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Effect of Health Education Program on Knowledge, Attitude, and Practice Towards Tuberculosis among Nomads in Adamawa State, Nigeria

Stephen John[1*], Bappah Lawan[2], Abubakar A. Ahmad[3], Suraj Abdulkarim[4]
[1]*Department of Public Health, Texila American University Guyana*
[2]*Department of Education, Federal College of Education (Technical) Gombe*
[3]*Department of Geography Federal College of Education Katsina*
[4]*SUFABEL Community Development Initiative, Gombe State, Nigeria*

Abstract

Nomadic communities pose a significant challenge in the ongoing battle against tuberculosis (TB) because of their restricted healthcare access and limited knowledge about the disease. This study assessed the effectiveness of a health education program conducted using a newly developed training module on TB prevention knowledge, attitudes, and practices among nomads in Adamawa State, Nigeria. The developed module was based on the Integrated Behaviour Model (IBM). A quasi-experimental survey approach that included both intervention and control groups was used. The module was implemented by researchers in the intervention group. An interviewer-administered, validated, and structured questionnaire was used for data collection. Data was collected at baseline, immediate post-intervention, and 6-month follow-up surveys to evaluate their knowledge, attitudes, and behaviors related to TB. The results reveal a significant increase in the post-intervention score of the intervention group on knowledge (from 21.91 to 27.94 and p=.000), attitude (from 19.63 to 23.99 and p=.000), and practice (from 17.48 to 24.19 and p=.000). The findings suggest that the newly developed module resulted in a significant improvement in the Knowledge, Attitudes, and Practices (KAP) ratings of the intervention group compared to the control group. This positive effect was still present after a 6-month follow-up period, with statistical significance ($p < 0.05$). This study showcases the substantial influence of TB health education modules in improving TB awareness and fostering favorable behavioral modifications among nomadic people. This strategy has the potential to serve as a helpful tool in enhancing knowledge, attitude, and practice related to TB, ultimately could lead to a decrease in TB incidence among the Nomads; one of the TB Key and vulnerable populations in Nigeria.

Keywords: *Adamawa, Attitudes, Health Education, Knowledge, Nomadic Populations, Nigeria, Practices, Tuberculosis.*

Introduction

The global fight against tuberculosis (TB) presents major hurdles, particularly in resource-constrained, low-income countries. Sub-Saharan Africa suffers a disproportionate burden of the disease due to a confluence of factors [1]. While a global strategy for TB prevention, detection, management, and control exists, effectively addressing this complex public health issue necessitates a multidimensional approach that meets individual regional challenges [2]. Reaching remote and mobile populations that live in hard-to-reach places is a key problem for TB control efforts in many regions. The Nomadic pastoralist communities in Adamawa State face a particularly difficult problem [3]. The nomads, who are concentrated in the State's central and northern districts, travel from place to place with their animals and children in

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****Corresponding Author: wizemannstv2@gmail.com***

search of water and pasture for their livestock [3].

Nigeria has an estimated 9.4 million nomadic population with over 5 million being nomadic pastoralists, with the remainder being nomadic farmers and fishermen [4]. Notably, the Fulani, also known as Fulfulde, make up a sizable component of Nigeria's nomadic population, and Adamawa State has the biggest concentration of these pastoralists, with an estimated 450,000 nomads [4]. The nomadic pastoralist lifestyle presents a substantial barrier to TB control efforts. Their temporary communities in isolated places frequently lack basic infrastructure, including access to quality healthcare services required for TB prevention, diagnosis, and treatment. This limited access, combined with the nomads' intrinsic movement impedes efforts to provide critical TB-related information and promote healthy behaviors [4].

Nigeria is one of 14 countries worldwide that are on all three lists of high-burden nations for TB, TB/HIV, and MDR-TB [5]. Despite this, TB case notification has remained consistently low and plateaued throughout the years. A state-level investigation of the Case Notification Rate (CNR) indicated that all States had very low CNRs, with only 43% of States having CNRs for all forms of TB above the national average, indicating a very low TB case detection rate [4]. Furthermore, case detection among key and vulnerable populations such as Nomadic Pastoralists and Children has been a challenge in the country [3]. Even though a desk review that identified and mapped various key populations in Nigeria exists and was included in the current NSP, TB control interventions targeting Nomads have been limited [4]. Because of their remote location, Nomadic populations have limited access to information and health services, including TB, low immunization coverage, and inadequate housing conditions that often lead to overcrowding - all significant contributors to the spread of TB among nomadic pastoralists [4].

Adamawa, like several other States in northern Nigeria, encounters challenges in delivering healthcare services, particularly in TB programs. The nomadic groups pose difficulties for the State's TB programs in reaching out to provide TB services, resulting in missed TB cases within this population. This, in turn, contributes to the continuous spread of TB, and the growing number of people with TB that go undetected in Nigeria [4].

The Guidelines for the National TB, Leprosy, and Buruli Ulcer Control Programme (NTBLCP) states that health education is a critical component of TB control efforts [6]. Adamawa State has been providing TB control services to nomadic communities since 2011, with financial support from the STOP TB Partnership's TB REACH Waves 2 and 6. As part of the project, various awareness-raising initiatives were implemented, such as training nomadic school teachers on TB awareness, health-seeking behavior, preventive practices, and stigma reduction. Additionally, radio jingles in local languages (fulfulde) were broadcast. However, despite these activities, nomadic pastoralists had low awareness of TB and were less likely to seek medical attention with a resultant low rate of TB diagnosis [6]. This shows that existing TB health education initiatives have not had the expected impact on nomadic populations' knowledge, attitudes, and practices, thereby limiting the effectiveness of TB interventions in nomadic communities.

This study affects the deficiencies identified in current tuberculosis (TB) health education modules designed for interventions among nomadic pastoralist populations. As a result, using the Integrated Behaviour Model (IBM), we developed an innovative TB health education module that takes into account important cultural and gender aspects that influence TB transmission in nomadic communities among pastoralists. This paper assesses the effectiveness of the newly developed module on TB preventative

knowledge, attitudes, and practice among nomadic pastoralists in Adamawa State.

Materials and Methods

Study Designs

This study employed a quasi-experimental survey approach, consisting of both intervention and control groups. The study was conducted sequentially. Initially, we carried out a baseline survey in both the intervention and control groups that assessed the participants' basic understanding of TB, including knowledge, attitude, and practices (KAP). Subsequently, the intervention was implemented in the intervention group in which the new TB health education package was utilized. The Integrated Behaviour Model (IBM) played a pivotal role in the development of the module. This model guaranteed a methodical approach that takes into account the distinct cultural backgrounds and requirements of the nomadic people. The newly developed module was taught to the selected people in the intervention group for 3 months. After the intervention, a subsequent Knowledge, Attitudes, and Practices (KAP) survey was repeated in both the intervention and control groups. This enabled us to assess any changes in TB knowledge, attitudes, and practices that can be ascribed to the intervention. To determine the long-term effect, both groups were further assessed after a 6-month follow-up.

Study Area, Participants, Sample Size, and Sampling Technique

The study took place in Adamawa State, Nigeria, which has an estimated population of 4.3 million with roughly 10% of this population being nomads [7]. To ensure scientific rigor and adherence to methodology, a multistage random sampling strategy was employed to target nomadic pastoralists. Initially, twelve potential Local Government Areas (LGAs) with significant populations of nomadic pastoralists were identified. From these twelve LGAs, two were randomly selected using a random number generator to eliminate selection bias.

The intervention group received the new TB health education module, while the control group did not receive any intervention. Within each selected LGA, a nomadic community was randomly chosen by listing all nomadic communities within the LGA and using a random number generator to select one community from the list.

In the chosen nomadic communities, households were systematically selected. Starting from a central location within the community, every 10th household was chosen to ensure an even distribution across the community. Within the selected households, individuals aged 18 years or older were chosen using cluster sampling. This involved grouping individuals by household and randomly selecting participants until the target sample size of 160 individuals per LGA was reached.

Before participation, informed consent was obtained from all selected individuals. To be included in the study, individuals had to meet the following criteria: self-identify as a nomadic/pastoralist, be aged between 18 and 60 years, be willing to participate in the study, be residents of Adamawa State, and be mentally competent to provide informed consent. Individuals were excluded from the study if they were younger than 18 or older than 60 years, mentally incompetent to provide informed consent, did not self-identify as nomadic/pastoralists, or were not residents of Adamawa State.

By employing this multistage random sampling strategy, the study aimed to minimize selection bias, ensure representativeness, and enhance the generalizability of the findings.

Data Collection Methods

Data was collected using a validated and pretested structured interviewer-administered questionnaire. The Questionnaire was a modified version of that used by Bashorun et al

[17]. The questionnaires included demographic information and questions about knowledge and items about attitudes and practices. Knowledge was assessed with 22 questions on transmission, diagnosis, and treatment of TB; attitude was assessed with 10 and practice with 7 items based on the NTBLCP guidelines for the control of TB. Reliability analysis of the instrument revealed a Cronbach Alpha value of .883 for knowledge, .812 for practice, .795 for attitude, and .948 for the overall instrument indicating that the questionnaire is reliable.

The Intervention

The health education intervention module on knowledge, attitude, and practice regarding tuberculosis (TB) among the nomadic population was meticulously developed through consultations with a panel of experts in preventive medicine and behavior modification. The novel module seeks to link standard health education and communication strategies by including critical socio-cultural components. The module's development adhered to the Information, Motivation, and Behavioral Skills (IMB) model, ensuring a comprehensive approach to behavior change. The information component of the module provided essential facts about TB, including modes of transmission, prevention methods, risk factors, vulnerability, and common misconceptions. This foundational knowledge served to inform and educate participants accurately. The motivation component focused on addressing and countering misconceptions about TB, fostering positive attitudinal changes. This motivational aspect aimed to encourage individuals to seek screening and preventive services, which were provided free of charge to the participants. The knowledge acquired during the training is expected to reinforce preventive behavior skills, promoting long-term health benefits.

Participants in the intervention group have undergone a standard pre-test and post-test evaluation. The health education training on TB, using the newly developed module, was administered between these tests. In contrast, the control group received the standard health education module from the National Tuberculosis and Leprosy Control Programme (NTBLCP) for comparison purposes.

The educational intervention was delivered through a combination of group lectures, posters, and discussion sessions, followed by question-and-answer segments to reinforce learning. The intervention arm received the module training for 2 hours, twice weekly, over 3 months. This structured and iterative approach aimed to maximize the retention and application of knowledge, ultimately improving TB-related outcomes in the nomadic population.

Ethical Consideration

Ethical approval to conduct the study was obtained from the Adamawa State Ministry of Health's Ethics Committee for Research. In addition, permission was sought and obtained from Nomadic community leaders from all participating communities. Verbal informed consent was also obtained as many participants may not be able to read.

Data Analysis

Data analysis was carried out using Statistical Package for Social Sciences (SPSS) version 22 (IBM 2014). Parametric tests such as Paired t-test, Independent t-test, mixed design ANOVA, and nonparametric tests (Chi-square) were used to analyze the data. A 5% level of significance was applied. Chi-square was used to analyze categorical variables, t-tests were used to analyze the baseline and post-intervention data, and mixed-design ANOVA served as the primary analytical method to determine the effectiveness of the intervention.

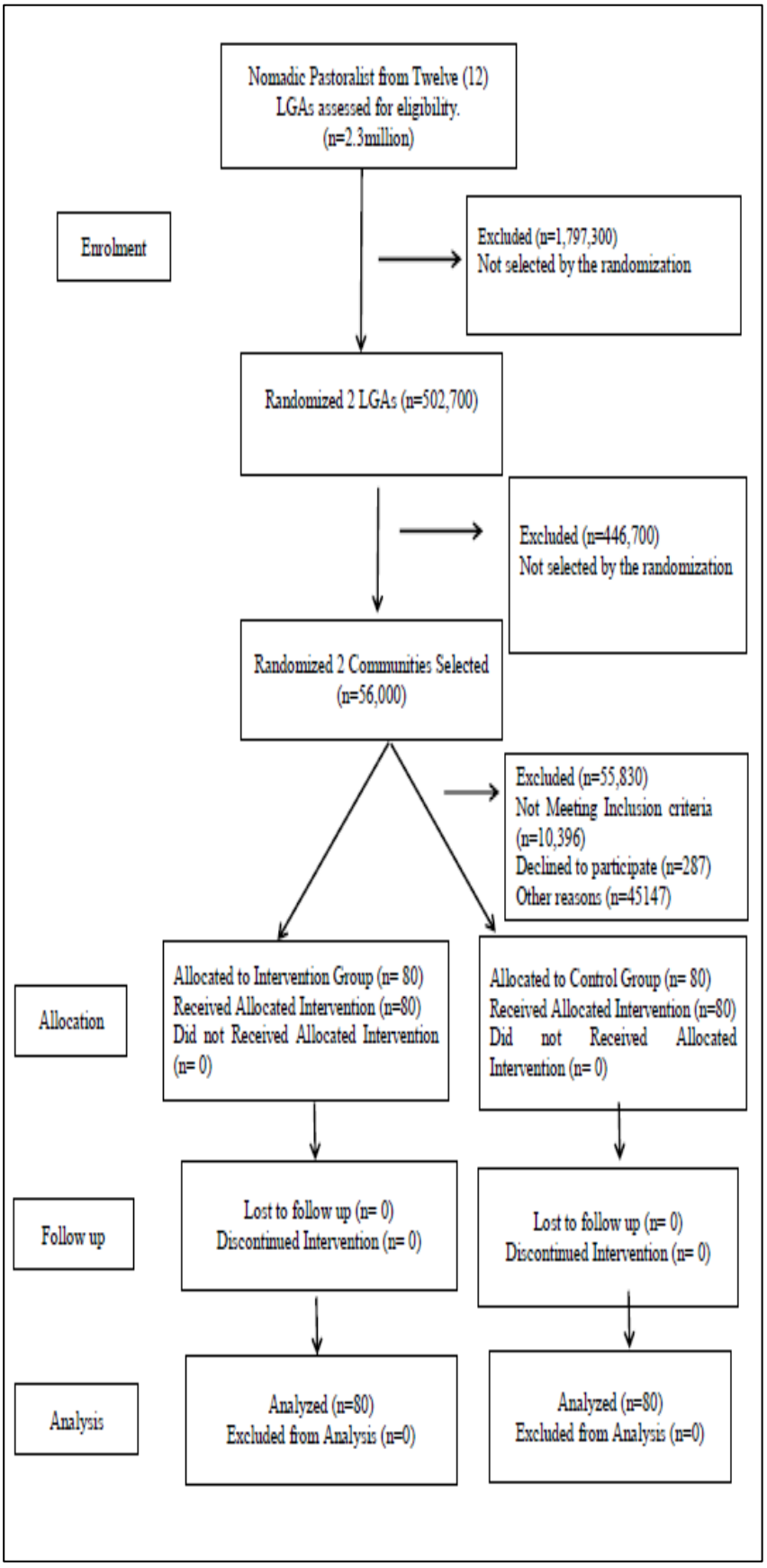

Figure 1. Consort Diagram

Results

Demographic Characteristics of the Respondents

Demographic characteristics of the Nomads in the Intervention and control groups are given in Table 1 below.

Table 1. Demographic Information of Participants

Variable	Study Group		Total (N=160) (%)	P value
	Intervention (N=80) n (%)	**Control** (N=80) n (%)		
Gender				
Male	60(75.0)	54(67.5)	114(71.2)	.421
Female	20(25.0)	26(32.5)	46(28.8)	
Marital Status				
Single	6(7.5)	14(17.5)	20(12.5)	.871
Married	61(76.3)	54(67.5)	115(71.9)	
Widow	13(16.3)	12(15.0)	25(15.6)	
Widower	0(0)	0(0)	0(0)	
Age				
18-25 years	7(8.8)	12(15.0)	19(11.9)	.815
26-35 years	29(36.3)	30(37.5)	59(36.9)	
36-45 years	34(42.5)	26(32.5)	60(37.5)	
Above 45 years	10(12.5)	12(15)	22(13.75)	
Education Status				
Primary	9(11.3)	12(15.0)	21(13.1)	.845
Secondary	4(5.0)	8(10.0)	12(7.5)	
Tertiary	1(1.3)	2(2.5)	3(1.9)	
Islamic	31(38.8)	26(32.5)	57(35.6)	
None	34(42.5)	32(40.0)	66(41.3)	
Others (Nomadic)	1(1.3)	0(0)	1(0.6)	
Occupation				
Herder	13(16.3)	12(15.0)	25(9.4)	.883
Farmer	61(76.3)	62(77.0)	123(76.9)	
Herder & Farmer	2(2.5)	4(5.0)	6(2.8)	
Others (Trader)	4(5)	2(2.5)	6(3.8)	
Relationship with Family Head				
Household Head	39(48.8)	46(57.5)	85(53.1)	.980
Wife	11(13.8)	10(12.5)	21(13.1)	
Child	9(11.3)	12(15.0)	21(13.1)	
Brother	0(0)	0(0)	0(0)	
Sister	15(18.8)	8(10)	23(14.4)	
Others	6(7.5)	4(5.0)	10(6.3)	
Time taken to reach the nearest Health facility				
1 hour	2(2.5)	2(2.5)	4(2.5)	.334
2 hours	24(30.0)	44(55.0)	68(42.5)	

3 hours	51(63.8)	30(37.5)	81(50.6)	
4 hours	3(3.8)	4(5.0)	7(4.4)	
People living in the Household				
Less than 5 people	4(5.0)	6(7.5)	10(6.3)	.848
5-14 people	52(65.0)	60(75.0)	112(70.0)	
15 & above	24(30.0)	14(17.5)	38(23.7)	
Income Level				
0-20 cattle heads	12(15.0)	10(12.5)	22(13.8)	.188
20-40 cattle heads	40(50.0)	42(52.5)	82(51.2)	

p-value Calculated using the Chi-square test (X). John et al. [8]

Table 1 above revealed that in the intervention group, 75% of participants were male, and 25% were female, while the control group comprised 67.5% males and 32.5% females. Gender distribution did not exhibit a significant difference between the groups (p = 0.421). The majority of individuals in both groups were married, accounting for approximately 71-72%, with no significant disparities observed in marital status. Similarly, there were no significant discrepancies in age distribution, educational backgrounds, or occupations between the intervention and control groups. In both cohorts, the household head predominantly served as the family head, with no noteworthy differences in this regard.

Although the time taken to reach the nearest health facility varied between the two groups, statistical analysis revealed a non-significant difference (p = 0.334). Household sizes displayed variation, with the majority comprising 5-14 individuals, yet no significant distinctions were observed between the intervention and control groups. Participants in both groups exhibited diverse income levels associated with cattle ownership, with no statistically significant differences noted, although the p-value approached significance (p = 0.188).

Normality Test

To ensure the validity of statistical analyses, it is crucial to assess whether the data conforms to a normal distribution, particularly when applying parametric tests that assume normality. In this study, the Shapiro-Wilk test was employed to evaluate the normality of the data sets for the variables under investigation. The Shapiro-Wilk test is recognized for its power in detecting deviations from normality, making it a preferred method for small to medium sample sizes.

The results of the Shapiro-Wilk test for each variable are presented in Table 1 below. A p-value greater than 0.05 indicates that the data does not significantly deviate from a normal distribution, while a p-value less than or equal to 0.05 suggests a significant departure from normality.

Table 2. Normality Test

Variable	Statistic	Df	p-value
Pre-intervention Knowledge	0.854	160	0.000
Pre-intervention Practice	0.950	160	0.000
Pre-intervention Attitude	0.927	160	0.000
Post-intervention Knowledge	0.926	160	0.000
Post-intervention Practice	0.949	160	0.000

Post-intervention Attitude	0.951	160	0.000
Follow-up Knowledge	0.954	160	0.000
Follow-up Practice	0.957	160	0.000
Follow-up Attitude	0.917	160	0.000

The Shapiro-Wilk test was performed as shown in Table 2 above to assess the normality of the data for knowledge, practice, and attitude at three different time points: Pre-intervention, Post-intervention, and 6 months follow-up. Across all variables and time points, the Shapiro-Wilk test results consistently show p-values less than 0.05, indicating that the data is not normally distributed. As a result, the assumption of normality is violated, and non-parametric statistical methods should be considered for further analysis. This finding has important implications for the choice of statistical tests in subsequent analyses.

Baseline of Knowledge, Practice, and Attitudes of Nomads toward TB Infection in Adamawa State

The baseline analysis of knowledge, practice, and attitudes of nomads toward TB in the intervention and control group was carried out using Wilcoxon Signed-Rank Test and is presented in Table 3. below:

Table 3. Baseline Assessment of Knowledge, Practice, and Attitudes of Nomads toward TB Infection in Adamawa State

Variable	Group	N	Mean	S.D	P-value
Knowledge	Control Group	80	22.34	2.60	0.337
	Intervention Group	80	22.00	2.41	
Practice	Control Group	80	18.08	2.84	0.790
	Intervention Group	80	17.63	4.78	
Attitude	Control Group	80	16.25	5.20	0.121
	Intervention Group	80	17.48	5.45	

Table 3 presents the baseline assessment of knowledge, practice, and attitudes toward TB infection among nomads in Adamawa State, comparing the Control and Intervention groups. The mean scores for each variable (Knowledge, Practice, and Attitude) were analyzed using p-values to determine whether there were any statistically significant differences between the two groups.

For knowledge, the Control Group had a mean score of 22.34 with a standard deviation of 2.60, while the Intervention Group had a mean score of 22.00 with a standard deviation of 2.41. The p-value of 0.337 indicates that there is no statistically significant difference in knowledge levels between the two groups at baseline.

Regarding practice, the Control Group's mean score was 18.08 with a standard deviation of 2.84, compared to the Intervention Group's mean score of 17.63 with a standard deviation of 4.78. The p-value of 0.790 suggests no significant difference in practice scores between the two groups, implying that both groups had similar practices related to TB infection before the intervention.

In terms of attitude, the Control Group had a mean score of 16.25 with a standard deviation of 5.20, while the Intervention Group had a mean score of 17.48 with a standard deviation of 5.45. The p-value of 0.121 indicates that there is no statistically significant difference in attitudes toward TB infection between the two groups at baseline.

Overall, the lack of significant differences across all variables suggests that both groups were relatively comparable in terms of knowledge, practice, and attitude toward TB infection at the start of the study. This establishes a balanced foundation for assessing the effects of any interventions applied during the study.

Intervention Effects

Table 3 above presents the results for the comparison between KAPS scores for the groups at baseline. Wilcoxon Signed-Rank Test (Table 4) was also conducted to compare the immediate post-intervention scores between the intervention and control groups. This helps to highlight the differences in outcomes between the groups after the intervention. Additionally, a Friedman Test of Repeated Measures (Table 4) was carried out to evaluate the changes over time (pre-intervention, immediate post-intervention, and 6 months follow-up) and between groups (intervention and control) simultaneously. This analysis helps confirm the results from the Wilcoxon Signed-Rank Test and provides a more comprehensive view of the intervention's effect.

Table 4. Immediate Post-intervention Assessment of Knowledge, Practice, and Attitudes of Nomads toward TB Infection in Adamawa State.

Variable	Groups	N	Mean	S.D	P-value
Knowledge	Control Group	80	21.80	3.28	.000
	Intervention Group	80	27.94	5.98	
Practice	Control Group	80	18.45	3.12	.001
	Intervention Group	80	20.71	4.40	
Attitude	Control Group	80	18.08	5.70	.000
	Intervention Group	80	23.91	4.12	

Table 4 above presents the results of a Wilcoxon Signed-rank test comparing the Control and Intervention groups' scores on Knowledge, Practice, and Attitude toward TB infection in the immediate post-intervention phase. The data includes the mean scores, standard deviations, degrees of freedom (df), and p-values for each variable.

For knowledge, the Control Group had a mean score of 21.80 with a standard deviation of 3.28, while the Intervention Group had a significantly higher mean score of 27.94 with a standard deviation of 5.98. The p-value of .000 indicates a statistically significant improvement in knowledge in the Intervention Group compared to the Control Group after the intervention.

Regarding practice, the Control Group had a mean score of 18.45 with a standard deviation of 3.12, whereas the Intervention Group had a higher mean score of 20.71 with a standard deviation of 4.40. The p-value of .001 suggests a significant positive change in practice in the Intervention Group compared to the Control Group following the intervention.

In terms of attitude, the Control Group had a mean score of 18.08 with a standard deviation of 5.70, while the Intervention Group's mean score increased to 23.91 with a standard deviation of 4.12. The p-value of .000 indicates a statistically significant improvement in attitudes toward TB infection in the Intervention Group compared to the Control Group after the intervention.

Overall, the Wilcoxon signed-rank test results demonstrate that the intervention had a significant positive impact on the knowledge, practice, and attitudes of the participants in the Intervention Group, as evidenced by the higher mean scores and the statistically significant p-values across all three variables.

Table 5. Assessment of Knowledge, Practice, and Attitudes of Nomads toward TB Infection Across Pre-Intervention, Post-intervention, and 6-month Follow-up in Adamawa State

Variable	Test	N	Mean	S.D	P-value
Knowledge	Pre-intervention	80	21.91	2.41	.000
	Immediate post-intervention	80	27.94	5.95	
	6 month follow up	80	25.06	3.91	
Attitude	Pre-intervention	80	17.63	4.78	0.000
	Immediate post-intervention	80	20.71	4.40	
	6 month follow up	80	22.29	4.54	
Practice	Pre-intervention	80	17.48	5.45	.000
	Immediate post-intervention	80	23.90	4.11	
	6 month follow up	80	25.30	3.57	

The Friedman test results from Table 5 above reveal significant findings across the three variables: Knowledge, Attitude, and Practice, measured at three distinct time points (Pre-intervention, Immediate post-intervention, and 6-month follow-up).

For knowledge, the mean score at the Pre-intervention stage was 21.91 with a standard deviation of 2.41. Following the intervention, there was a marked increase in the mean score to 27.94, accompanied by a higher standard deviation of 5.95, indicating a significant improvement in knowledge. However, by the 6-month follow-up, the mean score slightly decreased to 25.06, with a standard deviation of 3.91, suggesting some retention of knowledge over time, albeit with a slight decline compared to the immediate post-intervention period. The p-value of .000 for knowledge indicates that the differences observed across the three time points are statistically significant.

For attitude, the initial mean score was 17.63 with a standard deviation of 4.78 at the Pre-intervention stage. This score increased to 20.71 with a standard deviation of 4.40 immediately after the intervention, reflecting an improvement in participants' attitudes. Interestingly, the mean score continued to rise to 22.29 at the 6-month follow-up, with a standard deviation of 4.54, suggesting that the positive changes in attitude were not only maintained but slightly improved over time. The p-value of 0.000 confirms that these changes are statistically significant.

For practice, the mean score before the intervention was 17.48, with a standard deviation of 5.45. After the intervention, there was a significant jump in the mean score to 23.90, with a standard deviation of 4.11, indicating a substantial improvement in practice. This positive trend continued, with the mean score increasing further to 25.30 at the 6-month follow-up, accompanied by a standard deviation of 3.57. The p-value of .000 for practice also indicates that the observed differences across the three time points are statistically significant.

Overall, the findings from the Friedman test suggest that the intervention was highly effective in improving participants' knowledge, attitudes, and practices. The statistically significant p-values across all three variables underscore the meaningful impact of the intervention, with sustained positive effects observed over time. Although there was a slight decline in knowledge at the 6-month follow-up, the overall levels of knowledge, attitude, and practice remained significantly higher than pre-

intervention levels, indicating a lasting benefit of the intervention.

Discussion

The baseline assessment aimed to evaluate the knowledge, practice, and attitudes of nomads toward tuberculosis (TB) infection before the implementation of the health education intervention program. The results revealed no statistically significant differences between the control and intervention groups across all three measured variables: knowledge, practice, and attitude. This finding suggests a relatively homogenous understanding of the disease among nomads in Adamawa State. Similar results were reported in our previous study [8], we found that rural populations exhibited comparable baseline knowledge levels about TB, highlighting the need for educational interventions in these communities. The result on attitude aligns with research conducted in Iraq [9], which found that initial attitudes could influence the effectiveness of subsequent educational interventions, suggesting that an open attitude may facilitate better engagement with health education efforts. These results further indicate no significant differences in health-seeking behaviors and practices concerning TB between the two groups. This lack of variation is consistent with other findings [8], which demonstrated that community practices surrounding TB were similar among populations with limited access to healthcare education.

In essence, the baseline data underscores the necessity for targeted educational interventions to improve knowledge, practices, and attitudes toward TB among nomads in Adamawa State. The absence of significant differences at this stage presents a critical opportunity for the intervention to make a measurable effect, as both groups start from a similar foundation.

The immediate post-intervention assessment demonstrated significant improvements in knowledge (Δ=6.14, p=0.000), attitude (Δ=5.83, p=0.001), and practice (Δ=2.26, p=0.000), toward tuberculosis (TB) infection among nomads in Adamawa State, particularly in the intervention group. These findings were consistent with those of Shatat et al. [10] and Panaligan and Guiang [11], who reported similar increases in knowledge following health education interventions targeted at rural communities, suggesting that such programs can significantly influence awareness levels. It also aligns with research by Shatat et al. [10] which found that educational interventions can effectively lead to improved health-related practices in similar populations, underscoring the potential for such programs to foster positive behavioral changes. These results further corroborate findings from a Nigerian study [12], which highlighted that educational programs can shift attitudes positively, especially in communities with limited access to health information.

The results from the Friedman's Test of the Health Education Intervention Program underscore its effectiveness in significantly enhancing participants' knowledge, practice, and attitudes toward tuberculosis prevention among nomads in Adamawa State. The notable increase in knowledge scores, from a pre-intervention mean of 21.91 to a post-intervention mean of 27.94 (t=6.14, p=0.000), illustrates the program's success in conveying essential information about TB. This aligns with findings from Mohammadi et al. [13] and Idris et al. [14] [18], who similarly used a culturally tailored educational program, collected data at 4 months follow-up, and observed substantial improvements in knowledge following health education interventions targeting at-risk populations.

Moreover, the program's effect on attitudes is evidenced by the increase in scores from 17.48 to 24.19 (t=5.83, p=0.000). This significant shift suggests that the intervention successfully fostered more positive attitudes toward TB among participants. These findings were supported by Liu et al., [15] and [14] [19]

in studies conducted among people in a rural area, which emphasized the role of educational programs in positively influencing health-related attitudes, particularly in marginalized communities.

The significant enhancement in practice scores, which rose from 19.63 pre-intervention to 23.99 post-intervention ($t=2.26$, $p=0.001$), further supports the efficacy of the intervention. This outcome suggests that the educational program not only informed participants but also motivated them to adopt better health-seeking behaviors regarding TB prevention. These results are consistent with other research [13] [14], and studies conducted in Minna, Nigeria [16] [20], indicating that educational interventions can effectively lead to improved health practices in communities with limited access to health education.

In summary, the significant improvements across all measured variables demonstrate the effectiveness of the health education intervention program in positively influencing knowledge, practice, and attitudes toward TB prevention among nomads in Adamawa State. The findings not only highlight the program's immediate effect but also suggest a valuable framework for continued education and intervention efforts to sustain and enhance TB awareness and prevention in this population's perceptions and beliefs, aligning with existing literature and theories of planned behavior.

Our Health Education Intervention Program proved successful in improving TB Prevention knowledge, practice, and attitudes among nomads in Adamawa State. These findings suggest potential contributions to TB incidence reduction, enhanced healthcare-seeking behavior, and improved support for affected individuals. The program's impact highlights the importance of health education in public health initiatives.

Conclusion

The study's thorough analysis confirms the significant effect of the Health Education Intervention Program in improving TB Prevention knowledge, practices, and attitudes among Adamawa State's nomadic population in Northeast Nigeria. These substantial improvements underscore the program's effectiveness in enhancing healthcare awareness and promoting behavior change within the community. The program's effect highlights its crucial role in reducing TB incidence, fostering better healthcare-seeking behavior, and addressing associated stigma, representing a significant advancement in TB prevention and control in Nomadic communities.

Recommendations

1. **Sustained Program Implementation**: Continuously implementing and expanding similar health education initiatives within nomadic communities in Adamawa State and beyond is advised. This ongoing effort can further solidify TB Prevention knowledge, practices, and positive attitudes.

2. **Tailored Interventions**: Customizing interventions to match the unique cultural and social context of nomadic communities can enhance program effectiveness. Aligning content and approach with community beliefs and lifestyles will increase engagement and receptiveness.

3. **Monitoring and Evaluation**: Regular assessment and monitoring of program impact are essential. Periodic evaluations can track sustainability and identify areas for improvement in knowledge, practices, and attitudes.

4. **Community Involvement**: Engaging community leaders, local healthcare providers, and volunteers can enhance program reach and acceptance among nomadic populations. Collaborating with these stakeholders ensures inclusivity and sustainability.

5. **Resource Allocation**: Securing sustained funding and resources for health education initiatives is vital. Investments in

educational materials, qualified instructors, and technological resources will support program continuity and effectiveness.

6. **Implement Targeted Health Education and Support Programs for Internally Displaced Persons (IDPs) And Those Affected by Insurgency.** These initiatives should address the specific health challenges and psychological needs of these vulnerable groups, ensuring they receive adequate care, information, and support for TB prevention and overall well-being. Collaborate with humanitarian organizations and leverage existing support networks to enhance the reach and impact of these programs.

Conflict of Interest

The authors hereby declare that there are no potential conflicts of interest, financial or otherwise, that could be perceived as influencing the outcomes or interpretations presented in this research paper.

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