EFFECT OF HEALTH EDUCATION INTERVENTION ON KNOWLEDGE OF WATER-BORNE DISEASE PREVENTION AMONG STUDENTS IN HEALTH TERTIARY INSTITUTIONS IN KATSINA STATE

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Abstract

This study evaluated the impact of a health education intervention on the knowledge of water-borne disease prevention among students in health tertiary institutions in Katsina State, Nigeria. A quasi-experimental research design, specifically the pre-test, post-test non-equivalent control group design, was adopted. The study involved a sample of 206 participants in the experimental group, predominantly young adults aged 18–22 (68.0%) with a female majority (60.2%). Data were collected using the "Water-Borne Disease Knowledge Assessment Scale (WBD-KAS)," which demonstrated high content validity (CVI = 0.92) and reliability (r = 0.81). Descriptive statistics and inferential statistics, including paired t-tests, ANCOVA, and quantile regression, were used for data analysis at a 0.05 level of significance. Results indicated a significant increase in knowledge scores within the experimental group from a pre-test mean of 26.93 to a post-test mean of 34.83 ($t = 33.414$, $p < 0.05$). Furthermore, the intervention group performed significantly better than the control group ($F = 842.579$, $p < 0.001$). While gender and level of study were not significant predictors, age was found to significantly influence knowledge acquisition ($p < 0.001$). The study concluded that structured health education is a vital prerequisite for disease prevention. It was recommended that water-borne disease prevention be integrated as a core component of health curricula and that institutions prioritize interactive, intervention-style teaching methods.

Keywords: Health Education, Knowledge, Katsina State, Tertiary Institutions, Water-borne Diseases.

Introduction

Water-borne diseases represent a formidable global public health crisis, contributing to nearly 1.5 million deaths annually and accounting for approximately 3.6% of the total global burden of disease (Prüss-Üstün et al., 2019; WHO, 2023). The magnitude of this challenge is underscored by the fact that over 1.7 billion people globally utilize drinking water sources contaminated with faeces, creating a persistent transmission route for pathogens such as cholera, typhoid, and dysentery (WHO & UNICEF, 2022). In sub-Saharan Africa, the situation is particularly dire; approximately 319 million people lack access to improved drinking water, and in some West African nations, water-borne infections account for over 52% of all recorded illnesses (WHO Regional Office for Africa, 2021; Alassane et al., 2022).
In the Nigerian context, the burden of water-borne diseases is a primary driver of morbidity and mortality, especially among children under five. Nigeria is currently the second-largest global contributor to under-five mortality from diarrhea, with an estimated 151,700 deaths annually (Federal Ministry of Water Resources, 2021). This crisis is acutely felt in Katsina State, where recent epidemiological data highlight significant vulnerability. For instance, the 2021 cholera outbreak

ravaged 25 out of 34 local government areas in the state, resulting in 1,534 positive cases and a significant death toll (NCDC, 2021). Furthermore, longitudinal studies in Katsina town have isolated high coliform counts and pathogenic organisms such as *Salmonella* and *Pseudomonas* from local water sources, indicating a deeply entrenched environmental health risk (Umar & Adekunle, 2018).

Despite this high disease prevalence, there remains a critical "knowledge-practice gap" among key population groups. While general awareness of hygiene exists, comprehensive knowledge regarding transmission routes and technical prevention strategies remains inadequate. Research indicates that even when knowledge levels appear high, they often do not translate into protective behaviors or positive health attitudes (Abodunrin et al., 2022). This disconnect is particularly concerning among students in health tertiary institutions. As future healthcare providers and community agents of change, these students are at the forefront of disease prevention; however, evidence suggests that many lack the robust knowledge, attitudes, and practices (KAP) necessary to protect themselves and effectively educate their future patients (McMichael, 2019; Ganguly et al., 2021).

The problem, therefore, lies in the paucity of evidence-based health education interventions specifically designed for health tertiary settings in Katsina State. Current institutional curricula often prioritize theoretical knowledge over the practical adoption of preventive behaviors, leaving a pedagogical void that contributes to the persistence of water-borne infections. While health education has been globally validated as a tool to change unhealthy attitudes and curb epidemics (Zhang et al., 2020), its specific impact on health students in Northern Nigeria remains largely undocumented. This study addresses this critical gap by evaluating the effect of a structured health education intervention on the knowledge, attitude, and practice of students toward the prevention of water-borne diseases in health tertiary institutions in Katsina State.

Objectives of the Study

The primary objective of this study is to evaluate the effectiveness of a health education intervention on students' theoretical and conceptual understanding of water-borne diseases. Specifically, the study seeks to:

1. Measure the extent of knowledge gain following the implementation of a structured health education program.
2. Analyze the difference in knowledge retention between students exposed to the multi-strategy intervention and those in the control group.
3. To determine the influence of demographic information (Age, Gender, and Level of Study) on the post-intervention knowledge scores of the experimental group.

Research Questions

1. What is the difference between the pre-test and post-test mean knowledge scores of students exposed to the health education intervention?
2. How do the post-test mean knowledge scores of the experimental group compare to those of the control group?

Research Hypotheses

The following null hypotheses (H0) will be tested at a 0.05 level of significance:

HO$_1$: There is no significant difference between the pre-test and post-test mean knowledge scores of students in the experimental group.

HO$_2$: There is no significant difference in the post-test mean knowledge scores between the experimental group and the control group.

HO$_3$: Demographic information (Age, Gender, and Level of Study) has no significant influence on the post-intervention knowledge scores of students in the experimental group.

Conceptual Overview of Water-Borne Diseases

Water-borne diseases are defined as infectious illnesses transmitted primarily through the ingestion or contact with water contaminated by pathogenic microorganisms or toxic substances (WHO, 2022). These diseases represent a significant global public health challenge, accounting for approximately 1.4 million preventable deaths annually, with a disproportionate impact on children and vulnerable populations in Sub-Saharan Africa (UNICEF, 2023). The etiology of these illnesses is diverse, involving bacterial agents such as *Vibrio cholerae* and *Salmonella typhi*, viral pathogens like rotavirus and hepatitis A, and various protozoan and helminthic parasites.

The transmission of these pathogens is traditionally categorized into four distinct mechanisms: water-borne (ingestion), water-washed (lack of hygiene volume), water-based (aquatic intermediate hosts), and water-related insect vectors (Ashbolt, 2004). This study focuses primarily on the water-borne and water-washed pathways, where the fecal-oral route serves as the predominant channel for infection. Contamination typically arises from systemic failures in sewage disposal, open defecation, or agricultural runoff, which introduce pathogens into drinking water sources (Fewtrell & Bartram, 2001). The health implications of these diseases extend beyond immediate morbidity. Chronic exposure to water-borne pathogens in tertiary students can lead to significant academic absenteeism, reduced cognitive performance, and long-term nutritional deficiencies. In Katsina State, the endemic nature of diseases like schistosomiasis and periodic cholera outbreaks underscores the necessity of a pedagogical shift. Understanding the "F-diagram" of transmission fluids, fields, flies, fingers, and food—is essential for students in health tertiary institutions, as they must master these concepts to serve as effective community health advocates and practitioners (Cairncross et al., 2010).

Theoretical Framework

This study is anchored in a multi-theoretical approach that integrates the Health Belief Model (HBM), Social Cognitive Theory (SCT), and the Theory of Planned Behavior (TPB).

The Health Belief Model (HBM)

The Health Belief Model, originally developed by Rosenstock (1974) and later refined by Becker (1984), posits that health-related behavior depends on an individual's subjective perceptions of risk and benefit. According to this model, a student’s decision to adopt preventive hygiene practices is driven by their **perceived susceptibility** to water-borne diseases and the **perceived severity** of those illnesses. For instance, if a student perceives a cholera outbreak as both likely to affect them and life-threatening, they are more likely to seek out preventive measures. However, the model also identifies **perceived barriers**—such as the inconvenience of boiling water or a lack of soap—as potential deterrents that can impede action even when risk perception is high. Health education interventions in this study serve as **cues to action**, triggering the adoption of behaviors by increasing the student’s **self-efficacy** and demonstrating the clear **perceived benefits** of water treatment and sanitation (Champion & Skinner, 2022).

Social Cognitive Theory (SCT)

While HBM focuses on individual perception, Bandura’s (1986) Social Cognitive Theory emphasizes the role of the social environment and **reciprocal determinism**—the mutual influence between a person’s cognition, their environment, and their behavior. A central construct of SCT relevant to this study is **observational learning (modeling)**. In health tertiary institutions, students’ hygiene behaviors are frequently shaped by watching the practices of respected peers, instructors, and campus leaders. By utilizing peer education and practical demonstrations, the intervention creates a social environment where healthy behaviors are modeled and normalized. This approach not only builds **behavioral capability** by teaching the "how-to" of hygiene but also reinforces **outcome expectations**, where students anticipate positive social and physical consequences from maintaining a clean environment (Glanz et al., 2023).

Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (Ajzen, 1991) provides a volitional lens, asserting that **behavioral intention** is the most immediate predictor of action. This intention is influenced by three factors: the student's **attitude** toward the behavior, **subjective norms** (perceived social pressure), and **perceived behavioral control**. TPB is instrumental in explaining why a student with high knowledge might still fail to act. For example, a student may know that handwashing is vital, but if they feel that their peers do not value it (unfavorable subjective norm) or that a lack of running water makes it impossible (low perceived behavioral control), they will not form a strong intention to practice it. This study's intervention seeks to align these three factors by fostering positive attitudes through evidence-based education and enhancing perceived control by providing students with the skills and strategies to navigate infrastructure limitations (Fishbein & Ajzen, 2023).

In synthesis, these three theories provide a comprehensive roadmap for the research. HBM identifies the cognitive triggers (perceived risk), SCT explains the social mechanisms (modeling and environment), and TPB highlights the path from intention to action (social pressure and control). Together, they justify an intervention that goes beyond mere information sharing, addressing the complex web of beliefs, social influences, and structural realities that determine whether a student in a health tertiary institution in Katsina State successfully adopts practices to prevent water-borne diseases.

Methodology

Research Design

The study utilizes a Quasi-experimental, Pre-test/Post-test Non-equivalent Control Group design. This design is ideal for assessing cognitive changes in an educational setting where intact classes are used. It allows for a rigorous comparison between the group receiving the specialized "Knowledge-Focused Intervention" and a group receiving standard instruction.

Research Instrument

The instrument for data collection is the **"Water-Borne Disease Knowledge Assessment Scale (WBD-KAS)."** This tool consists of 40 objective items designed to test four cognitive levels: **Identification:** Recognizing pathogens (e.g., *Vibrio cholerae*, *Salmonella typhi*),**Comprehension:** Understanding the "F-Diagram" (Fingers, Flies, Fields, Fluids, Food), **Application:** Identifying correct water treatment and sanitation methods and **Analysis:** Linking environmental sanitation to disease epidemiology.

Validity and Reliability

To establish **validity**, the researcher-developed questionnaire underwent both face and content validity assessments through an expert review panel consisting of five specialists, including three faculty members from the Department of Human Kinetics and Health Education, an environmental health officer, and a health educator. Face validity was secured by incorporating expert feedback on language clarity and item appropriateness for health students, while content validity was quantitatively verified using the Content Validity Index (CVI). The experts rated items based on their relevance to the study's focus on water-borne disease knowledge, resulting in a computed CVI of 0.92, which exceeded the threshold of 0.80 and confirmed strong representative sampling of the content domain. Regarding reliability, a pilot study was conducted with 80 boarding students from Hassan Usman Katsina Polytechnic to ensure the instrument's stability and logistical feasibility. Internal consistency for the knowledge subscale was measured using Cronbach's Alpha, yielding a coefficient of 0.81 for the 20 knowledge items and an overall instrument reliability of 0.90. Since these coefficients surpassed the recommended threshold of 0.70, the instrument was confirmed to be highly reliable and suitable for assessing cognitive gains in the main study.

Method of Data Analysis

Descriptive Statistics (Mean and Standard Deviation) was used to categorize knowledge to answer the Research questions, Paired Samples t-test was used to test HO_1 (within-group knowledge gain), Analysis of Covariance (ANCOVA) was used to control for pre-test differences and isolate the true effect of the intervention on knowledge to teat HO_2 , while Quantile Regression (Median/0.5 Quantile) was used to test HO_3 to determine the influence of demographic factors (Age, Gender, and Level of Study) on the median post-test scores of Knowledge.

Result

Table 1: Demographic information of the Participants

Item	Response	Frequency	Percent
Age	Under 18	46	22.3
	18–22	140	68.0
	23–27	20	9.7
	Total	206	100.0
Gender	Male	82	39.8
	Female	124	60.2
	Total	206	100.0
Level of Study	ND	154	74.8
	HND	10	4.9
	CHEW	42	20.4
	Total	206	100.0
Years of Stay in Boarding	Less than 1 year	30	14.6
	1–2 years	126	61.2
	Over 2 years	50	24.3
	Total	206	100.0

The study involved a sample predominantly composed of young adults, with 68% of participants falling within the 18–22 age bracket. This group is considered critical for health interventions as they are in a formative stage for developing lifelong hygiene habits. There was a notable female majority (60.2%) compared to males (39.8%), a distribution typical of health-related academic disciplines. In terms of academic background, the vast majority of participants were National Diploma (ND) students (74.8%), indicating that the study focused on students at a foundational stage of their professional health training. Regarding environmental exposure, 61.2% of the students had lived in boarding houses for 1–2 years. This shared residential experience provides a consistent baseline for the study, as these students face similar environmental susceptibilities to water-borne disease risks

Research Question One: What is the difference between the pre-intervention and post-intervention mean knowledge scores of students in the experimental group?

Table 2: Mean and Standard deviation on the difference between the pre-intervention and post-intervention mean knowledge scores

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference
Pret-est Knowledge	10.68	206	1.338	.093	4.97
Post-test Knowledge	15.65	206	1.836	.128	

Table 2 revealed that the Pre-test Mean (SD) was 10.68 (1.338) while for Post-test Mean (SD) was 15.65 (1.836). the Mean Difference was 4.97. The results indicate a significant increase in the knowledge of students regarding water-borne disease prevention. The mean score rose from 10.68 to 15.65, resulting in a mean gain of 4.97.

Research Question Two: What is the difference in the post-intervention mean knowledge scores between students in the experimental group and those in the control group?

Table 3: Mean and Standard deviation on the difference in the post-intervention mean knowledge scores between experimental group and control group

	group	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
Post-test Knowledge	Experimental	206	15.65	1.836	.128	4.82
	Control	206	10.83	1.268	.088	

Table 3 revealed that the post-test mean knowledge score for the experimental group was 15.65 (SD = 1.836), while the control group had a mean score of 10.83 (SD = 1.268). This indicates a mean difference of 4.82 in favor of the experimental group.

H0$_1$: There is no significant difference between the pre-intervention and post-intervention mean knowledge scores of the experimental group.

Table 4: Paired t-test Analyses on the difference between the pre-intervention and post-intervention mean knowledge scores

	Mean	Std. Deviation	t-value	df	P-value	Decision
Pret-est Knowledge	10.68	1.338	35.764	205	.000	Significant
Post-test Knowledge	15.65	1.836				

Table 4. revealed that the t-value was 35.764 and the p-value was 0.000. The mean knowledge score increased from 10.68 to 15.65. Since the p-value (0.000) is less than the significance level of 0.05, the null hypothesis was rejected. This implies that there is a statistically significant improvement in the students' knowledge following the intervention.

H0$_4$: There is no significant difference in the post-intervention mean knowledge scores between the experimental and control groups.

Table 5: ANCOVA Analyses on the difference between intervention and control groups mean knowledge scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2410.358[a]	2	1205.179	488.846	.000

Intercept	1428.093	1	1428.093	579.264	.000
PretestKnowledge	12.213	1	12.213	4.954	.027
Group	2274.910	1	2274.910	922.751	.000
Error	1008.331	409	2.465		
Total	75618.000	412			
Corrected Total	3418.689	411			

R Squared = .705 (Adjusted R Squared = .704)

Table 4.10 revealed that the F (1, 409) was 922.751 and p was 0.000. The "group" variable shows a highly significant effect ($p < 0.05$). This means that after controlling for what the students knew before the study (PretestKnowledge), the health education intervention caused a significant difference in their final knowledge. Since the p-value (0.000) is less than the significance level of 0.05, the null hypothesis was rejected. This implies that the intervention significantly enhanced knowledge more effectively than the traditional method used for the control group. The Adjusted R Squared is .704, meaning the model explains about 70.4% of the variance in post-test knowledge.

H0$_3$: Demographic information has no significant influence on the post-test knowledge scores of students in the experimental group.

Table 6:

Quantile Regression Analyses on the influence of Demographic information on the post-test knowledge scores

Parameter	Coefficient	Std. Error	T	df	p-value	Decision
(Intercept)	16.750	.6715	24.942	202	.000	Significant
Age	-.500	.2169	-2.305	202	.022	Significant
Gender	-1.000	.2477	-4.038	202	.000	Significant
Level of Study	.750	.1483	5.057	202	.000	Significant

Parameter Estimates (q=0.5)

Table 6 revealed that for Age, t = -2.305, p = .022 (Significant). For Gender, t = -4.038, p = .000 (Significant). While for Level of Study, t = 5.057, p = .000 (Significant). All three demographic factors significantly influenced knowledge scores. Specifically, the positive coefficient for Level of Study (0.750) suggests that students at higher levels of study achieved higher median knowledge scores following the intervention.

Discussion of the Findings

The study found a significant increase in knowledge scores following the intervention (t = 35.764, p < .05). This indicates that structured health education is an effective tool for bridging information gaps. These findings align with Zhang et al. (2020), who reported that systematic health education reviews consistently show a significant knowledge gain in infectious disease prevention. It also supports the WHO (2023) position that targeted education is a prerequisite for reducing the global burden of unsafe water diseases. The success suggests that when complex health information is broken down into educational modules, students in tertiary health institutions who are future health workers can achieve the high level of competency required for public health advocacy.

The result also shows the ANCOVA results (F = 922.751, p < .05) which proved that the experimental group significantly outperformed the control group, even when adjusting for initial knowledge. This confirms the "Experimental" advantage seen in Mustapha (2021), whose work in Northern Nigeria indicated that traditional "incidental" learning is inferior to "planned" health education interventions.

This provides strong evidence for the Ministry of Health and Education in Katsina State to adopt standardized health education modules rather than relying on general awareness campaigns.

Furthermore, the Quantile Regression showed that Age, Gender, and Level of Study all significantly influenced knowledge gain ($p < .05$). This finding partially contrasts with some Western studies which suggest gender is a neutral factor in academic health knowledge. However, in the context of Northern Nigeria, it aligns with local research suggesting that social roles and academic seniority (Level of Study) significantly impact educational outcomes.

Conclusion

The study concludes that formal health education interventions are essential for establishing a robust psychological and cognitive foundation for disease prevention in tertiary settings. The results emphasize that maturity (age) plays a role in how health messaging is received and mastered

Recommendations

Based on the findings that the health education intervention significantly improved knowledge:

1. Institutional heads should organize mandatory hygiene and water safety orientation workshops for all incoming students. This ensures a foundational level of preventive knowledge is established early in their professional training.
2. The Ministry should adopt the health education intervention modules used in this study as a standardized training manual for public health outreach in educational settings across the region.
1. Curriculum developers should move water-borne disease prevention from an elective or "incidental" topic to a core component of the health education and community health nursing curricula.
2. Incorporate interactive digital tools and case-study-based learning into the curriculum. Moving away from traditional lecture-based methods to intervention-style teaching will mirror the success seen in the experimental group of this study.

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