Original Article

Hearing Thresholds among Individuals with Dependence on Psychoactive Substances: A Comparative Cross Sectional Pilot Study

Oladeji Raheem Quadri[1], Nurudeen Adebola Shofoluwe[2], Sa'adudeen Olarenwaju Idris[3], Jamila Lawal[4], Abubakar Imam[5], Jafar Abdulkadir[1], Titus Sunday Ibekwe[6]

[1]Department of ENT Surgery, Gombe State University and Federal Teaching Hospital, Gombe, Gombe State, Nigeria. [2]Department of Surgery, Division of Otorhinolaryngology, Faculty of Clinical Sciences, College of Medical Sciences. Ahmadu Bello University and Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria. [3]Department of ENT Surgery, University of Ilorin Teaching Hospital, Ilorin, Kwara State, Nigeria. [4]ENT unit, Department of Surgery, Barau Dikko Teaching Hospital and Kaduna State University, Kaduna, Kaduna State, Nigeria. [5]Department of Community Medicine, University of Abuja Teaching Hospital Gwagwalada, Abuja, Nigeria. [6]Department of Otorhinolaryngology, University of Abuja & University of Abuja Teaching Hospital Gwagwalada, Abuja, Nigeria

Abstract

Background: Globally, the use of multiple psychoactive substances (MPS), either together or at different times, is on the rise. It is associated with a significant public health burden, including an increased risk for hearing impairment. This study aimed to determine the hearing thresholds among individuals with dependence on multiple psychoactive substances.

Methodology: It was a comparative cross-sectional study of 41 subjects with dependence on multiple substances and an equal number of age and sex-matched comparison groups. The test group further had three subgroups, based on their predominant substances of dependence; Group I: Cigarettes, Cannabis, and Codeine; Group II: Group I substances and intravenous Pentazocine. Group III: Group II substances and intravenous Ketamine. Specific Substance Involvement scores for each of the psychoactive substances and their associated level of risk were determined, based on the ASSIST V3 questionnaire. All participants had tympanometry and pure tone audiometry. A Pure Tone Average (PTAv) was calculated. Data were analysed using SPSS 25 and statistical significance was set at a p-value 0.05.

Results: There were 36 (87.8%) males and 5 (12.2%) females. The mean age of the test and comparison groups was 27.93 5.47 years and 27.98 5.70 years (p = 0.969). The mean PTAv of the test and comparison groups were 16.07 ± 5.53 dBHL and 11.01± 3.52 dBHL: (p 0.001). The p-value for the difference in the mean PTAv between sub-groups of the test group was 0.173, 0.037, and 0.719, respectively, between Group I and II, Group I and III, and Group II and III, respectively.

Conclusion: Hearing thresholds were higher among individuals with dependence on MPS and statistically significant in those that were dependent on cigarettes, cannabis, and codeine. Further studies are needed on the relationship between PS and hearing loss.

Keywords: Dependence; Multiple psychoactive substances; Hearing Threshold; Pure Tone Audiometry.

Corresponding Author: *Shofoluwe Nurudeen Adebola
Division Of Otorhinolaryngology, Department Of Surgery, Ahmadu Bello University And Ahmadu Bello University Teaching Hospital, Zaria, Kaduna State, Nigeria.

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Introduction

Psychoactive substances (PS) or drugs are substances that can affect mental processes such as cognition or affect,[1,2] and they include cigarette, cannabis, alcohol, opium, marijuana, sedatives (e.g. diazepam).[1-3] The modes of intake of these substances are smoking, snorting, ingesting, and injecting.[1-3] A number of different substances are taken by different routes over a period of time (e.g. drinking alcohol, smoking tobacco or injecting heroin) with occasions of inter-switch from one method of taking drugs to another (e.g. from smoking to injecting heroin).[1,2] The lack of availability, accessibility, and/or affordability of certain commonly used drugs makes substance users seek and use a range of alternatives to achieve the desired effect. Indeed, many users of psychoactive substances take more than one type of drug.[1-3]

The use of multiple psychoactive substances (MPS) can be hazardous, harmful or dependent, and the associated problems can be due to acute intoxication or dependence syndrome.[2] Dependence typically develops after repeated or regular use over time and is characterised by a cluster of symptoms that may include a strong desire for the substance(s), impaired control over use, persistent use of the substance(s), even when harm is caused, increased tolerance to the effects of the substance(s), and a withdrawal reaction when use is stopped or reduced.[1,2]

The kinds of problems relating to dependence range from physical to mental health and social problems[2] The consequent symptoms of dependence related to psychoactive substances vary with different substances. However, the direct or indirect effects of these substances on the central nervous system are associated with memory loss, lack of attention, and impaired cognition [1-4], as well as hearing loss, which is usually considered unusual and less acknowledged. Globally, the use of these psychoactive substances, either together or at different times, is on the rise. [1-3,5] It is associated with a significant public health burden.[1,2,5] Similarly, there is a huge public health concern over the rising prevalence of disabling hearing loss worldwide,[6] and there have been several case reports linking hearing loss to the use of psychoactive substances. [5,7-14]A hearing threshold beyond 25dBHL, at any frequency, is indicative of impairment, while the degree of impairment is dictated by the Pure Tone Average (PTAv), which is the arithmetic average of the hearing thresholds at octave frequencies within the speech frequency range.[6] There is a paucity of data on the risk of hearing impairment in psychoactive substance use in Nigeria, and there is no evidence on this subject among individuals with dependence on MPS in North eastern part of Nigeria.. The goal of this study is to find out the hearing thresholds of people who depend on MPS, within the community in the Northeastern part of Nigeria, with findings here from being a template for future studies.

Methods

It was a comparative cross-sectional pilot study at the ENT Surgery department, of a Tertiary Hospital in the Northeastern part of Nigeria. Ethical approval was obtained before the commencement of the study. The inclusion criteria were consenting individuals who were dependent on MPS, including members of a registered body, known as People Who Inject Drugs (PWID), residing within a metropolis in Northeastern part of Nigeria while exclusion criteria included history suggestive of exposure to loud noise, ototoxicity, trauma to the ears/head, measles, meningitis, family history of hearing loss, and previous ear discharge.

Fifty individuals with MPS involvement were recruited for the study from the community, but seven of them were not eligible, while two did not turn up for tympanometry and pure tone audiometry. The remaining 4, with self-reported dependence on MPS, participated fully. The study enrolled an equal number of age- and sex-matched comparison groups from the same community, all of whom had never used psychoactive substances. The 41 MPS-dependent individuals are comprised of three subgroups based on the psychoactive substances' involvement; Subgroup I: Cigarette, Cannabis, and Codeine alone – 23; Subgroup II: Group I substances and intravenous Pentazocine – 10; Subgroup III: Group II substances and intravenous Ketamine – 8.

Informed consent was obtained from each of the participants. A semi-structured interviewer

administered ASSIST V3 questionnaire [2] was used for data collection. The ASSIST V3 questionnaire is standardized and has 7 of its 8 questions being graded with scores such that there is a Specific Substance Involvement (SSI) score, for each of the psychoactive substance. The SSI scores were calculated by adding up the respective scores received for questions 2 through 7 inclusive, for substances taken through means other than injections, while question 8 bothers on drugs used by injections. Associated level of risks were determined. A score of 0 – 3 was low risk, 4 – 26 was moderate risk, and 27+ was high risk. Low risk: low risk of health and other problems from current pattern of use. Moderate risk: moderate risk of health and other problems from current pattern of substance use. High risk: high risk of experiencing severe problems (health, social, financial, legal, relationship) as a result current pattern of use and are dependent. For the substances being injected, usage of once weekly or less or fewer than 3 days in a row is associated with moderate risk while usage of more than once per week or 3 or more days in a row is associated with high risk.

Participants were allowed to choose a convenient time for audio logic evaluation between 10:00 and 14:00 hours, four days a week over a 5-week period. All the participants had tympanometry (using Amplivox Otowave Diagnostic Tympanometer Model 102, Serial No: 36888) and pure tone audiometry (with Amplivox Diagnostic Audiometer Model270, Serial No: 6498) In amplisilence anechoic room. Tympanograms were noted, Hearing thresholds were recorded, Pure Tone
Averages were calculated, and the types and degree of hearing loss were confirmed.[15] Data was collated and analysed using SPSS 25.0, with statistical significance set at a p-value of 0.05.

Results

There were 36 males and 5 females in both the test and comparison groups; M: F of 7.2: 1. The mean age (in years) of the test and comparison groups were 27.93±5.47 and 27.98±5.70 respectively; range was 16 – 40 years. Table 1 below outlines the sociodemographic characteristics of the participants.

Table 1: Socio-demographic characteristics of the Participants

Variables	**Test Group n=41(%)**	**Comparison Group n=41(%)**	χ^2/t-test	*p-value*
Age Group				
16 – 20	3(7.3)	3(7.3)		
21 – 25	11(26.8)	10(24.4)		
26 – 30	13(31.7)	12(29.3)		
31 – 35	8(19.5)	11(26.8)		
36 – 40	6(14.6)	5(12.2)		
Mean Age	27.93±5.47	27.98±5.70	0.040	*0.969*
Sex				
Male	36(87.8)	36(87.8)	0.000	*1.000*
Female	5(12.2)			
Occupation				
FemaleSex Workers	2 (4.9%)	5(12.2)		
Securityservice	3 (7.3%)			
Trading	4 (9.8%)			
CivilService	6 (14.6%)			
Schooling	8 (19.5%)			
Unemployed	18 (43.9%)			

Table 2a: Distribution according to the multiple psychoactive substances of involvement among the test group

Psychoactive substances	Frequency of those involved in each substance (N = 41)		
	YES (%)	NO (%)	TOTAL
Cigarette	41 (100%)	0 (0%)	41 (100%)
Cannabis (Indian hemp)	41 (100%)	0 (0%)	41 (100%)
Codeine	41 (100%)	0 (0%)	41 (100%)
Diazepam	37 (90.2%)	4 (9.8%)	41 (100%)
Alcohol	24 (58.5%)	17(41.5%)	41 (100%)
Inhalation of Premium Meter Spirit	13 (31.7%)	28 (68.3%)	41 (100%)
Cocaine	11 (26.8%)	30 (73.2%)	41 (100%)
IV Pentazocine	18 (43.9%)	23 (56.1%)	41 (100%)
IV Ketamine	8 (19.5%)	33 (80.5%)	41 (100%)

Amongst the test group, the least SSI score for Cigarette, Cannabis and Codeine were 34,31 and 28 respectively. All the users of IV Ketamine were involved in their usage for at least 3 days in a week. The SSI scores and pattern of usage of pentazocine and Ketamine were indicative of dependence and high risk of experiencing severe problems.

Table 2b: Duration of involvement for the most consistent Psychoactive Substances

	Psychoactive Substances						
Durations of involvement (years)	Cigarette	Cannabis	Codeine	Diazepam	Pentazocine.	Ketamine	Cocaine
1 – 5	15	16	16	18	9	3	5
6 – 10	7	4	6	5	4	3	4
11 – 15	11	10	6	2	1	1	-
16 – 20	6	9	9	3	1	1	2
> 20	1	-	-	-	-	-	-
Median duration (in years)	9.5	8.0	5.5	5.0	5.0	8.0	6.5

Table 3a: Pure Tone Averages (PTAv) between the

test and comparison groups

Variables	Comparison Group n=41 (Mean + SD)	Test Group n=41 (Mean ± SD)	t-test value	*p-value*
Right PTAv	10.88±3.58	17.10±6.76	-5.207	*<0.001**
Left PTAv	11.13±4.16	15.03±4.89	-3.890	*<0.001**
Better PTAv	9.45±3.04	14.09±4.39	-5.556	*<0.001**
Worse PTAv Mean PTAv	12.56 4.00 **11.01±3.5**	18.05±6.67 **16.07±5.53**	-4.519	*<0.001** ***<0.001***

While five of the participants in the test group had tinnitus (12.2%) and two (4.9%), had auditory hallucination, usually, after taking cannabis, none reported hearing impairment. However, there were seven (8.5%) ears audiometrically diagnosed with hearing loss, from five (12.2%) subjects in the test group; four subjects (9.8%) with mild SNHL (two bilateral and two unilateral – 7.3% of the ears), and one with right moderate CHL (type As tympanogram and PTAv of 43.75dBHL). SNHL was found in 3 of the 5 with tinnitus; 1 with bilateral and 2 with unilateral; and the two with hallucination.

Table 3b: Degree and Types of Hearing loss among subjects

Variables	**Test Group n=82(%)**	**Comparison Group n=82(%)**	****FET**	***p-value***
Hearing Loss – Degree				
Normal (0 – 25dBHL)	75(91.5)	81(98.8)	4.579	*0.064*
Mild hearing loss (26 – 40dBHL)	6(7.3)	1(1.2)		
Moderate hearing loss (41 60dBHL)	1(1.2)	0(0)		
Hearing Loss – Types				
SNHL	6(7.3)	1(1.2)		
CHL	1(1.2)	-		
MIIL	-	-		

**p-value significant at <0.05 **FET = Fisher's exact test*

The Mean PTAv of Subgroups I, II and III were 18.02 ±6.24, 14.44 ±3.04, and 12.50 ±3.03 respectively. The Analysis of Variance (ANOVA) for the Mean PTAv between Subgroups of the Test Group revealed a statistically significant difference (F= 4.025; p = 0.027) while Post Higher Order Component HOC Analysis (Tukey Honest Significance Difference HSD) revealed a p-value of 0.173 between subgroups I and II; 0.037 between subgroups I and III; and 0.719 between subgroups II and III.

Discussion

In 2013, about 24.6 million Americans, aged 12 and above, were actively involved in the use of illicit drugs. [3] In 2017, the United Nations World Drug Report revealed an estimated 35 million individuals, 15–65 years old, that accounted for opioid misuse. [5] In 2018, 466 million people were estimated to have disabling hearing loss worldwide, with 93% of them being adults (15 years and above).[6]

In this study, the age range of the individuals involved in the use of PS falls within what was reported by the United Nations,[5] with the majority being within the 21-to-30-year age bracket. There was no statistically significant difference in the mean ages of the test and comparison groups; this confirms the matching of the groups. The male preponderance observed is consistent with what has been well established in the literature. [1-3] All the members of the test group were dependent on the various psychoactive substances, as outlined in table 2, in different combinations. However, they were more consistent with smoking, cannabis, and codeine, while those involved with intravenous drugs (in addition) were taking pentazocine and ketamine.

Idleness from unemployment can lead to abuse of psychoactive substances with possible dependence. [1] About 44% of those dependent on MPS were unemployed in this study.

Hearing loss is rarely considered as a possible consequence of substance use. Some studies have reported sensorineural hearing loss as a known but uncommon sequelae of MPS use and dependence[5, 7, 12 – 14], attributable to altered pharmacokinetics, genetic polymorphisms of drug-metabolizing enzymes, vascular spasm/ischemia, a cute intra labyrinthine haemorrhage, and encephalopathy. [13]

In this study, the individuals with MPS involvement had higher hearing thresholds in relation to the

comparison group, with a statistically significant ($p<0.001$)7.3% to 9.8% of SNHL compared to 1.2% to 2.4%. Furthermore, there was a statistically significant difference in the PTAv among those involved in MPS, mainly between those that were dependent on cigarettes, cannabis, and codeine (CCC), and those with dependence on intravenous pentazocine and ketamine, in addition to CCC. In fact, all those with hearing loss were among those dependent on CCC.

There is a need for awareness creation on the neglected harmful effects of PS on hearing, with a view to emphasise the importance of hearing in communication and interpersonal relationship, as well as the effect of impaired hearing/ disabling hearing loss on quality of life. To this end, advocacy to policymakers and law enforcement agencies on the need for / measures to ensure the prohibition of supply/ prevention of access to these substances by the youths is too obvious to require emphasis. Provision of productive and satisfying employment, with reasonable welfarism, may address the idleness from unemployment, thereby curbing the menace of substance abuse and dependence, including hearing loss.

Further studies on the relationship (and its extent) between psychoactive substances and hearing loss, with a focus on specific substances, the duration/extent of involvement, and possibly molecular basis/genetic susceptibility, will be quite instructive. This preliminary report will be a template for such further studies, possibly with larger sample sizes.

Conclusion

The hearing thresholds were higher among the individuals with dependence on MPS and significant in those that were dependent on cigarettes, cannabis, and codeine, amongst whom were those with hearing loss. Further studies are needed on the relationship between PS and hearing loss.

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Conflict of Interest: None

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