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APPLICATION OF RANDOMIZED RESPONSE TECHNIQUE ON A SURVEY OF DRUG ABUSE AMONG UNDERGRADUATE STUDENTS IN NIGERIA

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ABSTRACT

This study investigated the efficacy of the Randomized Response Technique (RRT) in addressing the challenge of underreporting in surveys related to drug abuse in Nigerian Universities. Recognizing the inherent social stigma and confidentially concerns associated with self-disclosure, the RRT is employed as a methodological strategy to elicit more accurate and truthful responses. The research assessed the feasibility and effectiveness of the RRT in uncovering the prevalence and patterns of drug abuse among survey undergraduate students of the Federal University of Technology, Akure, Nigeria. Estimate-adjusted proportion was used to ascertain the drug abuse prevalence while the chi-square test proved to be the most suitable statistic for comparing the relationship between the variables. Confidence interval was used to determine the range in which the true prevalence lied. It was deduced that the proportion of drug abuse among undergraduates using the RRT is 0.3907 which amounts to 39% of the population. Additionally, 64% believed that peer pressure proved to be a strong contributing factor to drug abuse among this population group. While there was no significant relationship between drug abuse and the students' allowance. Consequently, efforts that aimed at empowering undergraduates in the universities or higher schools of learning against drug abuse should be vigorously pursued by the government and other stakeholders to eradicate or reduce this menace called drug abuse.

Keywords: Prevalence, Adjusted Proportion, Confidence Interval, Peer Pressure, Factors

INTRODUCTION

Drug abuse also known as illicit drug is a significant public health issue that affects individuals, families, and communities worldwide. It is the use of medications in methods other than instructed. It is also used to describe non-medical self-administration of a substance to get psychoactive effects, intoxication, or different body image, despite the understanding of its potential adverse effects (Oshikoya and Alli, 2006). Globally, the dominance of illicit drugs such as cocaine use has been projected at 0.4%, and use of such stimulants is linked with additional negative consequences, increased risk of death, blood-borne infections, mental health, lower educational achievement and awkward physical consequences. Adolescence and young adulthood constitute a critical neurodevelopmental period when the brain may be particularly prone to unfortunate effects of illicit drugs (Chamberlain et al., 2021). As at 2021, a total of 270 million people in the world were estimated to be using psychoactive substances. While, the prevalence of drug abuse among adolescents in Africa is about 41.6% (Idowu et al., 2023). Series of research had been made on illicit drug usage among university students, sport men and women, teenagers, young adults, prisoners and even children (Gillespie et al., 2007; Sani, 2018; O'Connor et al., 2020; Chamberlain et al., 2021; Paul et al., 2024)

In Nigeria, drug abuse among undergraduates has become a growing concern, particularly in higher education institutions. According to United Nations Office on Drugs and Crime (UNODC) in 2018, there were 14.3 million drug users in Nigeria and a prevalence of 20.9% among the students (Idowu et al., 2023). In order to effectively address this issue, it is crucial to have accurate and reliable data on the extent of drug abuse among Nigerian undergraduates. However, self-report surveys, which are commonly used to gather such data, may suffer from response biases and social desirability effects that lead to underreporting or misreporting of substance abuse behaviors (Warner, 1965). To effectively address this problem, Randomized Response Technique (RRT) which is an innovative research methodology that can provide accurate and reliable data on drug abuse prevalence will be employed. Previous studies have highlighted the effectiveness of the RRT in addressing sensitive topics, including drug abuse. Vogler (2016) emphasizes the importance of using the RRT in surveys related to drug abuse due to the high prevalence of underreporting and stigma associated with this topic. Moreover, the application of the RRT in a survey sampling of drug abuse among Nigerian undergraduate students hold significant potential. Researchers can overcome the limitations of traditional face-to-face survey methods and obtain higher responses, more accurate and reliable data on drug abuse prevalence. The RRT minimizes social desirability bias, ensures respondent privacy, encourages honest responses, and enables the estimation of drug abuse prevalence at the population level. Utilizing online survey formats, privacy-preserving variants like RAPPOR, and hybrid variants of the RRT can further enhance the effectiveness and efficiency of data collection in this research context (Adepetun & Adebola, 2014; Erlingsson et al., 2014; Hoglinger et al., 2016; Adebola et al., 2017a; Adebola et al., 2017b; Ewemooje et al., 2018). Therefore, this research investigates the application of randomized response technique on drug abuse among Nigerian undergraduates, while examining some factors such as socio-demographic characteristics, peer influence, and academic stress to determine their contributions to drug abuse among Nigerian undergraduates.

MATERIALS AND METHODS

Data collection

Data used in this study were collected from undergraduate students of the Federal University of Technology, Akure (FUTA), Nigeria as a case study for undergraduates in Nigeria higher institutions. It involved the utilization of the randomized response technique (RRT) through questionnaire administration. This technique was chosen to encourage honest responses while maintaining respondent

confidentiality. A carefully crafted questionnaire was developed, containing a mix of both sensitive and non-sensitive questions. The sensitive questions related to drug abuse behaviors, while the non-sensitive questions served as control questions to create randomness, otherwise referred to as "noise". Clear instructions were provided to respondents, emphasizing the importance of honest responses and assuring them of the confidentiality of their answers.

Sampling Method

Stratified random sampling was employed to ensure representation across different grade levels and demographics within the student population. The total number of students in the study area is distributed as follows: 3,812 in the 100 level, 4,237 in the 200 level, 3,967 in the 300 level, 4,558 in the 400 level, and 4,426 in the 500 level, totaling 21,000 students. The target sample size was determined using simple random sampling to achieve a 95% confidence level and a ±5% margin of error. Students were divided into strata based on academic levels (100-500) and demographic factors such as gender and age.

Questionnaire Administration

Using the simple random sampling formula (P = 1 – {(N – 1) / N }) to obtain sample size, a total of 300 questionnaires were administered to the students using the face-to-face administration method. To further ensure confidentiality, a randomized response mechanism was introduced. Respondents were asked to flip a coin before answering. If the coin landed on heads, they were instructed to answer truthfully. If it landed on tails, they were asked to answer "yes" regardless of their true response. This mechanism introduced an additional layer of uncertainty, making it difficult to ascertain an individual's true response, even by the interviewer.

Randomized Response Technique (RRT)

Randomized Response Technique (RRT) has gained prominence in survey sampling due to its ability to elicit responses to sensitive questions while ensuring respondent privacy and confidentiality. The RRT is a survey method that allows respondents to answer sensitive questions indirectly, reducing the fear of social desirability bias and increasing the likelihood of obtaining truthful responses (Opendra, 2023). This technique involves the use of randomized devices, such as coin, dice or cards, which are used to determine the response category for each respondent. By introducing randomness into the survey process, the RRT protects the confidentiality of individual responses and encourages participants to provide honest answers to sensitive questions (Mukherjee et al., 2018). One of the key advantages of the RRT is its ability to provide population-level estimates of drug abuse prevalence without exposing individual respondents to potential harm or social consequences. It aims to overcome the reluctance of participants to provide truthful responses due to social desirability bias (Warner, 1965). Blair et al. (2015) argue that traditional survey methods may underestimate drug abuse prevalence due to respondent reluctance to disclose sensitive information (Chaudhuri & Mukherjee (2008); Chaudhuri (2011); Le et al (2023)).

Level of Prevalence

In RRT, the following variables are used:

$P(A)$: The actual prevalence of the sensitive behavior in the population.

$P(R|A)$: The probability of responding affirmatively (for example "Yes") to the sensitive question given that the respondent is truly engaging in the behavior.

$P(R|\neg A)$: The probability of responding affirmatively to the sensitive question given that the respondent is not engaging in the behavior.

π: The proportion of respondents who provided randomized responses.

The formula for estimating the prevalence ($P(A)$) using the randomized response technique is:

$$P(A) = (P(R|A) - P(R|\neg A)) / (1 - \pi + \pi * P(R|\neg A))$$

Unbiased estimate proportion

Elementary probability theory can be used to get an unbiased estimate ($\hat{\pi}$) of the prevalence of drug use in the population. So mathematically, π is the true proportion of the subjects with the sensitive characteristic, and p is the proportion of coin with response "I tried drug", (1-p) is the proportion of coin with response "I have not tried drug". The probability of a "yes" response, λ, is:

$$\lambda = p\pi + (1 - p)(1 - \pi)$$

Solving for π, the Warner estimator is given as:

$$\hat{\pi}_w = \frac{\hat{\lambda} - (1-p)}{2p-1}, p \neq 0.5$$

Here, $\hat{\lambda}$ is the observed proportion of "yes" answers in the sample:

$$\hat{\lambda} = \frac{n_1}{n}$$

Note that the proportions p and $1 - p$ are known, as are the number of "yes" responses $n1$ and the sample size n. Hence, we can calculate the estimated values of π and sample variance.

Sample variance

The sample variance of the Warner estimator is:

$$Var(\hat{\pi}_w) = \frac{\hat{\lambda}(1-\hat{\lambda})}{(n-1)(2p-1)^2}$$

Test of Independence Chi-square

This test shows whether two categorical variables are independent or not:

$$\chi^2 = \Sigma [(O - E)^2 / E]$$

Where:

O: Observed frequency in each cell of the contingency table.

E: Expected frequency in each cell if variables are independent.

RESULTS AND DISCUSSION

Table 1 presents the demographic information of the respondents obtained after analysis. It includes key variables such as age, gender, and educational level, providing an overview of the population sample studied.

Table 1: Demographic Characteristics of the Respondents

Variable	Frequency	Percentage
GENDER		
Male	209	60.7
Female	91	30.3
AGE		
18-24	171	57.0
25-29	98	32.7
Less than 18	26	8.7
30 and above	5	1.7
LEVEL		
100	33	11.0
200	17	5.7
300	24	8.0
400	72	24.0
500	154	51.3

The demographic characteristics of the respondents are presented in Table 1. The data indicates that out of the 300 participants, 91 were females and 209 were males, constituting 30.3% and 69.7%, respectively. Regarding age distribution, 26 respondents were below 18 years old, 171 were between 18 and 24 years old, 98 were between 25 and 29 years old, and 5 were 30 years old and above, representing 8.7%, 57.0%, 32.7%, and 1.7%, respectively. In terms of academic levels, among the 300 undergraduate respondents, 33 were in 100 level, 17 were in 200 level, 24 were in 300 level, 72 were in 400 level, and 154 were in 500 level, accounting for 11%, 5.7%, 8%, 24%, and 51.3%, respectively.

Estimate Adjusted Proportion

RRT1: Have you ever used any illicit drug?

Total respondents = 300
Respondents who answered truthfully (head): 205
Respondents who answered "YES" truthfully: 145
Respondents who answered "NO" truthfully: 60
Respondents who answered "YES" (tail): 95
The proportion for "Yes", P = number of "Yes" responses under truthfully / total number of respondents who answered truthfully

$P = \frac{145}{205}$

P = 0.7073
Probability for "Yes" responses = Number of Yes Responses (tail) / Total number of respondents

$Prob = \frac{95}{300}$

Prob = 0.3166
Adjusted Proportion, $\hat{p}$ = Probability of Yes Response (Head) – Probability of Response (Tail)
$\hat{p}$ = 0.7073– 0.3166
$\hat{p}$ = 0.3907
The results of the randomized response technique analysis reveals that 39% of the undergraduates surveyed have engaged in drug abuse. This significant proportion highlights a pressing issue within the undergraduate population, suggesting that nearly two out of every five students are involved in illicit drug use. Such a high prevalence rate underscores the need for targeted interventions and comprehensive prevention strategies to address and mitigate the factors contributing to drug abuse among undergraduates. The findings call for increased awareness, education, and support services to help reduce the incidence of drug abuse and its associated negative consequences on this vulnerable group.

RRT2: Have you ever tried drugs out of curiosity?

Total respondents = 300
Respondents who answered truthfully (head): 190
Respondents who answered "YES" truthfully: 90
Respondents who answered "NO" truthfully: 100
Respondents who answered "YES" (tail): 110
Proportion for "Yes", P = number of "Yes" responses under truthfully / total number of respondents who answered truthfully

$P = \frac{90}{190}$

P = 0.4737
Probability for "Yes" responses = Number of Yes Responses (tail) / Total number of respondents

$Prob = \frac{110}{300}$

Prob = 0.3667
Adjusted Proportion, $\hat{p}$ = Probability of Yes Response (Head) – Probability of Response (Tail)
$\hat{p}$ = 0.4737 – 0.3667
$\hat{p}$ = 0.107
After conducting a randomized response technique analysis on respondents regarding drug use out of curiosity, the findings reveal that only 10.7% of the undergraduates reported engaging in drug abuse for this reason. This percentage suggests that curiosity, though a factor, is not the predominant driver of drug abuse among the undergraduate population. Understanding the primary motivations behind drug use is crucial for developing effective prevention and intervention strategies tailored to this demographic. Hence, the need for education and information on the adverse effect of drug abuse.

RRT3: Do you believe peer pressure is a factor contributing to drug abuse?

Total respondents = 300
Respondents who answered truthfully (head): 222
Respondents who answered "YES" truthfully: 200
Respondents who answered "NO" truthfully: 22
Respondents who answered "YES" (tail): 78
Proportion for "Yes", P = number of "Yes" responses under truthfully / total number of respondents who answered truthfully

$P = \frac{200}{222}$

P = 0.9009
Probability for "Yes" responses = Number of Yes Responses (tail) / Total number of respondents

$Prob = \frac{78}{300}$

Prob = 0.26
Adjusted Proportion, $\hat{p}$ = Probability of Yes Response (Head) – Probability of Response (Tail)
$\hat{p}$ = 0.9009– 0.26
$\hat{p}$ = 0.6409
The analysis using the randomized response technique reveals that 64% of the respondents believe peer pressure is a significant factor contributing to drug abuse. This high percentage underscores the influential role of social dynamics in the initiation and continuation of drug use among individuals. It suggests that interventions aimed at reducing drug abuse should focus on addressing peer influence, particularly in higher institutions where young people are susceptible to such pressures. Strengthening support systems and promoting awareness about the impacts of peer pressure could be vital strategies in mitigating this issue.

RRT4: Do you believe academic stress is a factor contributing to drug abuse?
Total respondents = 300
Respondents who answered truthfully (head): 170
Respondents who answered "YES" truthfully: 70
Respondents who answered "NO" truthfully: 100
Respondents who answered "YES" (tail): 130
The proportion for "Yes", P = number of "Yes" responses under truthfully / total number of respondents who answered truthfully
P = $\frac{70}{170}$
P = 0.4118
Probability for "Yes" responses = Number of Yes Responses (tail) / Total number of respondents
Prob = $\frac{100}{300}$
Prob = 0.3334
Adjusted Proportion, $\hat{p}$ = Probability of Yes Response (Head) – Probability of Response (Tail)
$\hat{p}$ = 0.4118 – 0.3334
$\hat{p}$ = 0.0784
After employing a randomized response technique to analyze the belief among respondents regarding academic stress as a contributing factor to drug abuse, the results revealed that about 7.8% of the respondents held this view. This percentage suggests that academic stress is not widely perceived as a significant factor in driving drug abuse among the population of study. This finding may point to the presence of other more dominant factors influencing drug abuse, such as peer pressure and curiosity.

Confidence Interval
RRT1: Have you ever used any illicit drug?
Calculating the confidence interval using the Wilson score interval.
$\hat{p}$ = 0.3907, $\hat{q}$ = 1 – 0.3907 =0.2927, n =300, $Z_{\propto/2}$ = 1.96

$$p = \frac{\hat{p} + \frac{z^2_{\alpha/2}}{2n} \pm z_{\alpha/2}\sqrt{\frac{\hat{p}\hat{q}}{n} + \frac{z^2_{\alpha/2}}{4n^2}}}{1 + \frac{z^2_{\alpha/2}}{n}}$$

$$p = \frac{0.3907 + \frac{1.96^2}{2\,x\,300} \pm 1.96\sqrt{\frac{0.7073\,x\,0.2927}{83} + \frac{1.96^2}{4\,x\,300^2}}}{1+\frac{1.96^2}{300}}$$

$0.2846 \leq p \leq 0.4280$
Using the Wilson score interval which provides a more accurate estimation, especially for proportions by correcting for asymmetry and providing better coverage probabilities, the result shows that at 95% confidence level, the true proportion of respondents who have used illicit drugs is between 28.46% and 42.80%.. The midpoint of the interval, which is the adjusted proportion ($\hat{p}$) at 39.07%, indicates that a significant portion of the population sample has engaged in illicit drug use. This finding highlights the prevalence of illicit drug use within the sample and underscores the importance of addressing this issue through targeted interventions and policies.

RRT2: Have you ever tried drugs out of curiosity?
Calculating the confidence interval using the Wilson score interval.
$\hat{p}$ = 0.107, $\hat{q}$ = 1 – 0.107 = 0.893, n =300, $Z_{\propto/2}$ = 1.96

$$p = \frac{0.107 + \frac{1.96^2}{2\,x\,300} \pm 1.96\sqrt{\frac{0.107x\,0.893}{300} + \frac{1.96^2}{4\,x300^2}}}{1+\frac{1.96^2}{300}}$$

$0.0616 \leq p \leq 0.1808$
This interval suggests that we can be reasonably confident at the chosen confidence level of 95% that the true proportion of respondents who have experimented illicit drugs out of curiosity lies between the values 0.0616 and 0.1808. This finding implies that the adjusted proportion ($\hat{p} = 0.107$), shows that 10.7% of the respondents have tried illicit drugs out of curiosity.

RRT3: Do you believe peer pressure is a factor contributing to drug abuse?
Calculating the confidence interval using the Wilson score interval.
$\hat{p}$ = 0.6409, $\hat{q}$ = 1 – 0.6409 = 0.3591, n =83, $Z_{\propto/2}$ = 1.96

$$p = \frac{0.6409 + \frac{1.96^2}{2\,x\,300} \pm 1.96\sqrt{\frac{0.6409\,x\,0.3591}{300} + \frac{1.96^2}{4\,x\,300^2}}}{1+\frac{1.96^2}{300}}$$

$0.5397 \leq p \leq 0.7486$
The confidence interval calculated using the Wilson score method suggests that between approximately 54% and 75% of respondents, 64% ($\hat{p}$ =0.6409) believes that peer pressure contributes to drug abuse which is a reasonable estimate of the population proportion. This range provides a high level of confidence in our estimate, indicating a prevalent perception among the studied population that peer pressure plays a significant role in influencing drug abuse behaviors. Such findings underscore the importance of targeted interventions focusing on social dynamics to address substance abuse effectively. This result is in line with the research by Oshikoya and Alli, 2006.

RRT4: Do you believe academic stress is a factor contributing to drug abuse?
Calculating the confidence interval using the Wilson score interval.
$\hat{p}$ = 0.0784, $\hat{q}$ = 1 – 0.0784 = 0.9216 n =300, $Z_{\propto/2}$ = 1.96

$$p = \frac{0.0784 + \frac{1.96^2}{2\,x\,300} \pm 1.96\sqrt{\frac{0.0784\,x\,0.9216}{300} + \frac{1.96^2}{4\,x\,300^2}}}{1+\frac{1.96^2}{300}}$$

$0.0194 \leq p \leq 0.1409$
This implies that Wilson score method suggests that between approximately 2% and 14% of respondents, 7% ($\hat{p}$ =0.078) believes that academic stress contributes to drug abuse which is a reasonable estimate of the population proportion. This indicates that while a minority acknowledges this connection, it is not widely considered a significant influence on drug abuse within the studied population.

Chi-square test

In this research, Person Chi-Square was used to show the significance of demographic variables and factor such as gender, age and allowance on drug abuse among undergraduates in Nigeria.

Test 1: Gender and Drug Abuse

Test	Value	Df	P-value
Pearson Chi-Square	8.156	1	0.04

This result shows that since the p-value (0.04) is less than the significance level (0.05), we have statistical reason to conclude that there is a significant relationship between drug abuse and gender. This finding suggests that gender influences the likelihood of drug abuse among the studied population. Such statistical significance implies that the association between gender and drug abuse is unlikely to have occurred by chance alone, rather, gender must be taken seriously as a high risk factor amongst Nigerian students. The result from this studied population on the significance of gender on drug abuse is at variance to the work by Chamberlain (2021). However, Rhoades et al., 2014 and Idowu et al., 2023 established gender as a significant factor.

Test 2: Age and Drug Abuse

Test	Value	Df	P-value
Pearson Chi-Square	10.942	3	0.02

This result shows that since the p-value (0.02) is less than the significance level (0.05), we have statistical reason to conclude that there is a significant relationship between drug abuse and age group. This suggests that different age groups show varying levels of susceptibility to drug abuse, highlighting the need for targeted interventions based on age-specific factors. This result is in agreement with Chamberlain et al., 2021 and Idowu et al., 2023, that age has significant effect on drug abuse.

Test 3: Allowance and Drug Abuse

Test	Value	Df	P-value
Pearson Chi-Square	2.995	3	0.392

This result shows that since the p-value (0.392) is greater than the significance level (0.05), we have statistical reason to conclude that there is no significant relationship between drug abuse and allowance. This indicates that receiving allowance or the type of allowance received does not appear to influence the likelihood of drug abuse among respondents.

CONCLUSION

Drug abuse is a serious public health issue that has continue to have detrimental effects on individuals and on the society as a whole. The prevalence of drug abuse among Nigerian undergraduates is a concern and requires accurate estimation for effective interventions. However, due to the sensitive nature of drug abuse, self-report surveys may not provide reliable estimates. The application of randomized response technique (RRT) on a sample of 300 undergraduates from FUTA in this study has provided insights into the prevalence of drug abuse amongst undergraduates in Nigeria. 60.7% of the sampled population were males and 57% were within the age bracket 18 years to 24 years. The study revealed a slightly high percentage (39%) of undergraduates' involvement in drug abuse, the proportion who had tried drugs out of curiosity at least once is 10%, the proportion who believed peer pressure and academic stress are factors contributing to drug abuse are 64% and 7% respectively. It also showed that gender and age have significant relationships with drug abuse. While allowances given to the students do not have a significant relationship with drug abuse. Hence, this research using RRT, revealed the prevalence and patterns of drug abuse among undergraduates, thereby contributing valuable insights to the field of drug abuse prevention and intervention in Nigerian higher education institutions.

RECOMMENDATION

Subsequently, advocacies that aims at empowering undergraduates in universities or higher schools of learning such as rightly dissemination of information on drug abuse should be strongly pursued by the government and other stakeholders to eradicate or reduce this menace called drug abuse.

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