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Effectiveness of an Educational Intervention Campaign on Knowledge and Attitudes towards COVID-19 and Vaccines among Senior Secondary School Students in Kaduna State

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Abstract
The study investigated the effectiveness of an Educational Intervention Campaign on Knowledge and Attitude towards COVID-19 and Vaccines among Senior Secondary School Students in Kaduna state. The study was anchored on three objectives three research questions and three hypotheses were postulated in line with the stated objectives. Relevant literature was reviewed on the key variables for this study. The study adopted a pre-and post-intervention study design to evaluate the impact of an educational intervention campaign on knowledge and attitudes towards COVID-19 and its vaccines among the respondents. The population for this study consists of senior secondary school students in Kaduna State, Nigeria. A sample of 50 senior secondary school students from four selected secondary schools in the state was used for the study. The instrument used for data collection was a pre-post intervention survey questionnaire, a multiple-choice objective test question with four sections: General information, knowledge assessment, attitude assessment, and additional information. Five modules were developed by the researchers covering an introduction to COVID-19, symptoms and transmission, prevention measures, COVID-19 vaccines, and benefits of vaccines. The instrument was validated by one professor and two chief lecturers, and its reliability was tested using a test/retest method.

Data was collected through the administration of pre-tests and post-tests. Descriptive statistics such as frequencies and percentages were used to analyze the bio-data of the respondents, while mean and standard deviation were used to answer the research questions. Kruskal Wallis was also used to test all the hypotheses at a 0.05% level of significance on the knowledge and attitude of the respondents. The findings showed a significant difference in knowledge of COVID-19 and its vaccines by subjects after their exposition to educational intervention. However, the subjects did not differ significantly in their attitude towards COVID-19 and its vaccines before and after the educational intervention. The study concluded that significant differences observed in knowledge levels before and after the campaign underscore the importance of targeted educational initiatives in enhancing understanding and acceptance of vaccines, as emphasized by previous research. Recommendations were made to include the development of targeted educational campaigns by the government that address specific knowledge gaps and misconceptions identified among senior secondary school students, utilization of diverse communication channels and interactive learning methods to effectively engage students.

Introduction
The COVID-19 pandemic has had a significant impact on societies worldwide, posing challenges to public health systems and disrupting daily life. (World Health Organization, 2021) [10]. In response to this global crisis, educational intervention campaigns have emerged as a crucial tool to disseminate accurate information, raise awareness, and shape attitudes towards COVID-19 and its vaccines (Ruggeri *et al*., 2024) [6]. Understanding the impact of such campaigns on knowledge and attitudes among specific populations, such as senior secondary school students, is essential for effective public health strategies. Kaduna State, located in Nigeria, is no exception to the challenges posed by the COVID-19 pandemic. Senior secondary schoolstudents in Kaduna State represent a critical demographic group that requires accurate information to navigate the pandemic safely and make informed vaccination decisions (OECD, 2021) [5]. Educational programs have been found to have a positive impact on

improving the knowledge about COVID-19 vaccination in a study population (Kumari *et al*., 2023) [4]. Similarly, students who possessed a heightened level of adequate understanding and favourable disposition towards COVID-19 exhibited a greater propensity to engage in effective preventive measures (All $p<0.001$) (Huynh *et al*, 2021) [2].

In another study, patients exhibited enhanced understanding after the educational intervention in six of the seven COVID-19 subjects ($p < 0.005$). After the involvement, there was an uptick in acceptance of vaccines; nevertheless, no noticeable difference was detected in the effectiveness between the two intervention methods (Takagi *et al*., 2023). Moreover, after the intervention, patients demonstrated reduced apprehension towards mild reactions associated with the virus ($p = 0.005$), the expeditious development of vaccines ($p < 0.001$), and potential vaccine side effects ($p = 0.031$). The data revealed that both attitude and knowledge experienced enhancements when comparing the period before the educational intervention to the follow-up stage, yet a decline was noted from the post-intervention phase to the follow-up assessment (Takagi *et al*., 2023).

Hence, evaluating the impact of an educational intervention campaign specifically targeted towards senior secondary school students becomes imperative. This research aims to investigate the effectiveness of an educational intervention campaign on knowledge and attitudes towards COVID-19 and its vaccines among senior secondary school students in Kaduna State. By examining the changes in knowledge and attitudes before and after the campaign, we can gain insights into the effectiveness of the intervention in promoting accurate understanding and positive attitudes towards COVID-19 and vaccination.

The findings of this study will contribute to the existing body of knowledge regarding educational interventions in the context of COVID-19. The insights gained can guide policymakers, educators, and healthcare professionals in designing more targeted and effective educational campaigns to enhance knowledge and foster positive attitudes among senior secondary school students in Kaduna State. Ultimately, such interventions have the potential to positively impact public health outcomes by promoting responsible behaviour and vaccination uptake among the younger population.

Problem Statement
Despite the global efforts to combat the COVID-19 pandemic, there remains a pressing need to address knowledge gaps and shape attitudes towards COVID-19 and its vaccines, particularly among senior secondary school students in Kaduna State, Nigeria. The lack of accurate information and misconceptions surrounding the virus and vaccination can hinder effective public health measures and contribute to the spread of misinformation. Therefore, there is an urgent need to evaluate the impact of an educational intervention campaign on knowledge and attitudes towards COVID-19 and its vaccines among senior secondary school students in Kaduna State. By identifying the existing gaps and assessing the effectiveness of educational interventions, policymakers, educators, and healthcare professionals can develop targeted strategies to enhance knowledge, correct misconceptions, and foster positive attitudes towards COVID-19 and vaccination. Addressing these challenges will not only empower senior secondary school students to

make informed decisions but also contribute to the overall public health response in Kaduna State and mitigate the impact of the ongoing pandemic.

Ethical Considerations
Ethical approval was obtained from the Kaduna State Ministry of Education, Kaduna before conducting the research. Informed consent was obtained from both the students and their parents or legal guardians. The confidentiality and anonymity of the participants were ensured by assigning unique identifiers to each survey response.

The objectives of the research
1. To determine the knowledge level of COVID-19 and its vaccines among senior secondary school students in Kaduna state.
2. Assess the attitude of senior secondary school students in Kaduna state towards.
3. Examine whether educational intervention campaign would have any impact on knowledge and attitude towards COVID-19 and its vaccines between male and female senior secondary school students in Kaduna state.

Research questions
1. What is the knowledge level of COVID-19 and its vaccines among senior secondary school students in Kaduna state?
2. What is the attitude of senior secondary school students in Kaduna state towards?
3. Does the educational intervention campaign have any impact on knowledge of COVID-19 and its vaccines between male and female senior secondary school students in Kaduna state?

Research hypotheses
1. There is no significant difference in the knowledge level of COVID-19 and its vaccines among senior secondary school students in Kaduna state before and after the educational intervention campaign.
2. There is no significant difference in the attitude of senior secondary school students in Kaduna state towards COVID-19 and its vaccines before and after the educational intervention campaign.
3. There is no significant difference in knowledge and attitude towards COVID-19 and its vaccines by male and female students before and after the educational intervention among senior secondary school students in Kaduna state.
4. There is no significant difference in the impact of educational intervention campaigns on knowledge and attitude towards COVID-19 and its vaccines by Senior Secondary School students of different socio-economic backgrounds in Kaduna state.

Materials and Methods
This research employed a pre-and post-intervention study design to evaluate the impact of an educational intervention campaign on knowledge and attitudes towards COVID-19 and its vaccines among senior secondary school students in Kaduna State. The population for this study consists of senior secondary school students in Kaduna State, Nigeria.

This includes students enrolled in public and private secondary schools within the state. To obtain a representative sample, the multi-stage sampling procedure along with the stratified random method for sample selection was adopted for sampling the required students for the study. The Senatorial zones were divided into strata and Local government were selected out of which the Senior Secondary Schools were selected after which the desired number of (50) students were selected from each of the schools.

The instrument used for data collection was a pre-post intervention survey questionnaire, a multiple-choice objective test question with four sections: General information, knowledge assessment, attitude assessment, and additional information. Five modules were developed by the researchers covering an introduction to COVID-19, symptoms and transmission, prevention measures, COVID-19 vaccines, and benefits of vaccines. The instrument was validated by one professor and two chief lecturers, and its reliability was tested using a test/retest method.

Data Collection: The selected students were approached during school hours, and their participation in the study was voluntary. Informed consent was obtained from both the students and their parents or their legal guardians.

Data analysis: Data analysis was carried out with the Statistical Package for the Social Sciences (SPSS), IBM version 26. Statistical procedures adopted included frequencies and percentages, means and standard deviation. Inferential statistics used included no non-parametric procedures of Mann-Whitney U, Wilcoxon W and Kruskal-Wallis H tests. The test of significance was fixed at the alpha value of 0.05.

Inclusion Criteria: Students who meet the following criteria were included:
▪ Enrolled in senior secondary schools in Kaduna State.

▪ Willingness to participate in the study.

Results and Discussion
50 students each were selected from 8 schools for the study, making a total of 300 subjects from:
Barewa, Government College, Kaduna, Government Commercial College, Zaria, Government.
College Giwa, Government Secondary School, Kachia and Queen Amina, Kaduna. The male subjects were 149 (49.7%) while the females were 151(50.3%). Of the total number of subjects, 95.7% were in their second year of Senior Secondary School while 2.0% were in their final year and 0.7% were in the first year of Senior Secondary School. The mean age of the subjects was 16.73 years with a standard deviation of 4.673 years. With these distributions, the subjects are shown to be within the expected age range in the Senior Secondary School and would be in a position to respond to educational intervention which would determine the impact on their knowledge and attitude towards COVID-19 and its vaccines.

Knowledge level of COVID-19 and its vaccines among senior secondary school students
Table 1: Shows the observed frequencies along with percentages enclosed in brackets. Knowledge level of COVID-19 and its vaccines among the Senior Secondary School students before the educational intervention as indicated in Table 1 was relatively low compared to the level after the intervention. On what is Covid-19 for example, only 11.3% of the students were of the view that it was a type of flu while 67.0% thought that it was a respiratory illness caused by a novel coronavirus and 16.0% held the view that it was a bacterial infection. Some (5.7%) of the subjects were not sure what Covid-19 was.

Table 1: Knowledge of subjects on COVID-19 and its vaccines before and after intervention

Variable	Variable options	Pre-intervention	Post-intervention
What is Covid-19	A type of flu	34(11.3)	42(14.0)
	A respiratory illness caused by a novel coronavirus	201(67.0)	223(74.3)
	Bacterial infection	48(16.0)	24(8.0)
	Not sure	17(5.7)	11(3.7)
Covid-19 primarily transmitted	Through mosquito bites	36(12.0)	42(14.0)
	Physical contact with infected persons	213(71.0)	224(74.7)
	Consuming contaminated foods	25(8.3)	25(8.3)
	Not sure	26(8.7)	9(3.0)
Common symptoms of Covid-19	Fever, Cough and shortness of breath	207(69.0)	222(74.0)
	Headache, sore throat and stomachache	46(15.3)	40(13.3)
	Muscle pain, Joint pains and rashes	36(12.0)	27(9.0)
	Not sure	11(3.7)	11(3.7)
Measures effective in preventing the spread of Covid-19	Washing hands frequently with soap and water	75(25.0)	84(28.0)
	Wearing a face mask in public places	64(21.3)	66(22.0)
	Practicing social distances	21(7.0)	19(6.3)
	All of the above	115(38.3)	116(38.7)
	Not sure	25(8.3)	15(5.0)
Covid-19 vaccines are safe and effective in preventing severe illness and hospitalization	True	259(86.3)	259(86.3)
	False	26(8.7)	20(6.7)
	Not sure	15(5.0)	21(7.0)
Covid-19 is a serious threat to public health	Strongly agree	125(41.7)	143(47.7)
	Agree	110(36.7)	101(33.7)
	Neutral	22(7.3)	24(8.0)
	Disagree	29(9.7)	23(7.7)
	Strongly disagree	14(4.7)	9(3.0)

Source: Field survey, 2023

After the intervention, 14.0% of the subjects were able to place the illness as a type of flu while 74.3% were then able to classify it as a respiratory illness caused by a novel coronavirus. The number of subjects who were classified as a bacterial infection decreased from 16.0% to 8.0% and those who were not sure decreased from 5.7% to 3.7% after the educational intervention. On knowledge of how the disease is transmitted, the subjects did not differ much in their opinion but there was still some uncertainty on the mode of the disease transmission. Prior to the intervention, 12.0% of the participants believed that the disease was transmitted through mosquito bites, while 71.0% believed that it was transmitted through physical contact with infected individuals. Additionally, 8.3% of the participants believed that the disease was transmitted through consuming contaminated foods. However, 8.7% of the subjects were not sure of how the disease was transmitted. After the intervention, 14.0% of the subjects were still of the view that the disease could be transmitted through mosquito bites. The number of subjects who were of the view that the disease could be transmitted through physical contact with infected persons increased from 71.0% to 74.7% of the total number of subjects involved in the study. The percentage (8.3%) who thought that the disease could be transmitted from consuming contaminated foods increased from 71.0 to 74.7. The number of subjects who were not sure decreased from 8.7% to 3.0%.

Knowledge of the associated common symptoms of COVID-19 among the subjects increased after the intervention. Subjects' knowledge of the disease manifestation of Fever, Cough and shortness of breath rose from 69.0% before to 74.0% after the intervention. The assumed symptoms of headache, sore throat and stomachache decreased from 15.3% to 13.3% among the subjects. Muscle pain, joint pains and rashes decreased from 12.0% to 9.0%. But the percentage (3.7%) for those not sure of the symptoms remained unchanged. After the educational intervention, there was a slight improvement in people's knowledge of measures that are effective in preventing the spread of COVID-19. Knowledge of frequent hand washing with soap and water increased from 25.0% to 28.0% among the subjects after the intervention and wearing of face masks in public places increased from 21.3% to 22.0% while the practices of social distances decreased from 7.0% to 6.3%. Subjects who were practising the above three measures only increased from 38.3% before to 38.7% after the intervention and subjects who were not sure of the measures to adopt to prevent the spread of the disease fell from 8.3% to 5.0%

after the intervention.

The educational intervention did not have much impact on the subjects' knowledge of vaccines as the 86.3% who agreed that the Covid-19 vaccines were safe and effective in preventing severe illness and hospitalization did not change before and after the intervention. It appears that the intervention has caused uncertainty about the safety and efficacy of vaccines. Before the intervention, 8.7% of individuals believed that the vaccines were not safe and effective. After the intervention, this belief was only reduced by 2.0%, increasing the number of people who were unsure about the safety and effectiveness of vaccines from 5.0% to 7.0%. The subjects' rating of the disease threat to public health in terms of its seriousness was slightly increased with the educational intervention. Subjects who strongly agreed with the seriousness of the disease threat to public health rose from 41.7% to 47.7% while those who agreed declined from 36.7% to 33.7% and those who were not sure increased from 7.3% to 8.0%. The percentage of subjects who disagreed with the threat of the disease to public health decreased from 9.7% before to 7.7% after the intervention while those who strongly disagreed declined from 4.7% to 3.0% after the intervention.

The attitude of senior secondary school students towards COVID-19 and its vaccines
Table 2 shows the rated attitude. Figures in brackets are percentages based on the independent group or stage of the intervention. The attitude of the subjects toward COVID-19 and its vaccines improved with the educational intervention. Before the intervention, 36.7% of the subjects strongly agreed that they trusted the information provided by healthcare professionals about Covid-19 and vaccines while 33.3% agreed with the opinion. But 14.7% were not sure of information provided by healthcare professionals about Covid-19 and vaccines while 11.3% disagreed and 9.3% strongly disagreed with the information provided by healthcare professionals about Covid-19 and vaccines. After the intervention, the number of subjects who strongly agreed that they trusted information provided by healthcare professionals about COVID-19 and vaccines increased from 36.7% before to 39.7%. Subjects who agreed with the opinion declined from 33.3% to 31.7% while those who were not sure declined from 14.7% to 14.0%. Those who disagreed with the information provided by healthcare professionals about Covid-19 and vaccines increased from 9.3% to 11.3% while those who strongly disagreed declined from 6.0 to 3.3%.

Table 2: Attitude of subjects towards COVID-19 and its vaccines before and after intervention

Variable	Variable options	Pre-intervention	Post-intervention
I trust the information provided by healthcare professionals about Covid-19 and vaccines	Strongly agree	110(36.7)	119(39.7)
	Agree	100(33.3)	95(31.7)
	Neutral	44(14.7)	42(14.0)
	Disagree	28(9.3)	34(11.3)
	Strongly disagree	18(6.0)	10(3.3)
I am willing to get vaccinated against Covid-19 when it becomes available to me	Strongly agree	114(38.0)	114(38.0)
	Agree	82(27.3)	92(30.7)
	Neutral	54(18.0)	47(15.7)
	Disagree	30(10.0)	30(10.0)
	Strongly disagree	20(6.7)	17(5.7)

Source: Field survey, 2023

The educational intervention did not seriously improve the subjects' willingness to get vaccinated against Covid-19 when it became available to them. The percentage of those who strongly agreed that they were willing to get vaccinated against COVID-19 when the vaccines became available to them remained at 38.0% before and after the intervention. Those who agreed rose slightly from 27.3% to 30.7% while those who were not sure whether they would be willing or not declined from 18.0% to 15.7%. Those who disagreed that they would be willing to take the vaccine remained 10% before and after the intervention while those who strongly disagreed declined from 6.7% to 5.7% after the intervention.

Impact of educational intervention on knowledge and attitude towards covid-19 and its vaccines
Subjects were generally of the opinion that educational intervention had a major impact on their knowledge of COVID-19 and its vaccines. Most (90.7%) of the subjects

agreed that educational intervention helped increase their knowledge about COVID-19 and its vaccines. Before the intervention, the percentage of subjects who held a positive view was 64.0% but it rose to 90.7% after the intervention. The educational intervention had a positive influence on the student's attitude towards COVID-19 and its vaccines. Before the intervention, 58.0 agreed that educational campaigns could positively influence attitudes towards COVID-19 and its vaccines. However, after the intervention, 80.0% of the subjects agreed that educational intervention positively influenced their attitude towards COVID-19 and its vaccines. These showed the information shrouded about COVID-19 and its vaccines. Subjects who did not agree with altitudinal change towards COVID-19 and its vaccines reduced from 42.0% to 20.0% after the intervention which further implied the positive impact of the educational intervention.

Table 3: Opinions of subjects on the impact of educational intervention on knowledge and attitude towards COVID-19 and its vaccines

Variable	Variable options	Pre-int	Post-int
Was the educational intervention campaign helpful in increasing your knowledge about COVID-19 and its vaccines?	Yes	192(64.0)	272(90.7)
	No	108(36.0)	28(9.3)
Did educational intervention positively influence your attitude towards COVID-19 and its vaccine?	Yes	174(58.0)	240(80.0)
	No	126(42.0)	60(20.0)
Ways the educational intervention had the most impact on your understanding of COVID-19 and its vaccines	Not sure	273(91.0)	212(70.7)
	Awareness of the Disease	17(5.7)	60(20.0)
	Social Distance	2(0.7)	3(1.0)
	Washing of hands/facemask	8(2.7)	25(8.3)

Source: Field survey, 2023

On ways in which educational intervention had the most impact on understanding of Covid-19 and its vaccines, 91.0% of the subjects were not sure of the various ways in which educational intervention had the most impact on their understanding of COVID-19 and its vaccines before the exposure but 5.7% were aware of the disease and 0.7% each were aware of social distance along with washing of hands and wearing of facemask as ways of preventing the spread of the disease. After the educational intervention, the number of subjects who were not sure of the ways educational intervention could impact their understanding reduced from 91.0% to 70.7% and those who had awareness of the disease rose from 5.7% to 20.0% and 1.0% were aware of social distancing while 8.3% were aware of hand washing and wearing of facemask as a measure of preventing the spread of the disease. These observations implied that the respondents were of the view that educational intervention had much impact on their knowledge and attitude towards COVID-19 and its vaccines.

Differential impact of educational intervention on knowledge of COVID-19 and its vaccines among senior secondary school students of different socio-economic backgrounds
The role of socioeconomic status on the impact of the educational intervention on knowledge of COVID-19 and its vaccines among Senior Secondary School students about their economic statuses was examined here to determine the differential attributable to the variable. Table 4 shows the distribution of the subjects before and after the intervention.

Table 4: Differential impact of educational intervention on knowledge of COVID-19 and its vaccines among subjects of different socio-economic backgrounds

Socio-economic background	Pre-intervention		Post-intervention	
	Freq.	%	Freq.	%
Low income	110	36.7	140	46.7
Middle income	58	19.3	84	28.0
High income	11	3.7	30	10.0
Not sure	121	40.3	46	15.3

Source: Field survey, 2023

The impact of education intervention had a major impact on subjects from different socio-economic backgrounds. Before the intervention, 40.3% of the subjects from different socio-economic backgrounds involved in the study were not sure of their knowledge of COVID-19 and its vaccines. Subjects who had relatively adequate knowledge from low socio-economic backgrounds were 36.7% 19.3% were from the Middle-income group and 3.7% were from high socio-economic backgrounds. After the intervention, the subjects from low socio-economic backgrounds who had adequate knowledge of COVID-19 and its vaccines rose from 36.7% to 46.7% and those with middle socio-economic backgrounds rose from 19.3% to 28.0% while those in high socio-economic backgrounds rose from 3.7% to 10.0%. The number of subjects who were not sure of the level of their knowledge of the disease and its vaccines declined from 40.3% before the intervention to 15.3% after the intervention. With these observations, it could be said that there was a differential impact of the educational

intervention on the socio-economic background of the subjects.

Relationship between knowledge and attitude towards COVID-19 and its vaccines among the senior secondary school students

The rating of the subjects' knowledge and attitude towards the disease and its vaccines were computed and correlated to establish the level of relationship. The Spearman rho was used in this test because of the non-quantitative measurement of the knowledge. The result of the relationship is shown in Table 5.

Table 5: Relationship between knowledge and attitude towards COVID-19 and its vaccines among subjects involved in the study

Stages	Variables	N	Mean	Std. Dev.	r-calc.	df	p-value
Pre-intervention	Knowledge	300	11.20	0.145	0.229	298	0.000
	Attitude	300	4.22	0.105			
Post-intervention	Knowledge	300	11.8133	2.50454	0.330	298	0.000
	Attitude	300	4.3467	1.90576			

The two variables (knowledge and attitude towards COVID-19 and its vaccines) were significantly correlated before and after the educational intervention. Before the intervention, the observed correlation coefficient was 0.229 obtained at 298, degrees of freedom. The p-value obtained was 0.000 (p < 0.05). After the intervention, the coefficient of correlation obtained was 0.330 with a p-value of 0.000 (p < 0.05). The only difference was that the level of relationship between subjects' knowledge and attitude towards COVID-19 and its vaccines became higher after the educational intervention. In other words, the two variables (and attitude towards COVID-19 and its vaccines) were significantly correlated irrespective of whether subjects were exposed to the educational intervention or not. By these observations, the null hypothesis that there is no significant relationship between knowledge level and attitude of senior secondary school students in Kaduna state towards COVID-19 and its vaccines is therefore rejected.

Test of hypotheses

The first hypothesis of the study was aimed at establishing the extent of difference in the knowledge level of COVID-19 and its vaccines among the Subjects before and after the educational intervention. Table 6 shows the result of the campaign Mann-Whitney U test procedure used for the comparison of the exhibited knowledge before and after the intervention.

Table 6: Mann-Whitney U test on COVID-19 and its vaccine knowledge before and after the educational intervention among the subjects

Stage of study	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z-value	p-value
Pre-intervention	300	276.78	83033.50	37883.500	83033.500	3.388	0.001
Post-intervention	300	324.22	97266.50				
Total	600						

There was a significant difference in knowledge of COVID-19 and its vaccines by subjects after their exposition to educational intervention. The Mann-Whitney U value observed was 37883.500 with a corresponding Wilcoxon W value of 83033.500 which assumes equality of samples in the groups. The Z-value obtained in the test was 3.388 with a p-value of 0.001 (p < 0.05). These observations implied significant differences in knowledge of COVID-19 and its vaccines by the subjects before and after the educational intervention. The null hypothesis that there is no significant difference in the knowledge level of COVID-19 and its vaccines among senior secondary school students in Kaduna state before and after the educational intervention is therefore rejected. The result indicated that knowledge of subjects significantly improved after the educational intervention.

The second null hypothesis was aimed at determining the extent of attitudinal differential among the students towards COVID-19 and its vaccines before and after the educational intervention. The level of attitudinal differences was determined by comparing the mean scores before and after the intervention using the Mann-Whitney U test as summarized in Table 7.

Table 7: Mann-Whitney U test on attitude towards COVID-19 and its vaccines before and after the educational intervention among the subjects

Stage	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z-value	p-value
Pre-intervention	300	305.68	91704.00	43446.000	88596.000	0.744	0.457
Post-intervention	300	295.32	88596.00				
Total	600						

The subjects did not differ significantly in their attitude towards COVID-19 and its vaccines before and after the educational intervention. The observed Mann-Whitney U value was 43446.000 while the Wilcoxon W for equality of samples was 88596.000. The Z-value obtained for the test was 0.744 with a p-value of 0.457 (p > 0.05). The implication here is that there is no sufficient evidence for rejecting the null hypothesis that, there is no significant difference in the attitude of senior secondary school students in Kaduna state towards covid-19 and its vaccines before and after the educational intervention. These observations implied that the educational intervention did not significantly improve the subjects' attitude towards COVID-19 and its vaccines.

The third null hypothesis of this study was aimed at establishing significant differences in knowledge and attitude towards COVID-19 and its vaccines between male and female subjects involved in the study. The results of the Mann-Whitney U test used for the comparison of the rated scores of the male and female subjects are summarized in Table 8.

Table 8: Mann-Whitney U test on knowledge and attitude towards COVID-19 and its vaccines before and after the educational intervention by male and female subjects

Pre-intervention	Sex	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z-value	p-value
Knowledge	Male	149	150.75	22461.50	11212.500	22688.500	-0.050	0.960
	Female	151	150.25	22688.50				
	Total	300						
Attitude	Male	149	154.47	23015.50	10658.500	22134.500	-0.799	0.424
	Female	151	146.59	22134.50				
	Total	300						
Post-intervention								
Knowledge	Male	149	152.72	22755.00	10919.000	22395.000	-0.446	0.655
	Female	151	148.31	22395.00				
	Total	300						
Attitude	Male	149	158.91	23678.00	9996.000	21472.000	-1.697	0.090
	Female	151	142.20	21472.00				
	Total	300						

The male and female subjects did not differ significantly in their knowledge and attitude before they were exposed to the educational intervention. The observed Mann-Whitney U value for knowledge before the intervention was 11212.500 while the Wilcoxon W value for equality of samples was 22688.500. The Z-value obtained for the test was 0.050 with a p-value of 0.960 (p > 0.05). For the attitude towards Covid-19 and its vaccines, the male and female subjects did not differ significantly. The observed Mann-Whitney U value was 10658.500 while the Wilcoxon W value was 22134.500. The Z-value obtained was 0.799 with a p-value of 0.424 (P > 0.05). After the educational intervention, the male and female subjects did not differ significantly in their knowledge and attitude towards COVID-19 and its vaccines. The observed Mann-Whitney U value obtained was 10919.000 while the Wilcoxon W value for equal samples was 22395.000. The Z-value obtained for the test was 0.446 with a p-value of 0.655 (p > 0.05). For attitude, the Mann-Whitney U value obtained was 9996.00 while the value for the Wilcoxon W was 21472.000. The p-value obtained for the test was 0.090 (p > 0.05). These observations showed that the male and female subjects did not differ significantly on the impact of the educational intervention on knowledge and attitude towards COVID-19 and its vaccines. The null hypothesis that there is no significant difference between males and females before and after the educational intervention campaign on the impact of COVID-19 and its vaccines among senior secondary school students in Kaduna state is therefore retained. The implication here is that the educational intervention improved the knowledge and attitude towards COVID-19 and its vaccines among the subjects and therefore eliminated the significant variability obtained before the intervention.

Discussions
The data suggests that there are noteworthy variations in the degree of understanding regarding COVID-19 and vaccinations among senior secondary school students in Kaduna state before and after the educational intervention campaign, this is consistent with the results of the study of Takagi et al. (2023b) [8] and Huynh et al. (2021) [2] who found improved knowledge surrounding SARS-CoV-2 and the COVID-19 vaccine has been shown to improve vaccination acceptance. Thus, it is imperative to improve perceptions and knowledge of the vaccine to improve overall vaccine uptake. On the attitude of secondary school students on COVID-19 and its vaccines. The educational intervention did not significantly improve the subjects'

attitude towards COVID-19 and its vaccines, this is in contrast with the findings of Huynh et al, (2021) [2] who found significant improvement in correspondent attitude after educational interventions.

According to the study, there was no significant difference in the knowledge and attitude towards COVID-19 vaccination between male and female subjects before and after they were exposed to an educational intervention. This is contrary to the findings of Aklil & Temesgan (2022) [1], who discovered that the chances of good knowledge towards COVID-19 vaccination among male students were 1.36 times higher compared to their female counterparts. This could be because males have greater exposure to various media and individuals, which helps them gather updated information about the COVID-19 vaccine.

The findings indicate a significant difference in knowledge and attitude towards COVID-19 and its vaccines among the subjects before the educational intervention. This suggests a need for targeted educational campaigns to address gaps in understanding and perceptions. Similar studies have shown comparable results, highlighting the importance of pre-intervention assessments to tailor educational interventions effectively. However, after the intervention, no significant difference was observed in the mean ranks of subjects with different socio-economic statuses. This suggests that the educational intervention was effective in improving knowledge and attitudes across socioeconomic groups, which is consistent with findings from other studies that emphasize the importance of inclusive education initiatives. This is in line with the findings of Kumari et al. (2023) [4] and Takagi et al. (2023) who found the positive impact of educational programs on COVID-19 in improving the knowledge and attitudes of the correspondents.

Conclusion
In conclusion, the findings of this research illuminate the effectiveness of an educational intervention campaign in enhancing knowledge and attitudes towards COVID-19 and vaccines among senior secondary school students in Kaduna State. The significant differences observed in knowledge levels before and after the campaign underscore the importance of targeted educational initiatives in enhancing understanding and acceptance of vaccines, as emphasized by previous research.

However, the lack of significant alterations in perspectives regarding COVID-19 and vaccinations following the intervention necessitates the implementation of more all-encompassing approaches to address misconceptions and

foster favourable attitudes. Despite no evidence of gender disparities in knowledge and attitudes within this investigation, it is necessary to conduct further investigation to examine the impact of media exposure on knowledge acquisition.

In summary, this study brings to light the significance of ongoing educational endeavours to tackle information gaps and mould attitudes effectively, especially in the context of public health crises like COVID-19. By tailoring interventions to address specific needs and leveraging inclusive education initiatives, stakeholders can contribute to improved vaccine acceptance and public health outcomes.

Recommendations
Considering the results and final thoughts of the investigation, multiple proposals can be formulated to boost educational interventions focused on enhancing knowledge and attitudes towards COVID-19 and vaccines among senior secondary school students:

1. Government should develop targeted educational campaigns that address specific knowledge gaps and misconceptions identified among senior secondary school students. These campaigns should utilize diverse communication channels and interactive learning methods to effectively engage students.
2. There should be a comprehensive approach to educational interventions that not only focus on increasing knowledge but also emphasizes the importance of fostering positive attitudes towards COVID-19 and vaccines. Strategies should include addressing vaccine hesitancy, debunking myths, and promoting trust in public health authorities.
3. Educational stakeholders should recognize the potential influence of gender on knowledge acquisition and attitudes towards COVID-19 and vaccines. Design educational interventions that consider the unique information needs and communication preferences of male and female students to ensure equitable access to accurate information.
4. The government should implement regular evaluations of educational interventions to assess their effectiveness and identify areas for improvement. This may involve conducting pre- and post-intervention assessments, as well as ongoing monitoring of knowledge and attitude trends over time.
5. Stakeholders should foster collaboration and coordination among stakeholders, including educational institutions, public health authorities, and community organizations. By working together, stakeholders can leverage resources and expertise to develop and implement more impactful educational initiatives.

Acknowledgement

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