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Prospective Study on the Effects of Marijuana Smoking on Lipase and Amylase Activities among Adult Nigerians

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Abstract:

Marijuana consumption is prevalent among young adults in Nigeria, and its effects on various physiological systems are of growing concern. This study investigates the impact of marijuana use on digestive enzymes, specifically serum amylase and lipase, to understand its potential implications on digestive health. This cross-sectional study was conducted in 120 participants comprising of 60 marijuana smokers and 60 non-smokers. Sociodemographic and lifestyle data were collected through structured questionnaires. Serum amylase and lipase activity levels were measured by spectrophotometric method and compared between the two groups. Statistical analysis was performed to assess differences and correlations. The study revealed that marijuana smokers had significantly higher serum amylase and lipase activities compared to non-smokers. Lipase activity correlated positively (r=0.425, p=0.019) with duration of marijuana use. Amylase activity was higher among males than females (r=-0.40, p=0.028). No significant correlation was found between the quantity of marijuana consumed and enzyme activities. Chronic marijuana consumption was associated with increased serum amylase and lipase activities, indicating potential alterations in pancreatic function. These findings suggest that marijuana use may have adverse effects on digestive health, warranting further investigation into the long-term implications. It is recommended that healthcare providers monitor digestive enzyme activities in marijuana users to detect early signs of pancreatic dysfunction.

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INTRODUCTION

Marijuana has been reported to induce pancreatitis which is difficult to diagnose because of lack of a clear diagnostic criteria. Therefore, a thorough history and identifying risk factors are vital in establishing the cause of pancreatitis and preventing recurrences to curb the incidence of chronic pancreatitis and/or pancreatic cancer. Marijuana was first reported as a possible cause of acute pancreatitis in 2004 and occurrence of the illness has increased with unclear aetiology [1].

Recently, the consumption of marijuana (Cannabis), has become increasingly prevalent worldwide, with varying cultural, legal, and health implications [2]. It has obtained significant attention globally due to its potential effects on human health especially in resource limited setting like Nigeria, where quality healthcare is a major contributor to health disparities and inequalities. Prevention of diseases is a more effective and sustainable approach than curative measures, as this would be cost-effective, improve health outcomes, reduce mortality, and improve quality of life.

The World Health Organization (WHO) estimated that more than 13 million adult Nigerians are active smokers and the prevalence of drug-related health problems underscores the urgent need for comprehensive strategies to address substance abuse [3]. Marijuana is the most commonly abused substance in Nigeria, with a prevalence rate of 10.8% among adults [4]. The increasing use of marijuana has prompted the interest on the possible impact on physiological processes such as digestive enzyme activity, given its potential to influence overall gastrointestinal health and function [5]. The pancreas secretes various digestive enzymes, including amylase and lipase which are required for the digestion of carbohydrate and fat, respectively. Conditions such as chronic pancreatitis, pancreatic cancer, cystic fibrosis, and pancreatic insufficiency can impair pancreatic enzyme secretion. Altered digestive enzyme activity is often associated with the development or exacerbation of gastrointestinal disorders such as inflammatory bowel disease, irritable bowel syndrome, celiac disease, lactose intolerance, and pancreatic disorders [6]. Marijuana use may be associated with specific gastrointestinal disorders such as pancreatitis, peptic ulcer disease inflammatory bowel diseases like Crohn's and ulcerative colitis. Cannabinoids can also alter gut motility by either increasing or decreasing it, depending on the type and concentration of cannabinoid , which interacts with gut microbiota in the gastro intestinal system [5].

The impact of marijuana consumption on digestive enzymes in adult Nigerians is a significant area of concern due to the widespread use of marijuana in the country and its potential effects on digestive health have not been evaluated. The reason(s) for the increased incidence of acute pancreatitis across the globe is not known. It appears to correlate with increasing acceptance and use- due to legalization- of marijuana consumption in some countries. It is unclear if the increase in the number of individuals who are smoking marijuana can be attributed to this single reason. This knowledge gap in understanding how marijuana specifically affects the enzymatic processes involved in digestion needs to be filled. Addressing this knowledge gap is essential for developing evidence-based strategies to promote digestive health and mitigate any potential adverse effects associated with marijuana consumption in the Nigerian population. This study is aimed at evaluating the impact of marijuana on serum digestive enzymes (amylase and lipase) activities in adult Nigerians who regularly smoke marijuana.

MATERIALS AND METHODS

Study Design and Population

This is a cross- sectional study of confirmed marijuana smokers recruited from smoking joints where volunteers, certified by co-smokers as consumers for at least two years, participated. Only subjects who gave consent and met inclusion criteria were enrolled in the study. Adult marijuana consumers ≥18 years old were recruited in the study. They consisted of 60 marijuana smokers and 60 age and sex matched non-marijuana smokers.

Participants were notified several days before the commencement of the study and were given appropriate instructions. The age and sex of the participants were recorded. All subjects were interviewed to establish their level of literacy and were assisted in filling out the questionnaire to minimize errors. Sociodemographic data were collected by an interviewer who administered a structured questionnaire to determine the age, educational levels, socioeconomic status, duration of marijuana use, and quantity of marijuana consumed. Information on

general health and history of past diseases and habits like the consumption of alcoholic beverages and addictions were also collected.

Inclusion and Exclusion Criteria

Adult marijuana consumers ≥18 years old, and tested positive for the presence of cannabinoids in their urine using cannabis test strips (ACRO BIOTECH diagnostics) were recruited. Control group were non-smokers of marijuana who gave consent and tested negative for cannabinoids in their urine. Human marijuana consumers below the age of 18 years and above age of 65 years and those with abdominal or gastric pain, individuals with nausea or vomiting were excluded. Also excluded were individuals with HIV, Hepatitis B and C infection or with any Cancer, Diabetes mellitus, Sickle Cell Disease, and Chronic Liver Disease.

Ethical Consideration

Ethical approval for the study was obtained from the College of Medical Sciences Research Ethics Committee, University of Benin, Benin City. The approval letter with reference CMS/REC/01/VOL.2/403 was dated 20th August 2023. Informed consent was obtained from each participant before the specimens were collected.

Sample Size Determination

The sample size for this study was calculated using the sample size determination formula ($n=Z^2$ P(1-P)/d by Lwanga and Lemeshow [7], and 2.5% world-wide annual prevalence of marijuana use [8]. The calculated sample size was 38 participant, but was raised to 60 subjects in order to increase the power of study. Therefore, 60 adult marijuana smokers and 60 healthy subjects who do not smoke marijuana or cigarette were enrolled as controls.

Sample Collection

Three milliliters (3 mL) of venous blood were withdrawn from the antecubital vein of each subject using a sterile needle and syringe and was dispensed into a labeled, clean and dry plain tube. The sample in the plain tube was allowed to clot undisturbed for 15mins and centrifuged at 4000 rpm for 10 minutes to separate serum from the clot. The serum was decanted into another labeled, clean and dry plain tube. The serum sample was stored at -20^{o}C until analyzed.

Sample Analysis

Serum Amylase and lipase activities were assayed using spectrophotometric method and reagents supplied by Linear Chemicals, Joaquin Costa, Barcelona (Spain).

Principle of α-amylase determination: The hydrolysis of a 2-chloro-4-nitrophenol salt to chloronitrolphenol (CNP) is catalyzed by alpha amylase. The increase in absorbance caused by the production of chloronitrolphenol, which is proportionate to the alpha amylase activity in the sample, is used to calculate the rate of hydrolysis.

Principle of lipase assay: The specific chromogenic lipase substrate 1,2-O-dilaurylrac-glycero-3-glutaric acid-(6'methyl-resorufin)-ester emulsified in stabilized microparticles is the basis for the lipase determination method. The substrate is converted to 1,2-O-dilauryl-rac-glycerol and glutaric acid-6'-methylresorufinester in the presence of particular activators of pancreatic lipase, such as colipase, calcium ions, and bile acids. This mixture then spontaneously breaks down into glutaric acid and methylresorrufin. The amount of lipase active in the sample is directly correlated with the increase in absorbance caused by the formation of methylresorrufin.

Statistical Analysis

Data obtained from the analysis was analyzed using the statistical software SPSS for Windows, version 17.0 (SPSS. Chicago, IL, USA). Values obtained in this study were presented as mean standard error of mean (SEM). The data generated was compared using Students' paired t-test and Analysis of Variance (ANOVA) at 95% confidence intervals and at 5% level of significance (p-value 0.05). Correlation between parameters was done using correlation coefficient test at 5% level of significance (p-value 0.05).

RESULTS

Table **1** shows the sociodemographic parameters of study participants (marijuana smokers). They were predominantly male subjects 55(91.7%) while the women were 05 (8.3%). More than half 34(56.7%) were single while only 26(43.3%) were married. Half of the subjects 30(50%) were between the age of 19-30 years, closely followed by those between the ages of 31-45 years 23(38.3%). The least number of subjects were those between the age range 46-50 years

Table 1: Sociodemographic Parameters of Study Participants

Variables	Classification	No. of subjects	Percentage (%)
Gender	Men	55	91.7
	Women	05	8.3
Marital Status	Single	34	56.7
	Married	26	43.3
Age Range (Years)	19-30	30	50
	31-45	23	38.3
	46-60	07	11.7
Smoking Duration (Years)	1-10	42	70
	11-20	11	18.3
	21-30	07	11.7
Quantity (Wraps/day)	1-5	55	91.7
	6-10	05	8.3
Educational Status	Primary	6	10.0
	Secondary	34	56.7
	Tertiary	20	33.3

07(11.7%). Most of the subjects 42(70%) have been smoking marijuana for 1-10 years, while those that have been smoking for 11-20 years were 11(18.3%), the least 07(11.7%) have been smoking for 21-30 years. It was also observed that 55(91.7%) of subjects smoke between 1-5 wraps of marijuana daily while 05(8.3%) smoke between 6-10 wraps of marijuana daily. More than half of the study participants 34/60(56.7%) had secondary school level of education, while those with tertiary and primary school levels were 20/60(33.3%) and 6/60(10%) respectively.

Table **2** shows the mean comparison of Lipase and Amylase activities between male and female control and Marijuana smokers. Males and females showed a significantly higher amylase activity among marijuana smokers when compared to controls ($p<0.05$). Lipase activity of male marijuana smokers was significantly higher than that of the control group ($p<0.05$). Likewise, lipase activity of female marijuana smokers was significantly higher than that of the control group ($p<0.05$). Most 50/60 (83.3%) of marijuana smokers had amylase activity above the normal range (28-100 U/L) while 38/60 63.3% had lipase activity above the normal range (33-78 U/L).

Table **3** shows the correlation between gender, age, duration and quantity of marijuana smoked with Amylase and Lipase Activity. Amylase activity was higher among male gender than female gender (r=-0.40, p=0.028), but no correlation was observed between age, duration of smoking and quantity of

Table 2: Comparison of Mean Alpha-Amylase and Lipase Activity between Marijuana Smokers and Non-Marijuana Smokers

Parameters	Gender	Marijuana smokers	Non-marijuana smokers	P-value
Alpha-Amylase(U/L) Reference range(28-100)	males	136.03±30.33 CI: 78.1, 58.4	71.30±10.14 CI:80.20,29.12	0.001
	Females	108.00±19.15 CI: 51.1, 6.6	79.14±11.73 CI:80.20,28.22	0.017
Lipase (U/L) Reference range(33-78)	Males	89.15±19.61 CI: 52.4, 34.0	45.96±10.46 CI:70.21,33.20	0.001
	Females	76.00±2.00 CI: 35.2, 4.8	56.00±10.94 CI:66.31,34.12	0.016

Table 3: Correlation between Gender, Age, Duration and Quantity of Marijuana Smoke with Amylase and Lipase Activity

Parameter		Gender	Age (Years)	Duration (Years)	Quantity (Wraps)
Amylase	r value	-0.400	0.189	0.245	0.288
	p value	0.028*	0.316	0.192	0.122
Lipase	r value	-0.276	0.305	0.425	0.111
	p value	0.139	0.101	0.019*	0.560

*p<0.05 was considered significant.

marijuana smoke with amylase activity (p>0.05). Lipase activity, however, correlated positively (r=0.425, p=0.019) with duration of marijuana use. There was no correlation between gender, age and quantity of marijuana smoke and lipase activity (p>0.05).

DISCUSSION

One uncommon cause of acute pancreatitis is marijuana-induced pancreatitis, which is hard to diagnose due to the lack of specific diagnostic standards. Marijuana-induced pancreatitis is difficult to identify due to absence of precise diagnostic criteria [1]. It is therefore, pertinent to investigate the risk of marijuana smoking to pancreatitis so that healthcare providers and users may be aware of its potential risks. This may enable the prevention and possibly eradicate the incidence of chronic pancreatitis and pancreatic cancer [1].

The sociodemographic characteristics of the study participants indicate a high prevalence of marijuana consumption among males, with the majority of users within the 15-30year age group. This aligns with global trends where younger males are more likely to engage in marijuana use [9]. The significant percentage of participants with secondary school education suggests that marijuana use is prevalent across various educational strata.

The study revealed that 90% of the marijuana smokers were males, and the mean age of the participants was 34.33 years. The prevalence of marijuana smoking among younger age groups (15-30 years) and the majority being single (56.7%) is consistent with previous studies indicating that younger, single individuals are more likely to engage in substance use [10]. The educational status data showing the majority having secondary education (56.7%) reflects the demographic trends in substance use, where educational attainment can influence substance use patterns [9].

The lifestyle characteristics showed that a majority of participants had been smoking marijuana for 1-10 years and consumed 1-5 wraps daily. These findings highlight the chronic nature of marijuana use among the participants, which is a critical factor in understanding the long-term effects on digestive enzymes. Chronic use has been linked to various health implications, and the quantity and duration of use are essential variables in assessing these impacts [11].

A significantly higher amylase and lipase activities among marijuana smokers compared to the control group observed in this study aligns with previous research indicating that marijuana use can influence enzyme activity due to its interaction with the endocannabinoid system. This interaction plays a role in regulating various physiological processes, including digestion [12,13].

The elevated levels of digestive enzymes among marijuana smokers can be scientifically justified by the interaction of cannabinoids with the endocannabinoid system. Cannabinoids have been shown to modulate the release of various digestive enzymes, potentially leading to increased enzyme levels [12]. The finding of significantly higher Amylase activity among male and female marijuana smokers compared to controls is consistent with the hypothesis that marijuana use can stimulate the pancreas, leading to increased secretion of digestive enzymes [14]. It was reported that chronic marijuana use may induce adaptive changes in the pancreas, resulting in altered enzyme secretion [14]. Elevated amylase levels have also been observed in other studies involving substance use, suggesting a possible common pathway for enzyme elevation [15].

The significant negative correlation between gender and amylase activity, is an indication that males had

higher enzyme levels than females. Additionally, a significant positive correlation was found between the duration of smoking and lipase activity, suggesting that prolonged marijuana use is associated with higher lipase levels. These findings are supported by previous studies indicating gender differences in enzyme activity and the impact of chronic substance use on digestive functions [16,17]. These findings highlight the complexity of the relationship between marijuana use and digestive enzyme activity.

While the exact mechanisms underlying the elevation of amylase and lipase enzymes in marijuana use are not fully understood, several potential pathways have been proposed [18]. Marijuana may directly stimulate the pancreas, leading to inflammation and enzyme release. It has been associated with an increased risk of gallstones, which can block the pancreatic ducts and cause pancreatitis. Marijuana may increase triglyceride levels, which can also contribute to pancreatitis. Cannabis contains cannabinoids that interact with the endocannabinoid system, which plays a role in regulating various physiological functions, including pancreatic function [19].

Cannabinoids may modulate inflammatory pathways in the pancreas, potentially leading to enzyme elevation. The islets of Langerhans in the pancreas have low expression levels of both CB1 and CB2 receptors [20-23]. Both CB1 and CB2 receptor expression and activation are elevated during pancreatic inflammation [22]. However, the roles play CB1 in the pathophysiology of acute pancreatitis in human have not sufficiently validated [19] Apart from this, not much is known about the way in which marijuana interact with pancreatic receptors to trigger acute pancreatitis [19,24]. A recent study has reported that symptoms of acute pancreatitis disappear upon stopping marijuana use in a case report suggesting that marijuana-induced pancreatitis is dose-and time-dependent [19, 20-21].

Lastly, the use of marijuana in combination with certain medications, such as opioids or anticholinergics, may increase the risk of pancreatitis and enzyme elevation [25]. There is however individual genetic variations which may influence the susceptibility to enzyme elevation in response to marijuana use [26]. The frequency and duration of marijuana use may also play a role in the likelihood of enzyme elevation. It's important to note that while elevated amylase and lipase levels can be a sign of pancreatitis, they can also be caused by other factors.

CONCLUSION

This study revealed that marijuana smoking significantly impacts digestive enzyme activities. Specifically, marijuana smokers exhibited higher serum amylase and lipase levels compared to non-smokers. These findings suggest that chronic marijuana use may alter pancreatic function, leading to elevated enzyme secretion. The observed correlations between smoking duration and enzyme activity further highlight the potential long-term effects of marijuana on digestive health. Further research is needed to fully understand the mechanisms underlying the association between marijuana use and enzyme elevation.

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