some degree of making teeth appear whiter. The ash was free and as a popular method for tooth cleaning among drug users. Some users also added lemon juice after brushing with a mixture paste of water and ash.

"They place the ash on the toothbrush." **(FGD1, P1)**

"The clients reported using charcoal. The charcoal is at their disposal from the ash after they made a fire…. About half of the patients use this practice. They said their teeth are clean and some say it is whitening their teeth." **(FGD1, P2)**

"If they don't have a toothbrush, they can make use of a cloth. They say they brush the teeth with the mixture of ash and water. The charcoal also gets crushed and then its mixed with water and then they brush their teeth." **(FGD1, P5)**

"Some even add some lemon juice afterwards." **(FGD1, P3)**

"…growing up in the Eastern Cape. And then my grandmother forced us to use a soap to brush teeth. And to make sure that you don't swallow. If there was no soap, when used the "baksteen" the red one. If there was no "baksteen", we would use the ash to brush our teeth." **(FGD3, P3)**

5.9.5.3 Influence of oral health on the physical well-being of the patient

This sub-theme was linked to oral health and its influence on physical well-being of the patient. Staff emphasized that better oral health contributed to improved quality of life, better self-esteem, prevented unnecessary discomfort and improving sleeping and eating patterns.

"…if the oral health is good, it eliminates a lot of the other problems…. Taking exercise, if you have tooth you're you are not gonna go running today. Because your tooth is sore, so you gonna lie in your bed you're ***not going to go and do healthy habits and healthy activities outside your house because you're not feeling good."*** **(FGD1, P1)**

*"… your **energy levels, your appetite, your sleep**… I never realized that, you know, one's appetite also links to that, because he **had been experiencing toothache makes him not wanting to eat because he's dosing himself with so many painkillers, just to numb the pain**."* **(FGD1, P3)**

*"The other day in my nutrition talk that your oral health will impact your physical health. If **you are not looking after your teeth and your mouth, you can get sick. It can have an impact on mood and mental health**."* **(FGD2, P3)**

*"I was thinking of what the consequences is of losing your teeth… you then **can't eat all kinds of food…it affects your gums**. One of our patients, who recently left, **he was eating everything that we gave him. Literally everything, but he had no teeth. So, I was just wondering, what does it do to your digestive system if you have no teeth … they are not able to break down the food before swallowing it**."* **(FGD3, P1)**

*"They come to us and then complain that **they cannot eat or sleep properly, because of toothache.** They also say that if they can't sleep properly, **they are tired the whole time**. Therefore, **they cannot attend the classes and there are further consequences**."* **(FGD3, P3)**
*"**Bad breath its regular. Pain, that is the constant complaint…**broken tooth and sometimes broken tooth is almost bearable, in comparison with tooth ache."* **(FGD4, P1 and 2)**

Influence of oral health on the self-image of the patient

*"… **they are ashamed to talk to the social worker**."* **(FGD1, P1)**

*"I distinctly remember had a client in Athlone and with her presentation, I observed that there are issues… **she was very shy**"* **(FGD1, P3)**

*"… **confidence or an awareness about her teeth … she's not a talker**. Just to find out where **her confidence levels are on with regards to how she's feeling or is she just generally a quiet person**."* **(FGD1, P4)**

*"I also think **it builds self-confidence** in our clients' engagements are, in motivating people to get confidence early earlier on, getting better on with people."* **(FGD1, P1)**
*"Yeah, I was also thinking, if clients actually do take care of their mouth and their teeth, there is a **level of confidence** that comes with that…"* **(FGD2, P1)**

"I just wanted to add that I had a patient in the lock-down (COVID-19 lockdown period), who said that ***they were so glad about wearing a mask, because they could cover their mouth because their teeth were in such a bad state****. Especially referring to ladies who said that they were very shy."* **(FGD3, P3)**

"I think it also ***affects confidence*** *...for many of them can I say deeper in a sense that it's not even about appearance to others, but sometimes it's just about them... One* ***of the things is self-image, one of the things that when they come in, they often mentioned****, I couldn't look at myself…it's oral health that still keeps them back. And when that is kind of taken care of, you "know, they start wearing that smile, you know, just the confidence really comes back. It's just a sense of self, identity, feeling better … just looking better now… sometimes it's not, it's just an extraction. There's not even a false tooth or anything, it is a sense of accomplishment that comes with it."* **(FGD3, P2)**

5.9.5.4 Oral health and the social functioning of the patient

5.9.5.4.1 Poverty and unemployment

Most patients at the rehabilitation clinics were from low socio-economic backgrounds and with no access private dental care. Poverty was mostly associated with a very high unemployment rate among drug users. Some staff members reported that due oral health problems, many patients did not attend interviews despite needing a job desperately. Many patients had low confidence due to badly broken, carious and discoloured teeth and together with pain and discomfort, their motivation to attend an interview was very low. The environment where people live needs to be supportive in order to assist the rehabilitated patient to remain a life of sobriety. From the focus group discussion many staff reported that supportive mechanisms and adequate living conditions were absent when patients returned to their home environments following treatment.

*"The next generation and the next it just continues with the poorer oral health, instead of continuing with good oral health…****problem is Sensodyne is expensive the clients cannot afford that. So even if we have the suggestion of how to do it better, they can't afford it… entering the workforce again, and none of our clients don't want to go for interviews****… they're not going to go to an interview to talk to a professional person behind the desk to get a job. So, they would rather just stay at home, and they'll go for the interview."* **(FGD1, P1)**

*"Many of our clients, are **living on the streets or the shelters**."* **(FGD1, P2)**

*"Many of the patients **do not have the financial ability**. Many are **unemployed**. Their family also does not have the finance to support them going to a dentist."* **(FGD3, P3)**

5.9.5.4.2 Interpersonal relations

*"You know, **even a social thing coming into recovery, you make new friends. People are going to judge you**."* **(FGD2, P3)**

*"If **your teeth are bad, people will tease you. Bullying** going around."* **(FGD2, P2)**

5.9.5.4.3 Communication

*"I remember had a client ... **I hardly could engage because of the mouth**."* **(FGD1, P3)**

*... **it was very difficult to engage with her**. And I normally screen clients for 30 to 40 minutes. After 20 minutes. I didn't know what to say, because she didn't want to speak, "So, it limits you, **it limits your ability to engage with someone if you have bad teeth**."* **(FGD2, P4)**

*"**Speech is another thing, the development of speech, the pronunciation from words, and the stigma stigmatization in terms of not being able to pronounce words**."* **(FGD3, P4)**

5.10 ORAL HEALTH-RELATED QUALITY OF LIFE (OHRQOL)

5.10.1 General description

The Oral Health Impact Profile (OHIP-14) questionnaire was used to measure oral health related-quality of life (OHRQoL). The 14 questions were grouped into seven dimensions namely functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability and handicap.

5.10.1.1 Functional limitation

Most of the responses for the functional dimension of OHIP-14 indicated minor negative impact. Almost two thirds of the sample (62.3%) said that they "never" had trouble pronouncing any words because of problems with their teeth, mouth or dentures over the

previous 12 months. Only 11% reported a negative impact (fairly often and very often) on their ability to pronounce words due mouth problems. About half of participants felt that their sense of taste has “never” worsened because of problems with their teeth, mouth or dentures. Only 18% had a negative impact on sense of taste over the previous 12 months (Table 105).

5.10.1.2 Physical pain

About a third of response for the physical pain dimension indicated a minor impact while slightly more than a quarter indicated a major impact on OHRQoL via physical pain.
On the question on having a painful or aching in the mouth over the preceding 12-month, the response was fairly evenly distributed across the scale. However, almost a third (fairly often and very often) of participants did indicate that they found it uncomfortable to eat food due problems with their teeth, mouth or dentures (Table 105).

5.10.1.3 Phycological discomfort

The question on being self-conscious because of oral health problems had the highest (26%) negative impact response (very often) among all the dimensions. Participant responses were clearly divided (48% vs 26%) by either having “never” or “hardly ever” being self-conscience vs “very often” or “fairly often” with only 16% reporting “occasionally”. Regarding feeling tense, response was again fairly evenly distributed except for an elevated (38%) “never” response to feeling tense (Table 105).

5.10.1.4 Physical disability

Over the preceding 12 months, more than half of the sample “never” had experience of their diet being unsatisfactory due to problems with their teeth, mouth or dentures. Only 20% reporting having a negative impact (very often or fairly often) on their diet. This trend was very similar with more than half of the sample “never” or “hardly ever” needed to interrupt meals because of oral health problems. Only 23% reported “fairly often” or “very often” having interrupting their meals due to oral health problems (Table 105).

5.10.1.5 Psychological disability

More than half of the sample “never” or “hardly ever” found it difficult to relax due to oral health problems while only a quarter (25%) reported “fairly often” or “very often” founding it difficult to relax. Almost half reported “never” or “hardly ever” feeling a bit embarrassed due to problems with their mouth, teeth or dentures. More than a third of the sample did report having a negative impact (“fairly often” or “very often”) on their OHRQoL by feeling a bit embarrassed over the preceding 12 months (Table 105).

5.10.1.6 Social disability

More than half of the sample reported “never” or “hardly ever” being irritable with people due to problems with their teeth, mouth or dentures. More than a quarter (27%) reported “fairly often” and “very often” being irritable with other people due to oral health problems. The majority of the sample (70%) “never” or “hardly ever” had difficulty doing their usual jobs due to oral health problems. Only 22% reporting having difficulty doing their daily job “fairly often” or “very often” (Table 105).

5.10.1.7 Handicap

This dimension of the OHIP-14 instrument had the most responses on the “0” and “1” end of the scale. Almost two thirds (64.5%) reported “never” or “hardly ever” feeling that life in general was less satisfying because of problems with their teeth, mouth or dentures. About 22% had felt life was satisfying “fairly often” or “very often”. Similar to the response to the previous question, almost two thirds of the sample had never or hardly ever been totally unable to function due to oral health problems. Only 12% reported having felt a negative impact on not being able to function (Table 107).

Question: In the last 12 months, n = 504	Never (0) n (%)	Hardly ever (1) n (%)	Occasionally (2) n (%)	Fairly often (3) n (%)	Very often (4) n (%)
FUNCTIONAL LIMITATION					
1. Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?					
	314 (62.3)	63 (12.50)	70 (13.89)	25 (4.96)	32 (6.35)
2. Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?					
	250 (49.6)	80 (15.87)	83 (16.47)	40 (7.94)	51 (10.12)
PHYSICAL PAIN					
3. Have you had painful aching in your mouth?					
	140 (27.8)	91 (18.06)	118 (23.41)	64 (12.70)	91 (18.06)
4. Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?					
	170 (33.7)	50 (9.92)	117 (23.21)	63 (12.5)	104 (20.63)
PSYCHOLOGICAL DISCOMFORT					
5. Have you been self-conscious because of your teeth, mouth or dentures?					
	189 (37.5)	48 (9.52)	83 (16.47)	51 (10.12)	133 (26.39)
6. Have you felt tense because of problems with your teeth, mouth or dentures?					
	193 (38.3	56 (11.11)	101 (20.04)	58 (11.51)	96 (19.05)
PHYSICAL DISABILITY					
7. Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?					
	256 (50.9)	72 (14.31)	72 (14.31)	41 (8.15)	62 (12.33)
8. Have you had to interrupt meals because of problems with your teeth, mouth or dentures?					
	224 (44.5)	74 (14.71)	86 (17.10)	55 (10.93)	64 (12.72)
PSYCHOLOGICAL DISABILITY					
9. Have you found it difficult to relax because of problems with your teeth, mouth or dentures?					
	218 (43.3)	77 (15.28)	83 (16.47)	60 (11.90)	66 (13.10)
10. Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?					
	199 (39.5)	47 (9.33)	77 (15.28)	55 (10.91)	126 (25.00)
SOCIAL DISABILITY					
11. Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?					
	216 (42.9)	72 (14.29)	79 (15.67)	49 (9.72)	88 (17.46)
12. Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?					
	274 (54.4)	80 (15.87)	59 (11.71)	41 (8.13)	50 (9.92)
HANDICAP					
13.Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?					
	262 (52.0)	63 (12.50)	67 (13.29)	46 (9.13)	66 (13.10)
14. Have you been totally unable to function because of problems with your teeth, mouth or dentures?					
	305 (60.5)	69 (13.69)	70 (13.89)	29 (5.57)	31 (6.15)

Table 107: Frequency distribution of OHIP-14 responses of the sample

5.10.2 Severity of OHIP-14

The total OHIP-14 score measures the severity of negative impact on OHRQoL. For each of the 14 questions, a 5-point Likert scale response format (0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, 4= very often) was given to measure oral functional limitation, discomfort, and disability.

The sum of the scores for each question (item) was used to calculate a total score (maximum of 56) as well as the sum for each dimension. Higher scores indicated a poorer OHRQoL. The mean OHIP-14 score for the sample was 18.93 (median = 17; SD = 15.44, IQR: 5 – 29.5) (Table 106). The physical pain and psychological discomfort dimensions of the instrument showed the highest negative impact on OHRQoL with a mean of 3.51 and 3.4 respectively for these two dimensions. The functional limitation and handicap dimensions showed the lowest means of 1.94 and 2.02 respectively indicating the lowest impact on OHRQoL due to problems with teeth, mouth or dentures (Table 108).

	OHIP specific dimension score				
Question: In the last 12 months,	**mean**	**median**	**range**	**SD**	**IQR**
FUNCTIONAL LIMITATION	1.94				
1. Trouble pronouncing words	0.81	0	0 – 4	1.22	0 – 2
2. Worsened taste	1.13	1	0 – 4	1.37	0 – 2
PHYSICAL PAIN	3.51				
3. Painful aching in mouth	1.75	2	0 – 4	1.44	0 – 3
4. Discomfort eating food	1.76	2	0 – 4	1.53	0 – 3
PSYCHOLOGICAL DISCOMFORT	3.40				
5. Feeling self-conscious	1.78	2	0 – 4	1.65	0 – 4
6. Feeling tense	1.62	2	0 – 4	1.54	0 – 4
PHYSICAL DISABILITY	2.50				
7. Poor diet	1.17	0	0 – 4	1.44	0 – 2
8. Interrupted meals	1.33	1	0 – 4	1.45	0 – 4
PSYCHOLOGICAL DISABILITY	3.09				
9. Difficult to relaxing	1.36	1	0 – 4	1.46	0 – 2.5
10. Embarrassed	1.73	2	0 – 4	1.65	0 – 3.5
SOCIAL DISABILITY	2.50				
11. Irritable with other people	1.46	1	0 – 4	1.53	0 – 4
12. Difficulty doing your usual jobs	1.04	0	0 – 4	1.37	0 – 2
HANDICAP	2.02				
13. Life less satisfying	1.19	0	0 – 4	1.47	0 – 4
14. Totally unable to function	0.83	0	0 – 4	1.23	0 – 2
Total	**18.93**	**17**	**0 - 56**	**1.23**	0 – 2

Table 108: Severity of OHIP-14 for the sample

5.10.2.1 Severity of OHIP-14 according to demographic information

The interaction between OHIP-14 total score and demographic information was investigated. Younger persons in the age group 18 – 35 years had a lower (17.97) OHIP-14 score than older people (20.48), however this difference was not significant ($p > 0.05$). OHIP-14 score for males and females were very similar (18.65 vs 19.65; $p > 0.05$).

However, there was a significant difference detected between single person vs married persons. Single people had a mean OHIP-14 score of 18.04 vs 21.73 for those who were married ($p < 0.05$). There was also no significant difference in OHIP-14 score between employed (18.1) vs unemployed people (19.58) ($p > 0.05$). There was also no significant difference in OHIP-14 score between the different categories for level of education ($p > 0.05$) (Table 109).

		OHIP-14 total score							
Variables		**n**	**%**	**mean**	**median**	**range**	**SD**	**IQR**	***p-value***
Age group	18 – 35	310	61.51	17.97	16	0 – 56	14.58	5 – 27	*> 0.05*
	36 and older	194	38.49	20.48	18	0 – 56	16.63	5 – 34	
Gender	Males	365	72.42	18.65	17	0 – 56	15.13	5 – 29	*> 0.05*
	Females	139	27.58	19.68	16	0 – 56	16.26	5 – 33	
Marital status	Single	382	75.79	18.04	16	0 – 56	15.10	4 – 28	*< 0.05*
	Married	122	24.20	21.73	18.5	0 – 56	16.20	8 – 35	
Employment status	Employed	219	43.45	18.10	15	0 – 54	15.65	5 – 29	*> 0.05*
	Unemployed	285	56.55	19.58	18	0 – 56	15.27	6 – 30	
Level of Education	No school and primary	43	8.53	16.98	11	0 – 49	15.15	4 – 28	*> 0.05*
	Secondary	364	72.22	19.38	17.5	0 – 56	15.48	6 – 30	
	Tertiary and Postgrad	97	19.25	18.12	15	0 – 56	15.47	5 – 28	
Total		**504**	**100**	**18.93**	**17**	**0 – 56**	**15.44**	**5 – 29.5**	

Table 109: OHIP-14 cross-tabulated by demographic information

5.10.2.2 Severity of OHRQoL according to main primary drugs

An analysis of the OHIP-14 score according the primary drug groups was also done. A significant difference in OHIP-14 score was detected for those who used alcohol as well as for those who used methamphetamine as a primary drug. Those who used heroin/opiates and methamphetamine had the highest OHIP-14 score among all the drug groups.

However only methamphetamine users had a significant difference in OHIP-14 compared to the rest of the sample ($p < 0.005$). Those who used alcohol as a primary drug had the lowest OHIP-14 score (mean = 12.71; SD = 12.27; IQR: 2 – 22) and this was significantly different to the rest of the sample (< 0.00005) (Table 110).

		OHIP-14 total score (severity)							
Primary drug		**n**	**%**	**mean**	**median**	**range**	**SD**	**IQR**	***p-value***
Alcohol	Yes	103	20.44	12.71	10	0 – 49	12.27	2 – 22	*< 0.0005*
	No	401	79.56	20.51	18	0 – 56	15.77	6 – 32	
Cannabis	Yes	45	8.93	19.40	16	0 – 54	16.28	6 – 28	*> 0.05*
	No	459	91.07	18.89	17	0 – 56	15.37	5 – 30	
Mandrax	Yes	52	10.32	19.53	14.5	0 – 56	18.25	2 – 36	*> 0.05*
	No	452	89.68	18.87	17	0 – 56	15.10	5.5 – 29	
Crack cocaine	Yes	10	1.98	15.00	17.5	1 – 36	11.06	5 – 19	*> 0.05*
	No	494	98.02	19.01	17	0 – 56	15.51	5 – 30	
Heroin/Opiates	Yes	25	4.96	22.76	24	1 – 46	11.43	18 – 30	*> 0.05*
	No	479	95.04	18.73	16	1 – 56	15.60	5 – 56	
Methamphetamine	Yes	259	51.39	20.98	19	0 – 56	15.74	7 – 34	*< 0.005*
	No	245	48.61	16.77	14	0 – 56	14.83	3 – 26	
OTC/PRE	Yes	9	1.79	20.00	17	5 – 49	16.11	6 – 28	*> 0.05*
	No	495	98.21	18.92	17	0 – 56	15.44	0 – 56	

Table 110: OHIP-14 total score according to primary drug groups

5.10.2.3 Severity of OHRQoL according to oral health symptoms being experienced during drug use

The range of different oral health systems being experienced during drug use was analysed according to OHIP-14 score for the presence and absence for each of the symptoms. A significant difference in OHIP-14 score was detected between the presence vs absence for each of the symptoms being included in the study. Experiencing a burning sensation in mouth, during drug use, had the highest negative impact on OHRQoL (mean = 26.42; SD = 15.7; IQR: 14 – 41) followed by tightening/stiffness of facial muscles (mean = 24.25; SD = 16.3; IQR: 9 – 38). It was interesting to note that the two above-mentioned symptoms were the least prevalent, but had the worst impact on OHRQoL.

Experiencing a dry mouth had the lowest mean OHIP-14 score (mean = 20.50; SD = 15.4; IQR: 7 – 31) followed by experiencing a bad taste (mean = 21.96; SD = 15.5; IQR: 9 – 34). Again, it was interesting to note that despite the fact that the above-mentioned systems were most prevalent among all symptoms, it had the lowest negative impact on OHRQoL (Table 111).

		OHIP-14 total score (severity)						
Oral health symptoms during drug use		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Grinding teeth	Yes	225	45	23.16	22	15.7	11 – 36	*< 0.0005*
	No	279	55	15.54	12.5	14.4	2 – 25	
Experience dental pain (toothache)	Yes	306	61	22.79	21	15.4	10 – 35	*< 0.0005*
	No	198	39	12.97	9	13.6	1 – 21	
Experience any problem with your gums	Yes	270	54	23.11	22.5	15.4	10 – 34	*< 0.0005*
	No	234	46	14.13	11	14.2	2 – 23	
Tightening/stiffness of facial muscles	Yes	181	36	24.25	24	16.3	9 – 38	*< 0.0005*
	No	323	64	15.85	14	14.1	2 – 24	
Experience a bad taste in mouth	Yes	342	68	21.96	20	15.5	9 – 34	*< 0.0005*
	No	162	32	12.68	8	13.3	1 – 21	
Experience a burning sensation in mouth	Yes	118	23	26.42	26.5	15.7	14 – 41	*< 0.0005*
	No	386	77	16.74	14	14.7	3 – 26	
Experience increased tooth sensitivity	Yes	296	59	23.38	22	15.1	11 – 35	*< 0.0005*
	No	208	41	12.30	6	13.7	0 – 20	
Experience a dry mouth	Yes	383	76	20.50	18	15.4	7 – 31	*< 0.0005*
	No	121	24	14.06	11	14.8	1 – 22	

Table 111: OHIP-14 total score according to oral health symptoms experienced during drug use

5.10.2.4 Severity of OHRQoL according the history of substance use

The different variables pertaining to substance use history was also analysed according to OHIP-14 score. A significant OHIP-14 score was found for poly-drug use, method of drug use, frequency of drug use and cigarette smoking. The mean OHIP-14 score for those who were using more than one drug type (poly-drug use) was 21.6 vs 14.61 for those who only used a primary drug. This difference was statistically different ($p < 0.0005$). Those who were injecting their primary drug of choice had the highest mean OHIP-14 score of 22.93 followed by those who smoked it (20.67). These were much higher than those who snorted (16.95) and swallowed it (13.05). The difference in means score was significant ($p < 0.0005$).

The mean OHIP-14 score for the different categories of duration of drug addiction was fairly evenly distribute (19 – 20) with no significant difference ($p > 0.05$). There was also no difference in mean OHIP-14 score between those who have been enrolled previously in a programme for SUD vs those were not ($p > 0.05$).

Those who used drugs on a daily basis had a mean OHIP-14 score of 20.35 while those who used it weekly and less frequently had a mean OHIP-14 score of 16.53. This difference was also significant ($p < 0.005$). Cigarettes smokers had a mean OHIP-14 score of 19.95 vs 13.98 for those who were not cigarettes smokers. This difference was significant ($p < 0.0005$) (Table 112).

		OHIP-14 total score						
Drug use history and cigarette smoking		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Poly-drug use	Yes	323	64	21.36	19	15.7	8 – 34	*< 0.0005*
	No	181	36	14.61	11	14.0	2 – 23	
Most preferred method of use	Injecting	15	3	22.93	24	10.9	14 – 29	*< 0.0005*
	Snorting	12	2	16.92	17.5	13.8	3.6 – 22	
	Swallow	113	22	13.05	10	12.6	2 – 21	
	Smoke	364	72	20.67	18	16.0	6 – 33.5	
Duration of addiction	1 – 10 years	204	40	18.81	17	15.5	5 – 29	*> 0.05*
	11 – 20 years	206	41	19.60	18	15.4	6 – 30	
	21 years and more	94	19	17.75	14	15.5	4 – 29	
Previous treatment received for SUD	Yes	188	37	20.64	19	16.0	6 – 34	*> 0.05*
	No	316	63	17.97	16	15.0	4 – 28	
Frequency of primary drug use	Daily	317	63	20.35	18	15.1	8 – 30	*< 0.005*
	Weekly and less	187	37	16.53	12	15.7	2 – 28	
Cigarette smoking	Yes	418	83	19.95	18	15.4	6 – 30	*< 0.0005*
	No	86	17	13.98	9.5	14.8	1 – 24	

Table 112: History of primary drug use and cigarettes smoking according to OHIP-14 score

Mean OHIP scores for each dimension according to the main primary drugs was also analysed. The mean OHIP scores for each of the questions of the instrument was significantly different for the different main primary drug groups except for question 12 which deals with participants having difficulty doing their usual job because of problems with their teeth, mouth or dentures. Those who used alcohol as a primary drug had the lowest OHIP-score for all the questions on the instrument while opiates users had the highest OHIP-score for most of the questions. Cannabis users were the most negatively impacted by life that felt less satisfying while mandrax users were the worst affected by trouble pronouncing words, meals being interrupted and having difficulty doing their usual jobs. Methamphetamine users were the most negatively impacted by finding it difficult to relax and feeling totally unable to function (Table 113).

Main primary drug groups	Alcohol	Cannabis	Mandrax	Opiates	Meth	*p-value*
	mean OHIP score					
FUNCTIONAL LIMITATION						
1. Trouble pronouncing words	0.53	0.91	1.02	0.64	0.87	*> 0.05*
2. Worsened taste	0.66	1.04	1.08	1.60	1.30	*< 0.005*
PHYSICAL PAIN						
3. Painful aching in mouth	1.37	1.51	1.60	2.48	1.92	*< 0.005*
4. Discomfort eating food	1.36	1.82	1.73	2.16	1.89	*< 0.05*
PSYCHOLOGICAL DISCOMFORT						
5. Feeling self-conscious	1.20	2.12	1.52	2.48	1.90	*< 0.0005*
6. Feeling tense	1.16	1.67	1.52	2.32	1.74	*< 0.005*
PHYSICAL DISABILITY						
7. Poor diet	0.72	1.16	1.19	1.40	1.33	*< 0.05*
8. Interrupted meals	0.86	1.22	1.60	1.52	1.49	*< 0.005*
PSYCHOLOGICAL DISABILITY						
9. Difficult to relaxing	0.92	1.44	1.44	1.20	1.55	*< 0.05*
10. Embarrassed	1.19	1.84	1.65	2.04	1.90	*< 0.005*
SOCIAL DISABILITY						
11. Irritable with other people	0.87	1.38	1.71	1.72	1.65	*< 0.0005*
12. Difficulty doing your usual jobs	0.63	0.98	1.33	1.24	1.14	*> 0.05*
HANDICAP						
13. Life less satisfying	0.71	1.44	1.19	1.28	1.34	*< 0.005*
14. Totally unable to function	0.48	0.80	0.96	0.68	0.98	*< 0.05*
Total OHIP-14 score	12.65	19.40	19.54	22.76	20.98	*< 0.0005*

Table 113: OHIP score for each dimension according to main primary drug use

5.10.2.5 Severity of OHRQoL according to oral health behaviour

Oral health behaviour included history of tooth brushing frequency, dental visits and sugar consumption in the diet. There was no significant difference in mean OHIP-14 score for last dental visit. However, tooth brushing frequency showed an association with OHRQoL. Those who were brushing teeth frequent (twice a day and more frequently) had an OHIP-14 score of 16.4 which was lower than those who were brushing teeth once a day or less frequently (20.5). This difference was significant ($p < 0.05$) and suggested that infrequent tooth brushing frequency had a greater negative impact on OHRQoL (Table 114).

		OHIP-14 total score						
Dental history and brushing habits		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Last dental visit	Within the last year	162	32	18.4	18	15.0	3 – 29	*> 0.05*
	> 1 year ago, < 5 years ago	154	31	20.0	16.5	15.5	6 – 32	
	> 5 years ago,	150	30	18.9	16.5	16.3	4 – 31	
	Never have been at the dentist	38	8	16.6	16	13.6	6 – 24	
Tooth brushing frequency	Frequent (twice a day and more)	189	38	16.4	13	14.5	4 – 26	*< 0.05*
	Infrequent (once a day and less)	315	62	20.5	18	15.8	6 – 34	

Table 114: OHIP-14 score according to last dental visit and brushing frequency

Dietary variables were analysed according mean OHIP-14 score. None had a significant difference in score except for those eating in-between-sweet snacks (19.75 vs 15.34; $p < 0.05$). Those indulging in between-meal snacking significant higher OHIP-14 scores (Table 115).

		OHIP-14 total score						
Diet variable		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Regular drinking of water	Yes	324	64	18.8	16	15.2	5 – 29	*> 0.05*
	No	180	36	19.1	18	15.8	5 – 30	
Regular drinking of soft drinks	Yes	289	57	19.46	17	16.0	5 – 31	*> 0.05*
	No	215	43	18.22	16	14.7	5 – 28	
Drinking alcoholic drinks[#]	Yes	363	72	18.2	16	15.1	4 – 28	*> 0.05*
	No	141	28	20.9	18	16.1	6 – 34	
In-between snacking (sweet)	Yes	407	81	19.75	17	15.7	6 – 31	*< 0.05*
	No	97	19	15.34	14	13.8	3 – 26	
In-between snacking (salt)	Yes	405	80	19.26	17	15.5	5 – 30	*> 0.05*
	No	99	20	17.59	16	15.0	5 – 28	
Appetite during primary drug use	Good	193	38	18.34	15.5	16	3.5 – 30	*> 0.05*
	Poor	311	62	19.16	17	15	6 – 29	

Table 115: OHIP-14 score according to diet variables

5.10.2.6 Severity of OHRQoL according to medical history

The mean OHIP-14 score was analysed according to medical history and presence of common medical conditions. Although a slightly higher OHIP-14 score was detected for presence of diabetes, mental conditions and respiratory conditions, none of these were significant different to those where the medical condition was absent (Table 116).

		OHIP-14 total score						
Dental caries status and OHIP-14 score		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
DMFT	0 – 7	138	27	12.65	8	13.3	2 – 20	*< 0.0005*
	8 – 14	161	32	18.60	17	15.0	6 – 28	
	15 – 21	123	24	22.46	20	14.9	11 – 34	
	> 21	82	16	24.88	24	16.7	11 – 40	
Active caries (untreated tooth decay) *	Yes	439	87	19.71	18	15.2	6 – 30	*< 0.005*
	No	65	13	13.72	8	16.1	1 - 24	
Caries prevalence (caries experience) #	Yes	492	98	19.19	17	15.4	5 – 30	*< 0.05*
	No	12	2	8.67	2	11.5	0 – 18.5	

Table 116: OHIP-14 score (severity) and dental caries status of the sample

***: D > 0; also referred to as untreated tooth decay**
#: DMFT > 0; also referred to as caries experience (%)

5.10.2.7 Severity of OHRQoL according to periodontal disease

The mean OHIP-14 total score was analysed according to periodontal status variables of the sample. Those who had periodontal health (a BPE score of maximum 2 with less than 10% BOP) had a mean OHIP-14 score of 14.8 while those who did not had periodontal health had a mean OHIP-14 score of 19.88. This was difference was significant ($p < 0.005$) and indicative that patients who had healthy periodontium had a less of a negative impact on their OHRQoL (Table 117).

		OHIP-14 total score						
Periodontal health and disease		**n**	**%**	**mean**	**median**	**SD**	**IQR**	***p-value***
Periodontal health	Yes	94	19	14.80	10	14.7	1 – 25	*< 0.005*
	No	410	81	19.88	18	15.5	6 – 30	
Gingivitis	Yes	117	23	18.03	15	15.4	6 – 26	*> 0.05*
	No	387	77	19.21	18	15.5	5 – 30	
Periodontitis	Yes	239	44	19.87	18	14.7	7 – 30	*> 0.05*
	No	265	56	18.09	15	16.0	4 – 29	

Table 117: OHIP-14 score (severity) and periodontal status of the sample

5.10.3 OHIP prevalence (prevalence of a negative impact on OHRQoL)

OHIP-14 responses were categorized and classified to signify the presence of a negative impact on OHRQoL if there was at least one response of “fairly often” or “often” with a question or

absence of impact in the case of answering "never", "hardly ever", and "occasionally". The prevalence of an oral health impact the percentage of "fairly often" and "very often" responses were added in the calculation to determine prevalence. This prevalence was analysed according to main primary drug groups and assorted variables to investigate for potential associations.

5.10.3.1 OHIP prevalence and history of substance use

Those who were using heroin or other forms of opiates showed the highest OHIP prevalence at 80% followed by methamphetamine (68%) and cannabis users (62%). Alcohol (46%) and mandrax (50%) showed the lowest prevalence (Table 118).

		OHIP overall prevalence*		**OR**	**RR**	***p-value***
Main primary drug		Yes	No			
Alcohol	Yes	47 (46%)	55	0.5	0.7	*< 0.005*
	No	261	141			
Cannabis	Yes	28 (62%)	17	1.1	1.0	*> 0.05*
	No	280	179			
Heroin/Opiates	Yes	20 (80%)	5	2.7	1.3	*> 0.05*
	No	288	191			
Mandrax	Yes	26 (50%)	26	0.6	0.8	*> 0.05*
	No	282	170			
Methamphetamine	Yes	175 (68%)	84	1.8	1.2	*< 0.005*
	No	133	11			
Entire sample		**61%**				

Table 118: OHIP prevalence according to primary drug use
*: A binary measure of the proportion of at least one "fairly often" or "very often" response

An association between alcohol use and OHIP prevalence was found ($p < 0.005$). The odds of a negative impact on OHIP (OHIP prevalence) were 0.46 times less among people who used alcohol compared to those who did not use alcohol as a primary drug (OR = 0.47; 95%CI: 0.3 – 0.7).

People who used alcohol were 0.7 times (30%) less likely to experience negative oral health impacts (OHIP prevalence) compared to those who did not use alcohol as a primary drug (RR = 0.7; 95%CI: 0.6 – 0.9). An association was also found between methamphetamine use and

OHIP prevalence ($p < 0.005$). The odds of a negative impact on oral health (OHIP prevalence) were 1.8 times more among methamphetamine users compared to those who did not use methamphetamine as a primary drug (OR = 1.8; 95CI: 1.2 – 2.5). Those who used methamphetamine as a primary drug were 1.2 times more likely to report a negative impact on oral health (OHIP prevalence) compared to those not using methamphetamine as a primary drug (RR = 1.2: 95%CI: 1.1 – 1.4) (Table 118).

As explained above, those who used heroin or other opiates reported the highest (80%) negative impact on oral health profile (Figure 27). The lowest negative impact on OHRQoL was reported by those who were using alcohol (46%) as a primary drug.

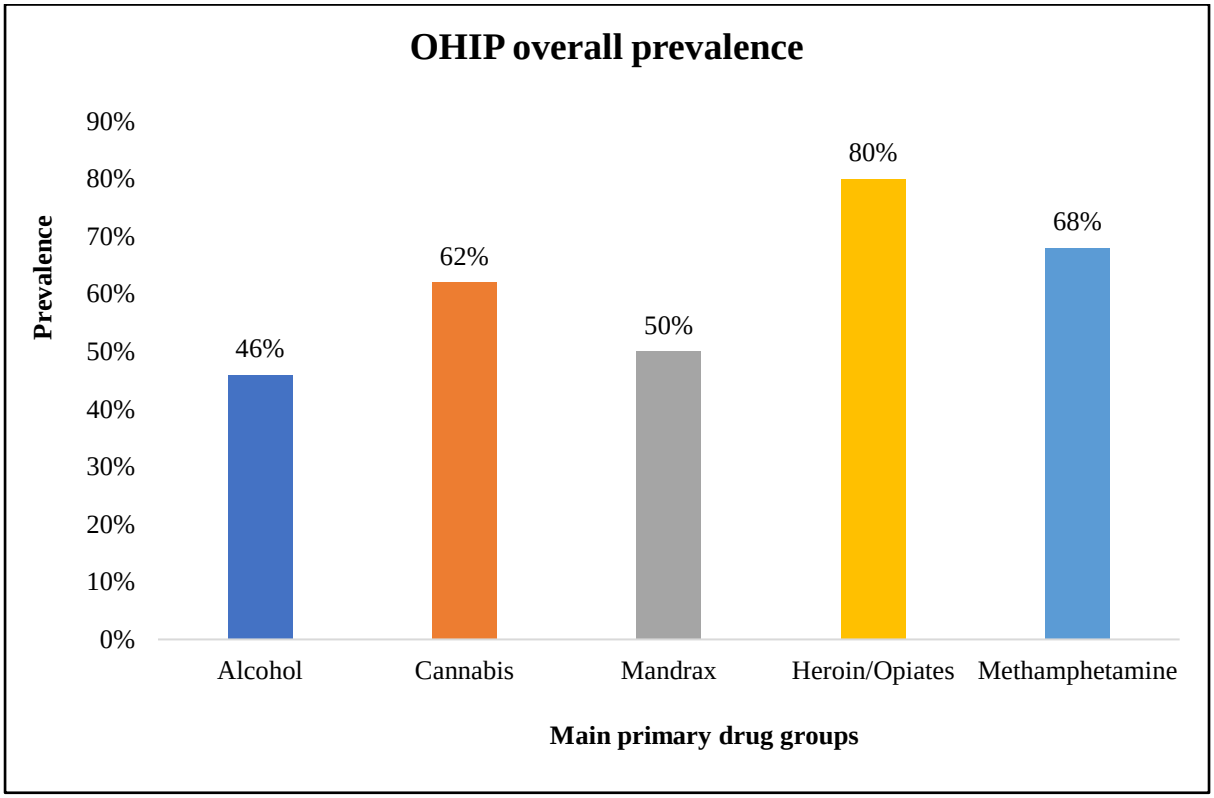

Figure 27: Prevalence of negative impact on oral health profile*
*: Percentage of at least one "fairly often" or "very often" response

5.10.3.2 OHIP prevalence for different dimensions according to main primary drugs

The prevalence of a negative impact on OHRQoL of each category for the different dimensions of the OHIP-14 instrument was determined and analysed according to main primary drug groups. The highest negative impact on OHRQoL was felt by opiate users reporting feeling self-conscience (60%), feeling tense (52%), having a painful aching in the mouth (52%) and

having discomfort when eating food (52%) due to problems with their teeth mouth or dentures. Those who were using mandrax reported the highest negative impact on OHRQoL related to trouble pronouncing words (17%), poor diet (25%), interrupted meals (31%), irritable with other people (37%), difficulty doing usual jobs (27%) and unable to function at all (13%). Those who used alcohol as a primary drug reported the lowest negative impact on OHRQoL for all categories except for being unable to function (Table 119).

	Main primary drug groups (n = 484) *					n = 504
	Alcohol	**Cannabis**	**Mandrax**	**Opiates**	**Meth**	**Total sample**
	n (prevalence in %)					
FUNCTIONAL LIMITATION						*112 (22%)*
1. Trouble pronouncing words	6 (6%)	7 (16%)	**9 (17%)**	1 (4%)	34 (13%)	57 (11%)
2. Worsened taste	5 (5%)	10 (22%)	9 (17%)	**6 (24%)**	59 (23%)	91 (18%)
PHYSICAL PAIN						*206 (41%)*
3. Painful aching in mouth	20 (19%)	12 (27%)	15 (29%)	**13 (52%)**	91 (35%)	155 (31%)
4. Discomfort eating food	24 (23%)	16 (26%)	17 (33%)	**13 (52%)**	93 (36%)	167 (33%)
PSYCHOLOGICAL DISCOMFORT						*212 (42%)*
5. Feeling self-conscious	22 (21%)	21 (47%)	17 (33%)	**15 (60%)**	100 (39%)	**184 (37%)**
6. Feeling tense	23 (22%)	14 (31%)	15 (29%)	**13 (52%)**	84 (32%)	154 (31%)
PHYSICAL DISABILITY						*145 (29%)*
7. Poor diet	10 (10%)	10 (22%)	**13 (25%)**	5 (20%)	63 (24%)	103 (20%)
8. Interrupted meals	13 (13%)	9 (20%)	**16 (31%)**	7 (28%)	73 (28%)	119 (24%)
PSYCHOLOGICAL DISABILITY						*201 (40%)*
9. Difficult to relaxing	16 (16%)	12 (27%)	14 (27%)	5 (20%)	**76 (29%)**	126 (25%)
10. Embarrassed	26 (25%)	17 (38%)	19 (37%)	**11 (44%)**	102 (39%)	**181 (36%)**
SOCIAL DISABILITY						*155 (31%)*
11. Irritable with other people	15 (15%)	11 (24%)	**19 (37%)**	7 (28%)	83 (32%)	137 (27%)
12. Difficulty doing usual jobs	9 (9%)	9 (20%)	**14 (27%)**	5 (20%)	52 (20%)	91 (18%)
HANDICAP						*129 (56%)*
13. Life less satisfying	13 (13%)	**13 (29%)**	13 (25%)	3 (12%)	66 (25%)	112 (22%)
14. Totally unable to function	6 (6%)	5 (11%)	**7 (13%)**	0 (0%)	40 (12%)	60 (12%)

Table 119: OHIP prevalence of categories for OHIP-14 dimensions according to main primary drugs

*: The main drug groups are the most common drugs being used and represent 96% of the sample (n = 484/504 = 96%)

The highest negative impact on OHRQoL was self-conscienceness (37%) and embarrassment (36%). The lowest impact on OHRQoL was difficulty in pronouncing words (11%) and not being able to function (12%). About a third of reported painful aching in mouth (31%) and discomfort eating food (33%), a quarter that they had to interrupt meals (24%), finding it difficult to relax (25%), irritable with other people (27%) and felt that life was less satisfying (22%) due to problems they perceived in the past 12 months related to their mouth, teeth or

dentures (Table 119). The value below that are underlined indicates the lowest value in each row while the values that are in bold indicated the highest.

5.10.4 Risk predictors for OHRQoL

A multivariate regression analysis for OHIP-14 score as the outcome variable was done on: age, sex, cigarette smoking, DMFT score, poly-drug use, highest school grade completed, number of extractions needed, frequency of drug use, having periodontal health, having active caries, duration of addiction, and having a medical condition. 19% of the variability in the OHIP score was explained by the combined effect of the predictors. Cigarette smoking, DMFT, poly-drug use, highest school grade completed, the number of dental extractions needed, having active caries and having a medical condition were significant predictor variables ($p < 0.05$) (Table 120).

Variable	**Coefficient**	**95% CI**	***p-value***	**R^2**
Age	0.165	-0.24 – 0.35	*> 0.05*	0.193
Sex	0.902	-1.90 – 3.70	*> 0.05*	
Cigarette smoking	4.624	1.12 – 8.13	*< 0.05*	
DMFT	0.462	0.26 – 0.66	*< 0.0005*	
Poly-drug use	6.180	3.31 – 9.05	*< 0.0005*	
Level of education	0.709	0.59 – 1.36	*< 0.05*	
Number of extractions needed	0.486	0.11 – 0.86	*< 0.05*	
Frequency of drug use	-1.83	-4.47 – 0.81	*> 0.05*	
Having periodontal health	-0.453	-3.83 – 2.92	*> 0.05*	
Having active caries	-4.577	-8.50 – -0.66	*< 0.05*	
Duration of addiction	-0.105	-0.29 – 0.08	*> 0.05*	
Having a medical condition	2.873	0.14 – 5.61	*< 0.05*	
CONSTANT	-3.052	-13.05 – 6.94	*0.549*	

Table 120: Multivariate regression analysis for OHIP-14 score and predictor

CHAPTER 6: DISCUSSION

6.1 Significance of the study

The present study is unique with regards to its primary focus on oral health and how it is impacted by use of from nearly all the common substances of use including alcohol within the South African context. The present study investigated the impact substance use disorder (SUD) has on oral health status (dental caries and periodontal disease) and Oral Health Related Quality of Life. In addition, it determined the extent of oral health interventions, if any were provided to patients while enrolled in treatment programmes for SUD. The study included a large sample and applied a mixed methods approach in its study design.

A number of studies have investigated the association between dental caries and substance use, but mostly focused on one particular drug group, unlike the present study that included a variety of drug groups. A systematic review by Yazdanian *et al*. (2017), selected 10 articles from an initial pool of 1836 articles with a primary focus on dental caries and periodontal disease among people who use drugs. Only one focused on multiple drug use (Yazdanian *et al.,* 2020). The meta-analysis included seven studies, with only two from low middle-income countries, such as South Africa. Another systematic review by Baghaie *et al*. (2017) included 28 studies with a primary focus on the association between oral health and substance use. Most were done in a similar setting (drug rehabilitation centre) as the present study, however only two studies by Reece (2007) and Ma (2012) included a similar group of substances (Baghaie *et al*., 2017). None of the studies included participants using alcohol as a primary drug of choice. The rationale for including alcohol in the present study was in consideration of the globally accepted definition of substance use disorder (SUD) which includes alcohol use. Mandrax (methquanolone) being included in the present study as a primary or secondary drug was also a unique aspect when compared to studies done in other countries. From available research on oral health impact of SUD, mandrax use appears to be unique to Soth Africa.

Another unique aspect of the present study, was its qualitative study design to determine the perceptions of staff at rehabilitation centres and the extent to which oral health interventions are offered to patients while enrolled in a treatment programme for SUD.

Robinson *et al*. (2005) described using a qualitative approach to investigate oral health-related attitude and behaviours (Robinson *et al*., 2005). Most studies on oral health and substance use are clinical and use questionnaires to determine the history of substance use, oral health behaviour and oral health related quality of life. The present study, utilized a mixed methods approach and applied a broad spectrum of research tools to investigate the research questions.

6.2 Demographic profile of the patient suffering from SUD in the study

In South Africa, local sentinel surveillance is carried out by the South African Epidemiology on Drug Use (SACENDU). According to their 2023 Research Brief that reported on the July – December 2022 Western Cape data, the mean age for all substance was 31 years (SAMRC, 2023a), slightly lower than the mean age of 33 years that was found for the present study. Other studies that had a comparative sample composition done in India, China and Australia found a mean age of 36, 35 and 31 years respectively (Reece *et al*., 2007; Gupta *et al*., 2012; Ma *et al*., 2012).

The present study found that 72.4% of participants were male. This is consistent with the latest SACENDU full report (SAMRC, 2023), which reported 73% of users being male, as well as the systematic review conducted by Baghaie *et al* in 2017 (73.2% male), Smit (2014) and D'Amore *et al*. 2011 (73%). The present study also found an association between gender and cannabis use with the odds of using cannabis among males being 3.3 times more compared to females. Females were also were 1.2 times more likely to be using methamphetamine as a primary drug compared to males.

High unemployment rates and poverty among people who suffer from SUD has has been reported by the SAMRC (2014) and Henkel (2011) and is regarded as a potential contributing factor of poor oral health (Henkel, 2011; SAMRC, 2014). The latest SACENDU full report showed that only 24% of users in the Western Cape were working, either full-time or part-time (SAMRC, 2023). The present study showed a higher employment rate with 32% being in full-time employment. These unemployment rates are similar to reports by Rommel (65%).

6.3 History of substance use

In the following section I present a summary of my key findings on substance use and oral health harms, particularly focusing on the different negative oral health effects as they relate to primary drug group, duration of substance use, frequency of use and methods of use.

6.3.1 Primary drug use

The present study found that methamphetamine (50%) was the most common primary drug used. This was consistent with the latest SACENDU full report that reported methamphetamine being mostly used by users in the Western Cape (SAMRC, 2023b). The main drugs being used were methamphetamine, alcohol, mandrax, cannabis and heroin (opiates).

The present study reported on method of use for each or the primary drugs being reported on. For the entire sample, most participants (70%) were smoking the drug and this finding concurs with the SACENDU reports and other studies (Shetty *et al*., 2017, Claque *et al*., 2018; SAMRC, 2023b).

Regarding the duration of drug use, the present study found a mean duration of 13 years, similar to Pourhashemi's (2015) study in Iran on methamphetamine and opiates users (n = 95) which found 11.6 year of drug dependence and Gupta's study (2010) in India (Opioid and Cannabis users) found a mean duration of 12 years. When duration of addiction was categorized, the present study found half of the sample used it for more than 12 years. This was consistent with findings from the Shekarchizadeh (2019) study that found 44% were using 11 years and longer.

The present study showed that almost two thirds were using on a daily basis with people who used alcohol being the exception with about half using 2 – 6 days per week. The study further showed that the highest proportion using daily was among opiate users (96%) and this finding was not only statistically significant, but concurred with the SACENDU report which showed 91% of heroin/opiate users used it daily. Methamphetamine which was used by largest group of the present study, showed daily use of 66% compared to 64% being reported by SACENDU (SAMRC, 2023b).

Most studies from the US report that methamphetamine users prefer using the IV injection route (Murphy *et al*., 2016), while research Smit and Naidoo (2015) from South Africa, report that the overwhelming majority (93%) of users preferred smoking the drug. This route of administration involved heating the methamphetamine crystals in a small glass container and then inhaling the smoke (Smit and Naidoo, 2015). The present study also found smoking as the overwhelming favourite method of use. Ravenel *et al.*, (2012) reported on a wide range of 0.75 – 25 years for the duration of methamphetamine use (Ravenel *et al*., 2012), while Smit and Naidoo a mean duration of methamphetamine use of 6.6 year (SD = 3.1) (Smit and Naidoo, 2015).

6.3.2 Secondary drug use

According the latest available SACENDU Brief, mandrax was most commonly used as secondary drug at 36% (SAMRC, 2024). In the present study mandrax was also most commonly used as a secondary drug, the prevalence was slightly higher at 46%. This discrepancy could be explained by the SACENDU data which label this category as Cannabis/Mandrax while the present study included patients who used mandrax with cannabis as well as those who used mandrax with tobacco.

6.4 Oral health behaviour and SUD

6.4.1 Oral health behaviour in general

It has been shown that substance use also leads to poor oral health behaviour such as infrequent tooth brushing. A study investigated oral health habits among poly-drug users in Spain and found that two thirds of the sample never brush teeth, 17% brushed only once a day and 18% brushed either twice of more per day (Mateos-Moreno *et al.*, 2013). Oral health behaviour is an important risk predictor of poor oral health (Tseveenjay *et al*., 2004; Khami *et al*., 2007). Despite the direct adverse effect drugs can have on oral health, indirect effects of poor oral health behaviour and lifestyle aggravates oral health problems. It is known that drug users have poor oral hygiene habits, a tendency to consume large amounts of sugar, irregular eating patterns and irregular dental visits (Sheridan *et al*., 2001, Morio *et al*., 2008; Turkylimans, 2010; Smit and Naidoo, 2011).

Tobacco smoking was very common among the present study with 83% smoking cigarettes, similar to studies (D'Amore *et al*., 2011; Shekarchizadeh *et al*., 2013; Rommel *et al*., 2016; Shetty *et al*., 2017).

Research has also found that smoking may contribute as a modifiable risk factor for increased dental caries prevalence especially among methamphetamine users (Shetty *et al*, 2017). However, this association was not found to be significant in the present study., perhaps on account of the fact that methamphetamine users represented only half the participants and alcohol and cannabis users, which represented a third, showed lower mean DMFT scores than methamphetamine users.

6.4.2 Diet profile during substance use

An unhealthy diet characterized by in-between meals snacking of refined sugar products, excessive amounts of sugar intake through beverages especially energy drinks is typically seen among people who suffer from SUD. This usually results in poor appetites and an increased craving for sugar (McGrath *et al*., 2005).

Robinson *et al*. (2005) showed that a typical diet consisted of biscuits, doughnuts, ice cream, yogurt and other confectionaries, and typically at least three teaspoons of sugar in beverages. Lifestyles required food that was easily accessible to consume on the move. Cooking food while using drugs is dangerous due to the likelihood of fall asleep while cooking (Robinson *et al*., 2005). The present study found a very amount of daily added sugar consumption, especially from cold and hot drinks. It was found that daily added sugar intake, only from beverages, was around 120g sugar per person. The NHS in the UK recommends that adults should not have more than 30g of free sugars per day (NHS, 2023). The American Heart Association (AHA) recommends that men should consume no more than 9 teaspoons (36 grams) of added sugar per day while women should consume no more than 6 teaspoons (25 grams or 100 calories) per day (AHA, 2023). More than half reported a poor or very poor appetite during periods of drug use and the most patients indulged in in-between meals snacking. Common snacks were inexpensive high sugar confectionaries accompanied by a high consumption of energy drinks with excessive amounts of sugar and caffeine. Studies have shown that the sugar content and acidic nature of energy drinks contributes to obesity and destruction of dental enamel (Kitchens and Owens, 2007; Owens and Kitchens, 2007; Ehlen *et al*., 2008).

Food choices are often limited to easily accessible food which are easy to consume and provide little nutritional value (Robinson *et al*., 2005). This was found in the present study where most patients reported not having three balanced meals, but instead opted for takeaway fast-food that included pastries, fried food, or processed meat with white bread.

6.4.3 Tooth brushing frequency

The literature reports that tooth brushing frequency is very low in people with SUD. Shekarchizadeh *et al*. (2013) investigated oral health behaviour (OHB) of patients receiving drug withdrawal treatment in Tehran, Iran. They found allow tooth brushing frequency, 81% never or seldom flossed and more than half were eating sugary products twice daily or more often between meals (Shekarchizadeh *et al*., 2013). Longer durations of addiction were also associated with lower oral health behaviour (OHB) scores (Shekarchizadeh *et al*., 2013). Molendijk *et al*. (1996) found 50% with poor oral hygiene behaviours. In the present study almost two thirds reported brushing their teeth once a day or less frequently when using drugs. These finding concurred with other studies (Morio *et al*., 2008, Hamamoto *et al*., 2009; Mateos-Moreno *et al*., 2013). The mean DMFT of those who were brushing twice a day or more was significantly lower than those who were brushing once a day or less frequent.

6.4.4 Dental visits

Shekarchizadeh *et al*. (2013) found that more than half the patients had visited a dentist during the previous year, and 25% most recent visit was more than 2 years previously or never (Shekarchizadeh *et al*., 2013). In the present study a third of the sample attended a dental visit over the preceding year and another third had not been to the dentist within the preceding five year. Rommel *et al*., (2105) found 34% had visited a dentist over the equivalent time period (Rommel *et al*., 2015). Dental extractions were the most common dental treatment received at the last dental visit. A study done by Åstrøm *et al*. (2022), in Norway found that drug use was associated with a poor OHRQoL and this was associated with insufficient dental follow-up because of dental anxiety and bad past experiences on account of perceived negative attitudes of dental workers (Åstrøm *et al*., 2022). Another confounder to low levels of dental visits is the limited access to public dental services. Only a third of clinics offered the basic oral health care package with waiting time for a dental procedure more than several months (Smit and Ossman, 2017).

6.5 Oral health status and SUD

6.5.1 Dental caries severity and prevalence and SUD

Specific dental status according to tooth position had been described in detail in this study. The analysis revealed very interesting trends in distribution of decayed, missing, filled and sound teeth.

Research had shown a clear association between poor oral health and a longer duration of drug use (Molendijk *et al*., 1996; Shetty *et al*., 2010; Brown *et al*., 2013) accompanied with significant difference in mean DMFT scores between the different age groups (Molendijk *et al*., 1996; Shetty *et al*., 2017). This was also seen in the present study where there were significant differences of DMFT scores found between those who were using drugs for shorted vs longer periods. The present study also found a mean DMFT of 11.85 among youth (18 – 35-year-olds) vs 15.42 among those who were 36 and older.

The present study found a mean decayed (D) score of 6.96 among heroin users, while Becart *et al*. (1997) found a mean decayed (D) score of 6.76. However, the present study showed a mean for filled (F-score) teeth that was lower and missing (M-score) teeth that was higher than the Becart *et al*. (1997) study. This could be attributable to poor access to basic oral health care in the Western Cape (Smit and Osman, 2017). This was lower than reported in the present study, 44% had six teeth and more missing, and this is much higher than reports by D'Amore *et al*., (2011) (29%) and Shetty *et al*., (2017) (31%). Di Cugno *et al*. (1981), Brown *et al*. (2013) and Rommel *et al*. (2016) reported that mean DMFT scores for methamphetamine users were 13.73, 15.2 and 12.3 respectively (Baghaie *et al*. 2017). These scores were consistent with the present study that found a mean DMFT score of 13.86 among methamphetamine users. The present study also showed that dental caries severity was significantly higher for methamphetamine users when compared to other drug groups.

Long-term use of methamphetamine lead to xerostomia rampant caries, bad taste bruxism and muscle trismus (Di Cugno *et al.* 1981; Shaner, 2002, Saini *et al*., 2005; Smit and Naidoo, 2016). A dry mouth is caused by the activation of alpha-adrenergic receptors in the vasculature of salivary glands that lead to vasoconstriction of blood vessels and reduced saliva secretion (Shaner, 2002).

Murphy *et al*., (2016), found that methamphetamine users were 7.2 times more likely to experience a dry mouth when eating compared to the general population (Murphy *et al.*, 2016). The present study supported the clinical findings.

A multiple linear regression analysis which adjusted for potential confounders such as age, gender and cigarette smoking showed that the amount of sugar intake, level of education and tooth brushing frequency were significant predictor variables for severity of dental caries. Dental caries is highly prevalent among patients using illicit drugs including alcohol. All of the main drug groups showed a dental caries prevalence ranging from 93% - 100% with a sample mean of 97.62%. This finding was consistent with the caries experience of 96% reported by the Shetty *et al*. (2015). However, untreated tooth decay reported by Shetty *et al.* (2015) (58%) and Hegazi *et al*. (2021) (60%) were much lower when compared to 87% reported by the present study.

6.5.2 Periodontal disease and SUD

The present study included an investigation of common oral health problems being experienced during drug use. Problems with gums were reported by just over half -they experienced sore or bleeding gums. The present study found a mean bleeding percentage of 41%, 23% with gingivitis the literature shows that periodontal disease is more prevalent among people who suffer from SUD than in the general population (Cho *et al*., 2005; Brand *et al*., 2008).

Drugs such as cannabis, opiates, amphetamine and alcohol lead to xerostomia which characterized by poor salivary flow and compromise protection against dental caries and periodontal disease (Laslett *et al*., 2008; Versteeg *et al*., 2008). In the present study cannabis, opiates, amphetamine and alcohol users reported the highest levels of self-perceived gum problems. This was also evident form the clinical investigations that showed that those who used alcohol, cannabis, opiates and methamphetamine as primary drugs, had periodontitis prevalence of 44%, 51% and 48% respectively. Rhodus *et al.* (2005) reported that periodontitis and gingivitis are commonly seen among patients who suffer from SUD especially those who use methamphetamine and cocaine (Rhodus *et al*., 2005). The present study concurred with this finding. Similar to the description of periodontal tissue given by Rosenbaum (1981), namely an inflamed free margin of the gingiva appearing cherry red, oedematous, glistening, and loss of stippling, these features were also observed among patients in the present study.

Furthermore, almost half of the sample (47%) had periodontitis. Cigarette smoking is an identified risk factor for periodontal disease. An association between tobacco smoking and cannabis use was found by Thomson *et al*. (2010) in a large cohort of young adults with a history of cannabis use in Dunedin, New Zealand (Thomson *et al*., 2010). The present study also showed an association between smoking and periodontitis. It was further established that smokers had an 88% prevalence of periodontitis, similar to the 89.5% reported by Shetty *et al*. (2015).

6.5.3 Oral health symptoms being experience during substance use

Among the most common oral health systems experienced by SUD patients is a dry mouth (xerostomia) (Ravenel *et al*., 2012). In the present study, 76% reported that they experienced a dry mouth during drug while they were using a drug, Mateas-Mareno *et al*. (2013) reported a 64% prevalence of a dry mouth. The present study found that the majority who reported xerostomia, experienced it within the first hours after they started using the drug and then a similar proportion (81%) reported that this lasted for up to a day. Other oral health symptoms related to SUD are bleeding gums, bad odour, a bad taste, loose and infected teeth and frequent tooth aches. All these symptoms were observed in the present study.

6.6 Dental treatment needs of people with SUD

Unmet dental treatment of people with SUD comes at significant cost especially in low resource and inaccessible locations. Smit and Naidoo (2016) previously reported that dental extractions were the most common treatment required among a sample of 308 methamphetamine users who were admitted to a substance use treatment programme in the Western Cape. The present study found that restorations and dental extractions were the most common treatment needed among drug users, with methamphetamine and opiate users needing a significant higher number of extractions than the rest of the sample.

An interesting finding was that those who were using alcohol needed the least number of extractions and this was significantly lower than the rest of the sample. The number of extractions needed in relation to the levels of education was significantly different. Participants with a primary school education needed three teeth to be extracted compared to those who attended college/university who only needed one extraction (Smit and Naidoo, 2016).

6.7 Oral health interventions as a part of treatment programmes for people with SUD

During the period of substance use many patients do not have control of their lives and the treatment centre where they are admitted can be a place of safety. During this dedicated treatment period the extent to which patients received assistance from staff and access to oral health plays a role in their non-drug using identity (Ettorre, 1987). From the focus group discussions, staff from the different treatment centres strongly agreed that oral health challenges had a negative role on the patient's ability to make progress during the enrolment period of treatment for SUD. There is strong evidence suggesting that brief interventions offered at the primary health care setting can lead to significant reduction in tobacco and alcohol consumption (Whitlock *et al*., 2004; Solberg *et al*., 2006; Fiore *et al*., 2008). The present study highlighted the need for more oral health interventions to complement existing substance use treatment programmes. Five main themes from the focus group discussions: oral health assessments, oral health interventions, health promotion, barriers to health and interrelated patient and oral health factors.

6.8 Oral Health Related Quality of Life and SUD

A limited number of studies have investigated the relationship between substance use disorder (SUD) and oral health related quality of life (OHRQoL), mostly using the OHIP-14 instrument to measure OHRQoL. There is overwhelming evidence that drug use has a negative impact on OHRQoL (Truong *et al*., 2015; Murphy *et al*., 2016; Van Wijk *et al*., 2016; Antoniazzi *et al*., 2017; Mukerjee *et al*., 2018; Abdelsalam, 2023).

The present study found a prevalence of impact on OHRQoL of 61%, among substance users, which is much higher that 17.5% that was found among the general South African adult population (Ayo-Yusuf *et al*., 2016).

Mukerjee *et al*. (2018) found that more than half (59%) methamphetamine users reported a painful aching in the mouth, discomfort while eating (63.5%), feeling embarrassed (60.7%) and avoidance of particular foods (56.5%) over the preceding year (Mukherjee *et al*., 2018). These findings were higher than the present study, probably on account of the fact that and the study was done only on methamphetamine users. The present study reported on other drug types including alcohol (20% of the sample) and found lower negative impact on OHRQoL.

On the other hand, Brown *et al.* (2021) investigated DMFT- and OHIP-14 scores of 398 psychoactive substance users in Brazil, the results on OHIP-14 severity for almost all the dimensions concurred with the present study. Only the mean OHIP-14 score for psychological discomfort was much higher than the present study (5.0 vs 3.4) and this could be attributed to the fact that the Brown study was done at psychiatric hospitals (Brown *et al.*, 2021). The relationship between dental caries and OHRQoL was also investigated in the present study with those who had a high DMFT score (15 and more) having a worse OHRoL than those with a lower DMFT score (14 and less) ($p < 0.0005$). This finding also concurred with Brown *et al*. (2021).

Poor adherence to dental visits was common among participants from the present study and this concurred with a study that found a poor OHRQoL being associated with poor dental visit attendance (Åstrøm *et al*., 2022).

In the present study, oral health status encompassed the severity and prevalence of dental caries and periodontal disease as well as specific oral health symptoms that were experienced during substance use. Symptoms included grinding teeth, experiencing dental pain, gum problems, stiff facial muscles, a bad taste, a burning sensation in the mouth, increased tooth sensitivity and a dry mouth. When univariate analysis was done between with each of these symptoms and the OHIP-14 score (severity of a negative impact on OHRQoL), all the symptoms had a significantly higher OHIP-14 score than those where the specific oral health symptom was absent. The study further showed that the mean OHIP-14 score was significantly associated with poly-drug use, methods of drug use, frequency of drug use and known risk factors such as cigarette smoking, in-between sweet snacking and tooth brushing frequency.

CHAPTER 7: RECOMMENDATIONS

7.1 RECOMMENDATIONS FOR ORAL HEALTH INTERVENTIONS DURING TREATMENT PROGRAMMES FOR PEOPLE WITH SUD

Prior to and during enrolment of patients with SUD the following factors need to be considered: access to oral health care, oral health pre-admission screening, referral process, oral health profession collaborative partnership, oral health education and behaviour, staff training, nutrition and food products at tuckshops.

7.1.1 Access to oral health care during and after treatment for SUD

Poor access to oral health was mostly due to lack of funding or absence of private health insurance. Patients often experience increased signs and symptoms of oral disease while they are enrolled for treatment and not using drugs. Therefore, patients need to have access to basic oral care, so that oral and dental problems including pain, that can hinder progress with SUD treatment, are addressed within the private or public sector. Dental management should be aligned with substance use treatments and it is recommended that this is done at the initial stage of admission.

7.1.2 Oral health pre-admission screening

A basic oral health screening pre-admission would allow staff at the centre to be prepared for potential oral and dental problems that may arise and that may affect planned SUD treatment. Pre-admission screening will permit staff to refer the patient for appropriate care. Furethermore, if urgent dental treatment is needed, it can be addressed prior to admittance.

7.1.3 Referral process

A clear referral process must be available during treatment and will require coordination with local private and public dental clinics. Staff at the treatment centre should be aware of the referral channels and processes.

7.1.4 Oral health profession collaborative partnership

There should be enhanced collaboration between oral health professionals and patients receiving treatment for SUD. Five main streams of the oral health profession had been identified as potential role players.

7.1.4.1 Private sector

The private sector represents about 80% of the oral health professionals in South Africa and potential private-public partnerships between treatment centres and private dental practitioners should be investigated. A funding model that incorporates a minimum of one dental visit could be built into existing fees structure of the treatment programme. Many treatment centres are registered charities and it may be possible for tax incentives for private practitioners who are willing to offer their services.

7.1.4.2 Public sector

The public sector provides oral health services to the majority of South Africans which include 84% who do not have access to private health care insurance. Clear referral pathways for oral health services within the public sector should be in place.

7.1.4.3 Academic institutions

Dental academic institutions can make a significant contribution to patient care at SUD treatment centres through community-based teaching and outreach programmes. Student rotations can include allied health and medical and dental students. Counselling skills for oral health professionals in research and service activities within the SUD sector is recommended.

7.1.4.4 Corporate

Corporate companies that manufacture oral health products such as tooth paste, tooth brushes, dental floss, mouth rinse etc. can enhance their social responsibility, by forming partnerships, formal agreements or donating to SUD treatement centres for the vulnerable and disadvantaged.

7.1.4.5 Associations and societies

The South African Dental Association (SADA) and Oral Hygienist Association of South Africa (OHASA) represent the majority of oral health professionals in the country. These networks of professionals can be mobilized to impact on treatment and support of SUD initiatives. Associations and preosssional societies can also promote national and global health agendas, including alignment with the World Health Organization (WHO).

7.1.5 Oral health education and behaviour

Health and oral health education and promotional material needs to be available at all SUD treatment centres. In addition, staff should have oral health education training to ensure appropriate oral health behaviour among patients on the programme. Education should include tooth brushing frequency, brushing with fluoridated toothpaste, dental flossing and diet description which include sugar consumption and the importance of dental visits.

7.1.6 Food products at tuckshops and nutrition

In-patient SUD treatment centres are equipped with a kitchen or external food service that provides patients with three balanced meals per day. Howvere, many treatment centres have tuckshops that sells confectionaries such as chocolates, crisps, biscuits and soft drinks, all high in sugar content. Given the history of a high sugar intake among SUD patients and risk this behaviour pose to oral health, it is recommended that all food should be carefully monitored sugar content and nutritional value. Healthy food choices and educating patients on the association between high sugar intake and dental caries should be included in oral health education material.

7.2 CHAIRSIDE MANAGEMENT OF THE SUD PATIENT

7.2.1 Overview

As far back as 2005, the American Dental Association (ADA) published a statement on the dental treatment for patients who suffer from SUD. Smit (2015) focused on dental management of the methamphetamine users while the Bullock (1999), Cuberos (2020) and Solomons (2014) provided a broader focus on the dental management of substance use groups.

Managing patients with SUD is difficult because there is often a lack of compliance with oral hygiene instructions and keeping to dental appointments. In some cases, patient may use drugs to reduce anxiety related to visiting the dentist. Therefore, its essential to acknowledge the anxiety and to offer reassurance, including the application of behavioural methods (Solomons and Moipolai, 2014). If substance use is suspected, queries should be made in a non-confrontational manner, careful tone of voice and body language. Confidentiality of patients should be protected. Moreover, the patient's involvement with regards to decision-making process is also important respecting the autonomy. Management of SUD requires an inter-professional team approach.

7.2.2 Early identification and referral

The first role of the dentist is to identify the oral signs and symptoms of substance use. This can be done when the social history of the patient is collected during the initial visit. Visual observations during extra-oral clinical examination should be noted. If there are any suspicion raised by either oral or physical signs and symptoms that cannot be explained by the patient's medical, social or dental history any future treatment should be planned with caution. Classical signs include blood-shot eyes, unusual smells on breath, pupil size changes, abnormal body posture or clothing, burns on the face and or hands, muscle tremors, constant grinding or clenching of the jaw and a slurred speech. History of substance use should be included in all consultations without stigmatizing the patient (Reimer, 2014; Solomans, 2014).

Early detection of the classical clinical intra-oral signs during oral examination is important. An example of this "Meth-mouth" which is characterized by dental cavities on the buccal smooth surfaces at the cemento-enamel junction and interproximal surfaces of upper and lower anterior teeth depicting a similar clinical picture as early childhood caries (ECC). Other clinical signs may include generalised dental caries, periodontal disease, mucosal dysplasia, a dry mouth, abnormal tooth wear and missing teeth in a young adult patient. Symptoms that may accompany clinical signs, include stiff facial muscles, difficulty chewing or swallowing due to a dry mouth. When a patient discloses using a substance, information for specialized treatment should be provided to the patient. More importantly the dentist should encourage the patient to stop using the substance and to seek professional help at a specialized treatment centre of substance use.

Patients also need to be educated about the damaging effects of dryg use and to be encouraged to maintain good oral health that will contribute to an improved oral health quality of life. The dentist should also educate the patient that further drug use may lead to severe dental, neurological, psychological and other complications that will be very difficult to treat. Inter-professional teams should be consulted and may include clinical psychologists, social workers, councillors, medical doctors, occupational therapists, professional nurses and dieticians. The supportive role of the patient's family and friends is essential and therefore it is recommended that oral health education and appropriate oral health behaviour be shared with those closest to the patient.

7.2.3 Oral health education and appropriate oral health behaviour

Aspects on the importance of oral health, basic oral health disease process and appropriate oral health behaviour should be included in eduction and promotion activities. Appropriate oral health behaviour such as brushing teeth twice a day, regular flossing of teeth, the importance of dental visits, limiting sugar intake, encouraging a balance diet plan and refraining from smoking should be encouraged. Moreover, the importance of regular water consumption and dietary counselling should be incorporated into the treatment plan.

7.2.4 Clinical interventions

Dental management of the SUD patient remains challenging and require high procedural skills and sophisticated planning that takes into consideration the medical and substance use history of the patient. A comprehensive dental treatment plan necessitates a stage-by-stage procedure schedule. For the initial prevention phase, appropriate prescription of fluorides for the patient specific dental caries risk profile can be applied.

For alleviating *xerostomia*, the patients should be encouraged to consume plenty of water and to rinse their mouth regularly with water and saline solutions. The patient should also be encouraged to refrain from consuming caffeine, tobacco and alcoholic drinks. Other suggestions are to chew sugar-free gum and use a straw when drinking beverages that contain sugar. Pharmacological interventions to address xerostomia include salivary substitutes, oral moisturisers and artificial saliva but need to be prescribed on a patient-specific case given their short duration of action and interaction with dental plaque index.

Prescription of pilocarpine which is an alkaloid, can also be considered because it is responsible for the stimulation of smooth muscle in minor and major salivary glands for increased saliva secretion. However, prescribing pilocarpine to patients with a medical history of hypertension, pulmonary or renal disease, cardiac dysrhythmia or hypersensitivity should be cautioned. Therefore, it is always advisable that the prescription of drugs for these patients should always be first discussed with their physician or substance treatment specialist.

Local anaesthetics which contain vasoconstrictors should be avoided in the patient who used cocaine and methamphetamine less than 6 - 24 hours preceding the dental appointment (Ratclif, 1987, Angelillo *et al*., 1991). A full blood count, INR and liver function test is prescribed for the patient with a history of chronic alcohol addiction when dental extractions are planned. This is particular important when surgery is planned for the alcoholic patient. The airway needs to be protected because of the depressed gag and cough reflex in patients. Moreover, a longer bleeding time, delayed blood clotting, wound healing and osteomyelitis have also been reported (Dunkley *et al*., 1968; Christen, 1983).

The prescribing of *analgesics* is variable and should be tailored to the patient's needs and background. The dentist should be vigilant for the patient who is addicted to over the counter medicine especially a history of long-term use of non-specified benzodiazepines for vague or unknown causes. This and other drugs such as cough/cold medicines (e.g., those containing dextromethorphan or pseudoephedrine), pain relievers (e.g., acetaminophen, ibuprofen) and sleep aid medication and antihistamines (e.g., diphenhydramine) are used as over-the-counter or prescription drugs. Cannabis users tend to have difficulty obtain favourable local anaesthesia and in this case the dentist should consider to use a longer acting LA such as bupivacaine to provide prolonged. Pain medication for opioid users should not contain opioids (Denisco *et al*., 2011) and thus the first choice should be nonsteroidal anti-inflammatory (NSAID) and paracetamol. Warning signs on medicine packages should be visible especially considering that NSAIDS may cause gastric bleeding (Seymour, 1983). On some occasions, low-dose ketamine is also considered. It is also advisable that post-operative pain medication should be controlled by a reliable family member of the patient to prevent inappropriate use and further use (Dunkley *et al*., 1968; Christen, 1983). Restoration of teeth that are grossly affected by extensive dental caries can be lengthy and expensive. Prior to commencing restorative treatment, the periodontal status needs to be stabilized with patient compliance with regards to presenting for scheduled appointment and improving oral health behaviour.

CHAPTER 8: SUMMARY AND CONCLUSION

8.1 Summary of oral health impact of substance use disorder

A framework was created to integrate previous research and findings of the present study. An articulated set of main components were connected with sub-components to describe the oral health impact of substance use disorder (SUD). Evidence from published articles referenced in this dissertation and an in-depth analysis was incorporated in this model to explain the different contributing factors towards poor oral health of the patient who suffers from SUD. The following components were included in this framework: physiological factors, socio-demographic profile, behavioural factors (including oral health- and substance use behaviour), direct (chemical) effect, psychological factors and oral health care offered during SUD treatment programmes (Figure 28).

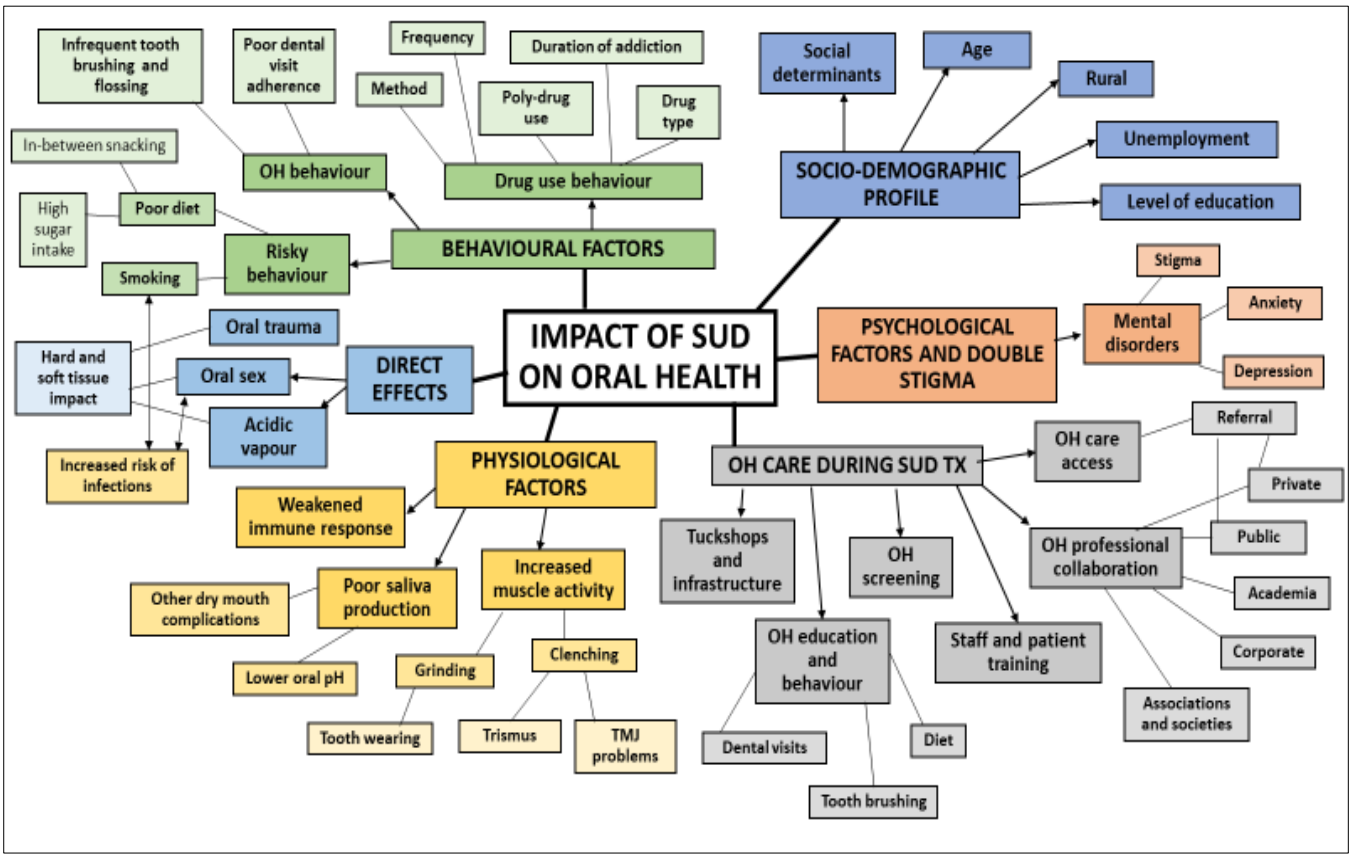

Figure 28: Framework for impact of SUD on oral health

8.1.1 Direct (chemical) effect

8.1.1.1 Hard tissue effect

Drugs such as methamphetamine are acidic. When smoked it acts as co-factor that contributes to the acidic oral environment, resulting in the higher dissolution of enamel and dentine, thereby accelerating the dental caries process. The present study and other studies, showed that a dry mouth is a common symptom and the dry environment in the mouth further diminishes saliva's buffering properties that protect tooth structure against demineralisation.

8.1.1.2 Soft tissue effect

Soft tissue damage result in burns from smoking the drug and mucosal ulceration, especially among cocaine users, is common. In some cases, cocaine users smear the drug on the gingiva, causing inflamed, bleeding gingiva associated with epithelial desquamation.

8.1.2 Physiological effects

During drug use, alpha-adrenergic receptors of the vasculature in salivary glands are stimulated leading to vasoconstriction of blood vessels, with reduced saliva production and dry mouth. Dry mouth is also caused by the stimulation of inhibitory alpha 2 adrenoreceptors which may lead to a slower saliva flow. The absence of saliva means that there is no buffering capacity in the mouth to protect teeth against the acidic demineralization process of dental caries, and contributes to inflammatory conditions such as cheilitis and glossitis as well as fungal infections such as oral candidiasis. Patients often have difficulty to swallowing.

Increaseding motor activity leads to increased muscle activity especially among stimulant users, and results in grinding and clenching of the teeth. Subsequently, causing further dental destruction of teeth, myofascial fatigue, temporomandibular disorder (TMD).

Drugs such as morphine lead to inhibition of phagocytosis of *Candida Albicans* by macrophages. The educed salivary flow predisposes to oral candidiasis. Concurrent smoking of cocaine and cannabis contributes to mucosal dysplasia and contain many carcinogens which leads to alteration of the oral epithelium and more susceptible to oral cancer.

Saliva contains secretory IgA which is a vital component of the immunological defence mechanism in the oral cavity. Patinets often have weakened immune responses often compromised by HIV and diabetes. Cocaine has a vasoconstrictive effect and when being used intra nasally, causes ulceration and atrophy of tissue. Cases of perforation of the nasal septum among regular cocaine users had been reported.

8.1.3 Behavioural factors

The behavioural factors related to the impact of SUD on oral health can be viewed firstly, as oral health behaviour and secondly, substance-specific behaviour and substance-associated risk behaviour.

8.1.3.1 Oral Health behaviour

Oral health behaviours include history of tooth brushing frequency, dental visits, flossing teeth, in-between snacking, brushing with a fluoridated tooth paste, degree of a high sugar diet and smoking. Oral health behaviour is poor among substance users and this behaviour contributes to increased prevalence of dental caries and periodontal disease.

8.1.3.2 Substance-related risk behaviour

Behaviour that related to substance that contributed to poor oral health included the type of drug being used, poly-drug use, duration of addiction and frequency of drug use. The present study had shown that a severity of dental caries and a negative impact on Oral Health Related Quality of Life was associated with a long duration of drug addiction, specific methamphetamine and mandrax use, poly-drug use and daily usage of the drug of choice. The literature has shown that the use of stimulants was associated with high risk genderual behaviour and usage of alcohol was associated with increased risk of maxilla-facial trauma due interpersonal violence and motor vehicle accidents.

8.1.4 Socio-demographic factors

The socio-demographic profile was one of being male, late 30s, unemployed, with a low level of education and from a poor socio-economic background. Most patients were first-time

admissions. Determinants that contributed to the socio-demographic profile included lifestyle environment such as access to safe water and sanitation, community safety, transport, food, education and health access. The environment where people live needs to be supportive in order to assist the rehabilitated patient maintain a life of sobriety.

Most patients only reached high school but did not complete grade 12 (matric). Low levels of education were associated with a higher mean score for DMFT (severity of dental caries) as well as a higher OHIP-14 score (severity of negative impact on OHRQoL). Patients from a rural background were found to have significantly worse access to basic oral health services.

8.1.5 Psychological factors and double stigmatism

Psychological factors include mental health disorders such as anxiety and depression. Patients suffer from depressive episodes when oral health is neglected and there is a lack of motivation for self-care. Furthermore, there is reluctance to attend for dental care related to anxiety about visiting the dentist. Patients with SUD and anxiety, experience a higher degree of dental phobia and display visible psychological distress. Long-term substance use can lead to the patient developing psychosis and paranoia. The double stigmatism among SUD patients refers to being treated unfairly or being discriminated against due to their history of substance use and/or because of their mental health disorder. Patients reported being stigmatised by oral health professionals on account of their history with drug addiction.

8.1.6 Oral health care during enrolment for SUD

During their enrolment period into a treatment centre, the following factors need to be considered: access to oral health care, oral health screening at admission, referral process, professional collaboration, curricular oral health content, staff training, tuckshops and infrastructure, diet and continuous support. The recommendations have addressed the abovementioned themes.

8.2 CONCLUDING REMARKS

The present study highlighted the drug-specific oral health impact of substance use disorder (SUD). The study found that Oral Health Related Quality of Life, dental status and oral health behaviour is poor among SUD patients. The study considered a multifactorial cascade of risk predictors related to the socio-demographic profile, history of substance use and oral health behaviour of the patient.

Dental management of the SUD patient varies from that of a non-addict due to the significant differences related to behavioural and personality issues. Nonetheless it important that oral health professionals play a significant part in the early detection and provision of oral health care. There were no dedicated oral health intervention programmes for enrolling patients in a SUD treatment programme, therefore a comprehensive oral care strategy at treatment centres to improve OHRQoL of these patients is required. This will require a collaborative effort between the different oral health professional and the SUD treatment centres.

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10. APPENDICES

Appendix 1: Permission letter to manager of treatment, local clinic or provincial department

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

For Attention:

STUDY PROJECT: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Sub-stance Use Disorder

ETHICS: Approved

This is a letter to elicit your support for a study that will investigate the oral health impact of substance use disorder as well as the extent to which oral health interventions are offered to patients while enrolled in a treatment programme.

The oral clinical picture of substance use, can be explained by contributing factors such as dry mouth, constant grinding of teeth, a poor appetite and ability of acidic vapor of the drug to demineralize enamel. Dentists and other health care workers are in the front-line regarding the diagnosis and recognition of the oral signs and symptoms of someone who suffer from substance use disorder. Primary detection can contribute to early intervention and prevention of further use. The study will be done at various substance use treatment centres in the Western Cape. A structured questionnaire will be administered to elicit demographical details, drug use, diet, dental history, employment status and level of education. Patients who are currently enrolled in a treatment programme for substance use disorder at you centre, will be asked to participate.

The qualitative part of the study will involve semi-structured interviews with facilitators/managers of substance abuse treatment centres to ascertain what are the oral health needs of patients when they enroll for treatment. The interview will also be used to determine to which extend are oral health interventions (oral health education, promotion and treatment services) offered as an adjunct to existing treatment programmes. The following themes will be covered during the interviews:

1. The importance of good oral health and good dental habits for general health and life
2. Appropriate diet to promote oral health and mechanism of tooth decay and gum infection
3. The effects of substance abuse on oral health

4. Good oral health behaviour (tooth brushing, dental visits, rinsing, diet)

Participation will be on voluntary basis and their identity will remain anonymous at all times. Signed informed will be obtained from all participants and they will have the right to withdraw from the study at any stage and this will not prejudice the patient in any future treatments.

The clinical part of the study will include an oral examination where their oral health status will be measured. This examination will be non-invasive and will be an ideal opportunity to detect dental problems that require further management.

The research proposal was approved by the Bio-Medical Research Ethics Committee of the University of the Western Cape (BM19/8/4). I would like to request a formal meeting with you to discuss your centre's prospective participation in the study. Appropriate research ethics application will be done at the respective governing authority of your centre.

This research is being conducted by Dr Dirk Smit under the supervision of Professor Sudeshni Naidoo. Should you have any questions regarding the study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please do not hesitate to contact:

1. **Researcher: Dr D. Smit**
   Senior lecturer/Specialist (Community Dentistry) PhD Student
   Department of Community Oral Health
   Faculty of Dentistry
   University of the Western Cape
   Private Bag X1, Tygerberg, 7505
   Tel: 021 937 3148
   Email: dsmit@uwc.ac.za

2. **Supervisor: Prof S. Naidoo**
   Email: snaidoo@uwc.ac.za

3. **Head of Department: Prof N Myburgh**
   Department of Community Oral Health
   Faculty of Dentistry
   University of the Western Cape
   (W) +27 21 937 3150

4. **Research Ethics Committee**
   Biomedical Research Ethics Committee (BMREC), University of the Western Cape
   Private Bag x17, Bellville, 7535
   Tel: + 27 21 959 4111
   Email: research-ethics@uwc.ac.za

Appendix 2a: Patient information page

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Project Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

What is this study about?

This is a research project being conducted by Dr Dirk Smit (a PhD student) under the supervision of Prof. Sudeshni Naidoo at the University of the Western Cape in South Africa. We are inviting you to participate in this research project because you meet the set criterion for the population of interest and your participation will help other people in your community and the country as a whole. The study will investigate the oral health impact of substance use disorder as well as the extent to which oral health interventions are offered to patients while enrolled in a treatment programme.

What will I be asked to do if I agree to participate?

You will be asked to sign a consent form agreeing to take part in the study. Your participation will involve a verbal questionnaire that should take no longer than 15 minutes for us to complete. These interviews will be conducted at a time and location that is convenient to you. The questionnaire will be administered to elicit demographical details, drug use, diet, dental history, employment status and level of education. Patients who are currently enrolled in a treatment programme for substance use disorder at you centre will be asked to participate. In addition, we will examine your mouth and photographs only of your teeth may be taken but will not show your identity or face.

Would my participation in this study be kept confidential?

All the information, including any personal information you provide will be kept strictly confidential. Your real name will not be included on the data capture sheet and all information collected will be locked in secure password protected files on the computer. Additionally, access to any information will be restricted to me, the researcher and my research supervisor only. Summary interview content or direct quotations from the interview that will be made available through my dissertation, academic publications or policy documents will be coded and anonymized. At the end of the study, all data will be kept for as long as legally required and thereafter will be properly disposed of, deleted or destroyed.

What are the risks of this research?

There are no risks associated with participation. As described above, all precautions (coding of data, restricted access, storage in locked cabinets and/or password protected computers) to protect anonymity and identity will be strictly applied. You also have the right to only answer questions you want to answer.

What are the benefits of this research?

At the end of this study, I will communicate to you and the community the oral health impact of substance use disorder. All participants who undergo an oral examination will have referral for any dental diseases. The results and findings of the study will be presented.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate, you have the right to withdraw at any time or only answer selected questions. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized in any way.

Is any assistance available if I am negatively affected by participating in this study?

If at any time of the study, you feel uncomfortable and need assistance, the researcher will refer you for counselling through social welfare office in your area.

What if I have questions?

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please do not hesitate to contact:

1. **Researcher: Dr D. Smit**
   Senior lecturer/Specialist (Community Dentistry)
   Faculty of Dentistry, UWC
   Tel: +27 937 3148
   Email: dsmit@uwc.ac.za

2. **Supervisor: Prof S. Naidoo**
   Email: suenaidoo@uwc.ac.za

3. **Head of Department: Prof N Myburgh**
   nmyburgh@uwc.ac.za

4. **Research Ethics Committee**
   Biomedical Research Ethics Committee (BMREC), University of the Western Cape
   Private Bag x17, Bellville, 7535
   Tel: + 27 21 959 4111
   Email: research-ethics@uwc.ac.za

Appendix 2b: Staff member information page

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Project Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

What is this study about?

This is a research project being conducted by Dirk Smit (a PhD student) under the supervision of Prof. Sudeshni Naidoo at the University of the Western Cape in South Africa. We are inviting you to participate in this research project because you meet the set criterion for the population of interest and your participation will help other people in your community and the country as a whole. The study will investigate the oral health impact of substance use disorder as well as the extent to which oral health interventions are offered to patients while enrolled in a treatment programme.

What will I be asked to do if I agree to participate?

You will be asked to sign a consent form agreeing to take part in the study. Your participation will involve a semi-structured focus group discussion to ascertain what are the oral health needs of patients when they enroll for treatment. **The interview will also be used to determine to which extend are oral health interventions (oral health education, promotion and treatment services) offered as an adjunct to existing treatment programmes for substance use disorders.**

The following themes will be covered during the interviews:

1. The importance of good oral health and good dental habits for general health and life
2. Appropriate diet to promote oral health and mechanism of tooth decay and gum infection
3. The effects of substance abuse on oral health
4. Good oral health behaviour (tooth brushing, dental visits, rinsing, diet)

Would my participation in this study be kept confidential?

All the information will be kept strictly confidential. Your real name will not be included on the data capture sheet and all information collected will be locked in secure password protected files on the computer. Additionally, access to any information will be restricted to me, the researcher and my research supervisor only. Summary interview content or direct quotations from the interview that will be made available through my dissertation, academic publications or policy documents will be coded and anonymized. At the end of the

study, all data will be kept for as long as legally required and thereafter will be properly disposed of, deleted or destroyed.

What are the risks of this research?

There are no risks associated with participation. As described above, all precautions (coding of data, restricted access, storage in locked cabinets and/or password protected computers) to protect anonymity and identity will be strictly applied. You also have the right to only answer questions you want to answer.

What are the benefits of this research?

At the end of this study, I will communicate to you and the community the oral health impact of substance use disorder.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate, you have the right to withdraw at any time or only answer selected questions. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized in any way.

Is any assistance available if I am negatively affected by participating in this study?

If at any time of the study, you feel uncomfortable and need assistance, the researcher will refer you for counselling through social welfare office in your area.

What if I have questions?

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please do not hesitate to contact:

1. **Researcher: Prof D. Smit**
   Associate Professor/Head Clinical Unit (Community Dentistry)
   Faculty of Dentistry, UWC
   Tel: +27 937 3148
   Email: dsmit@uwc.ac.za

2. **Supervisor: Prof S. Naidoo**
   Email: suenaidoo@uwc.ac.za

3. **Research Ethics Committee**
   Biomedical Research Ethics Committee (BMREC), University of the Western Cape
   Private Bag x17, Bellville, 7535
   Tel: + 27 21 959 4111
   Email: research-ethics@uwc.ac.za

Appendix 3a: Informed consent (patient)

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Title of Research Project: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

Principal Investigator:	Dr Dirk Smit (PhD Student; University of the Western Cape)
Supervisor:	Prof. S. Naidoo (UWC)
Department:	Community Oral Health
Telephone:	021 937 3148
Email:	dsmit@uwc.ac.za

Dear .....

You are being invited to participate in the above-mentioned research study. Please take time to read the information that is presented below.

The study entitled "Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder" will investigate oral health impact of substance use disorder as well as the extent to which oral health interventions are offered to patients while enrolled in a treatment programme.

Your participation will involve a verbal administered questionnaire that should take no longer than 15 minutes to complete and an oral examination. Participation is voluntary and you have the right to withdraw at any time, to only answer selected questions or to refuse to participate entirely without the risk of penalty or prejudice. There are no risks associated with participation in the study. Please indicate your willingness to participate through completion of the attached declaration on the next page.

Thank you for taking time to read this information sheet. Should you have any queries relating to participation or the nature of the study, please do not hesitate to speak to the researcher. You will receive copies of this informational sheet and consent form for your records.

Yours Sincerely

Dirk Smit

APPENDIX 3

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Title of Research Project: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

Declaration by the Participant

I (full name) ……..

- Declare that the study has been described to me in language that I understand;
- Have read, understood and received a copy of the foregoing informational sheet and consent form, written in a language with which I am fluent;
- Have had the opportunity to ask questions regarding the study and my questions have been answered to my satisfaction;
- understand that my identity will not be disclosed and that I have the right to withdraw from the study at any stage without giving a reason and without the risk of penalty; and that it will not negatively affect me in any way
- Freely and voluntarily agree to participate in this study.

Signature of participant: _____ **Date:** _____

Signature of Investigator: _____ **Date:** _____

We thank you for your contribution to our research

Appendix 3b: Informed consent (staff member of focus group discussions)

APPENDIX 3b: Informed Consent for staff for Focus Groups

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Principal Investigator: **Prof** Dirk Smit (PhD Student; University of the Western Cape)

Supervisor: Prof. S. Naidoo (UWC)

Department: Community Oral Health

Phone: 021 927 3148 **Email:** dsmit@uwc.ac.za

RESEARCH PROJECT: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

The focus group discussion will be a structured 30 – 40 min interview with the researcher. The researcher, will audio tape and video the information that will be transcribed for analysis. Your signed consent to participate in the study is required before I proceed with the focus group discussions. If you are willing to participate in this study, please read the following and sign below.

- I hereby agree to participate in the focus group discussion which required opinion regarding the …….
- I understand that I am participating freely and without being forced to do so in any way. I also understand that I can stop participating and withdraw from the study at any time should I decide to do so and that this decision will not in any way affect me negatively
- I understand that everything that is discussed in this group meeting is confidential and that all the participant's names will not be linked to anything that is said.
- I also agree to keep the content of the discussions confidential and not to repeat anything said by other focus group members or their identity to anyone outside of the group.

Signature of participants:

Witness Name & Signature: _____ **Date:** _____

APPENDIX 3b

Appendix 4: Consent for photography

APPENDIX 4: Consent for Photography

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Project title:

Principal Investigator:	Dr Dirk Smit (PhD Student; University of the Western Cape)
Supervisor:	Prof. S. Naidoo (UWC)
Department:	Community Oral Health
Phone:	021 927 3148
Email:	dsmit@uwc.ac.za

I, ... hereby consent to photographs being taken of me as requested, I understand that these photographs will be stored appropriately, treated with the utmost confidentiality and be part of my dental record. I hereby give consent for the images or recordings to be used ONLY for the boxes I have indicated with a tick (√):

☐ **Record purposes and for my/my child's future management**

The photographic images and recordings will form part of the information collected for your care and treatment. This information is handled in accordance with the HPCSA Booklet 9: Guidelines on the keeping of patient records.

☐ **Education and training purposes**

The photographic images and recordings may be used for teaching purposes and viewed by health professionals outside of the UWC Faculty of Dentistry. The images may be used for example, in talks, conference presentations, posters or on the internet to help train other health professionals in the management of dental and oral diseases

APPENDIX 4

APPENDIX 4: Consent for Photography

☐ **Approved research purposes & publication**

This may involve the photographic images and recordings being used for example in medical or dental publications, journals, textbooks, conference material, e-publications and on the Internet. Images will be seen by health professionals and researchers who use the publications in their professional education. The images may be seen by the general public. Images will not be used with identifying information such as name, however, full confidentiality is not guaranteed.

☐ **Other purposes** (please specify): ……..

Declaration by the Participant

I (full name) ……

- Have read, understood and received a copy of the foregoing photography consent form, written in a language with which I am fluent;
- Have had the opportunity to ask questions regarding this and any questions I have asked have been answered to my satisfaction;
- I understand that all efforts will be made to conceal my identity but that full confidentiality cannot be guaranteed.
- I understand that my consent or refusal will in no way affect my dental care.

Signature of participant: _____ Date: _____

Witness Name & Signature: _____ Date: _____

We thank you for your contribution to our research

APPENDIX 4

Appendix 5: Questionnaire (patient)

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

Rec no		Participant code		Date		Venue:	In / Out Pt

Demographic information

1.	Date of birth	DD / MM / YYYY						Age:				
2.	What is your marital status	Single	Married	Living as married	Separated	Divorced	Widowed					
3.	Gender							Male		Female		
4.	a. Do you have children?							Yes		No		
	b. If yes and female, did you become pregnant for the first time before age 20?							Yes		No		
5.	Where is your primary place of residence?	Neighborhood		Town		Province						
6.	Employment status	Full time job/Self employed	Unemployed	Part time/ contract/temp/casual	Other	Student/apprentice/intern	Pensioner/ Retired	Housewife	Medically unfit/ disable			
7.	a. Please indicate highest level of education reached:	No school	Primary school	High school	Tertiary (College or University)	Post Grad						
	b. Highest grade completed											
8.	a. What kind of work do you do?											
	b. If unemployed in 6, how long have you been unemployed?	a.Years										
		b.Months										

Drug history (Primary drug of choice)

9.	a. What is your 1st most frequently used substance? Excluding tobacco											
	b. Is this a "mixed or cocktail" drug?	Yes			No							
10.	a. At what age did you start using the drug											
	b. How long ago was the last time you used it (days)?											
11.	How long have you been using the drug (years)?											
12.	How often did you use the drug	Daily	2-6 days a week	Once a week	Once or twice a month	Less frequent						
13.	How did you use the drug	Inject	Snort / Sniff	Swallow	Smoke	Other						
14.	What is the cost (R) of a daily "dose" of the drug											
15.	a. Please indicate the amount (grams) that was used per day	< 1 g	1 > 2g	2 > 3g	3 > 4g	4 > 5g	> 5g					
	b. Did you use the above-mentioned amount all by yourself?	Yes		No								
	c. If no, how many people did you share the drug with?	1 person	2 - 5 people	> 5 people								

(If no secondary drug applicable, proceed to no. 23.)

Drug history (Secondary drug of choice)

16.	a. What is your 2nd most frequently used substance? Excluding tobacco					
	b. Is this a "mixed or cocktail" drug?	Yes				
17.	a. At what age did you start using the drug					
	b. How long ago was the last time you used it (days)?					
18.	How long have you been using the drug (years)?					
19.	How often did you use the drug	Daily	2-6 days a week	Once a week	Once or twice a month	Less frequent
20.	How did you use the drug	Inject	Snort / sniff	Swallow	Smoke	Other
21.	What is the cost (R) of a daily "dose" of the drug					
22.	a. Please indicate the amount (grams) that was used per day	< 1 g	1 > 2g	2 > 3g	3 > 4g	4 > 5g	> 5g
	b. Did you use the above-mentioned amount all by yourself?	Yes			No	
	c. If no, how many people did you share the drug with?	1 person	2 - 5 people	> 5 people		

Substance use treatment history

23.	a. Have you ever in the past gone to a drug treatment (rehabilitation) centre / programme (in/out pt.) prior to this time?	Yes		No	
	b. If yes, how many times have you been enrolled before?	once	twice	thrice	more

Tobacco use history

24.	Do you use any of the following tobacco products more than once a week?	Snuff	Vape/e-cigarettes	Cigarettes	Hookah pipe	Chewable tobacco	Pipe
25.	a. How frequently do you use it /day						
	b. /week						
26.	a. How many/much do you consume/day						
	b. /week						

Diet history: When you are using drugs:

27.	a. Liquids: What non-alcoholic drinks do you mostly drink	Water	Juice	Smoothies / Drinking yogurt	Fizzy drink (soft drinks	Hot drinks (coffee or tea)	Other
	b. How many glasses would you have of each per day						
	c. How many glasses would you have of each per week						
	d. How many teaspoons of sugar would you add with one cup of coffee or tea						
28.	a. Liquids (alcoholic): Describe the drinks you mostly drink	Beer	Ciders	Glass of wine	Spirits (Brand, Whiskey, Gin etc.)	Shots	Other
	b. How many glasses will you have per day						
	c. How many glasses will you have per week						
29.	a. Solids: What are the 3 most common food you will have for breakfast						
	b. How many teaspoons of sugar do you add to each of these						

30.	Solids: What are the 3 most common food you have for lunch										
31.	Solids: What are the 3 most common food you have for super/dinner										
32.	a. What salty snacks would you have in-between meals (e.g. chips, salty cracks, popcorn, peanuts).										
	b. How many packets of these would you have per day										
33.	a. What sweet snacks would you have in-between meals (e.g. chocolate, lollypop, sweat, ice cream, etc.)										
	b. How many/much of these would you have per day										
34.	a. How was your appetite when you were using the primary drug?	very good		good		normal		poor		very poor	
	b. How was your appetite when you were using the secondary drug?	very good		good		normal		poor		very poor	

Dental history

35.	How often do you brush your teeth?	Never		Less often		Once a day		Twice a day		More often	
36.	When was your last dental visit?	Within the last year		More than a year but less than 5 years ago			More than 5 years ago	Never have been at the dentist			
37.	What treatment was done at the last dental visit	Filling		Extraction		Cleaning		Just check-up		Other	
When you are using the primary drug..... 38 - 45											
38.	Do you experience that you grind your teeth?	Yes							No		
39.	Do you experience dental pain (toothache)?	Yes							No		
40.	a. Do you experience any problem with your gums?	Yes							No		
	b. If yes, please specify										
41.	Do you experience any tightening or stiffness in your facial muscles?	Yes							No		
42.	Do you ever experience a bad taste in your mouth?	Yes							No		
43.	Do you experience a burning sensation in your mouth?	Yes							No		
44.	Do you experience increased tooth sensitivity	Yes							No		
45.	a. Do you experience a dry mouth?	Yes							No		
	b. If yes, how long (time) after you start using the drug, does your mouth become dry, please be specific	≤ 5 min		> 5 ≤ 60 min		> 1h ≤ 6 h's		> 6 h's			
	c. If yes, how long (time) after you stopped using the drug, does your mouth go back to normal (amount of saliva) again	> 0 ≤ 60 min		> 1h ≤ 24h's		> 1 ≤ 7days		> 7days			
46.	How often do you brush your teeth?	Never		Less often		Once a day		Twice a day		More often	

If no secondary drug applicable, then proceed to question 55. **When you are using the secondary drug..... 46 - 54**							
47.	Do you experience that you grind your teeth?	Yes			No		
48.	Do you experience dental pain?	Yes			No		
49.	Do you experience sore gums?	Yes			No		
50.	Do you experience any tightening or stiffness in your facial muscles?	Yes			No		
51.	Do you ever experience a bad taste in your mouth?	Yes			No		
52.	Do you experience a burning sensation in your mouth?	Yes			No		
53.	a. Do you experience a dry mouth?	Yes			No		
	b. If yes, how long (time) after you start using the drug, does your mouth become dry, please be specific	≤ 5 min	> 5 ≤ 60 min	> 1h ≤ 6 h's	> 6 hours		
	c. If yes, how long (time) after you stopped using the drug, does your mouth go back to normal (normal amount of saliva) again	> 0 ≤ 60 min	> 1h ≤ 24h's	> 1 ≤ 7days	> 7days		
54.	How often do you brush your teeth?	Never	Less often	Once a day	Twice a day	More often	
Medical history (from treatment centre if available)							
55.	a. Do you suffer from any medical conditions?	Yes			No		
	b. If yes, what medical conditions	Cardiovascular disease:					
		Diabetes:					
		Respiratory diseases:					
		Mental health problems:					
		Liver Disease:					
		Hypertension:					
		Gastrointestinal tract diseases:					
		STD's:					
		Other:					
	c. Have you been tested for HIV	Yes in the last 12 months	Yes but not in the last 12 months	No	Decline to answer		
	d. If Yes, what was the result if you wish to disclose?		Positive		Negative		
	e. Are you taking any chronic medication		Yes		No		
	f. If Yes, what medication are you taking and its dosage?						

Appendix 6: OHIP-14 questionnaire

Rec no		Participant code		Date		Venue:	In / Out Pt

APPENDIX 6: OHIP Questionnaire

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Project Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

No	Question: In the last 12 months,	Never 0	Hardly ever 1	Occasionally 2	Fairly often 3	Very Often 4	Weight
1	Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?						0.51
2	Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?						0.49
3	Have you had painful aching in your mouth?						0.34
4	Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?						0.66
5	Have you been self-conscious because of your teeth, mouth or dentures?						0.45
6	Have you felt tense because of problems with your teeth, mouth or dentures?						0.55
7	Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?						0.52
8	Have you had to interrupt meals because of problems with your teeth, mouth or dentures?						0.48
9	Have you found it difficult to relax because of problems with your teeth, mouth or dentures?						0.60
10	Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?						0.40
11	Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?						0.62
12	Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?						0.38
13	Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?						0.59
14	Have you been totally unable to function because of problems with your teeth, mouth or dentures?						0.41

Appendix 7a: Oral examination data collection form

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Project Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

Rec no		Participant code		Date		Venue:	In / Out Pt

Age

Gender (1 = Female, 2 = Male)

CARIES STATUS AND TREATMENT NEEDS

	17	16	15	55 / 14	54 / 13	53 / 12	52 / 11	51 / 21	61 / 22	62 / 23	63 / 24	64 / 25	65 / 26	27
Status														
Treatment														

	47	46	45	44 / 85	43 / 84	42 / 83	41 / 82	31 / 81	32 / 71	33 / 72	34 / 73	35 / 74	36 / 75	37
Status														
Treatment														

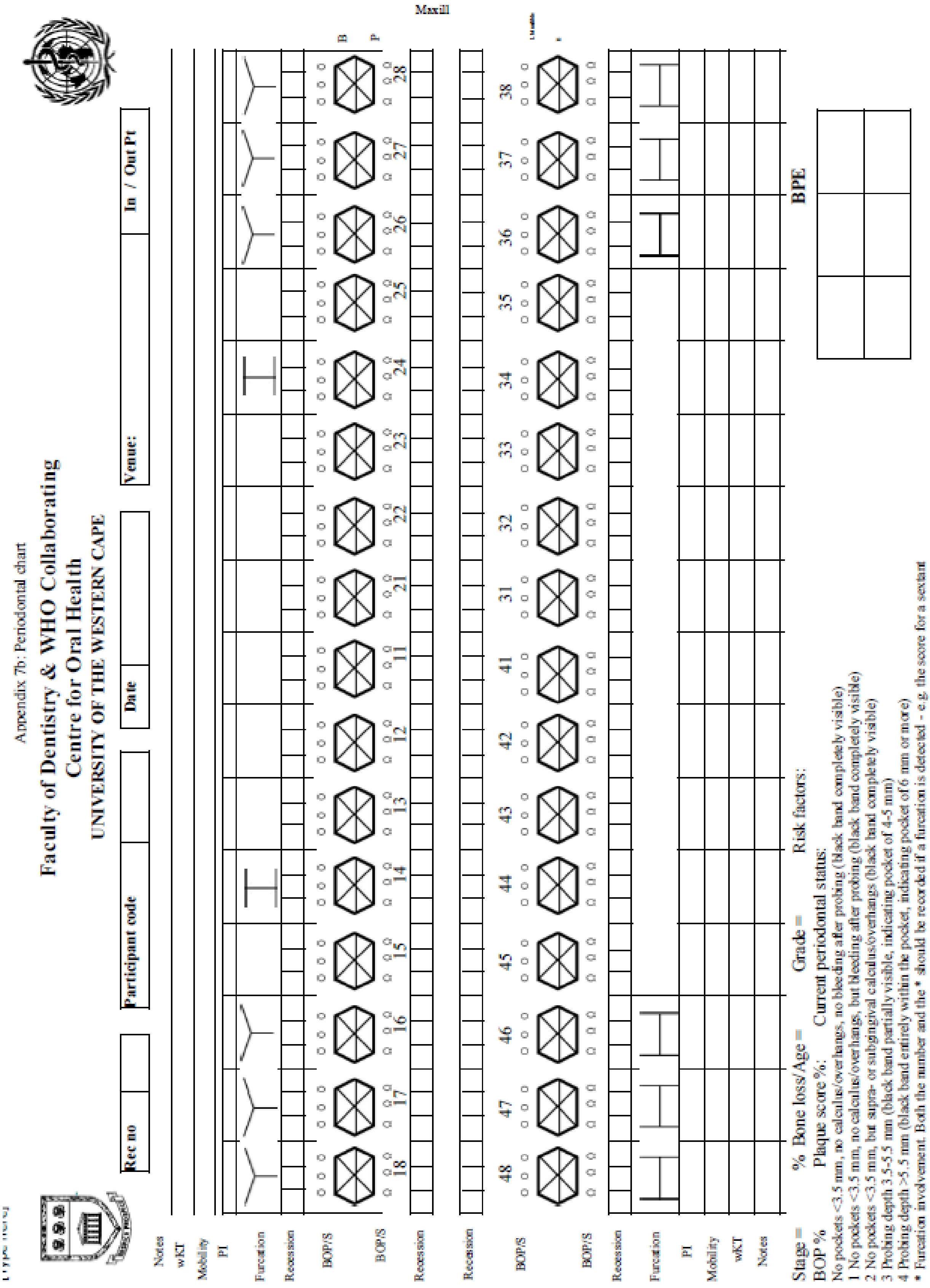
STATUS

0 = Sound
1 = Decayed
2 = Filled & decayed
3 = Filled, no decay
4 = Missing due to caries
5 = Missing any other reason
6 = Sealant, varnish
7 = Bridge abutment or special crown
8 = Unerupted tooth
9 = Excluded tooth

TREATMENT NEEDED

0 = None
1 = Caries arrest. or sealant care
2 = 1 Surface filling
3 = 2 or more surface filling
4 = Crown or bridge abutment
5 = Bridge element
6 = Pulp care
7 = Extraction
8 = Need for other care
9 = Specify

Appendix 7b: Basic periodontal examination (BPE) data collection form



[Type here]

Appendix 7b: Periodontal chart

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Rec no		Participant code		Date		Venue:	In / Out Pt

Notes
wKT
Mobility
PI
Furcation
Recession
BOP/S
B
P
BOP/S

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28

Recession

Maxill

Recession

48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

BOP/S
BOP/S
Recession
Furcation
PI
Mobility
wKT
Notes

Stage = % Bone loss/Age = Grade = Risk factors:

BOP % Plaque score %: Current periodontal status:

BPE

No pockets <3.5 mm, no calculus/overhangs, no bleeding after probing (black band completely visible)
1 No pockets <3.5 mm, no calculus/overhangs, but bleeding after probing (black band completely visible)
2 No pockets <3.5 mm, but supra- or subgingival calculus/overhangs (black band completely visible)
3 Probing depth 3.5-5.5 mm (black band partially visible, indicating pocket of 4-5 mm)
4 Probing depth >5.5 mm (black band entirely within the pocket, indicating pocket of 6 mm or more)
* Furcation involvement. Both the number and the * should be recorded if a furcation is detected - e.g. the score for a sextant

Appendix 7b: Periodontal chart

BPE Code	Probing depth	Observation
0	Pockets <3,5mm First black band completely visible	**Healthy** periodontal tissue No calculus/overhangs No BOP
1		No calculus/overhangs
		BOP present
2		Supra or subgingival **Calculus or plaque** retention factors
3	Probing depth **3.5mm – 5.5mm**	***First black band partially visible*** indicating pocket of **4-5mm**
4	Probing depth **>5.5mm**	***First black line entirely within the pocket,*** Indicating pocket **> 6mm**
*	Furcation involvement	Detection of a furcation

Appendix 8: Patient referral letter template

Appendix 8: Referral Letter

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Project Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

REFERRAL FOR DENTAL TREATMENT

Dear Participant,

You _____, have received an oral examination and have been found to have Tooth decay/ Gum disease/ or _____ which requires urgent treatment.

I recommend that you attend to _____dental clinic or a private facility of your choice for management. Please note that you will bear the cost of your or your child's treatment.

Yours Faithfully,

Dr Dirk Smit
PhD Student/Dental Researcher

APPENDIX 8

Appendix 9: Interview guide questions for focus group discussions

Faculty of Dentistry & WHO Collaborating Centre for Oral Health

UNIVERSITY OF THE WESTERN CAPE

Private Bag X1, Tygerberg, Cape Town
REPUBLIC OF SOUTH AFRICA

Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

Rec no		Group code		Date		Venue:	In / Out Pt

1. Do you offer any oral health programmes, oral health education, oral health promotion for your clients/patients while they are in a programme for substance use disorder?

1.a. If yes, what services are offered and how frequent are they offered.

2. What are your views on the effects of substance use on Oral Health (dental health / state of their teeth)?

3. Do you think oral health is important for your patients' general health?

4. Why do you think a person needs good oral health including health gums and teeth.

5. Do you find oral health problems in your patients? Yes or No

5.1 If yes, what kinds of problems

5.2 What do you do?

5.3 Do you refer them for oral health problems (dental problems)

5.4 If yes, who do you refer too

6. Do you think that there should be oral health education, promotion for these patients while they are enrolled for treatment at your facility?

7. What information do you think may be relevant for this group of patients?

8. Who should provide the oral health education and promotion for patients who are in a substance addiction programme?

9. In your opinion, which practical things can be done by a patient to maintain good oral health.

10. What might be the benefits of incorporating an oral health programme into the current general prgramme for substance us disorder

Appendix 10: University of the Western Cape (UWC) Bio-Medical Research Ethics Committee (BMREC) approval letter

UNIVERSITY of the WESTERN CAPE

60 YEARS of hope, action & knowledge

15 December 2020

Dr D Smit
Community Dentistry
Faculty of Dentistry

Ethics Reference Number: BM19/8/4

Project Title: Oral Health-related Quality of Life, Dental Status and Treatment Needs of People with Substance Use Disorder

Approval Period: 23 October 2020 – 23 October 2023

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

Please remember to submit a progress report annually by 30 November for the duration of the project.

Permission to conduct the study must be submitted to BMREC for record-keeping.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: BMREC-130416-050

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 11: Research ethics approval by City of Cape Town

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

CITY HEALTH

Dr Natacha Berkowitz
Epidemiologist: City Health

T: 021 400 6864 F: 021 421 4894
E: Natacha.Berkowitz@capetown.gov.za

Ref: 24714 2019-11-25

RE: Oral Health-related Quality of Life, dental status and treatment needs of people with substance use disorder

Dear Dirk Smit

Your research request has been approved as per your protocol. Please refer to the subsequent pages for the approval of any facilities or focus areas requested. Approval comments on any proposed impact on City Health resources are also provided.

Eastern & Khayelitsha:

Contact Person: Dr Virginia De Azevedo (Area East Manager)

Tel/Cell: 021 360 1258/083 629 3344

Email: Virginia.DeAzevedo@capetown.gov.za

Northern & Western:

Contact Person: Dr Andile Zimba (Area North Manager)

Tel/Cell: 021 980 1230/084 627 2425

Email: Andile.Zimba@capetown.gov.za

Tygerberg & Klipfontein:

Contact Person: Mr Ruberto Isaaks (Area Central Manager)

Tel/Cell: 021 444 0893/078 565 7607

Email: Ruberto.Isaaks@capetown.gov.za

Mitchells Plain & Southern:

Contact Person: Mrs Soraya Elloker (Area South Manager)

Tel/Cell: 021 400 3983/084 222 1478

Email: Soraya.Elloker@capetown.gov.za

Appendix 12: Research ethics approval from Provincial Government of the Western Cape (Health)

Western Cape Government
Health

STRATEGY & HEALTH SUPPORT
Health.Research@westerncape.gov.za
tel: +27 21 483 0866: fax: +27 21 483 6058
5th Floor, Norton Rose House,, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za)

REFERENCE: WC_201910_035
ENQUIRIES: Dr Sabela Petros

Private Bag X17
Bellville 7535
South Africa

For attention: DR Dirk Smit

Re: Oral Health-related Quality of Life, dental status and treatment needs of people with substance use disorder

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.
Please contact the following people to assist you with any further enquiries in accessing the following sites:

Stikland Hospital	**Dr Liezle Koen**	**021 940 4570**

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final feedback (**annexure 9**) within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. In the event where the research project goes beyond the *estimated completion* date which was submitted, researchers are expected to complete and submit a progress report (**Annexure 8**) to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
4. The reference number above should be quoted in all future correspondence.

Yours sincerely

DR M MOODLEY
DIRECTOR: HEALTH IMPACT ASSESSMENT
DATE:
CC

Dr Melvin Moodley
Director: Health Impact Assessment
03 DEC 2019

Appendix 13: Research ethics approval from Provincial Government of the Western Cape (Social Development)

Western Cape Government
Social Development

Research, Population and Knowledge Management

tel: +27 21 483 8658/483 4512

14 Queen Victoria Street, Cape Town, 8000

Reference: 12/1/2/4

Enquiries: Clinton Daniels/Petro Brink

Tel: 021 483 8658/483 4512

Dr D. Smit

1 Van Niekerk Street

Paarl 7646

Dear Dr Smit

RE: APPROVAL TO UNDERTAKE RESEARCH IN THE WESTERN CAPE DEPARTMENT OF SOCIAL DEVELOPMENT

1. Your request for ethical and access approval to undertake research in respect of 'Your request for ethical approval to undertake research in respect of '*Oral Health-related Quality of life, dental status and treatment needs of people with substance use disorder*' refers.
2. Kindly note that your request was found to meet the ethical requirements of the Department's Research Ethics Policy, specifically in respect of the interviewing of DSD officials, subject to the conditions stipulated below.

    - That the Secretariat of the Research Ethics Committee be informed in writing of any changes made to your proposal after approval has been granted and be given the opportunity to respond to these changes.
    - That ethical standards and practices as contained in the Department's Research Ethics Policy be maintained throughout the research study, in particular that informed consent (written or recorded) be obtained from participants.
    - The confidentiality and anonymity of participants, who agree to participate in the research, should be maintained throughout the research process and should not be named in your research dissertation or any other publications that may emanate from your research.
    - The Department should have the opportunity to respond to the findings of the research. In view of this, the final draft of the research reports or products compiled by members of the research team should be send to the Secretariat of the REC for comment before further dissemination.
    - That the Department be informed of any publications and presentations (at conferences and otherwise) of the research findings. This should be done in writing to the Secretariat of the REC.