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SYSTEMATIC REVIEW

Which school-based substance abuse intervention is effective for Nigerian schools? A systematic review

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ABSTRACT

BACKGROUND:
Substance abuse is a global public health concern, with secondary school adolescents being particularly vulnerable. School-based substance use interventions are cost-effective for long-term management, but none have been universally effective across populations.

OBJECTIVE:
This review aims to identify effective school-based interventions for the Nigerian population.

METHODS:
The review is reported according to Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) and Synthesis Without Meta-analysis (SWiM) guidelines. We searched ten (10) databases to retrieve relevant studies. We retained studies that were interventions to prevent or reduce substance abuse among secondary school students in Nigeria. Two reviewers independently screened the studies for eligibility, extracted data, and performed quality appraisal of the included studies.

RESULTS:
From 3,907 records screened, two studies with 3,385 participants met the inclusion criteria. Participants were secondary school students within the age range of 10 - 19 years. One study had a low risk of bias and used a bespoke intervention, the 'Unplugged' school-based substance use intervention program. It decreased the frequency of alcohol drinking regularly (every other day) by 34.0% (P=0.051) and the prevalence of drinking within the past month by 28.0% (P=0.038). There was a 38.0% (P=0.094) decline in the prevalence of daily alcohol usage. The second study had a high risk of bias used a peer-led smoking intervention. The results showed that the average knowledge about the harmful effects of smoking increased by 31.2% (P=0.000), 5.9% (P=0.143) increase in the proportion of respondents that felt public smoking should be banned and reduced the prevalence of last-month cigarette smoking by 0.6% (P=1.000).

CONCLUSION:
The review found limited evidence for effective school-based substance abuse interventions in Nigeria. Two studies were included, with varying results. More research is needed to determine the best strategies for preventing substance use among Nigerian secondary school students.

KEYWORDS:
Substance abuse, students, Nasarawa State, Nigeria, systematic review

INTRODUCTION

Over the past few decades, substance abuse and addiction have emerged as global threats to public health. [1] Worse, their damaging impact extends to the succeeding generation.[2] Many schoolchildren, typically teenagers, have a high risk of abusing substances and alcohol.[3] Adolescents face the unavoidable task of self-discovery, which involves exploration and experimentation that may constitute risky behaviors. Adolescence is a critical time for the onset of risky behaviors, such as substance abuse, and the ensuing negative effects of substance abuse. Substance abuse and its negative effects contribute significantly to global morbidity, mortality, and economic expenses each year. In a 20219 global estimate, 39.60 million people suffered alcohol and drug use disorders with 500, 000 deaths. [4] While the direct and indirect cost of substance was estimated at 1-2% of the global Gross Domestic Product (GDP).[5] Adult substance abusers and users picked up the habit in school, typically when they were teenagers.[6,7] Substance use and abuse negatively affect mental and physical health as well as long-term social consequences.[8,9] School-based studies and interventions to prevent or reduce substance use and abuse may be cost-effective preventive methods.

School-based substance use interventions have the potential to prevent or reduce adolescent substance use.[10,11]. Drug Abuse Resistance Education (DARE) is the most popular of such interventions in United States of America but it has the least evidence of success.[12,13] DARE aims to educate school children about the dangers of substance use and abuse. Other approaches to school-based substance use and abuse interventions are 'Life Skill Training'.[14,15] Project Toward No Drug Abuse, Positive Action,[16] and EU-dap *Unplugged*.[11] However, the effectiveness of these methods vary.[17] Some studies suggest that school-based substance use prevention programs may be bogus or require additional research to establish their effectiveness.[18,19] However, it appears that there isn't one universally effective school-based substance use intervention.[20] The type of substance of abuse, the individual user, and the context may affect the effectiveness of a particular method or program.

Adolescents and young adults in Nigeria frequently consume drugs, which negatively influences their mental and physical health, academic performance, and interpersonal interactions. According to a survey by the Nigeria's National Bureau of Statistics (NBS), about 14.3 million Nigerians abuse drugs,[21] and the prevalence is projected to increase. Adolescents and young adults constitute a sizeable proportion of Nigerians that use psychoactive substances for non-medical purposes. In Nigeria, the prevalence of substance use among in-school adolescents varies by location and study period. In South-West Nigeria, the prevalence was 26.3% in Ogbomosho and 49.8% in Oshogbo.[22,23] In Kwara State, North-Central Nigeria, 33.7% of secondary school students reported using psychoactive substances[24], while a scoping review indicated a 20.0-40.0% prevalence of substance use among Nigerian students.[25]

Secondary school students face unique challenges in substance abuse due to the developmental stage, peer pressure, academic stress, and emotional difficulties, requiring tailored interventions. Although, evidence-based interventions for this demographic are limited, school settings offer diverse populations and structured environments for effective interventions. Numerous systematic reviews have summarized the evidence of the effectiveness of classroom substance use prevention interventions. [26–28] There were, however, no previous systematic reviews assessing the effectiveness of the interventions among school children in Nigeria. Contextual findings from a systematic review focused on Nigeria can help inform policies, programs, and interventions aimed at preventing or reducing substance abuse among school children in the region. This can ultimately improve the health and well-being of school children in the country, reducing the burden of substance abuse on individuals, families, and communities.

This review aims to identify appropriate and effective substance abuse interventions in Nigerian schools to prevent or reduce the menace of substance abuse among students in Nigerian secondary schools.

METHODS

Ethics statement

The review is a synthesis of evidence from publicly available primary studies and there was no contact with participants, therefore, ethical approval was not required.

Protocol and registration

When performing this systematic review, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement[29] and Synthesis Without Meta-analysis (SWiM) guideline[30]. The protocol for the study was registered in the Prospective Register of Systematic Reviews (Prospero) with ID CRD42022356663.

Search strategy and selection criteria

We searched 10 online databases of medical literature. They include Embase, Pubmed, Cumulative Index to Nursing and Allied Health (CINAHL), Scopus, Cochrane Library (Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Methodology Register), WHO Global Health Library, IndMed, PakMediNet, KoreaMed, NHS Health Technology Assessment Database, African Index Medicus (encompassed in the WHO Global Health Library), POPLINE, and International Scientific Indexing (ISI) Web of Science. The searches were carried out between December 16 and 19, 2022.

Supplementary text S1 shows the search strategies used in searching each of the databases. Our search covered studies published in respective databases from October 1960 (or inception of the database if inception was later than 1960) to November 2022. We did not apply any language restriction. No expert in the field was consulted in Nigeria, as there were no identified experts with extensive research work in the field.

Studies were included if study participants were Nigerian secondary school students of any age, gender, ethnicity, or social background, where the study context is that the participants are part of a defined student body in secondary school. Studies with any number of participants were eligible for inclusion. Only intervention studies were included, including randomized controlled trials, cluster randomized controlled trials, controlled clinical trials, controlled before-and-after studies, and interrupted time series. The intervention was defined as any school-based substance abuse (primary or secondary prevention) intervention. The included studies must have been conducted in any state, region, or territory of the Nigerian geopolitical entity. The primary outcomes were stipulated *a priori* as prevention, reduction, or delay in initiating substance abuse among high school students.

Study selection

After the search in respective database, all articles were combined and exported to Endnote Reference Manager, where duplicate papers were removed. After removing duplicates, the articles were exported to Rayyan for title/abstract screening [31,32]. Two reviewers separately screened the papers (DKE & OO). Both reviewers reached an agreement on the final list of studies. There was no conflict requiring arbitration by the third reviewer.

Data Extraction and Risk of Bias

We developed a customized Microsoft Excel data extraction form. The form was piloted by DKE; necessary adjustments were made to capture all relevant information to answer the review question. The information also included general information about the included articles. Two reviewers used the finalized form to extract data (Supplementary text S2). Discrepancies in the extraction were resolved by discussion between DKE and VNO until consensus was achieved.

Quality appraisal

The risk of bias (RoB) or quality appraisal of the eligible studies was assessed with the Effective Practice and Organization of Care (EPOC) (Cochrane Effective Practice and Organization of Care [33,34] (Table S4). The EPOC tool is appropriate for intervention studies (Cochrane Effective Practice and Organization of Care.[33] The tool appraises six areas for each study: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias.[35,36] The quality assessments were performed for one or more items, which could include a variety of domain-related subjects or outcomes within each domain. Each domain is graded as 'high risk', 'low risk' or 'unclear risk'. Two reviewers (DKE and OO) independently assessed the quality of each study, and disagreement was

resolved by consensus or arbitrated by a third author (BN).

Grouping studies for synthesis

To enhance synthesis of the collected evidence, we planned to group the studies according to the types of school-based substance use/abuse interventions (DARE, 'Life Skill Training, Project Toward No Drug Abuse, Positive Action, and EU-dap *Unplugged*). Within this group, we also categorized the studies by outcomes. These groups were not feasible due to the differences in the study design, intervention method, and outcomes in the included studies; therefore, the evidence was synthesized according the SWiM guideline.

Data synthesis and statistical analysis

We used descriptive tables and textual narration to summarize key characteristics of the included studies. Meta-analysis was not possible, given the heterogeneity between the two included studies, both in study design, intervention, and outcome approaches. Thus, we performed a narrative-only synthesis using the SWiM guideline to summarize the key finding of the findings for each study separately, since it was not possible to compare and contrast the two studies. Table 3 shows the synthesis of evidence based on SWiM guideline. In this process, the strengths and weaknesses of each study were highlighted, as were a description and discussion of their key findings.

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RESULTS

Search results

The search in databases yielded 3,907 records. After removing duplicates, we screened 3,714 records by titles and/or abstracts. A total of 10 papers were left for full-text screening after 3704 papers were eliminated. After full-text screening, eight papers were further excluded; the reasons for exclusion were duplication (2), ineligible study population (4), and ineligible study design (2). Finally, two studies met the inclusion criteria for the review. Figure 1 depicts the PRISMA flowchart showing the literature screening process.

General characteristics of the studies

Study participants

Table S3 presents the general characteristics of the included studies in this review. A total of 3,385 Nigerian secondary school students participated in the two studies that met the inclusion criteria. The study by Raji et al. 2014 included 228 participants aged 10–19 (114 in each of the control and intervention groups) from 20 secondary schools in Sokoto State, Nigeria. Vigna-Taglianti and colleagues had 3,157 participants (1418 in the intervention group and 1739 in the control group) within the age range of 10–15 years from 32 federal secondary schools across the country, including the Federal Capital Territory (FCT), Abuja, in 2021. We did not identify any ongoing studies.

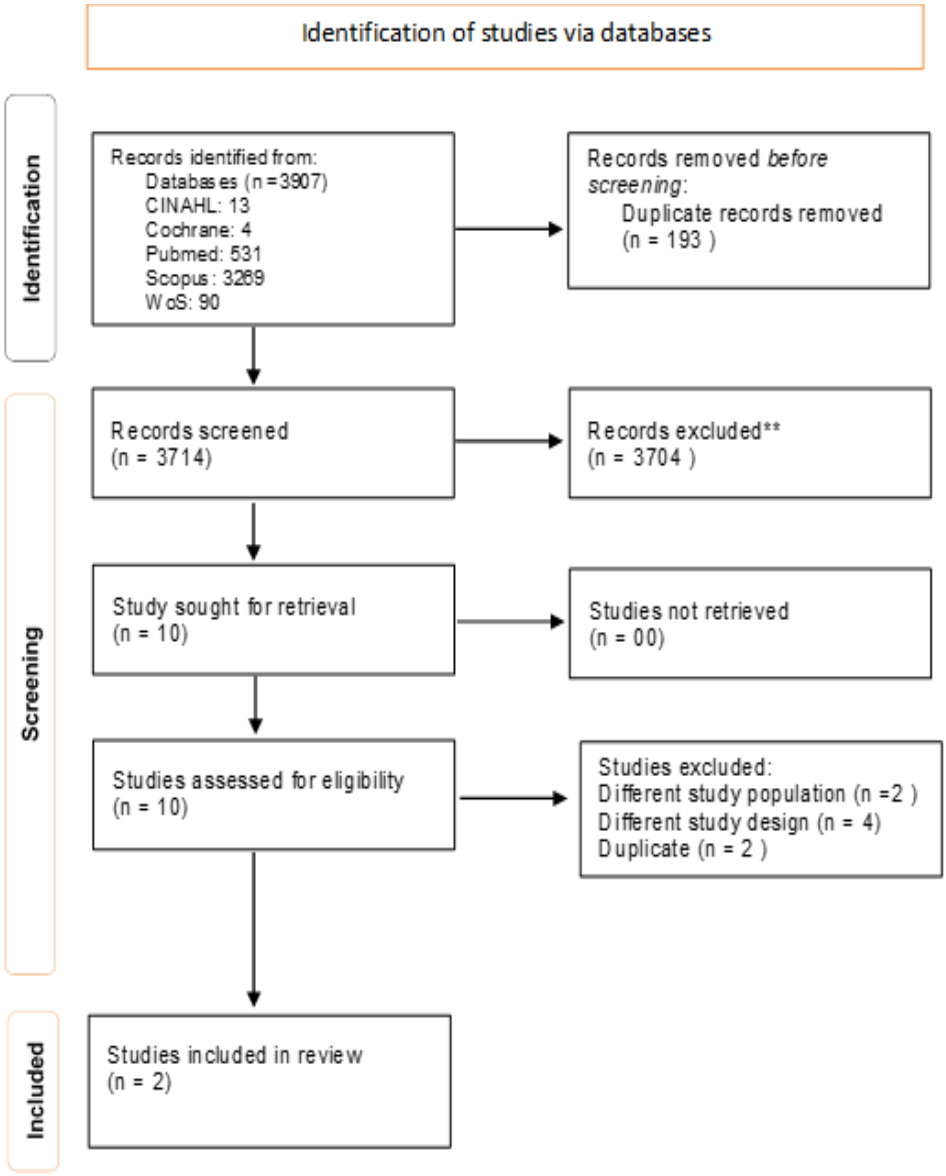

Figure 1. PRISMA flow diagram for systematic review

Study design

Raji and colleagues used a quasi-randomized controlled trial in their investigation. Because group assignment was not random, generalizing the findings to another population may be problematic. Vigna-Taglianti and colleagues performed a cluster-randomized controlled trial. The randomization was done at the zonal level, and the school was the unit of randomization.

Study context, intervention and its duration

The study by Raji and colleagues was a peer-led intervention focused on cigarette smoking. The study used the Global Youth Tobacco Survey (GYTS) [37] as the data collection tool. Data were collected at baseline and 3 months' post-intervention. The intervention group received a peer-led health education intervention that consisted of six sessions covering topics such as the harmful effects of smoking, reasons for smoking initiation, and strategies for quitting smoking. The peer trainers were previously trained. The control group

received no intervention. In the study by Vigna-Taglianti and colleagues, the intervention was 12 units delivered by the teachers. It adopted universal school-based substance use intervention. The study used a culturally adapted 'Unplugged' program of European Union Drug Prevention (EU-Dap) for data collection.[38,39] The intervention was delivered over a 5-month period. Data were collected at baseline and 5 months after the intervention. The control group received no intervention.

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Participation rate

The participation rate in the study by Raji was 95.6% for the intervention group and 98.2% for the control group, 58% in the intervention group and 81.0% in the control group, respectively, in Vigna-Tanglianti and colleagues' study. The attrition rate in Vigna-Taglianti's study was significant but somewhat balanced in both the control and intervention groups.

Instrument and method of data collection

In their study, Raji and colleagues collected data using a standardized tool, the Global Youth Tobacco Survey (GYTS). The data was collected before and three months after the intervention. The instrument was self-administered. Similarly, Vigna-Tanglianti and colleagues modified the EU-DAP data collection tool to account for the cultural peculiarities of Nigeria. The data was collected at baseline and 5 months after the intervention.

Outcomes studied

In Raji and colleagues' intervention, the outcomes studied were cigarette smoking-related knowledge, attitudes, and behaviors among in-school adolescents in Sokoto State, North-West Nigeria. The study assessed the impact of a peer-led health education program on these outcomes through a survey conducted before and three months after the intervention.

In the intervention by Vigna-Taglianti and colleagues, the outcomes of interest were the prevalence of substance use among school students. It also investigated substance use-related knowledge, attitudes, and behaviors among in-school adolescents in federal secondary schools across Nigeria. Overall, the study assessed the impact of the unplugged program on these outcomes through a survey conducted before and five months after the intervention.

Results of Risk of Bias

The summary of the risk of bias is shown in Supplementary text S4. The quality appraisal was reported using the EPOC tool:

Risk of bias in the study by Raji and colleagues. There was no random assignment of participants into intervention and control groups. The study design was quasi-experimental. It reported a low attrition rate. There was no report on the blinding of participants, peers, or other study personnel. The treatment and control groups were selected from a pool of schools; therefore, the groups were similar in most respects. Aside from the intervention, there was no report on whether or not the groups were treated differently. The outcomes were treated uniformly in the treatment and control groups. The study reported that follow-up was completed at 3-month post-intervention, and data were analyzed according to the group to which they were allocated. The sample size was small, less diverse, and geographically localized. Overall, the risk of bias in this study is assessed to be high.

Risk of bias assessment for Vigna-Taglianti and colleagues. According to the study report, clusters were assigned using a computer-generated list by an independent researcher not involved in the investigation. The study participants came from all over the country. The intervention and control groups were separated geographically, and the two had no interaction. The attrition rate was moderate and balanced in the intervention and control groups; the authors used multiple imputations to address missing data. The study reported that the intervention and control groups were similar at baseline, and the statistical analysis adjusted for potential confounders such as religion and cultural background. However, the study did not report blinding of outcome assessors, however, the researchers used cluster randomization which is appropriate for public health interventions that involve visible behavioral change. The study was funded by the developer of the intervention. However, the study reports that the funder had no role in the study's design, data collection, analysis, or interpretation, so this criterion was met. The RoB based on the EPOC tool is low.

Main findings

Only two studies by Raji and others and Vigna-Taglianti and colleagues fulfilled the inclusion criteria. The study by Raji and colleagues [40] was quasi-experimental, and the other by Vigna-Taglianti and colleagues was a cluster randomized controlled trial. The studies enrolled 3,385 participants. The study by Raji and colleagues studied the effect of peer-led health education intervention on cigarette smoking among in-school adolescents in Sokoto State, Nigeria. While the other by Vigna-Taglianti and colleagues studied the effect of the 'unplugged' school-based substance use on Nigerian students. Raji's study found that the intervention group reported a significant increase in respondents who knew that cigarette smoking and second-hand smoke were associated with lung disease and fetal malformation. The mean knowledge score of respondents in the study increased from 61.2% before the intervention to 92.3% after the intervention, and more than two-thirds of respondents did not feel that cigarettes should be sold to minors. At pre-intervention, 64.0% of respondents reported that they would leave a place where a cigarette is being smoked, and 7.9% of respondents had smoked in the month preceding the data collection.

In the study by Vigna-Taglianti and colleagues, the results of an adjusted multilevel regression model showed that the program consistently lowers the prevalence of self-reported marijuana use, alcohol use, and cigarette smoking in student in intervention group compared to those in the control group. However, a statistically significant effect was only observed for alcohol use indicators. The program reduced the prevalence of recent drinking by 28.0% (P=0.038) and the frequency of regular drinking by 34.0% (P=0.051). The 38.0% decline in the prevalence of daily alcohol use did not suggest significant improvement (P=0.094). Other results did not support the program's influence on cigarette, marijuana, and other substance use. The full record of data extraction and risk of bias assessment tool is found in Appendix 2.

DISCUSSION

Summary of main findings

This review included two studies, both comparing school-based substance use intervention methods to no treatment. From 3,907 records screened, only two studies with 3,385 participants met the pre-specified inclusion criteria. Participants in both studies were between the ages of 10-19 and-in secondary schools. One study using the 'Unplugged' school-based substance use intervention program decreased the frequency of alcohol drinking regularly by 34.0% (P=0.051) and the prevalence of drinking within the past month by 28.0% (P=0.038). Only a small difference (P=0.094) could be attributed to the 38.0% decline in the prevalence of daily alcohol usage. While the other study using peer-led smoking intervention showed that the mean knowledge about the harmful effects of smoking increased by 31.2% (P=0.000), 5.9% (P=0.143) increase in the proportion of respondents who felt public smoking should be banned, and a reduced prevalence of last-month cigarette smoking by 0.6% (P=1.000). Importantly, the two studies recognized the significance of peers in the fight against substance use among in-school adolescents. In particular, they promote knowledge about the dangers associated with substance abuse, improve attitudes, and modify the behaviors of students toward substance abuse. Both

studies conclude that intervention improved the classroom climate required for resilience, which is protective against substance use.

Strengths and weaknesses

The primary studies included in this review adapted standardized data collection tools, [37–39] to ensure consistency and comparability in data collection among different study populations. They assessed the impact of interventions on multiple outcomes, including substance use, knowledge, attitude, and behaviors of students about substance use. The necessity of including peers in the intervention process was also recognized in both studies, whether through peer-led instruction by Raji and colleagues or the support of norms among peers using emotional and social learning as in the study by Vigna-Tanglianti and colleagues. Despite these similarities, the studies expectedly had some weaknesses that have implications for interpreting the findings. Despite employing a thorough search strategy and conducting the actual search, we were only able to locate two pertinent studies. It is possible that some studies conducted among Nigerian secondary school students may not have been indexed in the databases searched. [41] The small number of studies and variation in reporting standards (reported estimates) in each study hampered the conduct of meta-analysis to estimate the pooled effects which precluded the estimation of small study effects that may have indicated publication bias. The short follow-up period in both studies was insufficient to assess the interventions' long-term impacts. The data collection was self-reported and may suffer from social desirability bias even though anonymity was applied. [42] In the Raji and colleagues' study, the sample size was small, there was no randomization of participants, and both studies had contextual factors, which makes the generalizability of the findings of this review somewhat problematic. Overall, the evidence for the effectiveness of school-based substance use intervention in Nigeria is weak.

Comparing the findings with previous studies

The main finding of this review was consistent with the conclusions of a review of systematic reviews, where 46 systematic reviews found that school-based intervention was effective in reducing and preventing cigarette smoking and alcohol use and abuse among students.[43] In a systematic review of randomized controlled trials (RCTS) by Agabio and colleagues, that included 53 included studies, 23 RCTs (43.4%) showed some evidence of the effectiveness of school-based substance use intervention, and 30 RCTs (56.6%) did not find a significant difference between the groups. [44] Furthermore, the finding of this review contradicts "#Tamojunto' program, the Brazilian adaptation of European school-based Unplugged program which found a protective effect for inhalant use (aHR = 0.79, 95% CI 0.66; 0.95) and a negative effect for alcohol use (aHR = 1.13, 95% CI 1.0; 127), wherein the prevalence of past-year alcohol use increased from 30.1% to 49.8% after 21 months in the intervention group, while the control group had a decrease from 29.9% to 45.8% within the same period.[45]

Interpretation of results

This review is the first to examine the effectiveness of school-based substance use interventions in Nigeria. It is an addition to the body of evidence for the effect of school-based substance use intervention. There was significant variability in sample size, study design, analysis strategy, and geographical distribution of participants. As a result, the precision of the summary of the findings differed significantly across the two studies. The present systematic review presents low to moderate evidence for the effectiveness of school-based substance abuse interventions. The RoB of the quality of the evidence was low in one study and high in the other. Although the findings of this review show low to moderate effectiveness and a low to high RoB for school-based substance use intervention programs, they are a viable option for the overall control and prevention of substance use among in-school adolescents. However, while school-based interventions for substance use may be effective, they cannot be sustained over time or alone. A variety of risk and protective variables contribute to the initiation, maintenance, and progression of alcohol, tobacco, and illicit drug use among high school students. The risk factors can be identified, or interventions may be performed at the individual, family, school, and community levels as appropriate. [46]This review must be interpreted in light of the mentioned weaknesses. It can be inferred from the number of studies that few school-based intervention studies have been conducted in

Nigeria. In this review, the evidence for the effectiveness of one intervention method or another is weak.

It is recognized that interventions for preventing and controlling substance use are more effective in the early developmental stages of young people. Adolescent substance use prevention intervention is especially important since, according to a scoping review, adolescents with substance use disorders lack access to prompt and appropriate treatment compared to adults. [47] The substance use phenomenon is complex, and interventions to curtail the menace need to be multi-pronged. Individualized interventions spanning numerous sessions appear to be particularly effective but less cost-effective or not always possible. The evidence for the effectiveness of family-based interventions was moderate. A study found low to moderate evidence for the effectiveness of individual-, family-, and school-based interventions for substance use in adolescents. [48] Only modest evidence exists for the effectiveness of brief and targeted substance use interventions in general medical practice. [49] The problem of substance use in students is complex; it involves economic, social, psychological, and biological components. The interventions for prevention could be no less complex. Therefore, interventions at the individual, family, and societal levels that are ongoing and contemporaneous may have longer-lasting effects. However, the role of school-based intervention in preventing or reducing substance while promising but the evidence of its effectiveness is inconclusive in the Nigerian context.

Implications of the findings

In this review, we identified only two trials, that assessed school-based substance use interventions at 3 and 5 months in Nigeria. The evidence from these studies shows uncertainty in the effectiveness of school-based substance use intervention, especially in the long term. Opportunities for addressing implementation challenges include identifying effective stigma reduction interventions, increasing provider capacity to provide substance misuse services to in-school adolescents, integrating substance misuse services into existing systems, and generating high-quality data that can be used to advocate for greater prioritization of substance misuse services in policy making and resource allocation. Individuals and healthcare professionals should be aware of the absence of substantial data in this area while deciding on a potential school-based substance use intervention method.

The results of this review have three public health implications. First, the transferability of the findings of a systematic review in public health intervention (SR-PHI) is not straight-forward. The challenge is that the settings and populations differ substantially in their health, health beliefs, behaviors, and other contextual factors. [50] Hence, applying a particular intervention can yield very different outcomes, especially in magnitude. Second, the primary studies for PHIs are less standardized: Contrary to the replication of prior findings in evidence-based medicine, the particular intervention specifications used in public health research vary frequently, and there are often no established thresholds for primary endpoints or minimally significant differences. Third, primary studies used for SR-PHIs often lack important characteristics that ensure a low risk of bias. For instance, the core component of PHI, behavioral therapy, cannot be blinded, and contamination is frequently unavoidable.
This study was undertaken as part of a body of research that assesses various strategies for preventing or decreasing in-school-specific or generic substance use. The implications for research related to evidence from across the prevention and decrease continuum:
There are few trials in Nigeria on school-based substance use intervention where active interventions are compared to no treatment or a placebo. Substance use is complex and subjective, with no 'gold standard' treatment. [51] Therefore, further research is needed to assess efficient methods for delivering school-based substance use preventive services, integrate them into classroom curriculum, and measure the long-term effects of service delivery.

Trialists should ensure that participants, study personnel, and outcome assessors are suitably blinded to the intervention wherever possible to decrease the possibility of performance and detection bias affecting study outcomes. Future research should also endeavor to follow participants for extended periods in order to determine whether interventions have long-term impacts.

Policymakers often rely on summary evidence synthesized from diverse studies for informed decision-making. Policymakers would have to exercise severe caution in relying solely on the findings of this review for decision- and policymaking as the quality of the review and evidence for the effectiveness of school-based substance use intervention is weak. Policymakers should be involved in systematic reviews to ensure relevance. [52] However, school administrators, stakeholders and policymakers could be assembled to formulate and implement policies that make access to and use of psychoactive substances unattractive to students within and about the school environment.

A systematic review summarizes the evidence from different studies that could inform decision-making and policymaking. The ultimate beneficiary of a systematic review is society. The findings of this review can help in policy decisions aimed at reducing smoking and substance use among in-school adolescents, which have important societal implications in terms of improving health outcomes, reducing healthcare costs, preventing or reducing drug-induced or drug-related crimes, and promoting the social and economic development of the country.

CONCLUSION

Very few intervention studies were identified on school-based substance use in Nigeria. The findings of this review suggest that school-based interventions may effectively prevent or reduce substance use among students. However, the review lacks sufficient power to state categorically which school-based substance use interventions were effective. Contextual factors should be considered in interpreting this review's conclusions.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to the current work.

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The research presented in this manuscript received no external funding.

AUTHORS' CONTRIBUTIONS

Dennis Kudu Egga led the execution of the study, developed the protocol, conducted screening of articles and data extraction, quality appraisal, and wrote the first draft of the manuscript. Omobola Oduyoye fine-tuned and proof-read the protocol, served as the second reviewer, conducted screening of articles, data extraction, and quality appraisal. Victoria Nwakanma Onwochei fine-tuned the protocol, conducted data screening as the second reviewer, data extraction, and quality appraisal. Bright I Nwaru conceived the idea of the study, supervised the development and execution of the study, and arbitrated in data screening, data extraction, and quality assessment. All authors read and approved the submitted the manuscript.

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SUPPLEMENTARY MATERIAL

S1: Search strategies in the databases

1. **PUBMED**

Concept 1: Intervention

"EU-dap" OR Unplugged OR "school-based education" OR “Project SUCCESS” OR “Project ALERT” OR “school education” OR "Life Skills Training" OR “Project TND” OR “resistance education" OR "D.A.R.E" OR "Project ALERT" OR "Freedom from Smoking" OR "skill-building program" OR "L.I.F.T" OR "Smoking Prevention Program*" OR "Project TNT" OR "Not-on-Tobacco Program*" OR "Smoking Prevention Interactive experience" OR “Primary Prevention"[Mesh] OR prevention OR "Randomized Controlled Trial" [Publication Type] OR Randomized controlled trial

Concept 2: outcome

"Substance-Related Disorders"[Mesh] OR “substance-related disorders” OR “Substance Use Disorder” OR “substance abuse” OR “substance use” OR "Substance Abuse, Intravenous"[Mesh] OR “substance misuse” OR "Substance Abuse, Oral"[Mesh] OR “drug abuse” OR “Substance Use” OR "Alcoholism"[Mesh] OR alcoholism OR "Alcohol Drinking"[Mesh] OR “alcohol drinking” OR “alcohol use” OR “solvent” OR dipsomania OR “tobacco use” OR “opium abuse” OR “narcotic abuse” OR “drug habit” OR “drug dependence” OR "Opioid-Related Disorders"[Mesh] OR “opioid abuse” OR “opioid addiction” OR "Cocaine-Related Disorders"[Mesh] OR “cocaine abuse” OR "Amphetamine-Related Disorders"[Mesh] OR “Amphetamine abuse” OR "Morphine Dependence"[Mesh] OR “Morphine abuse” OR “Morphine use” OR "Heroin Dependence"[Mesh] OR “Heroin dependence” OR “Heroin abuse” OR "Substance Abuse, Intravenous"[Mesh] OR “intravenous substance abuse” OR “intravenous substance use” OR “intravenous drug abuse” OR “intravenous drug use”

Concept 3: location

"Nigeria" OR “Federal Republic of Nigeria” or Nigeri* OR “Abia state” OR Umuahia OR Aba OR “Adamawa state” OR Yola OR “Akwa Ibom state” OR Uyo Or “Anambra State” OR Awka OR Onitsha OR “Bauchi State” OR Bauchi OR “Bayelsa State” OR Yenagoa OR “Benue State” OR Markudi OR “Borno State” OR Maiduguri OR “Cross River State” OR Calabar OR “Delta State” Or Asaba OR Warri OR “Edo State” OR “Benin City” OR “Ekiti State” OR “Ado Ekiti” OR “Enugu State” OR “Gombe State” Gombe OR “Imo State” OR Owerri OR Kano OR “Katsina State” OR Katsina OR “Kwara State” OR Ilorin OR “Lagos State” OR Ikoyi OR Badagry OR Eko OR “Nasarawa State” OR Lafia OR Keffi OR “Niger State” OR Minna OR “Ogun State” OR Abeokuta OR “Ondo State” OR Akure OR “Osun State” OR Oshogbo OR Ile-Ife OR “Oyo State” OR Ibadan OR “Jos North” OR “Jos South” OR “Port Harcourt” OR “Sokoto State” OR “Taraba State” OR Jalingo OR “Yobe State” OR Damaturu OR “Zamfara State” OR Gusau OR Abuja OR “North Central Nigeria” OR “North East Nigeria” OR “North West Nigeria” OR “South-South Nigeria” OR “South East Nigeria” OR “South West Nigeria” OR “Northern Nigeria” OR “Southern Nigeria”

2. **AIM = AFRICAN INDEX MEDICUS**

#1 Concept

tw:(tw:(substance use) AND (mj:("Substance-Related Disorders" OR "Alcohol Drinking" OR "Schools" OR "Illicit Drugs" OR "Smoking" OR "Substance Abuse Detection" OR "Tobacco Use Disorder" OR "Cannabis" OR "Marijuana Smoking")))

hits = 64

#2 Concept

tw:(intervention OR prevention OR “clinical trials” OR “randomize controlled trial” OR unplugged)

hits: 2,532

#3 Concept
tw:(schools OR "secondary school" OR "high school" OR "middle school")
hits: 513
#4 concept
tw:(nigeria)
hits= 2,581
Combined hits = #1 + #2 + #3 + #4 = zero

3. PAKMEDINET

Concept #1:
substance use | "substance-related disorder" | "drug abuse" | alcoholism | "alcohol-related disorders" | tobacco Or Smoking | cannabis | Marijuana
finds =256
Concept #2:
intervention | prevention | "Clinical trials" | "randomized controlled trial" | unplugged
total = 1949
Concept #3:
schools | "secondary school" | "high school" | "middle school"
total 694
Concept #4:
Nigeria
Total find= 179
Findings: Advanced search can only combine 3 concepts. This means I did get the combined result using the boolean operator AND

4. KOREAMED

Concept #1
substance["substance use"[ALL] OR "Substance-Related Disorders"[ALL] OR "Alcohol Drinking"[ALL] OR "Illicit Drugs"[ALL] OR "Smoking"[ALL] OR "Tobacco Use Disorder"[ALL] OR "Cannabis"[ALL] OR "Marijuana Smoking"[ALL] OR “narcotic[ALL] AND use”[ALL] OR “codeine[ALL] AND use”[ALL] OR “Opium[ALL]
hits= 5,527
Concept #2
intervention[ALL] OR prevention[ALL] OR "Clinical trials"[ALL] OR "randomized controlled trial"[ALL] OR unplugged[ALL]
hits: 22,779
Concept #3
schools[ALL] OR "secondary school"[ALL] OR "high school"[ALL] OR "middle school"[ALL]
hits= 3,595
Concept #4
Nigeria[ALL]
Hits: 203

Combined= AND #1 AND #2 AND #3 AND #4 = 0

5. **International HTA**

The search builders and MeSH are identical to Pubmed except 3 searches do not give result when combine. When 2 searches are combined adding a third using Boolean operator AND does not produce result.
However, i didn't find NHS HTA database other than the international HTA

6. **POPLINE DATA**

Popline was retired on September 1, 2019.

7. **Cochrane CENTRAL**

"substance use" OR "substance use disorder" OR Cannabis OR marijuana OR tobacco in Title Abstract Keyword AND Intervention OR prevention OR "clinical trial" OR "Randomize Controlled Trial" in Title Abstract Keyword AND school OR "Secondary School" OR "High School" in Title Abstract Keyword AND Nigeria in Title Abstract Keyword

Hints = 4

8. **Scopus: 3269**
9. **Web of Science (WoS): 90**
10. **Cumulative Index to Nursing and Allied Health Literature (CINAHL)**: 13

Table S2: Data extraction

Study ID *[Surname] [Year]*	Vigna-Tanglianti (2021)	Raji (2014)
Title of the study	Effects of "Unplugged" school-based substance use prevention in Nigeria: A cluster randomized controlled trial	Using peer-led health education intervention to improve in-school adolescents' cigarette smoking-relate knowledge attitude and behaviors in North-West Nigeria State
Contact address	Department of Clinical and Biological Sciences, University of Torino, Regione Gonzole 10, 10043, Orbassano, Torino, Italy	Department to Community Health, Usman Danfodio University, Sokoto State, Nigeria
Email	federica.vignataglianti@unito.it	mansurraji@gmail.com

Co-authors	Emina Mehanovic, Marta Alesina, Ljiljana Damjanovic, Akanidomo Ibanga, Juliet Pwajok, Glen Prischard, Peer Van de Kreeft, Hirsheth Kaur Virk, The unplugged Coordination Group	Isa Abubakar, Mansur Oche, Aminu Kaoje, Balarabe Isa
Title of article	Effects of "Unplugged" school-based substance use prevention in Nigeria: A cluster randomized controlled trial	Using peer led health education intervention to improve in-school adolescents' cigarette smoking related knowledge, attitude, and behavior in a North-West Nigeria State
Journal	Drug and alcohol dependence	Health science journal
Date of extraction *[yyyy-mm-dd]*	2/7/2023	2/15/2023
Study design	Cluster Randomized Controlled Trial	Quasi-Experimental
STUDY POPULATION		
Country	Nigeria	Nigeria
Source(s) of study population	Public Federal secondary school students in Nigeria	Federal, state, and private secondary schools in Sokoto state, Nigeria
Inclusion criteria	Students in first grade (13-15 year olds)	Secondary students (10- 19 year olds) in four metropolitan LGAs in (Wamako, Sokoto North, Sokoto South, Dange-Shuni)
	Students in Federal secondary schools	of Sokoto state

Exclusion criteria	Students above first grades, i.e >15.5 years & students in private schools	Secondary students outside the selected 4 Local Government Areas (LGAs) of Sokoto state
Recruitment procedure (including any randomization)	Randomization took place by zone. To obtain representative sample by geographical distribution of the population, the number of schools to be randomized to selected in each zone was decided based on the population of the zone. Six (6) schools in North West, 4 in North East, 4 in North Central, 2 in Abuja, 8 in South West (WITH 2 Lagos), 4 in South East, and 4 in South South were selected to participate. Within a zone a random number was assigned to each school using random function in excel. The list was ordered and the needed number of schools was extracted in each strata. Thirty two (32) schools with 96 classes were selected.	Recruitment was done from 3 strata: Federal, state, and private ran schools.
Number recruited	Total: 3157 Intervention group: 1418 Control group: 1739	Total: 228 Intervention group: 114 Control group: 114
Number included	2,685	221
Participation rate (%)	61.5	96.9

METHODS

Aim of study	To evaluate the effects of the Unplugged prevention program among Nigerian secondary school students	To determine the effect of peer led health on smoking related knowledge, attitude, and behavior among secondary school students in Sokoto state, Nigeria
study hypothesis	Not stated	Not stated
Design	Cluster Randomized Controlled Trial	Quasi-Experimental
Study period/date	December 2015 to June 2016	February to July 2012
TIME TREND ANALYSES		
Duration of follow-up	5 months	3 Months
Drop-out rate / loss to follow-up measures	In the intervention group there was 42% drop and 19% in the control	In study group it was 2.6% and 1.8% in the control
Time trend details	N/A	N/A
Participation rate (%)	Intervention group it was 58% and 81 in the control	In the study group 97.4% and 98.2% in the control participated

PARTICIPANTS

Total no. randomized		
Age	12-15.5 years	10-19 years
sex	Male and female	Male and female
Clusters	Six clusters based on geopolitical zones of the country	NA
INTERVENTION GROUP		
Number randomized to groups	Twelve randomized groups in six clusters	NA
Intervention development approach	Teacher-led health education intervention	Peer-led health education intervention
Theory-base	The unplugged curriculum is a combined social competence and social influence universal school curriculum	Peer-led health education sessions
Intended usage	It aimed to develop and enhance personal and social skills with a special focus on normative education.	To improve students' knowledge, provide positive attitude and behavior with regard to cigarette smoking, highlighting the harmful of use with the aim to prevent or reduce smoking.
Duration of treatment	5 months	2 months
Timing	One hour per session of 12 standardized units	Each session lasted 60 minutes

Delivery	The intervention was delivered by trained teachers. A teacher manual, quiz card sets and students booklets were provided	The intervention was delivered by peers, 18- minute video clips, posters, and interactive discussions.
OUTCOMES		
Outcome name	Prevention of substance use (a drop in prevalence of substance use)	Prevention of cigarette use (a reduction in the prevalence of nicotine use)
Measurement tool	Standardized questionnaire	Standardized questionnaire
Time point measured	At baseline and at 6month	At baseline and 3 months post-intervention
Outcome definition	Prevention/Reduction of substance use among secondary school students	1. Reduction the proportion of students who smoke. 2. Improvement in smoking related knowledge, attitude and behaviors
Is the outcome/tool validated?	Yes	Yes.
Assumed risk estimates		
RESULTS		
Change from baseline	There was 2 8% decrease in last month use; 34% regular use, and 38% daily use of alcohol. However, the change was not significant for tobacco, marijuana, and other drugs use post-intervention.	1. There was a 31.07% (from 61.24 to 92.31%) increase in mean knowledge after intervention 2. There was 0.6% reduction in prevalence of smoking at post intervention

No. missing participant and reasons	Not stated	Not stated
Any other result reported	a). Reduction in adolescents' low negative belief on the consequences of drug use b). Improvement in classroom climate c. peers' alcohol use	Improvement in knowledge of the students regarding harmful effect of smoking and second-hand smoke
Unit of analysis	Schools (clusters)	Individual student at pre & post intervention
Statistical methods used and appropriateness	Descriptive statistics for summarizing baseline characteristics; Chi-square tests (inferential),	Means, paired t-test, McNemar Chi-square test
Reanalysis required	No	No
Note:		
APPLICABILITY		
Have important populations been excluded from the study	No	No

Is the intervention likely to be aimed at disadvantaged groups	No	No
Does the study directly address the review question?	Yes	Yes
OTHER INFORMATION		
Key conclusions of the study authors	The unplugged was effective in Nigeria by reducing the prevalence of recent alcohol use among secondary students by improving beliefs, class climate, and risk perception	Using peer led health education intervention was effective in reducing the prevalence of smoking and improving smoking related knowledge, attitude and behaviors among adolescent students in North-West Nigeria
Reference to other relevance studies	Yes	Yes

Table S3: General characteristics of included studies

Author/date	Title of the study	Study location	Study design	Aims of the study	Number of participants	Intervention method	Who delivered intervention	Age range of participants	Participation rate at the end of study	Outcomes (Data collection instrument)	Follow-up period	Findings

Raji et al/2014	Using Peer Led Health Education Intervention to improve In-School Adolescents' Cigarette Smoking Related Knowledge, Attitude and Behavior in a North West Nigeria State	Sokoto state, North-West Nigeria	Quasi-experimental study	To determine the effect of peer-led educational intervention on: a) knowledge about the harmful effects of cigarette smoking b) Attitude toward cigarette smoking c) Prevalence of cigarette smoking among studuents.	Total: 228 Intervention group: 114 Control group: 114	Modified Global Youth Tobacco Survey	Peers	10-19 years	Intervention group - 95.6% and Control group - 98.2%	Global Youth Tobacco Survey (GYTS).	3 months	· The peer-led health education intervention was effective at improving cigarette smoking-related knowledge, attitude and behavior of the respondents. · It reduced the prevalence of smoking at post-intervention.

Vigna-Taglianti et al /2021	Effects of the "Unplugged" school-based substance use prevention program in Nigeria: a cluster randomized controlled trial	Nigeria, Nationwide	Cluster randomized controlled trial.	To determine the effects of 'unplugged' program on: a) knowledge about substance abuse b) Attitude toward substuance abuse c) perception of risk of substance use d) Prevalence of substance abuse among secondary school students.	Total: 3,157 (Intervention group: 1418 Control group: 1739	Adapted from European Drug addiction prevention trial.	Teachers	10-15.5 years	79.1% in the intervention and 90.0% in the control group.	European Union Drug Addictin Prevernt ion (EU-DAP)	1 month	· Reduction in recent alcohol use.Improved beliefs and risk perceptions among Nigerian students.There is no significant effect on nicotine, marijuana and other substances used among Nigerian students.

Table S4: Effective Practice & Organization of Care (EPOC) TOOL: risk of bias assessment

Domain	Vigna-Tanglianti et al. 2021	Raji et al. 2014
1. **Random sequence generation** *(selection bias)*	Low risk	High risk
2. **Allocation concealment** *(selection bias)*	Low risk	Low risk
3. **Blinding of participants and personnel** *(performance bias)* ... *(if required)*	Low risk	Unclear risk
(if required) 4. **Incomplete outcome data** *(attrition bias)*	Low risk	high risk
5. **Selective outcome reporting?** *(reporting bias)*	Low risk	Low risk
6. Other bias		
Overall risk of bias	Low risk	High risk
Note		

Table S5: Synthesis Without Meta-analysis (SWiM) items(30)

SWiM reporting item	Item description
Method	
	1a1. **Populations**: The study populations were adolescent (10-19 years) Nigerian Secondary school students

1.	Grouping studies and synthesis	**1a2. Intervention**: The two studies included were school-based interventions **1a3. Study design**: The study designs included were experimental (cluster/quasi)- randomized controlled trials **1a4. Outcomes**: The outcomes of studies that met inclusion criteria were prevention, reduction or delay in initiation of substance (specific or generic) use and abuse among students 1b. Groups synthesis were conducted as outlined in the protocol for the study.
2.	Describe the standardized metric and transformation method used	No standardized metric or transformation was done, because the two included studies varied in the reporting outcomes estimates.
3.	Describe the synthesis method	We used descriptive tables and textual narration to summarize key characteristics of the two included studies. Meta-analysis was not possible, given the heterogeneity and the small number of included studies.
4.	Criteria used to prioritize results for summary and synthesis	The criteria for selection of studies include: **Population**: Nigerian students. **Study design**: Experimental; (quasi and cluster) randomized controlled trials. **Outcome:** prevention, deferral, or reduction in substance use among respondents
5.	Investigation of heterogeneity in reported effects	**Clinical heterogeneity** Study designs, intervention method, intervention outcomes, and quality of the studies (risk of bias) were all different. **Statistical heterogeneity** The statistical outcome estimates for each study were different. **Number of studies** The number of included studies were only two. Therefore, heterogeneity cannot be established. Heterogeneity was assessed to be very high
6.	Certainty of evidence	Effective Practice and Organization of Care (EPOC) tool was used to assessed the risk of bias of the studies and the certainty of the evidence. The certainty of the evidence was weak.
7.	Data presentation methods	**Table 1:** Presents the general characteristics of included studies **Table 2**: Presents the EPOC used for RoB assessment. **Appendix 2**: Present data extraction tools used for extracting pertinent information from each of the included studies. **Study design**: the study by Raji et al(37) used quasi-experimental while, that conducted by Viagna-Tanglianti and colleagues (11) utilized cluster randomized controlled trial. **Risk of bias**: EPOC tool was used to as assess the risk of bias of the included studies.
8.	Reporting result	Two studies with 3,385 participants, aged 10–19, met the inclusion criteria from the 3,907 records screened. One study using the 'Unplugged' school-based substance use intervention program decreased the regular alcohol drinking by 34.0% (P=0.051) and the prevalence of drinking within the past month by 28.0% (P=0.038). Only a small amount of statistical significance (P=0.094) could be attached to the 38.0% decline in the prevalence of daily alcohol

	usage. While the other study using peer-led smoking intervention showed that the mean knowledge about harmful effects of smoking increased by 31.2% (*P*=0.000), 5.9% (*P*=0.143) increase in the proportion of respondents that feel public smoking should be banned, and reduced prevalence of last-month cigarette smoking by 0.6% (*P*=1.000). Overall, the first study had a low risk of bias, while the other had a high risk of bias.
9. Limitation of the synthesis	Very few intervention studies were identified on school-based substance use in Nigeria. The findings of this review suggest that school-based interventions may effectively prevent, delay or reduce substance use among students. Very few intervention studies were identified on school-based substance use in Nigeria. The review lacks sufficient power to state categorically which school-based substance use interventions were effective. Contextual factors should be considered in interpreting this review's conclusions