LEVERAGING ARTIFICIAL INTELLIGENCE IN EVALUATING THE EFFECT OF HEALTH EDUCATION INTERVENTIONS ON HEPATITIS B PREVENTION PRACTICES AMONG STUDENTS IN RURAL SOUTH-WESTERN NIGERIA

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Abstract

Prevention of Hepatitis B virus (HBV) infection is most effectively achieved through early childhood vaccination programs. However, when vaccination opportunities are missed, primary prevention strategies become essential before individuals are exposed to the virus. This study examined the impact of an educational intervention on HBV infection prevention practices among secondary school students in Ogun State, Nigeria. A quasi-experimental design was employed to recruit 256 consenting students from four secondary schools, which were randomly assigned to three intervention groups and one control group (C). Data were analyzed using ANOVA, paired-sample t-tests, and Cohen's d effect size (ES). At baseline, there were no significant differences ($p > .05$) in HBV infection prevention practices among the four groups. However, by the 14th-week follow-up, a statistically significant improvement was observed across all intervention groups compared to the control group. Paired-sample t-tests revealed significant changes between baseline and the 14th-week follow-up for all intervention groups, but not for the control group (15.20 ± 2.44 vs. 15.25 ± 2.4; $p = .92$). The most pronounced improvement in HBV prevention practices was observed among participants in the peer-directed intervention group (E2) with an effect size of 3.11, 95% CI [2.66–3.55], $p < .001$. These findings suggest that peer education is an effective strategy for enhancing HBV infection prevention practices among peer network and should be integrated into school-based health promotion programs with the use of AI-enhanced learning tools like chatbots, analytics, and gamification, schools will actively promote Hepatitis B prevention and well-informed students.

Keywords: Hepatitis B, Teacher-instructed, Peer-directed, Control group, Infection prevention

Introduction

Developing effective strategies to address the challenges and concerns related to hepatitis B virus (HBV) infection among adolescents in Nigeria, who represent a high-risk group for transmission remains a significant public health priority. Adolescents account for over 42% of Nigeria's population and play a substantial role in the spread of HBV (Omejeet al., 2017). A major concern is that many adolescents engage in high-risk sexual behaviors and share injection drug-use paraphernalia, both of which facilitate the transmission of HBV and HIV infections (Okonkoet al., 2010). Hepatitis B virus infection

has long been recognized as a major contributor to serious liver diseases, including advanced liver cancer and related complications.

A study on HBV infection among sexually active young individuals in Abeokuta, Ogun State, reported a prevalence rate of 6.1% (Okonkoet al., 2010). Similarly, an adolescent gender-based study conducted in Calabar found prevalence rates of 0.8% among males and 1.8% among females in six secondary schools, while another study in southwestern Nigeria reported a 1.0% prevalence among children attending outpatient clinics at a tertiary health facility (Ikobah, 2016). Although several studies in Nigeria have explored HBV prevalence, only a limited number have examined disease-related interventions focusing on prevention and control. The few intervention-based studies available have largely assessed the impact of peer- or instructor-led educational interventions on adolescents' knowledge and preventive behaviors regarding hepatitis infection. However, limited attention has been given to adolescents' perceptions and health beliefs about HBV, which are essential for understanding the behavioral dynamics underlying risky practices (Famuyiwaet al., 2015).

Schools present an excellent platform for implementing educational interventions on HBV infection. Teachers play a pivotal role not only in fulfilling students' academic needs but also in influencing and shaping their behavioral development across multiple aspects of life (Ayers, 2017). Schools, therefore, provide an ideal setting for delivering factual, clear, and age-appropriate HBV-related information to adolescents, who represent a captive audience. Teachers serve as vital agents in disseminating HBV information and equipping students with the knowledge and skills needed to protect themselves from infection.A peer-led approach also offers distinct advantages, as adolescents are often more receptive to learning from and being influenced by their peers. Trained peer educators can serve as relatable role models who foster trust and confidence, creating a supportive environment for discussing sensitive health topics. Through active peer participation, adolescents can be empowered to take responsibility for their personal development and contribute meaningfully to community health promotion.

Several studies have demonstrated the effectiveness of both peer-led and teacher-instructed interventions in improving adolescents' HBV prevention practices (Mathew et al., 2019). However, comparative analyses of these two educational strategies particularly those structured within behavioral theory frameworks remain limited. Such comparisons are essential for identifying the most cost-effective and contextually appropriate approaches to HBV prevention among in-school adolescents. Furthermore, evidence from such studies can inform policymakers in designing relevant policies for HBV control and prevention within the school setting.

The prevention of HBV transmission and infection can be effectively achieved through primary prevention strategies, including health promotion, vaccination, and the use of protective measures during procedures that may involve exposure to infected blood or body fluids. Accordingly, this study investigates the impact of an educational intervention on HBV prevention practices, comparing the effects of teacher-instructed, peer-directed, and combined approaches among in-school adolescents in rural areas of Ogun State, Nigeria.

Methodology

A pretest posttest quasi-experimental design was adopted, involving the randomization of selected secondary schools in Ogun State into three intervention groups; teacher-instructed, peer-directed and a combined teacher–peer approachalongside one control group. Students who provided assent to participate and obtained parental consent, as well as teachers who gave informed consent, were enrolled in the study. As part of the intervention planning process, participants were asked to nominate their preferred teachers and students to serve as educators for the hepatitis B virus (HBV) infection prevention programme. Based on these nominations, eight teachers were selected for the teacher-led intervention, while four teachers were assigned to the combined teacher–peer intervention group. The selected teachers participated in a three-day training session facilitated by the researchers, which covered topics such as communication skills, liver function, risk factors for HBV exposure, transmission routes, symptoms of HBV infection, and prevention strategies.

Similarly, each group of eight peer educators undergo a five-day training programme based on the same curriculum as the teachers. However, their training was more intensive, as they were new to instructional delivery and required additional capacity-building support to effectively communicate HBV-related health messages to their peers.Pretest and posttest data collection was conducted using a self-administered questionnaire approach, in which participants independently completed the instruments under the supervision of trained research assistants (RAs). The RAs provided clarifications when necessary and ensured that all questionnaire items were properly completed. The selected students assembled in designated classrooms within their respective schools, where they received standardized instructions on how to complete the questionnaires. These instructions also included an overview of the ethical procedures guiding the study.

Data were collected at three distinct time points for all study variables: at baseline (prior to implementation of the intervention program), at six weeks (immediately post-intervention), and at fourteen weeks (follow-up) to assess changes that might have occurred during the follow-up period. The 66-item questionnaire obtained information on participants' demographic characteristics, knowledge of hepatitis B virus (HBV) infectivity, perceptions of HBV infection and its consequences, as well as HBV prevention practices. Perceived threat of infection from HBV exposure was measured using a three-point Likert scale ("agree," "disagree," and "no opinion") across thirty-five statements relating to HBV infection, Knowledge on Hepatitis B virus and its prevention practices was measured dichotomously.To ensure the validity and reliability of the instrument, a pilot test was conducted among twenty adolescents from one secondary school located in the Ogun Southwest Senatorial District. Feedback from the pre-test was used to refine the questionnaire before the main data collection.

Results

Table 1: Baseline Assessment on Hepatitis B virus related knowledge, perception and infection prevention practices in the control and intervention groups.

Variables	Teacher-Led Education	Peer-Led Education	Teacher-Led Education & Peer-led Education	Control	F-Statistic	*P*-value
Knowledge	15.58 ± 5.0	16.75 ± 4.60	16.20 ± 4.70	16.34 ± 3.10	0.760	0.520
Perception	17.78 ± 4.14	16.23 ± 5.35	17.53 ± 3.60	17.05 ± 3.76	1.501	0.210
Preventive practice	17.21 ± 3.07	15.57 ± 1.90	17.90 ± 3.10	15.20 ± 2.44	14.95	0.001

14th week Follow-up Assessment of the Respondents

The results from pairwise comparison at 14th week follow-up on personal-level dispositions of the participants for all groups except Control regarding HBV infection and its prevention showed a significant differences.

Table 2: Comparison of mean scores for Hepatitis B related knowledge, perception and prevention practices baseline and after the intervention

Variabls	Teacher-instructed education* - x ±SD	*p*-value	Peer-directed education* - x ±SD	*p*-value	Teacher-instructed and peer-directed education* - x ±SD	*p*-value	Control* - x ±SD	*p*-value
Time	*Before After*		*Before After*		*Before After*		*Before After*	
Knowlege of Hepatitis B	15.58 ± 5.0 33.90 ± 2.4	0.001	16.75 ± 4.6 33.40 ± 2.1	0.001	16.20 ± 4.7 34.92 ± 1.7	0.001	16.34 ± 3.1 16.40 ± 3.1	0.32
Perception of threat of hepatitis B	17.78 ± 4.14 30.59 ± 2.3	0.001	16.23 ± 5.35 30.31 ± 3.0	0.001	17.53 ± 3.60 31.45 ± 4.5	0.001	17.05 ± 3.76 17.09 ± 3.8	0.32
Prevention practices of hepatitis B	17.21 ± 3.07 23.09 ± 2.4	0.001	15.57 ± 1.90 22.6 ± 3.6	0.001	17.90 ± 3.10 23.82 ± 2.3	0.001	15.20 ± 2.44 15.25 ± 2.4	0.92

Impact of the intervention on the outcome variable at 14th week follow-up

These results clearly indicate that the intervention led by peer educators had the strongest influence on participants' HBV infection prevention practices, while the control group demonstrated the least improvement (Table 4).

Table 3: Intervention effect on participant's Hepatitis B virus infection knowledge, perception, and prevention practices.

Variable	Time	Teacher-led educa-tion (*n* = 64) −x ±SD	Peer-led education (*n* = 64) −x ±SD	Teacher-led and peer-led education (*n* = 64) −x ±SD	Control (*n* = 64) −x ±SD
Knowledge of hepatitis B	Baseline	. . . . .	16.75 ± 4.6	16.20 ± 4.7	16.34 ± 3.1
	Follow up	34.67 ± 1.9	34.10 ± 2.1	35.79 ± 1.3	16.45 ± 2.9
	Paired sample T-test results	*P* = 0.001	*P* = 0.001	*P* = 0.001	*P* = 0.44
	*ES (95%CI)	5.50(-5.71to 4.40)	4.85 (-5.47 to 4.24)	5.65(-6.24 to 5.04)	0.03(-0.55 to -0.48)
Perception of threat of hepa-titis B	Baseline	17.78 ± 4.14	16.23 ± 5.35	17.53 ± 3.60	17.05 ± 3.76
	Follow up	33.40 ± 1.3	32.46 ± 1.9	33.48 ± 1.6	17.09 ± 3.7
	Paired sample T-test results	*P* = 0.001	*P* = 0.001	*P* = 0.001	*P* = 0.32
	*ES (95%CI)	5.11(-5.64to 4.58)	4.06(-4.75 to3.37)	5.75(-6.23 to 5.27)	0.01(-0.66 to -0.64)
Prevention practices of hepatitis B	Baseline	17.21 ± 3.07	15.57 ± 1.90	17.90 ± 3.10	15.20 ± 2.44
	Follow-up	23.18 ± 2.9	23.53 ± 3.12	25.1 ± 2.6	15.25 ± 2.4
	Paired sample T-test results	*P* = 0.001	*P* = 0.001	*P* = 0.001	*P* = 0.92
	*ES(95%CI)	2.02(1.50 to 2.53)	3.11(2.66 to 3.55)	2.54(2.5 to 3.03)	0.021(-0.40 to 0.4

Discussion of Findings

The findings from this study demonstrate that the applied interventions had a significant influence on the moderating variables of knowledge and perception regarding the dynamics of hepatitis B virus (HBV) infection among adolescents. Notable improvements were observed between the pre-intervention and the 14th-week follow-up, indicating enhanced understanding of HBV infection pathways, transmission, and consequences, as reflected in participants' mean knowledge and perception scores.Participants in this study were secondary school students, and the intervention design employed a modified factorial approach involving teacher-instructed, peer-directed, and combined teacher–peer-led models. Among the three intervention groups, the peer-directed approach (E2) showed the most profound impact on HBV infection prevention practices, with an effect size of 3.11 (95% CI: [2.66–3.55]; p< 0.05). This improvement represented a 1.54-fold increase over E1, a 1.22-fold increase over E3, and a 1.55-fold improvement compared with the control group. Interestingly, although one might have expected that combining teacher- and peer-led interventions (E3) would yield additive or synergistic effects, this was not observed in the study outcomes.

The results of this study are consistent with previous research by Amaugo (2014), Borawisket al. (2015), and Rohrbach et al. (2015), who reported that educational interventions significantly enhance participants' knowledge. The positive impact of peer

education in improving adolescents' knowledge has also been demonstrated in studies by Matthew et al. (2019), Yakubu et al. (2016), and Baghianimoghadamet al. (2012). At baseline, more than half of the adolescents in the current study exhibited a fair understanding of HBV. However, post-intervention results revealed significant gains in both the teacher-instructed and peer-directed groups, which were sustained through the 8th-week follow-up period.Knowledge acquisition is not only encouraging but also crucial, as it typically represents the first step toward behavioral change. Previous studies have established that both teacher-instructed and peer-directed interventions are effective in improving adolescents' knowledge of HBV prevention (Matthew et al., 2019). While earlier studies reported that combined interventions yielded the greatest impact, the present findings suggest that peer-led programs alone may be particularly effective within the Nigerian context. This underscores the potential of tailored, school-based educational programs in significantly enhancing HBV-related knowledge among in-school adolescents.

Similarly, both teacher-instructed and peer-directed interventions significantly improved participants' perceptions of HBV infection. This aligns with previous research indicating that such interventions positively shape secondary school students' perceptions of hepatitis B (Matthew et al., 2019). Comparable findings were reported among Iranian students, where teacher- and peer-led education improved perceptions toward HIV/AIDS prevention (Baghianimoghadamet al., 2012). These changes in perception are particularly meaningful when viewed through the lens of the Health Belief Model (Glanz, Rimer, & Viswanath, 2008), which posits that health behaviors are influenced by individuals' perceptions of disease severity, perceived benefits of action, and perceived barriers to change.Notably, the peer-led intervention produced the largest effect size on adolescents' HBV prevention practices compared with both teacher-led and combined approaches. A plausible explanation for this outcome is that adolescents may feel more comfortable, confident, and open when discussing sensitive health behaviors with their peers rather than with teachers. This interpretation aligns with study conducted in Jos, Northern Nigeria, Mary Mathew et al. (2019) which also found peer education to be effective in improving HBV-related preventive practices. Similarly, findings by Baghianimoghadamet al. (2012) and Acemoglu et al. (2011) corroborate the results of this study, emphasizing that peer education exerts a strong influence on adolescents' behavioral outcomes.

Overall, these findings suggest that fostering positive behavioral change among adolescents requires incorporating interactive and participatory learning strategies into the school curriculum. Integrating peer education within school-based health programs can therefore serve as a powerful tool to enhance HBV prevention practices and promote sustainable behavioral change among young people.

Conclusion

The findings from this study provide clear evidence that peer-delivered health education interventions have substantial potential to improve hepatitis B virus (HBV) infection prevention practices and, by extension, other risk-related health behaviors among in-school adolescents. The computed effect sizes strongly demonstrate that peer-led interventions can significantly influence behavioral outcomes. These findings affirm that,

with adequate training and supportive supervision, both teachers and students can serve as effective change agents within the school environment, facilitating the implementation of high-quality, evidence-based health programmes.Most secondary schools in Nigeria possess the necessary human resources to implement and sustain HBV prevention programs. The success of such interventions can be further amplified when teachers and students collaborate in complementary roles. This supports the theoretical premise that multi-component interventions combining instructional and peer-led approaches enhance program effectiveness through synergistic engagement and reinforcement of learning. Importantly, the pronounced impact of the peer-directed intervention observed in this study underscores the critical role of peer education in promoting HBV prevention practices among adolescents. Based on the conclusion drawn, the researchers recommend that:

i. Artificial intelligence (AI) into peer-led HBV prevention initiatives within schools and communities to enhance student engagement and information retention. AI-driven health promotion systems can personalize educational content by analyzing students' demographic profiles, cultural contexts, knowledge levels, and risk factors to tailor prevention messages that resonate more effectively.
ii. AI to support cultural appropriateness by generating context-specific messages in multiple languages, enabling peer educators to communicate HBV information in culturally sensitive and relevant ways. Through continuous learning from peer and student responses, AI algorithms can refine message clarity, motivation, and recall, ensuring ongoing program optimization.
iii. AI-based systems will also help to identify students at higher risk or with lower HBV awareness levels, enabling peer educators to prioritize outreach and provide targeted, personalized support.
iv. AI technologies will generate diverse educational materials such as customized texts, images, videos, or chatbot interactions, allowing peer educators to select the most effective communication medium for each learner.

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