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Modeling the Impact of Drug and Substance Abuse on Students' Academic Performance

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Abstract
The belief and addiction of students in tertiary institutions to drugs and substance usage to motivating themselves to perform better in their academics and their day-to-day activities cannot be overemphasized, this in turns has become a thing of concerned not to schools' management alone but also to parents, community's leaders and the governments of the day globally. Hence the need for this research "modelling of level and effect of drugs and substance abuse on students' academic performance. Data were collected from both public and private tertiary institutions. Some statistical tools; correlation coefficients, regression model and chi-square were employed. The results generally indicated a concerning negative relationship and association between drugs/substance intake and academic performance, that is as drugs and substance levels of intakes increases the academic performance decreases. There is also a high positive correlation between levels of intake and its effect on the users; meaning that the higher the intake of drugs and substance the higher the effect and the lower the academic performance.

Key words: *Modelling, Drugs abuse, Substance abuse, association, relationship, academic performance*

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I. Introduction

Drug and substance abuse has become a pressing concern globally, with the youth population being particularly vulnerable to its devastating effects. The world Health organization (WHO) defines substance abuse as the harmful or hazardous use of psychoactive substances, including alcohol, tobacco, and illicit drugs. Youths defined as individuals between the ages of 15 and 24, are at a critical stage of physical, emotional, and psychological development, making them susceptible to theallure of drugs and substances use.The alarming rate of drug and substance usage among youths poses significant threats to their health, well-being, and future prospects. According to the United Nations office on Drugs and crime (UNODC), approximately 31%of global population aged 15-24 have at one time or the other used illicit substances in their lifetime. Substance and drug abuse among youths has been steadily on the increase with specific statistics and trends.Among students in tertiary institutions drug and substance abuse has become a pervasive issue worldwide and Nigeria as a nation, posing significant threats to their academic performance, mental health, and overall well-being (UNODC, 2020).

Research has consistently shown that substance abuse is negatively correlated with academic achievement, leading to decrease GPAs, increase dropout rates, and reduced educational aspirations (Dupont,2014; NIDA, 2019).Studies have identified several factors contributing to substance abuse among higher institutions of learning around the globe these includes; pear pressure, stress, and mental health issues (SAMHSA,2020). Moreover, the easy availability of substances and drugs on campuses and the perceived normalization of its use among students further increased the problems (Johnston et.al., 2019).

In Nigeria, the prevalence of drug and substance abuse among students of higher institutions is alarming, with studies indicating that 53.20% of students have used substance at least once (NBS, 2019)

This study aims to model the level of intakes of drugs and substances and it impact on academic performance among students of both publics and private tertiary institutions in Southwestern states of Nigeria.

Drug and substance abuse among tertiary institutions students has garnered significant attention in the resents years, with research highlighting its detrimental impacts on academic performance. Studies has also shown consistently that substance and drug abuse is wide spread among tertiary institution students. In Nigeria

and United State, study reported 53.2 % and 34.6% of students had used illicit drugs in the past years respectively (NBS,2019; SAMHSA, 2020).

Research has identified several factors contributing to substance abuse among students of higher institution, includes; peer pressure (Kaplan et.al 2017), stress and anxiety (wang et.al,2018), mental Health issues (NIDA,2019).Akoth, A.A (2009) in his research work on the impact of drug abuse on academic performance in secondary schools, in kabondo Division, Kenya, concluded that drug and substance abuse among the students led to school dropouts, strained relationship with other students, lack of interest in studying, truancy and low concentration on academics by students who indulge in it.

Abuse of drugs and substances has been found to affects students by having a lower GPAs (Arria et.al., 2013), increased dropout rates (Dupout,2014), reduced educational aspirations (NIDA,2019) , and also decreased cognitive function and memory (Wang et.al;2018).

Several theoretical frameworks have been employed to understand substance abuse and academic performance, these includes; social learning theory (Banduru,1977), self Determination theory (Deci and Ryan,2000), problem behaviour theory (Jessor and Jessor, 1977).Previous studies have utilized various methodological approaches includes; surveys and questionnaires (Kaplan et.al, 2017), interviews and focus groups (wang etal,2018), regression analysis (arrialet.al. 2013) and structural equation modelling (Dupont,2014)

Hence the needs for this research, the types of drugs investigated includes; Tobacco, Alcohol, Marijuana, Amphetamine, Hallucinogen.

II. MATERIALS AND METHODOLOGY

Questionnaire method was adopted for the collection of data used in this research work. Relevant questions were arranged in a logical manner and administered in some selected tertiary institutions which includes both public and private higher place of learning in the southwestern states of the country (Nigeria); these includes; Ekiti, Ondo, Oyo, Ogun, Lagos and Osun states.

Regression Analysis

Regression indicates the nature of relationship or the nature of influence or association among variables. Regression analysis therefore refers to the methods by which estimate are made of the values of the variables from knowledge of the value of one or more other variables with the measurement of errors involved in the estimation.

Multiple regression analysis

This is a statistical techniques used to model the relationship between a dependent variable (Y) and multiple independent variables (X1, X2,…,Xn). The model is given as; $Y = \beta 0 + \beta 1X1 + \beta 2X\mathbf{2} + \cdots + \beta nXn + \varepsilon$

Where; β0 is the intercept or constant term, β1, β2,…. βn, are the regression coefficient (slopes) and ε is the error terms (residual). The regression coefficients β represent the change in the dependent variable for a one-unit change in the independent variable, while holding all other independent variable constant. The coefficients are typically estimated using ordinary least squares (OLS) method, which minimizes the sum of the squared residuals. The formula for estimating the coefficients is given as; $\beta = (X^T X)^{-1} X^T Y$ where X is a matrix of independent variables, $X^T$is the transpose of X , Y is vector of dependent variable and βis the vector of regression coefficients.

The coefficient of determination (R-squared) is determined by $R^2 = 1 - (SSE/SST)$ where SSE is the sum of square residuals and SST is the total sum of squares.

The positive coefficient is interpreted as the increase in independent variable leads to increase in dependent variable. When the coefficient is negative it means increase in the independent variable leads to a decrease in dependent variable. The coefficient values therefore represent the magnitude of the relationship.

Hence by understanding multiple regression analysis one can model complete relationship between variables and make predictions based on the data.

Correlation

There are various techniques of measuring the existing relationship between two variables. The mostly used techniques is correlation coefficient analysis. The primary objective of investigating the correlation between two variables is to determine whether is any casual connection between them.

Correlation may therefore be defined as the degree of relationship between two or more variables. The degree or strength of relationship connecting three or more variables is called multiple correlation.

In other word correlation is the mathematical measure of the amount Γ degree of relationship or influence or association between two or more variables.

There is perfect positive correlation between x and y if all the points of the scatter diagram lie on the straight line. The parameter Γ is called the population correlation coefficient and it measures the strength of the linear relationship between x and y.

The sample correlation coefficient is defined by the formula

$$\Gamma_{x,y} = \frac{n\Sigma xy - \Sigma x\Sigma y}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

Data analysis

All analyses were done using Minitab version 16 and R version 4.4.1 (R Core Team, 2024)

Table 1: Data description

Item	Variable Code
Respondent Demographics	
Age	AGE
Gender	GENDER
State of Origin	STATE_ORIGIN
Name of Educational Institution	INSTITUTION_NAME
Type of Educational Institution	INSTITUTION_TYPE
Classification of Educational Institution	INSTITUTION_CLASS
Data description on Drug Use Awareness and Exposure	
Have you ever used drugs before?	EVER_USED_DRUG
Have you ever heard that drug abuse is dangerous to your health?	AWARE_DRUG_DANGER
Which of these drugs have you heard of?	DRUGS_HEARD
Which of these drugs have you used before?	DRUGS_USED
How did you get to start the usage of the drugs?	DRUG_START_REASON
How often do you take the drugs?	DRUG_USE_FREQ
Usage Patterns	
At what occasion do you use drugs?	DRUG_USE_OCCASION
What is your method of ingestion of the drugs?	DRUG_INGEST_METHOD
Academic Performance	
Does the drug affect your academic performance?	DRUG_EFFECT_ACADEMIC
Does it help you with difficult academic tasks?	HELP_WITH_TASKS
Rate your level of drug intake (1–5)	DRUG_USE_LEVEL
Rate the level of effect on your performance	EFFECT_ON_PERFORMANCE
What is your G.P.A class in the last semester?	GPA_LAST_SEM
What is your current cumulative C.G.P.A?	CGPA_CURRENT
Academic Score in Percent	PERCENT_SCORE
Final GPA	GPA

Table 2: Descriptive Statistics for numeric variables

Statistic	*PERCENT_SCORE*	*GPA*
Mean	61.2930	3.4249
Standard Error	0.3088	0.0244
Median	60	3.5
Mode	68	3.5
Standard Deviation	10.2028	0.8077
Sample Variance	104.0974	0.6524
Kurtosis	-0.5324	-1.1053
Skewness	-0.2872	0.0450
Range	39	2.8
Minimum	40	2
Maximum	79	4.8
Sum	66932	3740
Count	1092	1092

The dataset comprises the PERCENT_SCORE and GPA of 1,092 students. The average PERCENT_SCORE is approximately 61.29%, with a GPA mean of 3.42. The median GPA is slightly higher at 3.5, suggesting a modestly skewed distribution toward higher GPAs. The modal values, 68 for PERCENT_SCORE and 3.5 for GPA, indicate that a significant number of students scored around these values. The minimum and maximum scores range from 40 to 79 for PERCENT_SCORE and 2.0 to 4.8 for GPA, showing a moderately wide spread in academic performance.

In terms of dispersion, the PERCENT_SCORE has a standard deviation of about 10.2, while GPA has a lower variability with a standard deviation of 0.81. The range for PERCENT_SCORE is 39 percentage points, and 2.8 for GPA, reflecting greater score spread in percentage terms. The sample variances (104.10 for PERCENT_SCORE and 0.65 for GPA) further confirm that PERCENT_SCORE values are more dispersed than GPAs. This disparity may be due to GPA's more restricted scale (0 to 5), compared to raw scores out of 100.

Distributional characteristics show a negative kurtosis for both variables (−0.53 for PERCENT_SCORE and −1.11 for GPA), suggesting flatter-than-normal distributions with lighter tails. The skewness is minimal for both: slightly negative (−0.29) for PERCENT_SCORE, indicating a mild left-tail, and nearly symmetric for GPA (0.045). These values suggest that while both distributions are roughly normal, PERCENT_SCORE has a slight left skew, and GPA is almost symmetric with slight peaking around the mean.

Table 3: Descriptive Statistics for categorical variables

Category	Freq	%	Category	Freq	%
INSTITUTION_TYPE			USE_FOR_WELLBEING		
University	704	64.47	No	684	62.64
Polytechnic	376	34.43	Yes	192	17.58
College of Education	12	1.1	Missing	216	19.78
INSTITUTION_CLASS			HELP_WITH_TASKS		
Public	988	90.48	No	684	62.64
Private	104	9.52	Yes	172	15.75
			Missing	236	21.61
EVER_USED_DRUG					
No	792	72.53	USE_FOR_FUN		
Yes	300	27.47	No	652	59.71
			Yes	184	16.85
AWARE_DRUG_DANGER			Missing	256	23.44
Yes	1008	92.31			
No	84	7.69	DRUG_USE_OCCASION		

DRUG_START_REASON		
Missing	476	43.59
Others	392	35.9
Parents	92	8.42
School Friends	64	5.86
Class friends	56	5.13
Hostel mate	12	1.1
DRUG_USE_FREQ		
None at all	804	73.63
Once a week	152	13.92
Once Daily	68	6.23
More than once a week	68	6.23
USE_FOR_CURIOSITY		
No	780	71.43
Yes	128	11.72
Missing	184	16.85
USE_TO_FEEL_HIGH		
No	756	69.23
Yes	136	12.45
Missing	200	18.32
USE_TO_CONCENTRATE		
No	772	70.7
Yes	120	10.99
Missing	200	18.32
Before Exams	152	13.92
Before Lectures	124	11.36
Before Presentation	100	9.16
Missing	716	65.57
DRUG_INGEST_METHOD		
Oral	216	19.78
Injection	108	9.89
Smoke	88	8.06
Sniff	36	3.3
Missing	644	58.97
DRUG_EFFECT_ACADEMIC		
No	560	51.28
Yes	84	7.69
Missing	448	41.03
GPA_LAST_SEM		
Upper (2.1)	432	39.56
Lower (2.2)	296	27.11
Distinction (1st Class)	208	19.05
Pass	88	8.06
3rd Class	68	6.23
CGPA_CURRENT		
Upper (2.1)	424	38.83
Lower (2.2)	324	29.67
Distinction (1st Class)	196	17.95
Pass	76	6.96
3rd Class	72	6.59

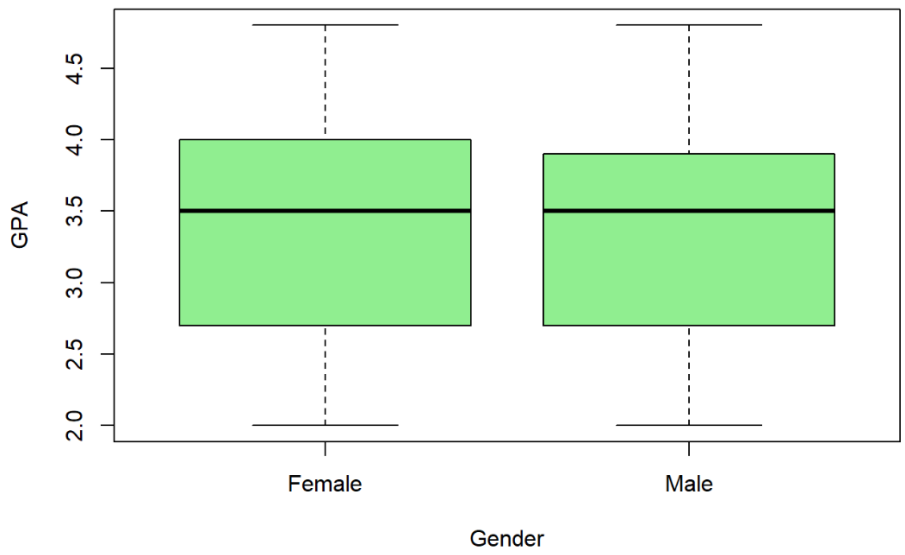

Fig. 1: GPA by gender

The boxplot compares GPA distributions between female and male students. Both groups have similar GPA ranges, roughly from 2.0 to just below 4.8. The median GPA for both genders is around 3.5, indicating that the central tendency is virtually the same. The interquartile ranges (middle 50% of the data) for both genders also appear quite similar, suggesting comparable GPA consistency within each group.

There are no extreme outliers in either group, and the whiskers extend to roughly the same minimum and maximum values for both genders. The slight visual difference in the shape and spread of the boxes may indicate marginal variation in GPA distribution, the academic performance between males and females is largely balanced. This suggests that gender does not significantly influence GPA in this sample.

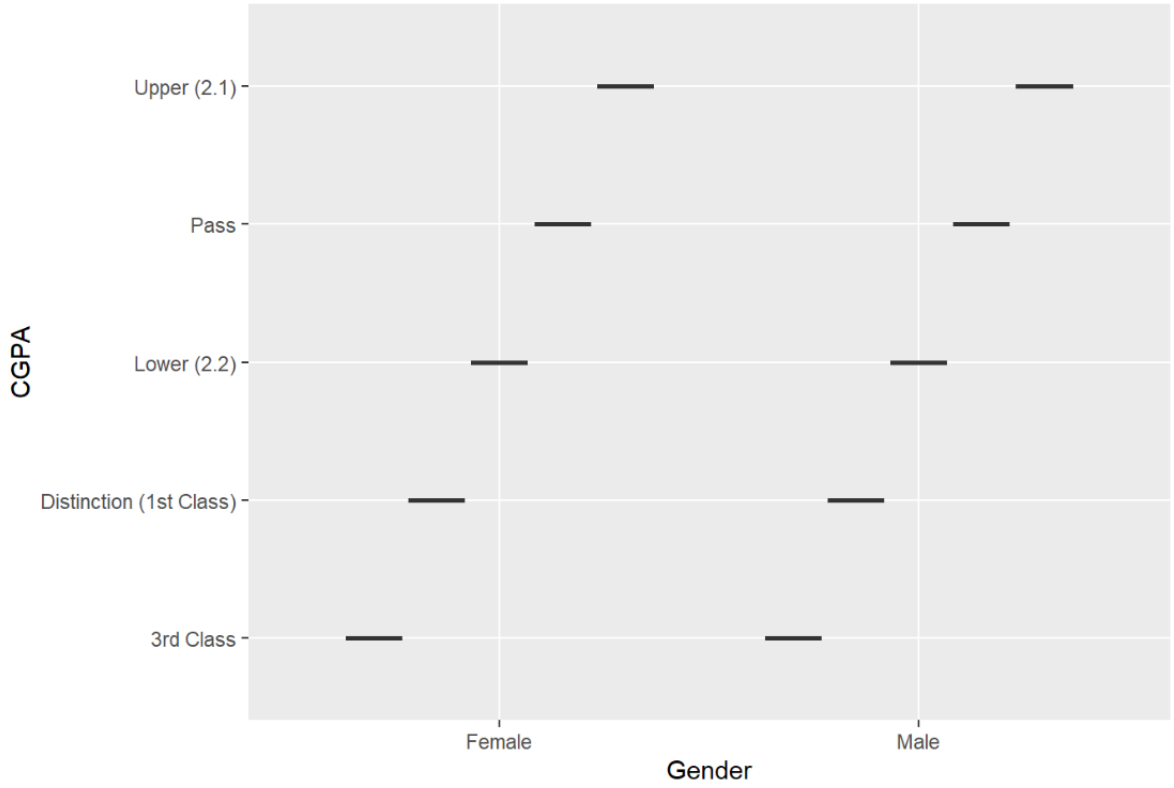

Fig. 2: Distribution of current CGPA by gender

The chart displays the distribution of academic classifications (CGPA categories) across gender. Both male and female students are represented in all classification levels—Distinction (1st Class), Upper Second Class (2.1), Lower Second Class (2.2), Pass, and Third Class. Notably, both genders have comparable representation in the Distinction and Upper Second Class categories, suggesting that high academic performance is achieved by both male and female students.While the distribution pattern appears relatively balanced, subtle differences can be observed. For instance, slightly more female students seem to fall into the Pass and Third Class categories compared to their male counterparts, whereas male students show a marginally stronger presence in the Upper Second Class and Lower Second Class brackets. Overall, the chart indicates that academic performance outcomes, in terms of CGPA classification, are fairly even across genders, with no extreme disparities.

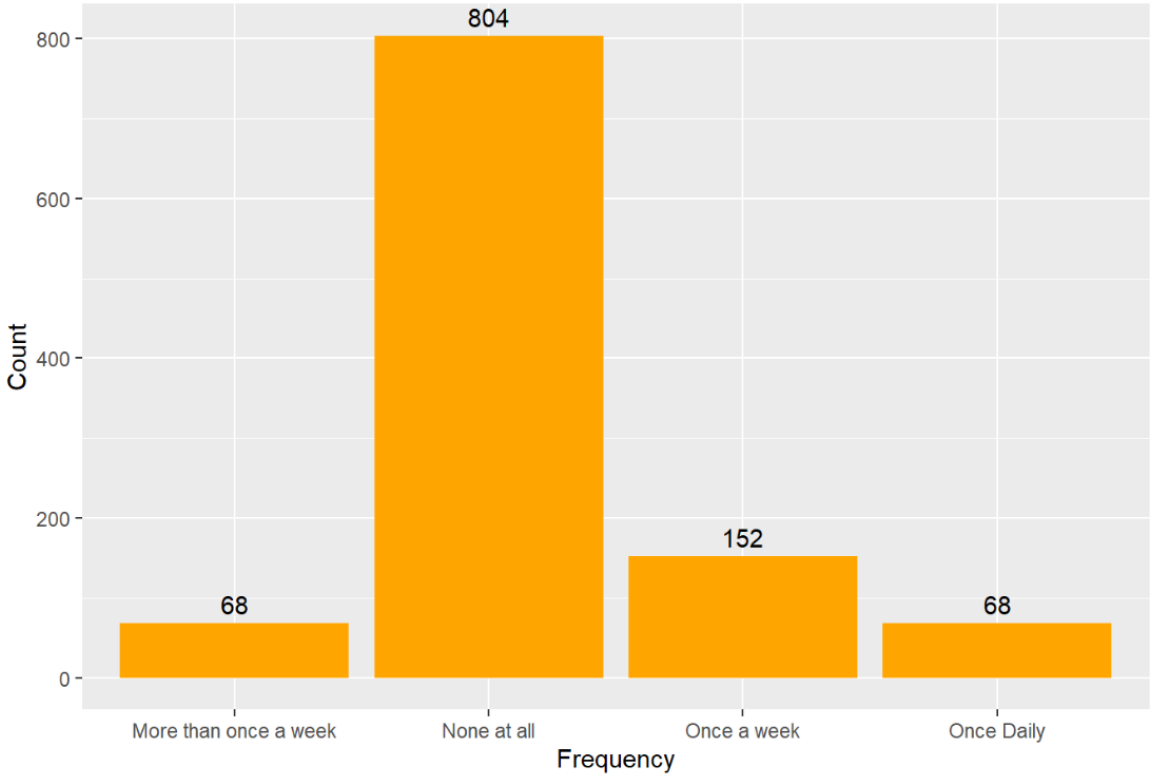

Fig. 3: Frequency of Drug Use

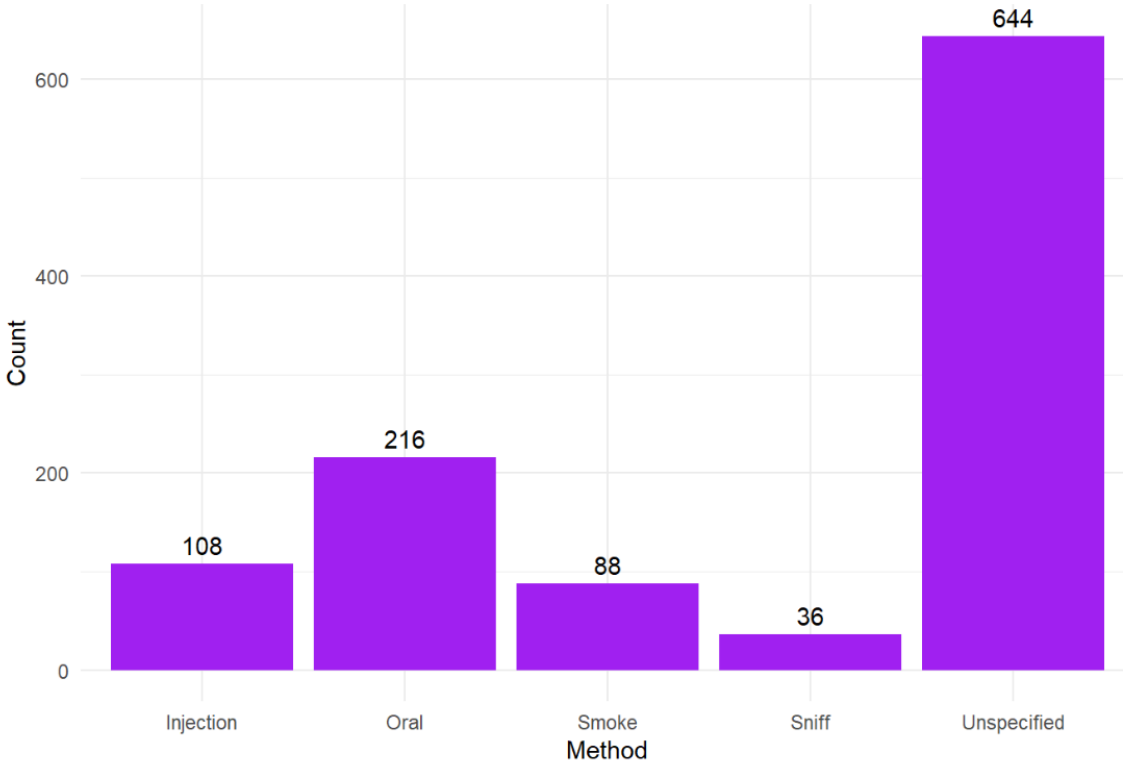

Fig. 4: Method of Drug Ingestion

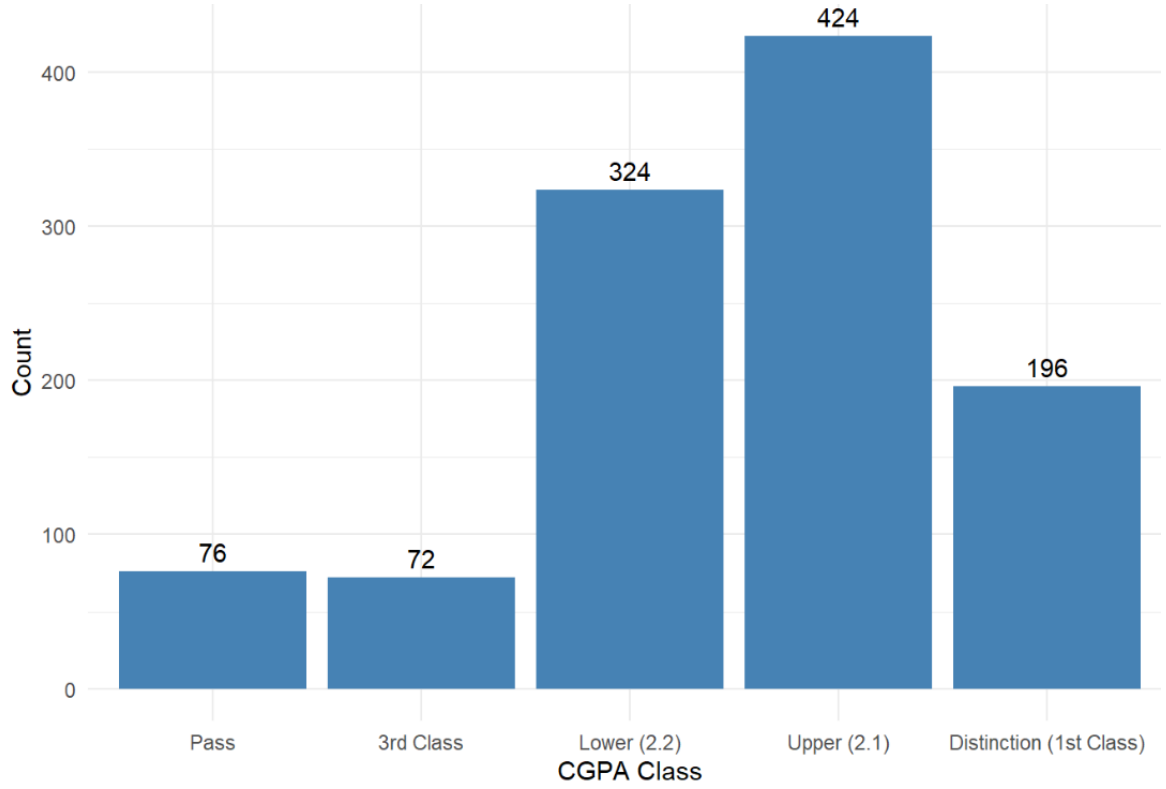

Fig. 5: CGPA Classification of Students

To determine the existence of association between types of drugs and substance usage and students academic performances, chi-square test of association is employed and shown below.

Table 4: Typesofdrug * CGPA Crosstabulation

Count

		Pass	3rd class	CGPA lower	Upper	Distinction	Total
Typesofdrug	tobacco	0	4	0	12	12	28
	Alcohol	36	12	56	96	40	240
	marijuana	0	8	4	8	0	20
	amphetam	0	0	8	0	0	8
	hallucinogen	4	0	0	4	0	8
	None	32	52	252	304	148	788
Total		72	76	320	424	200	1092

Table 5: Chi-Square Tests

	Value	Df	P-value
Pearson Chi-Square	145.524	20	.000
Likelihood Ratio	126.707	20	.000
Linear-by-Linear Association	5.874	1	.015
N of Valid Cases	1092		

Since $p<\alpha$ there is no evidence in support of H_0, we conclude that there is association between drug usage and academic performance.

Regression Analysis: cumulative percentage (y)versus level of drug intake (x1) and drugs effect (X2) on academic performance (based on Percentage scores)

Table 6: Coefficients of Predictors

Predictor	Coefficient (β)	Std. Error (SE)	t-value	p-value	Significance
Constant	62.946	0.702	89.64	0.000	Significant
x_1	-1.088	0.688	-1.58	0.115	Not significant
x_2	-1.347	0.618	-2.18	0.030	Significant

Regression Equation: $\hat{y} = 62.9 - 1.09x_1 - 1.35x_2$

Table 7: Model Summary

Metric	Value
S (Standard Error)	9.89
R-Squared (R^2)	7.0%
Adjusted R^2	6.3%

Table 8: Analysis of Variance (ANOVA)

Source	DF	SS	MS	F	p-value
Regression	2	1985.73	992.87	10.15	0.000
Residual	270	26406.82	97.80		
Total	272	28392.56			

Table 9: Sequential Sums of Squares

Predictor	DF	Seq SS
x_1	1	1520.45
x_2	1	465.29

The regression analysis presented in Table 6 shows that the constant term (intercept) of the model is statistically significant, with a coefficient of 62.946 and a p-value of 0.000, indicating a strong baseline academic performance when predictor variables are zero. Of the two predictor variables, x_1 has a negative coefficient of -1.088 but is not statistically significant (p = 0.115), suggesting its influence on academic performance is not strong enough to be considered reliable. On the other hand, x_2 has a coefficient of -1.347 and is statistically significant (p = 0.030), indicating that increases in this predictor are associated with a meaningful decline in academic performance.

The model summary in Table 7 reveals a low R-squared value of 7.0%, suggesting that only a small portion of the variation in academic performance is explained by the two predictor variables. The adjusted R-squared is slightly lower at 6.3%, which accounts for the number of predictors in the model and indicates that the model may not generalize well to other data. The standard error of the estimate is 9.89, which provides an average measure of the accuracy of the predictions. These results suggest that while the model includes one statistically significant predictor, it only explains a limited amount of the overall variability in student performance.

The Analysis of Variance (ANOVA) table in Table 8 supports the overall statistical significance of the regression model. The F-statistic of 10.15 and the corresponding p-value of 0.000 indicate that the model as a whole is significant and that at least one of the predictor variables contributes meaningfully to predicting academic performance. However, given the low R-squared value, the practical significance or explanatory power of the model is limited, and other unmeasured variables may be influencing the outcome.

Regression Analysis Summary - Model 2

Table 10: Coefficients of Predictors

Predictor	Coefficient (β)	Std. Error (SE)	t-value	p-value	Significance
Constant	3.519	0.057	62.18	0.000	Significant
x_1	-0.0582	0.0554	-1.05	0.294	Not significant
x_2	-0.0799	0.0498	-1.61	0.109	Not significant

Regression Equation: $\hat{y} = 3.52 - 0.0582x_1 - 0.0799x_2$

Table 11: Model Summary

Metric	Value
S (Standard Error)	0.797
R-Squared (R^2)	3.6%
Adjusted R^2	2.9%

Table 12: Analysis of Variance (ANOVA)

Source	DF	SS	MS	F	p-value
Regression	2	6.4502	3.2251	5.08	0.007
Residual	270	171.5004	0.6352		
Total	272	177.9506			

Table 13: Sequential Sums of Squares

Predictor	DF	Seq SS
x_1	1	4.8120
x_2	1	1.6382

The regression analysis summary for Model 2 indicates that the constant term is statistically significant, with a coefficient of 3.519 and a p-value of 0.000, suggesting a baseline GPA of approximately 3.52 when the predictors are zero. However, both predictors x_1 and x_2 are not statistically significant, with p-values of 0.294 and 0.109 respectively. This implies that neither variable has a strong or reliable individual impact on GPA in this model. The regression equation is:

$\hat{y} = 3.52 - 0.0582x_1 - 0.0799x_2$, reflecting a small negative relationship between the predictors and GPA.

The model summary in Table 11 shows that the R-squared value is 3.6%, indicating that only a very small portion of the variability in GPA is explained by the two predictors. The adjusted R-squared is even lower at 2.9%, further reinforcing the weak explanatory power of the model. The standard error of the estimate is 0.797, suggesting that the predicted GPA values tend to deviate from the actual values by about 0.8 points on average. This underlines the limited predictive usefulness of the model.

Despite the weak individual predictor significance, the ANOVA results in Table 12 show that the overall regression model is statistically significant, with an F-value of 5.08 and a p-value of 0.007. This indicates that, collectively, the predictors do provide some explanatory power for GPA, albeit minimal. The sequential sums of squares in Table 13 reveal that x_1 contributes more (Seq SS = 4.8120) to the model compared to x_2 (Seq SS = 1.6382). While statistically significant as a group, the model's practical value is limited and could be improved by including more relevant or stronger predictors.

To determine the type and strength of association between the variables correlation coefficient is used.

Table 14: Correlation Coefficient Between CGPA, Drugs Intake Level and Drug Effect

	CGPA	*DRUGS INTAKE*	*DRUG EFFECT*
CGPA	1		
D.INTAKE	-0.164442571	1	
D.EFFECT	-0.179741004	0.6492662	1

There is negative correlation between and levels of drugs intake and also a negative correlation between CGPA and effect of drug usage, however there exist a high positive correlation between level of intake and effect of drugs usage.

The research findings reveal a significant and troubling inverse relationship between drug and substance abuse and students' academic performance. The results indicate that increased intake of drugs and substances is associated with decreased academic outcomes. Specifically, the model demonstrates a strong negative correlation between both the quantity of drug intake and its effects, and academic performance. Furthermore, a high positive correlation exists between the levels of drug and substance consumption and the severity of their effects on users. This suggests that as drug usage increases, the adverse effects on the user also intensify, leading to further deterioration in academic performance.

The negative consequences of drug use on academic success are manifold. These include impaired cognitive functions such as reduced attention, memory, and decision-making ability, which are critical to academic achievement. Additionally, drug dependence can lead to diminished motivation and engagement, thereby lowering students' commitment to academic tasks. The risk of school dropout is heightened among those struggling with addiction, as is the prevalence of mental health challenges like anxiety and depression—further compounding academic decline. On a broader level, widespread drug use threatens campus safety and the overall well-being of the student community. It can also erode academic standards and institutional reputation, necessitating greater investment in student support services.

To combat these challenges, institutions should implement a multi-faceted approach. This includes providing accessible counselling, therapy, and support groups for affected students, alongside educational campaigns to raise awareness about the dangers of drug use. Strict campus policies and enforcement measures should be introduced, along with regular screenings and appropriate disciplinary actions. Encouraging healthy alternatives—such as participation in sports, mindfulness practices, and creative activities—can offer students constructive outlets for stress. Collaboration with parents and the broader community is also essential in addressing root causes and offering comprehensive support. Early identification of at-risk students and the

implementation of evidence-based intervention programs can significantly mitigate the impact of drug abuse, fostering a healthier, more supportive academic environment that promotes student well-being and success.

III. CONCLUSION

Based on the analysis conducted, there is clear evidence that drug and substance abuse negatively affects students' academic performance. The descriptive statistics revealed a moderate average academic performance among students, with a GPA mean of 3.42 and a mean percentage score of approximately 61%. However, the presence of a negative skew and a negative kurtosis in percentage scores indicates that while most students score near the average, there is a noticeable portion performing below expectations. The regression analyses further reinforce this concern, showing a consistent negative relationship between drug/substance intake and academic outcomes, although not all predictors were statistically significant in isolation.

In Model 1, the coefficient for drug usage levels ($\mathbf{x_2}$) was statistically significant ($p = 0.030$), showing a significant negative impact on percentage scores, while the coefficient for drug effect ($\mathbf{x_1}$) was not statistically significant. However, the overall model was statistically significant (ANOVA $p = 0.000$), suggesting that the predictors together explain a small but meaningful portion of the variance in academic performance ($R^2 = 7\%$). In Model 2, which used GPA as the outcome, neither $\mathbf{x_1}$ nor $\mathbf{x_2}$ was significant individually, yet the overall model still achieved statistical significance (ANOVA $p = 0.007$), with a lower R^2 of 3.6%. This suggests the relationship between drug use and GPA exists but is weaker compared to percentage scores.

In conclusion, while the statistical models show that drug use and its effects are associated with academic decline, the relatively low R-squared values indicate that other variables also play a major role in students' academic performance. The findings highlight the need for institutional intervention through awareness campaigns, counseling, policy enforcement, and early intervention programs. Tackling drug use holistically—by engaging students, families, and communities—can lead to healthier behaviors and better educational outcomes, thereby improving both individual student success and the academic environment as a whole.

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