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The term "drug" in the title of the journal refers to all psychoactive substances other than alcohol. These include tobacco, cannabis, inhalants, cocaine, heroin, prescription medicines, and traditional substances used in different parts of Africa (e.g., kola nuts and khat).

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CAN A MOTIVATIONAL-INTERVIEWING-BASED OUTPATIENT SUBSTANCE ABUSE TREATMENT ACHIEVE SUCCESS? A THEORY-BASED EVALUATION

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ABSTRACT

This study evaluated a South African outpatient drug counselling centre's motivational interviewing-based treatment programme from theory and outcomes-based perspectives. 142 participants were interviewed at admission to the programme and followed up 6 and 10 weeks later. Trajectories of substance use, substance dependence, self-efficacy, motivation (using SOCRATES sub-scales of Problem Recognition, Ambivalence and Taking Steps) and NA/AA affiliation were examined. Self-efficacy and SOCRATES Taking Steps scores increased and were significantly associated with substance use levels, which decreased significantly over time. Higher self–efficacy scores at end-of-treatment (6 weeks) predicted lower substance use scores at 10 weeks. More programme attendance was associated with lower levels of substance use/dependence. Abstinence was achieved by 47% of participants.

Key words: substance abuse, substance dependence, treatment outcomes, self-efficacy, motivation, evaluation.

Global estimates suggest that approximately 5.4% of the global burden of disease is attributable to alcohol and illicit drug use (World Health Organization, 2014), making substance abuse treatment an urgent priority world-wide. As in other low- and middle-income countries (World Health Organization, 2010), in South Africa many treatment centres, especially those operating in the non-profit sector, operate under severe budgetary constraints (Myers and Parry, 2003), with the financial concerns of the population they serve typically creating significant barriers to treatment access (Myers et al., 2011).

Treatment based on motivational interviewing (Miller and Rollnick 1991) has shown promise as a shorter, more flexible treatment than traditional treatment programmes. Motivational interviewing (MI) helps people increase motivation

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for changing substance use habits by exploring and resolving ambivalence about change (Lundahl and Burke, 2009). A feedback process using personal assessment results together with pure MI is termed motivational enhancement therapy (MET) (Burke et al., 2003; Cloud et al., 2006; Hettema, Steele, & Miller, 2005). MET is considered at least as effective as cognitive-behavioural therapy and Twelve Step programmes (Hettema et al., 2005), similar to them in terms of durability (Lundahl and Burke, 2009), and a cheaper option than other competing therapies due to its relative brevity (Lundahl and Burke, 2009). These findings, combined with MET's enduring effects (Burke et al. 2003; Lundahl et al., 2010; Lundahl and Burke 2009), offer good support for the use of MET in treatment centres. Previous research has focused on examining MET within the parameters of efficacy studies, but outcome studies of MET-based real-world treatment programmes under pragmatic conditions are rare.

The Cape Town Drug Counselling Centre offers a low-cost, outpatient treatment programme with MET as its basis, and serves a multicultural clientele drawn mainly from the lower socio-economic areas of Cape Town and surrounds. This makes it an ideal setting for a pragmatic effectiveness study exploring the possibility of the success of MET under the usual conditions of a non-profit treatment centre.

METHOD

The theory of change for the treatment provided by the Centre

Elaborating a theory of change for a programme includes mapping the desired responses of participants to programme activities, as well as the mediating processes between programme services and the achievement of programme goals (Weis, 1998). Clients admitted to the Cape Town Drug Counselling Centre's programme are expected to attend six compulsory weekly sessions each of individual counselling, group therapy and psychoeducational lectures/discussions, and two family sessions. All are delivered using the key concepts of motivational interviewing techniques. The Centre also uses referral to Alcoholics Anonymous (AA) or Narcotics Anonymous (NA) groups, drug testing and family workshops as additional treatment resources.

Increased self-efficacy and motivation levels were identified by staff as key mediating processes in order to achieve abstinence. This was supported by the literature which postulates that both lead to positive behavioural change and resultant reduced substance use (Read, Kahler, & Stevenson, 2001). We were also interested in the relationship between levels of AA/NA attendance and affiliation and substance use outcomes. We hypothesized that self-efficacy levels, motivation levels and AA/NA affiliation would increase over time and would be associated with reduced substance use and substance dependence; that substance misuse would decrease over time; and that higher self-efficacy levels at end-of-treatment would be inversely associated with substance use outcomes four weeks after end-of-treatment. We further expected that programme "dose" - the number of sessions clients attended – would be negatively associated with levels of substance use.

Evaluation design

The Centre could not suspend normal operations during the evaluation,

eliminating the possibility of a controlled design. We therefore chose a theory-based approach (Weiss, 1998), with assessments at admission, immediately after the programme, and again at one month after the end of treatment, which allowed us to accomplish several goals: (1) assess whether self-efficacy, motivation and AA/NA affiliation would change over time and be related to outcomes, as predicted by the Centre's programme theory (Shadish et al., 2002) ; (2) assess whether the desired outcomes were achieved; and (3) assess whether those outcomes, if achieved, were sustained for at least a month post-treatment.

The study was approved by the University of Cape Town Humanities Faculty Research Ethics Committee.

Measures

Substance use. Substance use and substance dependence levels were determined by the Alcohol, Smoking and Substance Involvement Screening Test (WHO ASSIST v3.0; Humeniuk et al., 2008). Respondents were assessed for risk in respect of alcohol, cannabis, cocaine, methamphetamines, inhalants, sedatives, hallucinogens, opiates, and 'other drugs'. Scores measure whether respondents are at low, moderate or high risk of experiencing problems relating to substance abuse: These risk categories are good predictors of, respectively, substance use, substance abuse and substance dependence (Newcombe et al., 2005). The instrument has been tested for cross-cultural relevance (World Health Organization, 2013) and has been successfully utilized in a South African study involving substance abuse among South African primary care clinic patients (Ward et al., 2008).

Variables assessing mechanisms of treatment

***AA/NA Anonymous Affiliation Scale*.** This is a short and reliable assessment of participants' levels of affiliation with AA/NA and includes seven close-ended questions relating to number of meetings attended, service at meetings, literature read and sponsors obtained (Humphreys et al., 1998).

Socrates Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES). This is a 19-item instrument designed to assess levels of motivation for change in substance users, with three sub-scales - Problem Recognition, Taking Steps (towards change) and Ambivalence (Miller and Tonigan, 1996). The Recognition sub-scale assesses respondents' self-perceptions of drinking problems. Recognition scores are positively associated with problem severity, with high scores indicating acknowledgement of problems related to excessive drinking or drug use, while low scores reflect little or no desire for change. The Ambivalence sub-scale assesses a "weighing up" attitude towards change. Ambivalence scores should be interpreted in conjunction with Recognition scores to avoid ambiguity of results (Miller and Tonigan, 1996). This is exemplified by a questionnaire statement, "I think that I am an addict", attracting misleading 'Disagree' scores because clients expressed that they 'knew' that they were addicts - they did not merely think it. Therefore Ambivalence variables were restructured and recoded as follows: If the ambivalence score was equal to 1 and the recognition score was either 4 or 5 then the ambivalence score was altered to 5. If the ambivalence score was equal to 2 and the recognition score was either 4 or 5 then the ambivalence score was

changed to 4. The Taking Steps sub-scale assesses the level of action being taken by respondents to make positive changes to their drinking or drug use. High scores may predict successful change and taking active steps toward change.

Drug-Taking Confidence Questionnaire-8 (DTCQ-8). This is an 8-item assessment of levels of self-efficacy to resist temptation to drink or use drugs, in a variety of situations. Compared against a 50-item drug-taking confidence questionnaire, global self-efficacy is evaluated with 95% accuracy, is appropriate for use before, throughout and after treatment, as well as being a particularly appropriate tool in telephone follow-ups (Sklar and Turner, 1999).

Programme "dosage" received by each participant. This was obtained through record review, by adding the number of individual counselling sessions, group sessions and psycho-education discussions attended by each participant.

Sample

The Centre operates on a rolling admission basis. A total of 261 participants were recruited between 24 May 2011 and 3 April 2012, and interviewed at their assessment visit after consenting to participate. Clients were followed by telephone immediately post-treatment (6 weeks from admission) and again four weeks later, with each follow-up having a "window period" of two weeks. As more than half of heroin users who relapsed after residential treatment did so within the first three days after discharge and 75% within one week (Gossop et al., 2002), and 56.5% of treatment-seekers in an outpatient Southern California methamphetamine treatment study were still using at discharge (Rawson et al., 2005), this was considered an acceptable follow-up period for our study. Inclusion criteria were a minimum age of 18 years and active substance use or drinking during at least the three months before initial intake. Of the original 261 interviewees, 56 who did not begin the treatment programme were excluded, as were 47 who were referred by the Centre to in-patient facilities and 16 others, leaving 142 participants in our sample. Of these, 89 were interviewed at all three time points, 17 at only admission and 6 weeks after admission, and 98 at admission and 10 weeks after admission.

The demographic composition of our in-treatment sample (N=142) was: 61% Coloured, 24% White, 14% Black[1], 1% unknown; 75% male, 25% female; and mean age 30. These characteristics did not differ significantly in any way from the group who only stayed for the assessment. However, individuals using heroin at high-risk levels (according to their baseline ASSIST scores) were significantly less likely to enter the treatment programme than those not doing so (χ^2 (df=1) =11.938, p=0.001). Conversely, individuals using methamphetamines at high-risk levels were significantly more likely to enter treatment than those who did not (χ^2 (df=1) =4.289, p=0.027) and methamphetamine was the substance most used at high-risk levels in the group who stayed for treatment.

Analyses

Because of an assumption that drug users who cannot be contacted on follow-up

1 "Black", "Coloured" and "White" are racial classifications used under Apartheid. While we reject the ideology associated with these pejorative terms, we note them here because of their continuing influence on access to healthcare, such as substance abuse treatment centres (Myers and Parry, 2005).

Table 1. Substance use history on admission (N=142)

Risk categories	Low	%	Medium	%	High	%
Methamphetamines	3	2%	34	24%	55	39%
Alcohol	54	38%	22	15%	27	19%
Cannabis	14	10%	50	35%	25	18%
Opioids	2	1%	8	6%	18	13%
Cannabis	14	10%	50	35%	25	18%
Sedatives	9	6%	32	23%	14	10%
Cocaine	8	6%	19	13%	11	8%
Other	1	1%	1	1%	2	1%
Inhalants	2	1%	2	1%	0	0%
Hallucinogens	2	1%	12	8%	0	0%

may have relapsed (Shadish et al., 2002) we performed an intent-to-treat analysis, with baseline data imputed for missing data on the full in-treatment sample at admission and 10 weeks post-admission (*N*=142). We also conducted an analysis without missing data on the group of 98 participants (69% of the sample) who completed questionnaires at admission and 10 weeks after admission, as 10-week data was considered a better barometer of success than 6-week data and our response rate fell marginally short of the 70% level recommended for feasibility of findings (Digiusto et al., 2006; Hubbard et al., 1997). An analysis was conducted on the group of 89 participants interviewed at all three time points to determine the trajectories of all variables as well as the impact of end-of-treatment self-efficacy levels on 10 weeks post-admission substance use levels. Each analysis included mixed effect simple regressions on every variable to observe independent changes over time as well as mixed effect multiple regression tests to establish the impact of covariates on the global ASSIST score in conjunction with time. Mixed effect multiple regression tests were run on a final model, including only variables showing significance in the previous test, to calculate the relative contribution of each independent significant variable to global ASSIST scores. In addition a Spearman correlation test was performed on the three-time point group to ascertain whether higher self-efficacy levels at end of treatment (6 weeks after admission) were associated with lower global ASSIST scores four weeks later.

RESULTS

The results of all three analyses are summarized in Table 2.

Intent-to-treat analysis (N=142): Admission and 10 weeks post-admission

Changes occurred as expected for substance use, substance dependence and SOCRATES Ambivalence levels, which decreased significantly, while, also as expected, self-efficacy and SOCRATES Taking Steps levels increased significantly over time. There were no significant changes in either AA/NA affiliation or SOCRATES Recognition levels over time. Self-efficacy,

Table 2. Variables predicting global ASSIST scores

Variable	Full sample (intent to treat analysis; n=142)		Sub-sample with complete data (two time-points; n=98)		Sub-sample with complete data (three time-points; n=89)	
	(10 Weeks only)		(10 Weeks only)		(6 Weeks and 10 Weeks)	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Time (6 Weeks vs. Admission)	NA	NA	NA	NA	-1.33	(-5.71 , 3.06)
Time (10 Weeks vs. Admission)	-32.7***	(-40.16 , -25.24)	-34.55***	(-42.8 , -26.3)	34.08***	(26.07 , 42.1)
Dosage	-10.2*	(-18.52 , -1.89)	-7.44	(-15.56 , 0.68)	-10.27***	(-15.87 , -4.67)
Self-efficacy	-0.03**	(-0.04 , -0.01)	-0.02*	(-0.04 , 0)	-0.02**	(-0.03 , 0)
SOCRATES Taking Steps	-0.75*	(-1.51 , 0)	-1.37**	(-2.3 , -0.45)	-1.28***	(-1.94 , -0.63)
SOCRATES Recognition	1.47***	(0.86 , 2.08)	1**	(0.4 , 1.6)	0.79***	(0.45 , 1.12)
SOCRATES Ambivalence	-0.37***	(-0.47 , -0.27)	NA	NA	NA	NA

* p<0.05, ** p<0.01, *** p<0.001

SOCRATES Taking Steps, Ambivalence and dosage were all significantly negatively associated with substance use over time, i.e., as the levels of these variables increased, the global ASSIST scores decreased. SOCRATES Recognition was positively associated with global ASSIST scores, while AA/NA Affiliation was not associated with any change in score.

Analysis across participants who provided data at admission and ten weeks after admission (n=98)

Results were similar in magnitude and direction to those found in the intent-to-treat-analysis although differences include that SOCRATES Recognition significantly decreased over time and SOCRATES Ambivalence levels did not change significantly. The global ASSIST score and specific substance use scores decreased significantly over time while self-efficacy levels and SOCRATES Taking Steps levels increased significantly. Self-efficacy and SOCRATES Taking Steps were significantly negatively associated with the global ASSIST score in conjunction with time, while SOCRATES Recognition was significantly positively associated with the global ASSIST score. AA/NA affiliation did not individually change in any significant way nor was it associated with any change in the global ASSIST score. The association between programme dosage and the global ASSIST score approached significance (p=0.072), with 44% of participants attending at least 50% of required sessions and attendance figures ranging from one session to all possible sessions attended.

Substance use levels

At 10 weeks post-admission, 47% of participants reported abstinence from all substances while the remaining 53% reduced their substance use significantly. Alcohol was the one exception with the number of participants using alcohol 'once or twice' increasing by 50% (see Table 3) warranting further analysis: Of the 52 non-abstinent participants, 13 had used only alcohol once or twice in the follow-up period (none had reported only alcohol use at admission), resulting in 60% of participants either abstinent or having used alcohol only once or twice. A further 6 participants had used only alcohol

weekly at 10 weeks follow-up while the remainder of participants significantly reduced their substance use.

Analysis across participants who provided data at all three time points (n=89)

Tests showed the same magnitude and direction as the group of 98 participants. Figure 1 illustrates that self-efficacy and SOCRATES Taking Steps scores increased significantly from admission to 6 weeks post-admission; these increased levels were maintained in the month after treatment ended but not significantly further improved. Similarly, the global ASSIST and the substance use scores decreased significantly from admission to 6 weeks post-admission and maintained the downward trend between 6 weeks and 10 weeks post-admission, but not in a significant way. The remaining variables did not change significantly at any time point. The unique test on this group revealed that self-efficacy scores at 6 weeks post-admission had a significant effect on substance use scores at 10 weeks post-admission.

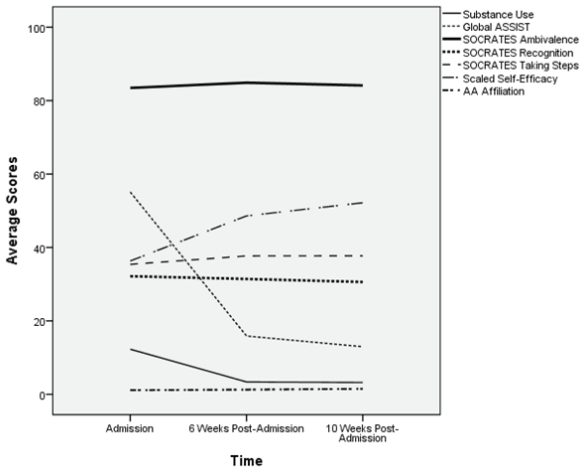

Figure 1. *Variable trajectories over all three time points (n=89)*

DISCUSSION

Substance use outcomes

In the group of 98 with no missing data our findings of 47% abstinence, a further 13% using alcohol only once or twice over the follow-up period, and significant reduction in substance use in the remainder of the participants, compared extremely favourably to Burke and colleagues' (2003) findings that 54% of participants receiving adapted motivational

Table 3. Changes in substance use frequencies for all 98 Participants interviewed at admission and 10 weeks after admission

	Using			Once/Twice			Weekly			Daily/Almost Daily		
	Number		% Change	Number		% Change	Number		% Change	Number		% Change
Substance	Ad	10 Weeks		Ad	10 Weeks		Ad	10 Weeks		Ad	10 Weeks	
Inhalants	2	0	-100%	2	0	-100%	NA	NA	NA	NA	NA	NA
Other	1	0	-100%	NA	NA	NA	NA	NA	NA	1	0	-100%
Sedatives	34	3	-91%	11	2	-82%	9	0	-100%	9	1	-89%
Opioids	18	2	-89%	2	2	0%	NA	NA	-100%	14	0	-100%
Hallucinogens	7	1	-86%	6	1	-83%	2	0	NA	NA	NA	NA
Cocaine	19	3	-84%	9	2	-78%	5	1	-80%	2	0	-100%
Amphetamines	55	15	-73%	10	9	-10%	12	3	-75%	26	3	-88%
Cannabis	56	18	-68%	13	9	-31%	11	4	-64%	25	5	-80%
Alcohol	68	40	-41%	16	24	50%	24	12	-50%	18	4	-78%

interviewing interventions experienced overall improvement in alcohol and drug use. Results for heroin use should be regarded with some caution as although 89% of participants reported abstinence from heroin use at follow-up, after- treatment abstinence from heroin is consistently significantly lower at up to one-year follow-up than that of any other drug (Gossop et al., 2002). Similarly, the 73% methamphetamine abstinence rate at follow-up compares favourably with outcomes of participants in an intensive 16-week out-patient programme, where findings include that 58.8% of methamphetamine users used both drugs and alcohol during treatment (Rawson et al., 2005).

Clearly, some participants replaced their illicit drug-of-choice with alcohol on occasion. This reduced drinking pattern of once or twice or weekly in the follow-up period may fall within moderate drinking limits (Whitlock et al., 2004) but not within the key outcome of abstinence of the Centre's programme theory.

Dosage

The significant impact of programme dose on the global ASSIST score, both in the group of 89 participants who were interviewed at all three time points and in the full in-treatment sample of 142 participants is encouraging. This suggests that the more exposure clients choose to have to the treatment programme, the more their substance dependence is reduced, thus suggesting that it is indeed the treatment programme that is leading to reduced substance use. This is consistent with findings that more time in treatment is associated with better outcomes (Simpson et al., 1997) and that there is a significant positive relationship between higher treatment doses and better outcomes (Burke et al. 2003).

Self-Efficacy

The significant increase in self-efficacy scores from admission to 10 weeks post-admission, and the significant association of self-efficacy scores over time with the reduction of global ASSIST scores, imply successful application of programme theory. The significant association between self-efficacy levels at 6 weeks post-admission and 10 week post-admission substance use scores supports findings of Goldbeck and colleagues (1997) that end of treatment efficacy levels are predictive of reduced substance use levels at follow-up, and that higher levels of abstinence self-efficacy are associated with better short-term substance abuse outcomes (Moos and Moos, 2007; Morgenstern et al., 1997). As self-efficacy levels indicate who will be less or more likely to experience positive outcomes after treatment (Ilgen et al., 2005), this questionnaire may be a useful tool to assess the need for clients to participate in the Centre's aftercare programme.

SOCRATES subscales

The significant positive relationship between SOCRATES Recognition scores and global ASSIST scores is in keeping with Miller and Tonigan's (1996) assertions that higher levels of recognition of a drinking or drug problem imply greater problem severity and vice versa. This relationship remained stable over time, indicating that the recognition sub-scale could be a useful additional treatment tool for counsellors to determine and address problem severity. The significant increase in the SOCRATES Taking Steps score implies again the successful application of

programme theory, in keeping with Miller and Tonigan's (1996) findings that high scores on this subscale are associated with successful change, offering counsellors the opportunity to gauge motivation levels of clients before and during their treatment process. A possible explanation for the inconsistent results of the ambivalence variable between analyses is that ambivalence is a constantly fluctuating state (Cloud et al., 2006) and consequently is not expected to follow a linear path to resolution. It is also possible that the ambiguity of the ambivalence-related questions, as acknowledged by Miller and Tonigan (1996), and the restructure of the ambivalence variable did not accurately reflect levels of ambivalence.

NA/AA affiliation

Although most subjects drop out of, or sporadically attend, Twelve Step programmes after end-of-treatment (Cloud et al., 2006), our findings showed no significant change in NA/AA affiliation even during the treatment period. As Twelve Step programmes are affordable and effective post–treatment support options (Read et al., 2001) and attending Twelve Step self-help groups improves post-treatment outcomes as well as reduces the cost of continuing care to government (Humphreys and Moos, 2007), it is extremely important that this Centre's clients be introduced to the benefits of NA/AA affiliation before end of treatment. We therefore recommend that referral procedures to AA/NA be revised: A directive strategy, where therapists actively followed up clients' engagement with AA during treatment (Walitzer et al., 2009), and an 'intensive referral' approach, in which both client and counsellor were actively involved in initiating contact with Twelve Step self-help groups (Timko et al., 2006), were both found to result in significantly more Twelve Step involvement and more improvement in alcohol and drug use after treatment than the treatment-as-usual condition.

As causal relations cannot be firmly inferred by data from a non-experimental study our findings remain tentative, and it is of course possible that it was the more motivated clients who were successful and completed treatment. Although reliance on self-report from participants is a methodological vulnerability, participants' self-reported substance use has been found to be consistent with the results of urine drug screens (Project MATCH Research Group, 1997a). The short duration of follow-up is also a limitation of this study as it is possible that findings may have differed after a longer period of time had elapsed. Although NA/AA affiliation did not increase as expected, this shortcoming increased confidence that changes found were due to the treatment programme rather than any other competing recovery mechanism. Possibilities for future research include investigating methods to optimize AA/NA attendance, particularly in poorly resourced communities, through the treatment community and beyond. Future studies should also include a control group, and follow participants over a longer period.

Despite these limitations this study provides good evidence of significant outcomes in the reduction of substance use and substance dependence and in the increase of motivational and self-efficacy levels. Findings support programme and motivational interviewing theory, which both postulate high levels of self-efficacy and motivation as beneficially impacting on substance use and substance

dependence, offering further evidence of programme efficacy. All of these programme effects are particularly encouraging in the context of the relative cost-effectiveness and short duration of the treatment programme.

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ALCOHOL USE RELATED INJURY IN NORTHWEST ETHIOPIA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Alcohol-related violence resulting in injury is a global public health problem and Africa is no exception. In the country of Ethiopia, there is a lack of statistical evidence regarding this issue. The aim of this study was to investigate the incidence prevalence of alcohol-related violence and injury and its associative factors. Hospital based cross-sectional research method was employed from January to June 30, 2014. The source population and study population were all interpersonal violence injured patients in the emergency department of University of Gondar Hospital. Data were collected using injury surveillance guidelines developed by the World Health Organization. Bivariate and multivariate logistic regressions were performed to identify the presence and strength of association. Odds ratios with 95% confidence interval were computed to determine the level of significance. A total of 395 participants were involved in the study. The proportion of ARVI was found to be 119 (30.1%); gender, poor behavioral control and poor family functioning were found to be independently associated with alcohol-related interpersonal violence injury. The prevalence of alcohol-related violence and injury is high in Ethiopia. There is an urgent need to step up health advocacy with respect to reducing alcohol consumption in the country.

Key words: Alcohol, Emergency Department, injury, violence

INTRODUCTION

Drinking of alcohol has been cited as risk factors for intentional or unintentional injury (Shahrzad, Tommi, Naihua, & Cheryl, 2007). Bars, nightclubs and other nightlife venues are frequently the scene of violence between inebriated young people.

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The impact of frequent deviant behavior not only negatively affects the health of these young people but places continuing burdens on the wider society (Mark, Karen & Zara, 2007).

Globally, patterns of alcohol drinking and rates of alcohol-related violence and injury (ARVI) vary widely. Because alcohol use directly affects physical and cognitive functions and can reduce self-control and ability to process incoming information, drinkers are more likely to engage in violent acts. Their ability to recognize warning signs of potentially dangerous situations is reduced making them an easier target for criminals (WHO, 2009).

Globally, alcohol use is estimated to be responsible for 26% of male and 16% of female Disability Adjusted Life Year (DALYs) lost through homicide. Furthermore, alcohol consumption as a risk factor for violent victimization is increasingly being identified throughout the world (WHO, 2009).

When abused, alcohol poses a significant risk for violence (Morgan & Atamney, 2009). In 2005 in Australia, there were over 70,000 victims of alcohol-related assaults (Laslett, Catalano, Chikritzhs et al., 2010). Males were more likely than females to be victims of alcohol-related verbal and physical abuse. However, the proportion of female victims of alcohol-related physical abuse more than doubled (3.1% to 6.6%) between 2007 and 2010 (AIHW, 2011).

In 2011/12, 46.9% of all domestic assaults in western Australia and 37.2% of all non-domestic assaults were related to alcohol (Western Australian Police, 2013). In 2005, 59% of alcohol-related assaults resulted in injury. Victims of alcohol related assaults are more likely to suffer injuries such as cuts or broken bones, compared to victims of non-alcohol-related assault (Laslett et al., 2010).

In 2006, it was estimated that alcohol was responsible for 24% of all injury-related health loss (27% male and 17% female). Alcohol-attributable injury was higher in Maori people, accounting for 35.5% of injury-related health loss in males and 24% in females(Ministry of Health , 2013).

Studies in South Africa reveal that 77% of patients admitted to Hospital Trauma Units with assault injuries had detectable blood alcohol levels. A multi-centre sentinel surveillance of alcohol and drug abuse in three cities in South Africa further highlights the prevalence and trends of alcohol-related injuries (Odero,1995). In Ethiopia interpersonal violence related injury is a common problem of the population (Ayana & Ahmed , 2012) and the negative effects of excessive alcohol consumption are all too well known (Subir, Balakrishnan, & Vasudevan, 2006).Since the situation has a significant impact on the health of the society, there is clear justification for conducting research not only to better illuminate the issue for policymakers but to help direct resources toward reducing this ubiquitous problem. To date, we know of no such studies of this kind in Ethiopia.

METHOD

Data collection for this cross-sectional study took place from January to the end of June 2014.The study was conducted at the University of Gondar Hospital, located 748 kilometers north of Addis Ababa, Ethiopia. The hospital is a 400-bed, tertiary care teaching facility serving approximately 5 million people. This hospital is also a teaching center for health science students.

Source population and study population

The study population was all patients suffering from interpersonal violence injuries in the emergency department of University of Gondar Hospital. Patients who visited the emergency department of the University Hospital as a result of interpersonal injury were included in the study. Those who needed immediate transfer to the operation room who received analgesia or had repeated visits as a result of injury were excluded in this study.

A single population proportion formula was used to determine the sample and confidence level of 95%. The margin of error was 5%. The prevalence of ARVI is 42.7 %(Ayana B & Ahmed E, 2012). Considering a 5% non-response rate, the final sample size was 395. Systematic random sampling technique was used to select study participants.

Data collection

Data were collected via face-to-face interviews. The data collectors were BSc trained nurses working in various hospital departments.

The data collection tool was adapted from injury surveillance guideline document of WHO developed in 2001 (WHO, 2001). In this study, the tool had internal consistency of Cranach's alpha of 0.890. Data collectors and supervisors were trained on the use of the tool. Supervision was carried out during the data collection time and the tool was pre-tested in the emergency department of Debark Hospital before the actual data collection

Statistical analysis

Data was entered and cleaned using EPI INFO and analyzed using SPSS for Windows version 20. Frequency distribution, as well as percentage calculation, was made to describe socio demographic characteristics. Percentages of admissions to hospital for treatment of injuries related to alcohol calculated. Binary logistic regression was used to check variables associated with the outcome variable. Those variables found to have p-values of ≤ 0.2 were further fitted to multivariable logistic regression. Odds ratios with 95% CI were computed and variables having p-values ≤0.05 in the multiple logistic regression models were considered significantly associated with the dependent variable. Model fitness was checked with the assumptions of Hosmer and Lemeshow goodness of a fit test (p= 0.82).

Ethical consideration

The study was initially approved by the ethical review board of the University of Gondar. A formal letter of permission was obtained from the hospital and submitted to the emergency department. The information about the study was given to the participants and written consent was sought for each participant who agreed to participate in the study and the data was collected in a separate room.

RESULTS

A total of 395 injury cases participated in this study. The response rate was 100%. Among the respondents, 322 (81.5%) were males. The age group of 20-29 was represented by a high proportion 147(37.25%) from the total study population. The mean (SD) age of the respondents was 27.59 (+/-13.37 years). Of the respondents, 214(54.2%) were single, 140(35.4%) illiterate, and 200(50.6%) came from rural areas (Data presented in Table 1).

Table 1. Socio-demographic characteristics of respondents, University of Gondar Hospital, Northwest Ethiopia, 2014 (n=395)

Variables		Frequency (%)
Age in years	<20	101(25.6%)
	20-29	147(37.25%)
	30-39	72(18.2%)
	40-49	43(10.9%)
	50-59	20(5.1%)
	>60	12(3%)
Gender	Male	322(81.5%)
	Female	73(18.5%)
Marital status	Single	214(54.2%)
	Married	169(42.8%)
	Divorced / Separated	11(2.8%)
	Widowed	1(0.3%)
Educational status	Illiterate	140(35.4%)
	Read and write	79(20%)
	Primary education	87(22%)
	Secondary education	72(18.2%)
	Certificate or college diploma	10(2.5%)
	Degree and above	7(1.8%)
Income/Ethiopian birr	<150	30(7.6%)
	151-650	58(14.7%)
	651-1400	82(20.8%)
	1441-2350	33(8.4%)
	2351-3550	13(3.3%)
	3551-5000	3(0.8%)
	>5000	1(0.8%)
	No income	128(32.4%)
	Unknown	47(11.9%)
Occupation	Farmer	161(40.8%)
	Student	107(27.1%)
	House wife	25(6.3%)
	Merchant	23(5.8%)
	Day laborers	53(13.4%)
	Civil servant	26(6.6%)
Residence	Urban	195(49.4%)
	Rural	200(50.6%)

Incidence of alcohol use related interpersonal violence injury

The number of ARVI, among all injury cases, was found to be 119(30.1%). Among males it was 107(89.9%). The male to female ratio was 8.9:1. Those between 20-29 years of age were the most affected 42(35.29%) followed by those less than

20 years of age 29(24.36%), while those older than 60 years of age were least involved 3(2.5%). The age group of 30-39, 40-49, and 50-59 were 21(17.64%), 16(13.44%) and 8(6.72%) respectively.

Slightly more than half of the victims 200(50.6%) came from rural areas while the rest were from urban settings. As shown in Figure 1, the most common occupation among the patients was farming [64(53.78%)] followed by students [28(23.52%)], indicating a high probability of poor school performance and school drop-out.

In this study, the victim offender relationship was examined. The majority of offenders were known to be friends (62; 52.1%), relatives (22; 18.5%), police (12; 10%), partners (11; 9.2%), and three of the cases were injured by a parent. In 9(7.5%) of the cases, the relationship was unknown. The nature of the injuries were as follows: fractures 57 (47.89%), open wounds in 27(22.62%), superficial injury in 29(24.36%), organ system injury in 8(6.7%). The majority of the victims' were treated and discharged 71(59.66%) and 37(31%) were admitted to the hospital. In 11(9.2%) of the cases, victims were referred to other health institutions. Most of the violence occurred on roadways 57(47.89%). [Table 2]

Factors associated with alcohol use related interpersonal violence injury

In the bivariate logistic regression; low family income, sex, sex of the performer, educational status (primary education), residency, type of injury, poor behavioral control, and poor family functioning were significant risk factors. However, in the multivariate logistic regression, sex, poor behavioral control and poor family functioning were found to be independently

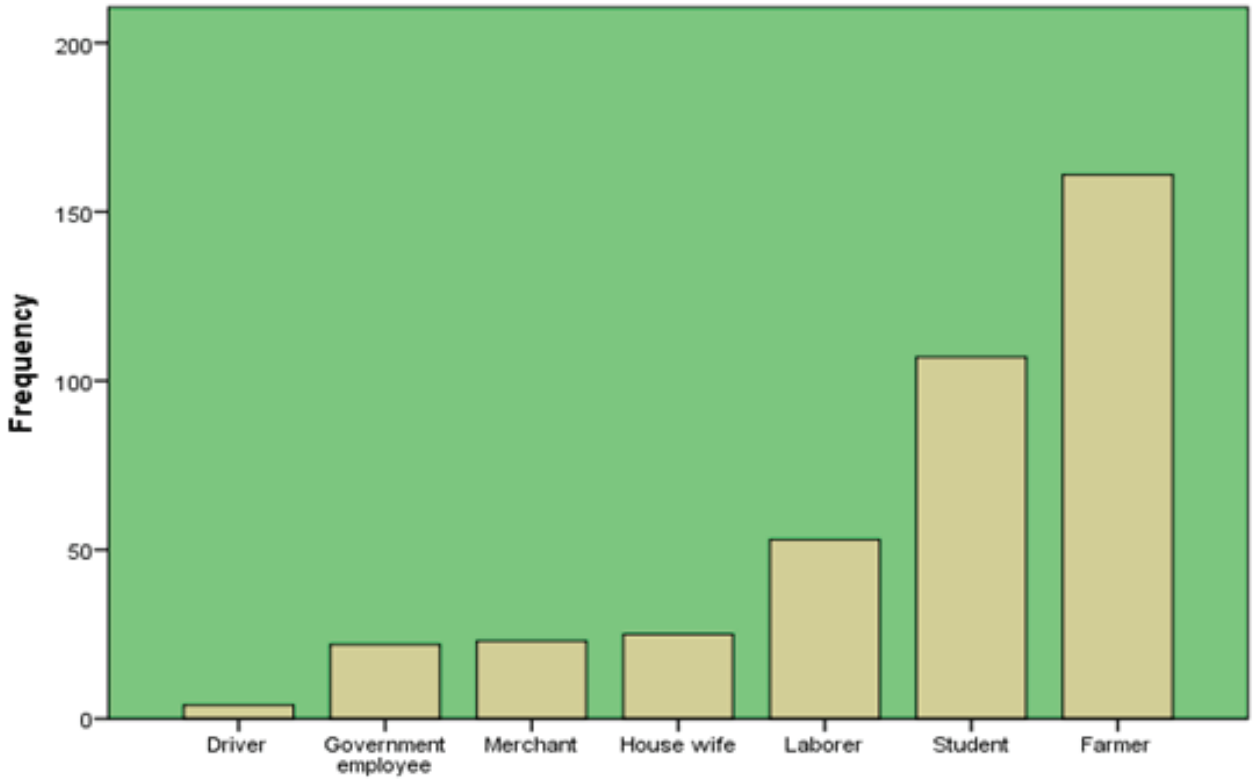

Figure 1. Alcohol use related interpersonal violence injury by occupation, University of Gondar Hospital, Northwest Ethiopia, 2014 (n=119)

Table 2. Location of alcohol use-related interpersonal violence injury, University of Gondar Hospital, Northwest Ethiopia, 2014 (n=119)

The location of the conflict	Frequency (%)
Road	57(47.89%)
Home surrounding	26(21.84%)
Bar	25(21%)
Marketplace	7(5.88%)
Farmland	4(3.36%)
Total	119(100%)

associated with the outcome variable (Table 3).

DISCUSSION

This study was intended to assess the prevalence and associated factors of alcohol use related interpersonal violence injury among patients visiting the emergency department of University of Gondar Hospital. The overall prevalence of

Table 3. Bivariate and multivariate logistic regression analysis of factors associated with alcohol use-related interpersonal violence injury(AURIPVI) at University of Gondar Hospital, Northwest Ethiopia, 2014. (n =395)

Variables	AURIPVI		OR with 95% CI						*p*-value
	YES	NO	Crude			Adjusted			
Sex									
Male	107	215	2.530	(1.306	4.899)	1.942	(.910	4.141)	0.86
Female	12	61	1			1			
Sex of the performer									
Male	48	211	1			1			
Female	71	65	.188	(.118	.301)	0.300	(.175	.512)**	0.001
Educational status									
Illiterate	50	90	.860	(.487	1.519)	.872	(.441	1.723)	
Read and write	31	48	1.641	(.906	2.974)	1.747	(.848	3.597)	
Primary education	22	65	2.778	(1.366	5.648)	2.060	(.893	4.753)	.289
Secondary education	12	60	.833	(.225	3.093)	.767	(.177	3.332)	
college diploma	4	6	897	(.731	.000)	.354	(.906	2.974)	
Degree and above	0	7	1			1			
Residence									
Urban	49	146	.623	(.403	.963)	1.036	(.571	1.881)	.907
Rural	70	130	1			1			
Type of injury									
Intentional	61	49	4.872	(3.034	7.826)	2.195	(.922	5.225)	
Unintentional	58	227	1			1			
Poor behavioral control									
Yes	38	20	6.005	(3.308	10.901)	3.024	(1.546	5.914)**	0.001
No	81	276	1			1			
Poor family functioning									
Yes	85	68	6.782	(4.221	10.899)	5.349	(3.033	9.433)**	0.001
No	34	208	1			1			
Low family income									
Yes	63	58	4.228	(2.664	6.711)	0.697	(0.333	1.462)	0.340
No	56	218	1			1			

**Significantly associated with AURIPVI

alcohol use related interpersonal violence injury was found to be 30.1%. This finding is the same as the finding from a Kenyan study which showed that nearly the same prevalence of the problem, i.e. 31.1% (Odero & Ayuku, 2003 W)

However the result is not in line with studies done in many parts of the world; for instance this study is inconsistent with a study done in USA with a prevalence of 42 % (Madan, Beech & Flint, 2001).This may be explained by the fact that the daily income of the population in the two countries is different so that peoples in USA can have extra money to drink alcohol as compared to the people in Ethiopia. The volume of alcohol use can increase the prevalence of the problem under discussion in USA. Also the finding of this work is not in line with a study in Northwest England and Brazil which revealed a prevalence of 72% (Patel, Jones, & Laverick, 2008) and 42.7% (Gawryszewski et al., 2008) respectively. For this the same reason as above can be mentioned for the existence of the differences between the countries.

In addition, this finding is not constant with many of the sub-Sahara African studies. For instance one study in South Africa documented it as 59% (Bowley et al., 2004) and another study in the same state reveled 60% prevalence (Peden, Vander, Smith & Bautz, 2000) and in Kenya there is a documented prevalence of 45% (Ranney, Odero, Mello, Waxman & Fife, 2009). The possible explanation for this contradiction could be the time, the length of the study period and the setting. One more, this finding is not in line with other work here in Ethiopia at St Luke Hospital, Oromia region which has a documented prevalence of 42.7 % in one year's time (Ayana & Ahmed, 2012).This could be because of the duration of the investigation between the two studies.

Even though other researchers were not recognized sex, poor behavioral control and poor family functioning as a significant factor for the presence of alcohol use related interpersonal violence injury, this study identified these variables to be independently associated with the outcome variable in the multivariate logistic regression.

Patients who were in a habit of poor behavioral control were three times more likely to have alcohol use related interpersonal violence injury as compared to those who were not in the habit of poor behavioral control (AOR: 3.02; 95% CI 1.54 - 5.914) and patients who were from poor family functioning were five times more likely to have alcohol use related interpersonal violence injury as compared to those who were not from low family income (AOR: 5.349 95% CI (3.033 - 9.433). Again females were 70% less likely to have alcohol related interpersonal violence injury as compared to their counter parts (AOR: 0.30095% CI 0.175-0.512).

CONCLUSION AND RECOMMENDATION

In this study, the overall incidence of ARVI was high. Multivariate logistic regression shows sex, poor behavioral control and poor family functioning to be independently associated with the outcome variable. As such, counseling services focusing on methods to reduce alcohol consumption, especially with those individual with poor self-control, are urgently needed.

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RELIABILITY AND FACTOR STRUCTURE OF THE AUDIT AMONG MALE AND FEMALE BAR PATRONS IN A RURAL AREA OF SOUTH AFRICA

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ABSTRACT

We assessed the reliability and dimensional structure of the Alcohol Use Disorders Identification Test (AUDIT) among bar patrons in a rural area of South Africa. In total, 406 bar patrons completed a questionnaire containing the AUDIT, and demographic and psychosocial measures. The participants consisted of 314 (77.3%) males and 92 (22.6%) females. Their combined mean age was 30.0 years (SD = 8.45). The data were analysed using Confirmatory Factor Analysis (CFA) and Cronbach's alpha reliability analysis which were conducted separately for males and females. We found that Cronbach's alpha for the AUDIT was 0.81 and 0.72 for the males and females, respectively. CFA supported a two-factor and three-factor model for the males but failed to support a one-factor, two-factor, or three-factor model for the females. The results suggest that the AUDIT is highly reliable, but that potential gender differences in its factor structure should be considered, particularly when applied in new contexts.

Key words: AUDIT; South Africa; Bar patrons

INTRODUCTION

The Alcohol Use Disorders Identification Test (AUDIT) is one of the most widely used screening instruments for alcohol problems globally (De Meneses-Gaya et al., 2009; Reinert & Allen, 2007). It was developed in order to be able to screen for problem drinking in the form of hazardous or harmful alcohol use (Saunders et al., 1993). The AUDIT consists of ten items which reflect three sub-dimensions:

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consumption (three items), dependence (three items), and alcohol-related consequences (four items). In sub-Saharan Africa (SSA) the 10-item AUDIT has been employed extensively in studies among males and females in countries as diverse as South Africa (Kader et al., 2012; Peltzer et al., 2009), Angola (Cheng et al., 2012), Kenya (Luchters et al., 2011), Nigeria (Li et al., 2010), Rwanda (Harbertson et al., 2013), and Tanzania (Mongi et al., 2013). Most of the studies have involved populations in community (Clausen et al., 2005; 2006; Li et al., 2010), health care (Kader et al., 2012), educational (Betancourt & Herrera, 2006; Pengpid et al., 2013), military (Cheng et al., 2012), and to a much lesser extent bar, restaurant and recreational settings (Choi et al., 2014; Kalichman et al., 2012; Mongi et al., 2013). Despite this extensive use, however, further research is needed to continue to evaluate the psychometric properties and dimensions of the AUDIT when used in SSA settings.

In general, the AUDIT has been found to have good internal consistency reliability in studies in the SSA region, as indicated by Cronbach's alphas of between 0.71 and 0.92 (Chishinga et al., 2011; Farley et al., 2010; Louw et al., 2011; Martinez et al., 2008: Naidoo et al., 2013; Nakimuli-Mpungu et al., 2011; Peltzer et al., 2011; 2012; Peng et al., 2012; Pengpid et al., 2013). Indeed, we are not aware of any studies conducted in SSA that have reported a Cronbach's alpha of less than 0.70 for the AUDIT.

There have been relatively few studies in the SSA region (except Chishinga et al., 2011; Peng et al., 2012) which have assessed the dimensional structure of the AUDIT using either exploratory factor analysis (EFA) or confirmatory factor analysis (CFA). In instances (mainly outside SSA) where a factor analytical study of the AUDIT has been conducted, the original three-component dimensional structure (Saunders et al., 1993) has not always been supported. Instead, most research using PCA or EFA, which has involved systematic and multi-country studies, has revealed between one and two factors (Karno et al., 2000; Maisto et al., 2000). Similarly, studies using CFA have generally supported two factors (see reviews of Reinert & Allen, 2007; Rist et al., 2009); and later studies (e.g. Cook et al., 2011; Peng et al., 2012). Fewer studies have supported the three factor (Shevlin & Smith, 2007) or one factor models (Carey et al., 2003).

More research is also needed to assess the validity of the individual AUDIT items in varied settings in SSA. Item-level analyses have revealed problems with respect to certain items (Knibbe et al., 2006). Some items that are of particular concern include Item 6 (morning drinking) and Item 9 (injury to self or others) (Karno et al., 2000; Peng et al., 2012). The possibility that participants interpret each AUDIT item differently to the intended manner has not been investigated extensively in SSA settings.

In summary, the AUDIT is put forward as a useful internationally validated tool for assessing and screening for hazardous or harmful alcohol use (Saunders et al., 1993). It is usually highly reliable, but studies have not always supported its originally proposed three-dimensional structure (Saunders et al., 1993). Furthermore, while used extensively in various settings, the AUDIT's utility in research studies among bar/tavern patrons in countries in SSA, such as South Africa, still needs further examination. Consequently, this study was conducted to determine the ex-

tent to which the AUDIT is an appropriate and valid tool for use in research among bar/tavern patrons in bar/tavern settings in a rural area of South Africa. The present study sought to assess the dimensional structure of the AUDIT, using CFA, among male and female bar/tavern patrons in two rural villages in North West province, South Africa. A further aim of the study was to assess the internal consistency reliability of the AUDIT in the same sample. The final aim was to assess participants' patterns of responses on each AUDIT item.

METHOD

Design and Participants

The research was approved by the Ethics Committee of the South African Medical Research Council (Protocol number EC10-13) and the Centers for Disease Control and Prevention.

The study was conducted among male and female bar/tavern patrons in two rural villages in North West Province, in South Africa. The study employed a cross-sectional design in which participants were recruited from within bar/tavern settings using purposive sampling. The participating bars were those that met the criteria of having: (i) at least 30 patrons on a normal weekday; (ii) at least 25% of the patrons as female; and (iii) a relatively stable clientele over time. The bar/tavern patrons were recruited systematically from the selected venues with every third person who crossed a predetermined intercept zone being approached and invited to take part in the study. Those who were eligible had to: (i) be at least 18 years old; (ii) visit the bar/tavern at least once a month; and (iii) not be intoxicated at the time of recruitment.

Measures

We used an interviewer-administered questionnaire which comprised various measures that were relevant to our initial study on alcohol use and sexual risk behaviour (Nkosi et al., 2014). The measures that are relevant for the current analyses were those that assessed the participants' demographic characteristics and alcohol consumption. The demographic factors that were assessed were age, gender, education level, marital status, and employment status. The ten-item Alcohol Use Disorders Identification Test (AUDIT) (Babor et al., 2001) was used to assess the participants' alcohol consumption.

Procedure

We obtained permission to conduct the study in the selected drinking venues from the establishments' managers and/or owners. Fieldworkers visited the bars/taverns during peak drinking periods (Friday evenings, Saturdays and Sundays) to conduct face-to-face interviews with the patrons. Informed consent was obtained from eligible bar patrons who were willing to take part in the study. The participants were then interviewed by the fieldworkers in quiet places in and around the bars/taverns. At the end of the interview they were given a t-shirt and a resource list with contact details of local counselling and treatment services that deal with problems related to alcohol consumption and sexual risk behaviour.

Statistical Analysis

We conducted CFA and Cronbach's alpha reliability analyses. All statistical analyses were conducted for the males and females separately.

Three alternative factor models were fitted using CFA. We used the STATA confa

command (Kolenikov, 2009) which fits CFA using maximum likelihood. The three (factor) models that we specified were: (1) a single factor model, for which all ten AUDIT items were specified to load on the one factor; (2) a two-factor model, for which Items 1-3, and Items 4-10 were specified to load on Factor 1 and Factor 2, respectively; and (3) a three-factor model, for which Items 1-3, Items 4-6, and Items 7-10 were specified to load on Factor 1, Factor 2, and Factor 3, respectively. We extracted several statistical indices to determine how well each of the three hypothesised latent structure models (the number of "a priori" factors and the constituent items) fit our data. We used the Chi-square test, the root mean square error of approximation (RMSEA), the comparative fit index (CFI), and the standardized root mean square residual (SRMR) to determine the model fit. Goodness of fit was based on the following rules of thumb: Chi-square to degrees of freedom ratio (χ^2/df) < 2; RMSEA < 0.05; CFI ≥ 0.95; and SRMR ≤ 0.08 (Hu & Bentler, 1999; MacCallum et al., 1996; Tabachnick & Fidell, 2013).

We conducted Cronbach's alpha reliability analyses to determine the internal consistency of the full 10-item AUDIT as well as the scales that would be made up of the sub-sets of AUDIT items that were specified in the three models. These scales and sub-scales comprise: (a) the full set of 10 items; (b) Items 1-3 (consumption dimension); (c) Items 4-6 (dependence dimension); (d) Items 7-10 (consequences dimension); and (e) Items 4-10 (alcohol-related problems dimension).

RESULTS

The participants consisted of 314 males and 92 females, with a mean age for both genders of 30.0 years (SD=8.45). As shown in Table 1, most of the participants had up to a Grade 12 level of education, most were single, and just over half were unemployed.

Table 2 depicts the males' and females' scores on each of the ten AUDIT items. As shown, the participants' mean scores on Items 1, 2 and 3 were at or above the mid-

Table 1. Participants' demographic characteristics

Variables		Total sample (N=406) N (%)	Male (N=314) N (%)	Female (N=92) N (%)
Age	18-24	112 (27.6)	78 (24.8)	34 (37.0)
	25-29	105 (25.9)	88 (28.0)	17 (18.5)
	30-34	90 (22.2)	60 (19.1)	30 (32.6)
	>34	99 (24.4)	88 (28.0)	11 (12.0)
Education	≤grade 12	289 (71.5)	227 (72.5)	62 (68.1)
	>grade 12	115 (28.5)	86 (27.5)	29 (31.9)
Marital status	Single	297 (73.2)	221 (70.4)	76 (82.6)
	Cohabiting	39 (9.6)	36 (11.5)	3 (3.3)
	Married	60 (14.8)	49 (15.6)	11 (12.0)
	Other*	10 (2.5)	8 (2.5)	2 (2.2)
Employment status	Employed	229 (56.5)	207 (66.1)	22 (23.9)
	Unemployed	176 (43.5)	106 (33.9)	70 (76.1)

*other includes divorced, separated, and widowed. Note: Totals do not always add up due to missing data.

Table 2. Mean scores and standard deviations (SD) on the AUDIT items for males and females

	Males		Females		
	Mean	**SD**	**Mean**	**SD**	**t**
1. How often do you have a drink containing alcohol?	2.58	0.92	1.96	1.00	5.62***
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	3.48	0.96	2.88	1.13	4.40***
3. How often do you have six or more drinks on one occasion?	2.12	1.16	1.63	1.11	3.45***
4. How often during the last year have you found that you were not able to stop drinking once you had started?	1.18	1.34	0.77	1.12	2.82**
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	0.82	1.15	0.44	0.92	3.08**
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0.83	1.28	0.51	0.98	2.43*
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	1.20	1.35	0.78	1.19	2.75**
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	0.72	1.18	0.19	0.50	5.97***
9. Have you or someone else been injured because of your drinking?	0.27	0.66	0.13	0.47	2.14*
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	1.03	1.40	0.67	1.18	2.40*

*ρ<0.05; **ρ<0.01; ***ρ<0.001w

point of the range of scores (i.e. around "2"). However, scores on the remaining seven items were all much closer to "1" which represents an infrequent (i.e. less than monthly or never) occurrence of the various alcohol-related outcomes. The males had a significantly higher mean score than the females on each item.

The results of the CFA for the male sample (Table 3) revealed that Models 2 and 3 met all the model fit criteria (while Model 1 did not). Model 3 was a slightly better fit than Model 2 as it performed slightly better with regard to three of the four fit criteria i.e. having a lower χ^2 to df ratio, a lower RMSEA, and a higher CFI. Table 3 also shows that all the factor loadings for each item in each of the three models were positive and statistically significant. In addition, almost all the loadings were high (ranging between 0.42-0.85) except for those for AUDIT Item 9 (which ranged between 0.26 and 0.29) in all three models.

For the females (see Table 4), none of the three models demonstrated a good fit for the observed data as none met any of the model fit criteria. Table 4 also shows that the factor loadings were positive and generally significant except for Item 1 in Model 1, Item 9 in Models 1 and 2, and Item 8 in Model 3. The factor loading of Item 1 in Model 1 (0.20), Item 8 in all three models (0.20, 0.20 and 0.10, respectively), and Item 9 in all three models (0.09, 0.10 and 0.16, respectively) was low.

Table 5 indicates that there were very good Cronbach's alphas for the total sample, the males, and the females for the 10-items (full AUDIT), and the 7-items (combined dependence/consequences dimension). However, Cronbach's alpha was only moderately high for the items

Table 3. Factor loadings (standard errors), factor covariance, and fit indices for three alternative factor models of the AUDIT for the males (n=282)

	Model 1	Model 2		Model 3		
	Factor 1:	Factor 1:	Factor 2:	Factor 1:	Factor 2:	Factor 3:
	Hazardous drinking	Alcohol consumption	Alcohol-related problems	Alcohol consumption	Dependence	Alcohol-related consequences
Item						
1. How often do you have a drink containing alcohol?	0.42 (0.05)*	0.46 (0.05)*		0.46 (0.05)*		
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	0.46 (0.06)*	0.51 (0.06)*		0.51 (0.06)*		
3. How often do you have six or more drinks on one occasion?	0.82 (0.07)*	1.09 (0.07)*		1.09 (0.07)*		
4. How often during the last year have you found that you were not able to stop drinking once you had started?	0.82 (0.08)*		0.80 (0.08)*		0.80 (0.08)*	
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	0.68 (0.07)*		0.73 (0.07)*		0.69 (0.07)*	
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0.67 (0.08)*		0.68 (0.08)*		0.66 (0.08)*	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	0.80 (0.08)*		0.84 (0.08)*			0.85 (0.08)*
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	0.64 (0.07)*		0.69 (0.07)*			0.71 (0.07)*
9. Have you or someone else been injured because of your drinking?	0.26 (0.04)*		0.28 (0.04)*			0.29 (0.04)*
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	0.75 (0.09)*		0.77 (0.09)*			0.78 (0.09)*
Factor Covariance						
Factor 1	1.00	1.00		1.00		
Factor 2		0.65 (0.06)*	1.00	0.74 (0.07)*	1.00	
Factor 3				0.58 (0.07)*	1.00 (0.06)*	1.00
Goodness of Fit Indices						
χ^2	117.26	57.07		50.63		
df	35	34		32		
ρ-value	0.000	0.008		0.019		
RMSEA	0.092	0.049		0.046		
CFI	0.84	0.96		0.97		
RMSR	0.07	0.05		0.05		

χ^2: Chi-square; df: degrees of freedom; RMSEA: root-mean-square error of approximation; CFI: comparative fit index; RMSR: root-mean-square residual *ρ<0.05

Table 4. Factor loadings (standard errors), factor covariance, and fit indices for three alternative factor models of the AUDIT for the females (n=76)

	Model 1	Model 2		Model 3		
	Factor 1:	Factor 1:	Factor 2:	Factor 1:	Factor 2:	Factor 3:
	Hazardous drinking	Alcohol consumption	Alcohol-related problems	Alcohol consumption	Dependence	Alcohol-related consequences
Item						
1. How often do you have a drink containing alcohol?	0.20 (0.11)	0.40 (0.11)*		0.40 (0.11)*		
2. How many drinks containing alcohol do you have on a typical day when you are drinking?	0.44 (0.14)*	0.47 (0.15)*		0.47 (0.16)*		
3. How often do you have six or more drinks on one occasion?	0.50 (0.14)*	0.88 (0.18)*		0.87 (0.18)*		
4. How often during the last year have you found that you were not able to stop drinking once you had started?	0.77 (0.13)*		0.76 (0.13)*		0.79 (0.14)*	
5. How often during the last year have you failed to do what was normally expected of you because of drinking?	0.59 (0.11)*		0.61 (0.11)*		0.60 (0.11)*	
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	0.47 (0.13)*		0.48 (0.13)*		0.45 (0.14)*	
7. How often during the last year have you had a feeling of guilt or remorse after drinking?	0.53 (0.15)*		0.53 (0.16)*			0.74 (0.17)*
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	0.20 (0.06)*		0.20 (0.06)*			0.10 (0.86)
9. Have you or someone else been injured because of your drinking?	0.09 (0.07)		0.10 (0.07)			0.16 (0.08)*
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	0.46 (0.14)*		0.47 (0.15)*			0.77 (0.20)*
Factor Covariance						
Factor 1	1.00	1.00		1.00		
Factor 2		0.51 (0.15)*	1.00	0.54 (0.16)*	1.00	
Factor 3				0.36 (0.17)*	0.62 (0.19)*	1.00
Goodness of Fit Indices						
χ^2	82.36	70.56		68.16		
df	35	34		32		
ρ	0.000	0.0002		0.0002		
RMSEA	0.134	0.120		0.123		
CFI	0.00	0.37		0.40		
RMSR	0.10	0.09		0.08		

χ^2: Chi-square; df: degrees of freedom; RMSEA: root-mean-square error of approximation; CFI: comparative fit index; RMSR: root-mean-square residual *p<0.05

Table 5. Cronbach's alphas

Dimensions	AUDIT items	Total	Males	Females
Full AUDIT	1-10	0.808	0.808	0.719
Alcohol consumption	1-3	0.687	0.684	0.582
Dependence	4-6	0.600	0.583	0.613
Alcohol-related consequences	7-10	0.632	0.633	0.502
Alcohol-related problems (Dependence and consequences)	4-10	0.758	0.756	0.696

making up the three sub-dimensions (i.e. consumption, dependence, alcohol-related consequences), particularly for the women.

DISCUSSION

The primary purposes of this study were to examine the reliability and factor structure of the AUDIT among male and female adults who were recruited from bars and taverns in a rural area of South Africa. This is one of the first studies of this kind to be conducted in SSA (apart from Chishinga et al., 2011; Peng et al., 2012), and in a cultural context in which the reliability and the validity of the AUDIT may be somewhat different from the cultural contexts in which most similar analyses have been conducted. Based on the assumption of the gendered nature of alcohol consumption (Bond et al., 2010), we analysed all the data separately for the males and females separately. The results supported this choice given the significant differences in males' and females' mean scores on all the AUDIT items, and the CFA results.

The findings of the CFA for the males concur with the trend of previous research in having supported a three-factor and two factor-model, but not supporting a one-factor model (Cook et al., 2011; Reinert & Allen, 2007). These results are consistent with those of similar analyses that were conducted for general population samples of men in two countries in SSA: Uganda and Nigeria (Peng et al., 2012).

On the other hand, the CFA for the females failed to support a three-factor, two-factor, or one-factor model. We are aware of a few other studies reporting similar findings. For example, in their cross-national study involving 15 countries, Peng and colleagues (2012) were generally less likely to lend support to any of the three models (i.e. the one-factor, two-factor or three-factor model) for the study's female sub-samples than for its male sub-samples. For the female sub-samples from the countries in SSA (Nigeria and Uganda) specifically, Peng et al. (2012) failed to support any of the three models for women in Nigeria, but did support a two-factor and one-factor model for women in Uganda.

The internal consistency reliability of the full 10-item AUDIT was high for both males and females, which is consistent with general findings of studies globally (Reinert & Allen, 2007) and in SSA (Chishinga et al., 2011; Farley et al., 2010; Louw et al., 2011; Martinez et al., 2008; Naidoo et al., 2013; Nakimuli-Mpungu et al., 2011; Peltzer et al., 2011; 2012; Peng et al., 2012; Pengpid et al., 2013). However, Cronbach's alpha was not as high for any of the three proposed sub-dimensions

of the AUDIT, although it was just under 0.70 for the seven-item combined dependence/consequences items for both males and females.

A subsidiary aim of the study was to assess the participants' patterns of responses on each of the AUDIT items. Examination of the participants' mean scores on each AUDIT item revealed high levels of endorsement of Items 1-3, but lower levels of endorsement of the remaining items. This concurs with the males' CFA finding which supported the two models in which Items 1 to 3 were not included with other items, but failed to support the model in which Items 1 to 3 were included with the remaining items (i.e. Model 1). Some authors have indicated that higher mean scores on the earlier appearing items could be due to an order effect (Bischof et al., 2005; De Meneses-Gaya et al., 2009). However, in the present study, conducted among regular bar/tavern patrons in a high consumption country where binge drinking is commonplace, it is not surprising to find participants endorsing these consumption items to a greater extent than the remaining dependence and consequences items.

The validity of individual AUDIT items may differ cross-culturally (Knibbe et al. 2006). The AUDIT items which seemed to be most problematic in this study were Item 1 (frequency of consumption) and Item 8 (memory loss) for the females, and Item 9 (injury to self or others) for both the males and the females. The observed low and non-significant loading of Item 1 on the first factor for women may reflect the observation that while women in South Africa drink relatively infrequently, their rate of binge drinking per occasion is relatively high (Peltzer & Ramlagan, 2009), not unlike their male counterparts. Indeed, other studies have found alcohol frequency to have a low correlation with the other AUDIT items (Knibbe et al. 2006). The observed non-significant loading of memory loss (Item 8) on Factor 3 (i.e. alcohol-related consequences) for the women may be due to the overall low level of reporting of memory loss among the women in the sample. Item 9 was problematic in terms of participants' low level of endorsement on it, its low (but significant) loading on all the factors in the CFA for the males, and its non-significant loadings for the females. A problem with Item 9 has been observed by other investigators (Karno et al., 2000; Kelly et al., 2010; Kypri et al., 2002; Peng et al., 2012) who have questioned how the injury item might be interpreted. In the current study among bar-goers, low endorsement of Item 9 may seem surprising, but participants may conceivably have interpreted the question to refer to a more severe level of harm than minor scrapes, bruises and falls that may occur relatively routinely due to alcohol consumption in drinking settings.

This study provides a potentially valuable addition to the literature by examining the factor structure of the 10-item AUDIT with patrons of bars and taverns in rural areas of South Africa. However, its main limitation is the small sample size for the females which limits our ability to be conclusive about the results. Another possible shortcoming is the limited generalizability of the findings to other populations.

Further validation studies on the AUDIT are warranted among populations of males and females in SSA. We recommend continued studies on the psychometric properties of the AUDIT, including its factor structure with larger samples, and its

specificity and sensitivity at different cut-off points. However, this study supports the growing body of literature supporting the two- and three-dimensional structure of the AUDIT in diverse populations and settings globally, particularly among males, and has important implications for research and clinical care.

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SUBSTANCE ABUSE AND ADHERENCE TO ANTIRETROVIRAL THERAPY AMONG PATIENTS ATTENDING CLINIC AT A SPECIALIST HOSPITAL IN JOS, NIGERIA

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ABSTRACT

Substance abuse does not only increase susceptibility to HIV/AIDS through high risk Sexual behaviors but it also hastens the progression of the disease among infected persons than in those who do not abuse drugs. Furthermore, drug use impairs adherence to antiretroviral therapy (ART) leading to reduction in ART effectiveness and ultimately increased HIV-related mortality. In North Central Nigeria there is a dearth of information concerning the influence of substance abuse on adherence to ART which has substantially altered the fate of HIV-infected people. The objectives of this study therefore, were to determine the type of substances abused by HIV-infected patients attending clinic at Plateau State Specialists Hospital (PSSH) and to determine the effect of substance abuse and sociodemographic factors on adherence to ART among these patients. Ethical approval was obtained before the commencement of the study which was cross-sectional in design. The study was carried out at the infectious disease unit of the Plateau State Specialists Hospital, Jos among 160 consecutive patients. The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) was used for the assessment of the types of substance abused and AIDS Clinical Trials Group(ACTG) adherence instrument was used to assess reasons for non- adherence. The results showed that 61.9% of the patients did not use any substance of abuse, 38.1% either abused one substance or a combination of substances. Substance abuse were (p = 0.0001), alcohol abuse (p = 0.003) and educational status (p = 0.0001) significantly associated with non-adherence to ART while, age (p = 0.954), employment status (p = 0.924) and marital status (p = 0.466) were not. However, logistic regression revealed that only alcohol abuse (B = -1.383, df = 1, p = .002) predicted non adherence to ART. We recommend the screening of patients on ART for substance abuse and a multi-disciplinary approach to the treatment of HIV/AIDS.

Key words: HIV, substance abuse, medication adherence

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INTRODUCTION

The impact of HIV/AIDS will continue to be felt for decade's world over. Sub-Saharan Africa remains the most affected region in the global HIV/AIDS epidemic. More than two thirds (68%) of all people who are HIV positive lived in Sub-Saharan Africa (UNAIDS/WHO/UNICEF, 2011). Similarly, of all AIDS deaths in 2010 more than three -quarters occurred in Sub-Saharan Africa (UNAIDS, 2011).

In recent years efforts have been intensified to increase access to effective treatment and prevention. Fewer than half of Africans are receiving it (UNAIDS/WHO/UNICEF, 2011). However, early confidence recorded with the introduction of antiretroviral therapy (ART) that led to significant reduction in HIV/AIDS associated morbidity and mortality has been compromised. To achieve effective treatment and realize the benefits of treatment, strict adherence to ART instructions is very critical. Adherence to therapy is therefore, an important determinant of clinical and virologic outcomes for patients who have been prescribed ART. Researchers have shown that even modest or occasional non-adherence can lead to emergence of drug resistant viral strains and the transmission of these viral strains in the population (Gifford, 2000; Liu, et al., 2001).

Unfortunately, poor adherence to ART is a common problem with more than half of individuals on combination therapies failing to take their medication with respect to dosage, time and dietary instruction (Murphy et al., 2001; Nieuwker et al., 2001). Although there are several reasons for treatment failure among HIV infected patients, co morbid substance abuse contributes significantly to non-adherence. HIV infected drug abusers may among other factors have mental health problems, medical conditions and sub-optimal support. These have been shown to tamper with adherence to medication (Komiti et al., 2003, Murphy et al., 2004).

The effect of alcohol use on adherence to antiretroviral therapy has also been reported in a meta-analysis by Henderhot et al (2009). In this study, approximately 50-60% of alcohol drinkers were found to be less likely adherent to ART compared to abstainers or those who drank relatively less and several variables were found to moderate the alcohol-adherence association. In a related study by Braithwaite et al (2005b) of a temporal and dose response association between alcohol consumption and ART adherence revealed the relative risk of non-adherence associated with alcohol consumption to be 1.5 on non-binge drinking days but 2.7 on binge drinking days. Daily binge alcohol consumption was therefore, found to decrease survival from 28.1 years to 21.4 years which corresponded to a 24 percent decrease.

There is increasing evidence showing that alcohol impacts negatively on HIV disease through various mechanisms namely: HIV transmission, hasten progression and non adherence to ART. Alcohol has been associated with the likelihood of HIV-infected individuals engaging in sexual risk behavior, thereby re-infecting themselves with a different strain and or infecting others (Kalichman et al., 2007). The same holds true for the use of other psychoactive substances. Alcohol hastens HIV disease progression through its action on proteasomes and immune-proteasomes which impede critical immune processes during progressive HIV-1 infection (Haorah et al., 2004). It has also been found that alcohol-exacerbated hepatoxicity could reduce the efficiency

of the liver. Consequently, it leads to reduction in bioavailability of ART needed to suppress the replication of HIV (Conigliaro et al., 2003). Furthermore, the association between alcohol abuse and HIV disease progression is also caused by non adherence to ART (Samet et al., 2003). For instance, HIV-infected individuals who use alcohol may less likely take their prescribed medication appropriately.

Some studies in Africa have shown high levels of adherence to ART amongst HIV-infected patients. However, recent reviews have shown the need for an increased focus on ART adherence. Hence, it is necessarily important to pay attention to screening of substance use among HIV-infected persons in order to reduce individual's chances of engaging in sexual risk behaviors; reduce the rates of non adherence to ART and slow down the rate of disease progression especially among those who are receiving ART. Therefore, this study was undertaken to assess the types of substances abused and secondly, to determine the effect of substance abuse and sociodemographic factors on adherence to ART among people living with HIV/AIDS receiving treatment at Plateau State Specialist Hospital Jos, Nigeria.

METHOD

The study was carried out at the infectious diseases unit of the Plateau State Specialist Hospital, Jos. Jos is the capital city of Plateau state. It is located in North central Nigeria and has an estimated population of 822,837 as at 2006 (Plateau State Ministry of Information). It offers both specialist and primary care services to in and out patients. This hospital serves as a reference centre for the seventeen government owned general hospitals spread across the state.

Ethical approval was obtained before the commencement of the study which was cross-sectional in design. A total of 160 patients were recruited for this study. Every consecutive consented patient aged 18 years and above that attended the infectious diseases unit with a diagnosis of HIV-infection was recruited for the study. This was done until the desired sample size of 160 was obtained. A participant must also have been on antiretroviral drugs for at least one month to be qualified for inclusion. Excluded were patients with chronic medical conditions, patients with other psychiatric conditions beside substance abuse, patients with altered sensorium and those who did not consent. Non adherence was assessed using self reported questionnaire. Self reported questionnaire has been used for evaluating adherence to ART in different parts of sub-Saharan Africa (Nwauche et al., 2006). Although self reported outcomes of adherence may have a weakness of reliability, a study by Oyugi et al (2004) found no significant difference between patient-reported and objective measures of adherence. In this study patients were asked if they had missed dosage or timing of ART in the past seven days. They were asked to recall starting from the day of interview if they have taken medication late with 2 hours or missed in the last seven days. Adherence to ART was considered optimal if patients reported no to both questions. Focus was on recent adherence in order to maximize recall and minimize bias.

AIDS Clinical Trials Group (ACTG) questionnaire was used to assess reasons for non-adherence. The Alcohol, Smoking and Substance Involvement Screening

Test (ASSIST) developed by WHO was used for assessing substance abuse in the last one month. ASSIST has been shown to be cross culturally valid and reliable screening test (New come 2005). A score of 11 points and above for alcohol and 4 points and above for all other substances was regarded as harmful use (abuse). Substances in this study are defined broadly to include alcohol, tobacco, illicit drugs and legal pharmaceutical agents that have high dependent potential. A semi-structured questionnaire was used to collect sociodemographic data.

Data was coded and analyzed using statistical package for social sciences SPSS 15. Frequency, cross tabulations and chi square were used to compare variables. The level of significance was set at $p < 0.05$.

RESULTS

The study showed that 55(34.4%) of the respondents were non-adherents. Table 1 shows that 99(61.9%) of the study sample did not use any substance of abuse while 66(38.1%) either abused one substance or combination of substances. The most abused of all the substances was alcohol 27(16.9%), followed by 11(6.9%) coffee. Others were 7(4.4%) analgesics, 5(3.1 %) antihistamines, 3(1.9%) cigarettes and 8(5.0%) others.

Table 1. Frequency and types of substances abused

Variables	Frequency(n)	%
No substance abuse	99	61.9
Substance abuse	66	38.1
Total	**165**	**100**
Types of substances	**Frequency(n)**	**%**
Alcohol	27	16.9
Antihistamines	5	3.1
Analgesics	7	4.4
Cigarette	3	1.9
Coffee	11	6.9
Others	8	5.0
Total	**66**	**38.1**

Table 2 shows that slightly greater than half 32(58.2%) of those who abused substances were non-adherents compared to 23(41.8%) who did not abuse substances. Higher proportion, 76(72.4%) of those who did not abuse substances were adherent to medication compared to only 29(27.6%) who abused substances. Those who did not abuse substances were significantly better adherents than those who abused substances ($x^2 = 14.292$, $df = 1$, $p = 0.000$). The abuse of alcohol was associated with non adherence to ART ($x^2 = 8.916$, $df = 1$, $p = 0.003$). The respondents' age ranged from 18 to 68 years old with a mean of 35.6 ± 8.67. The peak age group was 25-34 years representing 45% of the study sample. This group had the highest percentage 24(43.6%) of non-adherents. However, there was no significant relationship between age and adherence to medication ($x^2 = 0.333$, $df = 3$, $p = 0.954$). There was a preponderance of females 103(64.4%) and only 57(35.6%) were males. Females had higher percentage of both adherents 70(66.7%) and non-adherents 33(60.0%). There was no statistical significance between sex and adherence to medication ($x^2 = 0.699$, $df = 1$, $p = 0.403$). The married respondents 56(53.3%) had higher percentage of adherents compared to the singles 49(46.7%) ($x^2 = 0.531$, $df = 1$, $p = 0.466$). More 22(40.0%) of the respondents who had no formal education

Table 2. Relationship between substance abuse, alcohol abuse, socio-demographic factors and adherence to ART

Variables	Non adherents	Adherents	Statistic
No substance abuse	23(41.8%)	76(72.4%)	x^2 = 14.292
Substance abuse	32(58.2%)	29(27.6%)	*df* = 1
Total	55(100)	105(100)	*p* = 0.001
No alcohol use	39(70.9%)	94(89.5%)	x^2 = 8.916
Alcohol use	16(29.1%)	11(10.5%)	*df =1*
Total	55(100)	105(100)	*p = 0.003*
Age groups			
15 – 24	5(9.1%)	7(67%)	x^2 = 0.333
25 – 34	24(43.0%)	48(45.7%)	*df* = 3
35 – 44	17(30.9%)	32(30.5)	*p* = 0.954
45 and above	9(16.4%)	18(17.1%)	
Total	55(100)	105(100)	
Sex			
Male	22(40.0%)	35(33.3%)	x^2 = 0.699
Female	33(60.0%)	70(66.7%)	*df* = 1
Total	55(100)	105(100)	*p* = 0.403
Marital status			
Single	29(52.7%)	49(46.7%)	x^2 = 0.531
Married	26(47.3%)	56(53.3%)	*df* = 1
Total	55(100)	105(100)	*p* = 0.466
Employment status			
Unemployed	23(41.8%)	42(33.3%)	x^2 = 0.049
Employed	32(58.2%)	70(66.7%)	*df* = 1
Total	55(100)	105(100)	*p* = 0.924
Educational status			
No formal education	22(40.0%)	10(9.5%)	x^2 = 25.490
Primary	9(16.4%)	12(11.4%)	*df* = 3
Secondary	14(25.5%)	36(34.3%)	*p* = 0.001
Post secondary	10(18.2%)	47(44.8%)	
Total	**55(100)**	**105(100)**	

were non adherents compared to only 10(18.2%) who had post secondary education. Those who had post secondary education 47(44.8%) were better adherents compared to those with no formal education 10(9.5%). There was a significant relationship between educational level and adherence to medication (x^2 = 25.490, *df* = 3, *p* = 0.001)

Reasons given for non-adherence to ART

As shown in Table 3, the most prominent reasons for non-adherence were: simply forgot (13.8%), avoid side effects (12.5%), away from home (10.0%) and being busy (7.5%). The results of logistic regression analysis reported in Table 4 show that only alcohol abuse predicted non-adherence to ART (*B* = -1.383, *df* = 1, *P* = 0.002)

Table 3. Reasons for non-adherence to antiretroviral drugs

Variables	Frequency (n)	%
Avoid side effects	20	12.5
Overwhelmed	6	3.8
Many pills	3	1.9
Not want others to know	3	1.9
Drug toxic	6	3.8
Simply forget	22	13.8
Away from home	16	10.0
Being busy	12	7.5
Change in routine	6	3.8
Slept off	6	3.8
Specific time	2	1.3
Felt sick	5	3.1
Total	**107**	**100**

DISCUSSION

The prevalence rate of non-adherence in this study was 34.6%. This is in agreement with earlier studies done in this country (Erah and Arute., 2008), other parts of Africa (Kalichman et al., 2007) and in the Western countries (Mills et al., 2006).

High prevalence of substance abuse (39.1%) with alcohol being the most abused was found in this study. This concurs with several other studies that have demonstrated high prevalence of alcohol abuse among individuals with HIV/AIDS (Chander et al., 2008, Galvan et al., 2002). People with substance related problems are more likely to contract HIV because they tend to engage in behavior that places them at risk (Malow et al., 2001; Audu et al., 2010). They are also more likely to abuse substances either as an expression of maladaptive coping strategy or due to the presence of other co-morbid psychiatric conditions which are prevalent in patients with HIV/AIDS (Olley et al., 2003; Pence et al., 2008).

A significant relationship between alcohol abuse and non-adherence to ART was found. This is in agreement with a study done by (Hendershot et al., 2009) that showed that HIV infected patients with co-morbid alcohol abuse contribute significantly to non-adherence. There are variety of ways by which drinking can compromise ART adherence. For instance, intoxication impairs memory, planning, organizational skills and other cognitive abilities that can result in missed doses or timing of medication (Aloisi et al, 2002; Braithwaite et al, 2007). Recently, a study revealed that patients who take ART and abuse alcohol had intentionally stopped taking their medication based on the belief that mixing alcohol and ART

Table 4. Logistic regression analysis showing association between non-adherence to ART and predictors

Variables	B	S.E	Wald	df	Sig	Exp(B)
Alcohol use	-1.383	.454	9.270	1	.002	.251
Agegrp	.081	.229	.124	1	.725	1.084
Marital status	.283	.407	.485	1	.486	1.328
Employstatus	.043	.380	.013	1	.911	1.044
Edustatus	-.557	.402	1.923	1	.166	.573
Sex	.114	.388	.086	1	.770	1.120
Constant	.871	.887	.964	1	.326	2.390

is very toxic to the liver (Kalichman et al., 2012). It has also been shown to exacerbate emotional distress in HIV positive individuals which has the capacity to tamper with adherence to ART (Komiti et al., 2003). Additionally, HIV infected drug abusers may among other factors have mental health problems, medical conditions and sub-optimal social support that have been found to interfere with adherence to medication (Chesney et al., 2000).

However, aside alcohol abuse there are other several factors that have been associated with non-adherence to active antiretroviral treatment among HIV patients. These include individual characteristics such as gastro-intestinal conditions that interfere with response to medication, existing resistance to medication and to inability to adhere to treatment. Optimal adherence (≥85%) to antiretroviral regimen is required to achieve viral suppression in people living with HIV. In spite of this, there are often approximately 80% of patients with undetectable viral loads (Peterson et al., 2000). This is even more critical in Nigeria where majority of the people live below the poverty line and have to travel long distances to treatment centers that have poor facilities.

Studies on the relationship between medication adherence and socio-demographic factors have not been consistent. Some researchers have demonstrated that male sex, older age, higher income and higher education correlate with better adherence (Ickovics et al., 2002; Nwauche et al., 2006). It has also been found that adherence increases with age (Ghidei et al., 2013) except in the most elderly (those aged over 75 years). This may be because the elderly usually have more complex medical regimens and more co-morbidity, such as visual, hearing or memory impairment. On the contrary, Barclay et al, (2007) found that the rate of poor adherence was twice as high among younger patients (68%) than with older individuals (33%).

Although in our study there was a higher percentage of non-adherence in the younger age groups 25-34 and 35-44 years, it was not statistically significant. The non-adherence may have been influenced by the higher rate of substance abuse in the younger age groups which have been shown to compromise adherence to ART.

There was a preponderance of female participants in this study which reflects the fact that the rate of HIV infection is higher in women than men. However, there was no significant association between gender and medication adherence. This finding is in contrast to the study that was carried out in Port Harcourt, Nigeria by Nwauche, (2006) and in United States by Berg et al, (2004) who found that gender has influence on adherence to antiretroviral therapy.

In this study the percentage of the non adherents in the unemployed was more than the employed. There was no significant relationship between employment status and adherence to medication. This finding is in agreement with study done by Erah and Arute (2008). This may be explainable by the fact that antiretroviral drugs are free. Furthermore, it has also been shown that the positive effect of free treatment is often offset by indirect transportation costs in areas where patients live far away from health facilities (Mills et al., 2006). In addition, researchers had found that health services fees and cost of transportation are associated with lower adherence to ART (Mills et al., 2006).

High levels of education have been associated with increased adherence to ART (Peltzer and Pengpid, 2013; Stone., 2004) This was replicated in this study, people with higher level of education generally have greater access to information and are more likely to stick to informed decisions.

Some common reasons for missing medications have been simply forgot 66%, being busy 53%, away from home 57% and change in routine (Chesney et al., 2000, Talam et al., 2008). In this study we found simply forgot (13.8%) avoiding side effects 12.5%, away from home 10% and being busy 7.5%, were the common reasons. These reasons may have been associated with improved in health and patients may likely be working away from home and or lack of social support and cognitive impairment from substance abuse (Gonzalez et al, 2004).

In conclusion, this study underscores the critical importance of establishing a comprehensive therapeutic alliance between clinicians and patients to assess and address factors that tamper with treatment adherence. Most especially, in scarce resource countries where the second line treatment regimen is not readily available if resistance is developed to the first line regimen. Fortunately, most of these factors are amenable to medical and behavioral intervention once they are identified. Therefore, it is necessarily important to screen all patients on ART for substance abuse and to give clear instructions about regimen and it should be tailored to fit the individual lifestyle in other to achieve optimum benefits.

The study has several limitations most especially the sample size which was small and may not be a true reflection of what is happening and in other centers across the state. A diagnostic rather than screening instrument would have given clearer clinical picture of the magnitude of the problem. Furthermore, confounding variables such as psychosocial factors were not controlled which may have influenced the association between substance use and adherence to ART.

We suggest that further study in this area should look at psychosocial factors and the temporal relationship between substance misuse and adherence to ART in our environment.

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IDENTIFYING THE COMPOSITION OF STREET DRUG *NYAOPE* USING TWO DIFFERENT MASS SPECTROMETER METHODS

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ABSTRACT

Criminalization of trading and using of street drug *Nyaope* has had challenges in South Africa due to controversies about its composition. The high cost and complexity of its analysis using conventional chromatography methods also limit the testing availability in most routine laboratories. A state of the Art method with simple specimen processing and faster turnaround time at an affordable cost is urgently needed. To compare the ability of a new Time-of-Flight Mass Spectrometry with direct sample analysis (TOF-DSA MS) and Gas Chromatography Mass Spectrometry (GC-MS) methods in detecting the constituents of Nyaope against turnaround time and cost, in order to recommend a better system for routine use. Cross-sectional, qualitative and descriptive pilot study on samples purchased from various sources of 12 townships in Northern Gauteng Province. The constituents consistently detected in all samples were caffeine, drugs of abuse such as opiates, codeine, morphine, methyl-dioxy amphetamine (MDA) and heroin. Some samples contained antibiotics (citroflex) and antiretroviral drugs (zidovudine). Central nervous system (CNS) depressants such as phenobarbitone and benzodiazepines, benzitramide, moramide intermediates and thiofentanyl and stimulants such as Pipradol, and fenethyline were detected by the TOF-MS system. The usefulness of TOF-DSA MS was better as a screening method while GC-MS provides specificity and confirmatory detection. Due to direct sample analysis, the TOF-DSA provides analytical runtime of 15 sec while GC-MS takes 10 minutes per sample. The running cost for the GCMS is more expensive due to the high cost of reference materials and the need to perform specimen preparation as opposed to TOF-MS. We recommend TOF-DSA MS for initial screening of organic compounds in the Nyaope mixtures followed by confirmation by GC-MS for medico-legal interventions.

Key words: *Nyaope*, drug of abuse, Mass Spectrometry, Gas Chromatography, Anti-retrovirals

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INTRODUCTION

Nyaope, also known as *whoonga*, is a dangerous and highly addictive South African street drug (Department of Justice and Consitution SA, 2014). Nyaope is a fine brown powder due to its mixture with soil, sand or in some cases cement powder in order to disguise the underlying white power of drug of abuse. It is usually wrapped in marijuana (dagga) leaves and smoked. It is not always clear what all of the ingredients of Nyaope are, and the ingredients may vary from sources of sellers. But one thing is clear: Nyaope is very addictive and there are assumptions that it may include heroin, detergent powder, rat poison, and crushed anti-retroviral drugs (ARVs) (Facts for Nyaope, 2014). ARVs are the medications used to treat patients with HIV. In most users, Nyaope not only gives strong addiction but also severe abdominal pain and seizures which are withdrawal symptoms. With respect to drug to drug interaction between various drugs of abuse, clinical studies showed that they aggravate the body's addictive reaction and also causes untoward effects such as acute abdominal pain, seizures, vomiting, salivation, psychosis etc (Bruce, Altice, & Friedland, 2008). This makes the user consume more and more Nyaope due to the belief that consuming more would relieve these symptoms. Nyaope is relatively cheap - about R20 to 30 for one "hit" and a person can become highly addicted after using the drug only once (Department of Justice and Consitution SA, 2014.). A user will soon feel as if he needs several hits to make it through the day. Until and unless the exact nature of the contents of this street drug is understood, treatment strategies and rehabilitation support for the users may be difficult to achieve.

Figure 1. Nyaope sample

Nyaope first appeared in the townships around Durban in 2010, but is reportedly moving to impoverished areas around South Africa. Nyaope is a serious threat to South Africa's HIV-positive population. There have been reports of gangs robbing HIV/AIDS clinics in Soweto to obtain ARVs for making Nyaope, as well as addicted users mugging ARV patients to obtain the drugs for themselves. It also promotes drug resistance to ARVs which has a huge impact on the treatment programs for patients living with HIV/AIDS ("Facts for Nyaope," 2014). Since Nyaope appears similar to soil or cement powder, it is not easy to apprehend the users, sellers or distributors. Analysis of Nyaope is not done routinely at medical laboratories or forensic laboratories due to the high cost and complexity of conventional chromatography methods and lack of experience in dealing with materials of such nature.

The newly introduced TOF-MS method uses direct sample analysis and recent studies showing its ability in identifying individual compounds in the simulated mixture of drugs encourages the researchers to test its ability in the real drug mixture samples (Wilhide, Lacourse, & Crowe, 2013)

The objectives of this study were to identify the exact constituents of Nyaope by comparing the performance of two

analytical methods, namely the conventional GC-MS (Gas Chromatography Mass Spectrometry) and the new TOF-MS (Time of Flight Mass Spectrometry).

MATERIAL AND METHODS

Ethical approval for this study was obtained from the Medunsa Research Ethics Committee (MREC/H/165/2012:IR). The research method applied was a cross-sectional descriptive and comparative study.

Sample

Nyaope samples were randomly collected through the users from the townships and urban areas surrounding Pretoria in North Gauteng. The samples were collected over a period of one week from 12 areas in Gauteng province (with the number of samples collected from each area shown in brackets); Pretoria central (5), Sunnyside (4), Mamelodi (10), Bronkhorstspruit (3), Delmas (2), Winterveld (2), Ramogodu (3), Springs (1), Tembisa (4), Garankuwa (2), Soshanguve (2) and Witbank (2). However, obtaining Nyaope samples was a challenge as it requires building a relationship with the current users in order to build their trust and obtain their assistance.

Samples were collected in the sterile 30 ml specimen jars and were labelled with the name of the area and the number. Each specimen was thoroughly mixed before dividing it into two containers. The first container was marked A and the second one B. The lids were screwed tightly to prevent any leakage or contamination. All samples labelled A were analysed at the GC-MS laboratory at the SAPS forensic toxicology and the specimens labelled B were analysed at the Perkin Elmer Research and Development Laboratory in Midrand. All specimens were kept at room temperature and cool dry place during transportation to the laboratories.

Sample preparation before analysis

Gas Chromatography coupled Mass Spectrometry (GC-MS) is an internationally accepted analytical comparative technique where compounds are separated in the gas phase and a characteristic pattern (mass spectrum) of the separate compounds is obtained. Sample to be analysed, in a liquid form is injected into an inert gas stream (helium/argon) and swept into a column packed with a stationary phase inside the oven. Absorptive interaction between the components in the gas stream and the coating leads to a differential separation of the components of the mixture, which are then swept to the detector which is a Mass Spectrometry. Mass Spectrometry takes injected material, ionizes it in a high vacuum, propels and focuses these ions and their fragmentation products through a magnetic mass analyser and then collects and measures the amounts of each selected ion in a detector. When the interested compounds are not volatile in gas, the process of sample derivitization has to be done which is time consuming and the need to purchase the reference material for each compound in the mixture makes the testing very expensive (Foltz, Fentiman, & Foltz, 1980)

In the TOF-MS method, a PerkinElmer FlexarTMFX-15 LC pump with AxION™ TOF MS was used for analysis. It uses direct sample analysis with no need for sample preparation except extraction in liquid Methanol for the organic compounds. The supernatant was analysed through Time of Flight instrument by di-

rect application on the specimen grid. The extracted specimens are carried through the TOF path by the Nitrogen gas flow in a fixed temperature and gas pressure environment. The calibrator, Acetonitrile liquid was used for checking the resolution of this compound in an expected position and gamma hydroxyl butyric acid was used as a blank to check the baseline of separation and peak areas (Daugherty & Crowe, 2014)

Molecular identification of each compound in the mixture is achieved by its mass/charge (m/z) ratio which is matched to the best fit m/z in the isotopic patterns of known reference compounds prestored in the instrument software library. The sensitivity of the analysis is M/Z 100-1000 and error was < 1 ppm (parts per million). The direct sample application part can be removed and replaced by HPLC (High Performance Liquid Chromatography) for separation of compounds such as drug of abuse in more complex biological fluids (blood or urine) (Daugherty, 2011)

RESULTS

Both GC-MS and TOF-MS could report the compounds qualitatively although areas under the peaks may be used to estimate the amount of compound present. Table 1 represents the qualitative detection of the various compounds found in the Nyaope samples that were analysed. Although multiple samples were collected from most areas, representation of only one sample was chosen based on the highest number of compounds present.

Samples of Tembisa and Winterveld were not sufficient to share for GC-MS laboratory hence we could not report the spectra of drugs for these two areas done by GC-MS although the analyses of these samples were done on the TOF-MS.

Figure 4 represents the mass spectra of both methods for the specimen collected in Mamelodi Township as an example. In TOF-MS, calibrator's position is checked and correlate with its isotopic pattern and molecular mass. Then other organic compounds including drugs of abuse are identified in the same way.

DISCUSSION

GC-MS method could report the compounds quantitatively if the reference materials or internal standards are used for calibration of concentrations against m/z ratios of ionized molecules. However

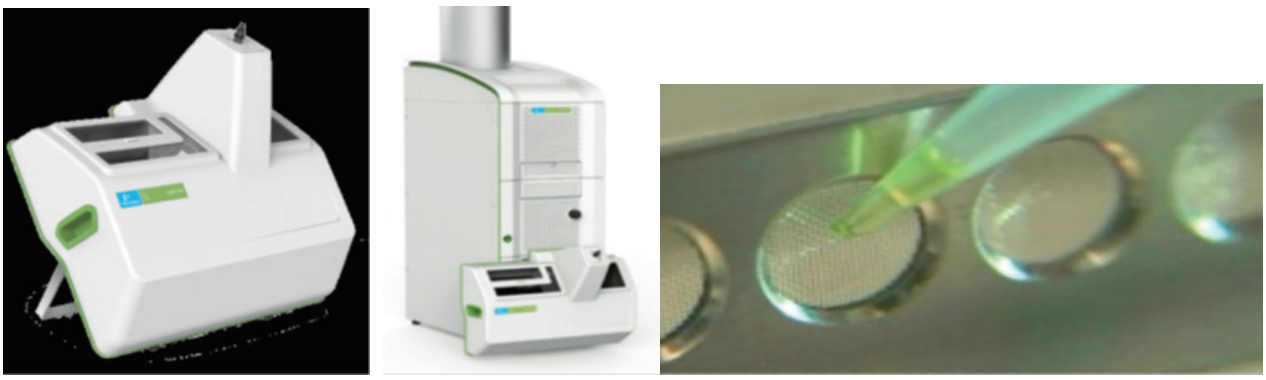
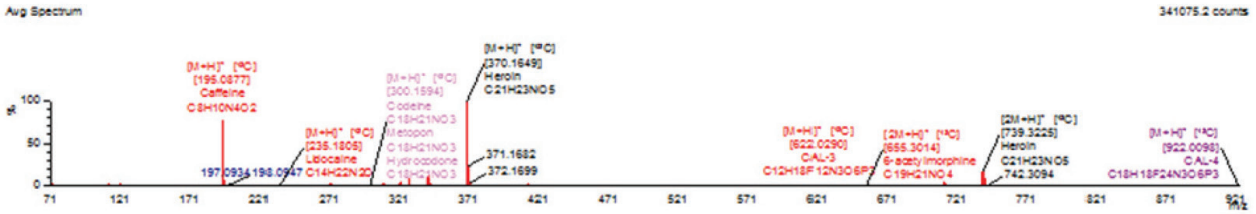


Figure 2. From left to right, direct sampling port, Time of Flight piece of the instrument TOF-MS and picture of sample application on to the disposable wire mash.

Table 1. Constituents of Nyaope samples acquired from various townships analysed by two different mass spectrometers

		CONSTITUENTS IDENTIFIED IN NYAOPE																	
Area and number of sources	Method	Caffeine	Acetaminophen	Opiate (meconin, methadone.papaverine, Dimenoxitol	Dextromethophan	Codeine/metabolites	Morphine /metabolites	Heroine	Amphetamine / meth- metabolites	Cathine (b OH amphet)	Citroflex A	Duracaine/lidocaine	Anti-retroviral (zidovudine)	Thiofentanyl	Benzitramide (narcotics)	Benzodiazepines	Phenobarbitone	Pipradol (Dopamine reupt)	Moramide narcotics	Fenethyline (stimulant)
Garankuwa (sample 2)	GC	+	+	+	+	+	+	+												
	TOF	+	+	+	+		+	+	+											
Soshanguve (sample1)	GC	+				+	+	+				+								
	TOF	+	+				+	+	+											
Bronkhorstspruit (sample 2)	GC	+				+	+	+			+									
	TOF	+		+			+	+	+	+					+		+	+	+	
Witbank (sample 2)	GC	+	+		+	+	+	+	+											
	TOF	+	+		+			+	+											
Mamelodi (sample 8)	GC	+			+		+	+	+											
	TOF	+		+	+	+	+	+	+	+		+		+						
Springs (sample 1)	GC	+	+		+	+	+	+												
	TOF	+		+	+			+	+						+					
Pretoria central (sample 5)	GC	+	+		+	+ +	+	+												
	TOF	+	+	+	+			+	+				+			+				
Ramogodu (sample 3)	GC	+						+												
	TOF	+	+				+	+	+	+			+							
Winterveld (sample 2)	GC	Not done due to insufficient samples																		
	TOF	+		+			+	+	+	+					+					
Delmas (sample 2)	GC	+			+	+	+	+												
	TOF	+			+		+	+	+	+										+
Tembisa (sample 4)	GC	Not done due to insufficient samples																		
	TOF	+		+		+		+	+					+	+			+	+	
Sunnyside (sample 9)	GC	+	+			+	+	+												
	TOF	+					+	+	+	+			+	+	+	+				

TOF-MS: average spectrum



GC-MS:

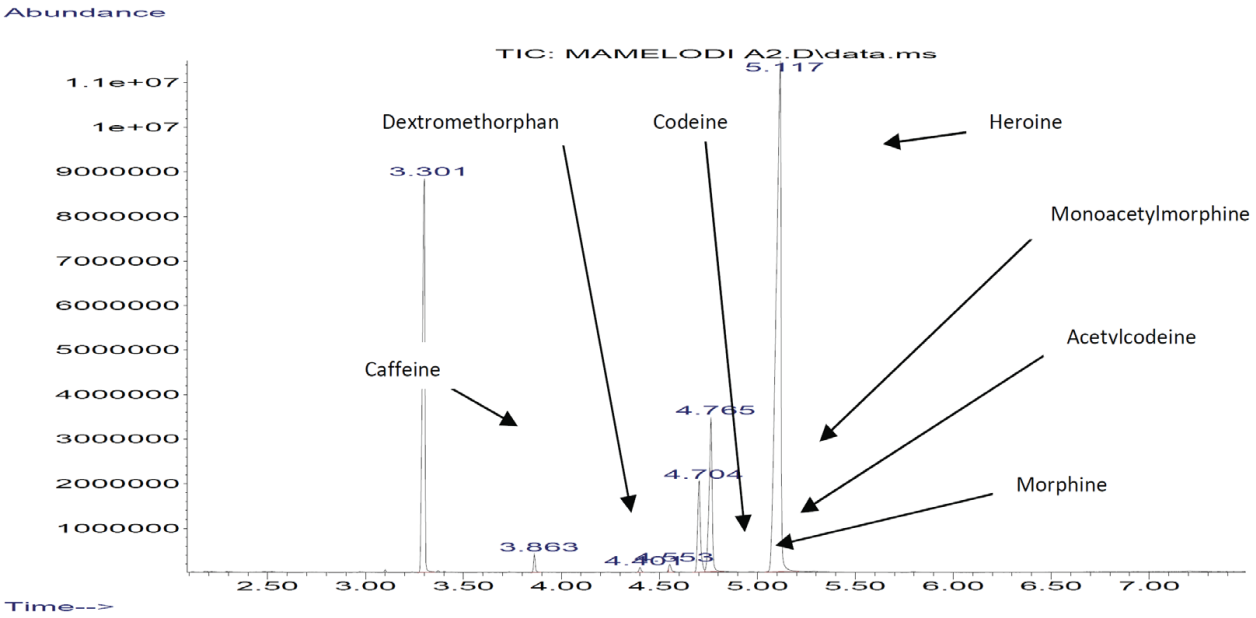


Figure 3. Example of Mass Spectra for one selected Nyaope specimen collected in Mamelodi township of Pretoria

using isotopic internal standards are relatively more stable than the natural compound but they are more costly (Karacic & Skender, 2000). Another study showed analysis of drugs of abuse in hair by LC-MS method (liquid chromatography) and it also uses expansive reference compounds, accessories and the method is complex requiring highly skilled operators (Paterson, Mclachlan-troup, Cordero, Dohnal, & Carman, 2001). In our study, to compare the performance of the two methods, we reported results qualitatively from both GC-MS and TOF-MS systems.

Consistently seen in all samples were caffeine, drugs of abuse such as opiates, codeine, morphine, methyl-dioxy amphetamine (MDA) and Heroine. A local anaesthetic Duracaine/lidocaine was also found in some samples which ~~It~~ has a mood enhancing effect. Detected by the TOF-MS but not by GC-MS were the antibiotic (citroflex) and the ARV zidovudine, CNS depressants such as phenobarbitone and benzodiazepines, benzitramide, moramide intermediates and thiofentanyl, stimulants such as Pipradol, and fenethyline. This could be due to the fact that GC-MS system requires reference materials of each of these compounds to verify and discriminate them from other compounds. Of note, Dextromethorphan, the antitussive cough suppressant was detected by both systems.

Resolution of unidentifiable peaks is challenging for both methods. In TOF-MS, the unknown peak can be matched in the instrument software library or on internet based on correlation of molecular mass and isotonic pattern and aim for more than 95% of match. In order to facilitate the accuracy of identification, drugs of abuse artificially made up in a mixture (without any soil, sand or cement like in Nyaope) was analyzed on TOF-MS by Perkin Elmer to identify and save the isotopic patterns in the instrument library (Wilhide et al., 2013) (Robinson, 2010). This makes the system possible to match 100% fitness with the patterns received from analysis of Nyaope samples. Confirmation of identified peaks is much efficient with GC-MS system as it can fragment the peak into various ions which show a specific pattern of mass and charge ratio however a reference material is needed to discriminate this pattern from the closely related other compounds for confirmation(Zhao & Zhang, 2012)

Regarding the analytical runtime, the TOF-MS produces results in 15 seconds for a mixture as opposed to GC-MS which takes 10 minutes for each compound. Time form collection to reporting of results marks the turnaround time and it may depend on the workload and specimen batching requirement of the testing laboratory for cost-effectiveness on the reagents and reference materials especially for the GC-MS lab.

Cost-wise, GC-MS is more expensive due to high cost of reference material and the need to perform specimen derivitisation for certain compounds. It costs approximately R 560 for quantitative drug assay per sample according to the scale of benefit guideline for South Africa. However, the discriminatory power of GC-MS due to its higher specificity to detect a particular suspected compound/drug in a sample and also ability to report in quantitative level provides a platform for confirmation of presence of a drug of abuse which is required for medico-legal procedures. Comparatively, the consumable cost for TOF-MS is R 10 for a disposable sample grid. Each specimen uses 500 micro litre of Methanol for extraction before analysis. With this relatively inexpensive running cost and faster analytical time, TOF- DSA MS provides an opportunity for screening of drugs and compounds in a mixture of unknown whereas the GC-MS system is more useful in confirmation of a particular screened positive compound in the same mixture.

Contrary to prior assumptions, our samples did not show any inclusion of rat poison but the anti-retroviral drug was found to be present in few samples of two areas. This has shed the light on perceptions and beliefs of users who are also living with HIV/AIDS in these areas and townships in their adherence problems due to poor tolerance to the side effects of ARV therapy. Consumption of ARVs in such inhalational form may enhance drug resistance or damage to the respiratory mucosa although no study has been done to prove this. This important finding has an impact on the HIV treatment programs nationwide and has to be taken into consideration when counselling for adherence is provided for patients living with HIV.

CONCLUSION

Identifying the constituents of Nyaope is important in order to select appropriate antidotes for the treatment of with-

drawal symptoms during rehabilitation as well as providing evidence for criminalization of dealers and users. The challenge is the heterogeneity and constant change in its formula depending on the availability of constituents in the community. For unknown drug mixtures such as Nyaope, TOF- DSA MS provides a better platform for the initial screening of constituents while GC-MS provides a confirmatory testing of a specific compound indicated as screen positive in the TOF-MS.

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