

Population-based Childhood Immunization Education Intervention Program: Process and Impact Assessment

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Abstract

Background: Vaccine hesitancy remains a public health issue, given the influence of parental belief, thoughts, feelings and perception on childhood vaccination. We assessed the process and impact of education intervention public health professionals conducted to eliminate the risks due to parental childhood vaccine indecisions behaviors.

Methods: We used cross-sectional research method with behavioral theories-informed tool to assess the process and impact of efforts on parental childhood vaccination hesitancy in our sample. Chi square statistic and logistic regression model were used to characterize the sample and test the study related hypotheses respectively.

Results: The overall response rate for the survey was 80% (359 of 450). Sixty-three percent of the participants were female, 62% were employed full time, and 77% were educated above secondary school level. Ninety-five percent of the 450 participants cast their votes of confidence for the safety and protectiveness of childhood vaccines. In the multivariable logistic regression analysis, study participants with positive response to TV as a good source of information were 4 times as likely to perceive childhood immunization risks judged against those with negative response, adjusted prevalence odds ratio (APOR) = 4.35, 95% Confidence Intervals (CI) = 0.10 – 0.74.

Conclusions: The source of information significantly influenced vaccine hesitancy in our sample. These data is suggestive of the need for public health education via mass media in reducing vaccine hesitancy.

Keywords: Childhood immunization, parental vaccine hesitancy; risk communications; behavior change; vaccine acceptance

Introduction

Parental concerns about childhood vaccines are the main cause of the drop in vaccination coverage against infectious diseases at infancy that inevitably leads to reduced herd immunity and large-scale outbreaks of serious diseases; some of which result in infant mortality and lifelong disability in others. Persistent anxieties about the safety and usefulness of vaccines among the population threatened vaccination programs [1–3]. For instance, parental apprehensions about the safety of polio vaccine in Nigeria led to a regional outbreak and severely set back a polio elimination program [4].

Investigators have advanced convincing proofs of the value of vaccines to avoid infant infectious diseases and ensure healthy children [5 – 10]. Risk communication makes a major impact on how well society is prepared to cope with risk and react to crises and disasters. Effective evidence-based childhood vaccination indecision risk-benefit communication fosters tolerance for conflicting viewpoints, provides the basis for their resolution, and creates trust in the institutional means for assessing and managing the risk and related concerns [11, 12].

The need for approaches and strategies to address the ever increasing problems of vaccine hesitancy in countries and communities all over the world is urgent [13]. Public health professionals have educated parents to prevent the occurrence or persistence of the age long risks due to parental childhood vaccine hesitancy. However there are no data to indicate whether or not such media campaign is beneficial in terms of parental knowledge, skills and behavior modification in vaccine adherence. The current study assessed the process and impact of messages on the dimensions of the participants' decision-making behaviors to vaccinate their children or not against the backdrop of increasing vaccine hesitancy.

Materials and methods

We administered a semi-structured, anonymous, self-reported, pencil and paper, questionnaire in a cross-sectional study to a cluster sampled 450 adult participants that met the inclusion criteria in Osun state in the southwestern part of Nigeria. We used the constructs of subjective risk perception and decision-making theories, such as Health Belief Model, Theory of Planned Behaviors, Protection Motivation Theory; hazard's severity, likelihood of occurring, and the effectiveness of preventive actions to build the tool in order to address the objective of this study [14 – 16]. We were cautious to avoid re-sampling or multiple sampling of the same individual. We obtained informed consent from each of the subjects that participated before collection of information using the questionnaire.

Inclusion Criteria: Potential participants were required to:

- Be residents of Osun State of Nigeria for more than six months incessantly prior to the study
- Understand, read, and speak English
- Be male or female not less than 18 years of age
- Comprehend and provide voluntary informed consent

Exclusion criteria: Participation was restricted from individuals who were:

- Mentally incapable of providing response
- Previously sampled by the same questionnaire
- Outside the scope of the inclusion criteria

Statistical Analyses: The data analyses in the study were in three stages: (a) tabulation of the response to each relevant variable, (b) test of association, (c) univariable and multivariable logistic regression. The X^2 statistic with Fisher's exact test (correcting for small cell counts) was used to assess differences in the relevant variables. Using an unconditional, univariable logistic regression model, we examined separately the relationships between parental vaccine hesitancy risk perception and the relevant variables: media of communication on childhood immunization. Next, we performed multivariable analysis by using unconditional logistic regression model to control simultaneously for the possible confounding effects of these variables on childhood vaccine hesitancy risk perception. All statistical tests were two tailed, at $p < 0.05$ significance level as type I error tolerance. We performed all analyses using STATA statistical software, version 13.0 (STATA Corp, College Station, TX).

Results

Table 1 presents the socio-demographic distribution/characteristics of the participants. The overall response rate for the survey was 80% (359 of 450). Among the respondents, 95% reported that they were high school and above graduates, 89% were Yoruba speaking, 71% were legally married, 63% were female and 54% were gainfully employed.

Tables 2a – 2c show parental childhood vaccine-related beliefs, attitudes, behavioral intentions, behaviors, concerns, and information sources of infant vaccination. All respondents had at least some knowledge of childhood immunization. Eighty-seven percent believed that the vaccines would improve/help the conditions (87%). Ninety-five percent of the participants cast their votes of confidence for the safety and protectiveness of childhood vaccine. The most common source of information on childhood vaccination was the radio (76%).

Table 2d summarizes the parental childhood vaccine-related beliefs, attitudes, behavioral intentions, behaviors, concerns. The participants listed “Too many shots in one doctor’s visit” as their least concern (52%) followed by “Concerned about the child’s pain from the shots” (53%). Highly significant were the proportions of the participants that responded positively to the items, “Vaccines are effective against childhood VPDs” (96%), “Confident childhood vaccines are protective and safe” (95%), “I will vaccinate each of my children against VPDs as at when due” (95%), “I am determined to be faithful to vaccinate my child against VPDs as at when due” (96%), “I will encourage my neighbors to vaccinate children against VPDs as at when due” (96%), and “I will encourage any pregnant teenager to vaccinate child against VPDs when due” (97%).

Table 3 presents Parents’ Sources of Information about Childhood Vaccination. The most important sources of information on childhood vaccines were the radio (76.3%) and TV (74.1%).

Table 4 illustrates the univariable logistic regression model. Participants with positive response to “There is enough prompt to vaccine-preventable diseases information action on”: (a) the radio were 29% more likely to perceive childhood immunization risk than those with negative response, POR = 1.29, CI = 0.65 – 2.58; (b) TV were 2 times as likely as those with negative response, POR = 2.63, CI = 1.53 – 4.51; (c) The news media were 2 times as likely as those with negative response, POR = 2.24, CI = 1.38 – 3.62; (d) The Internet were 2 times as likely as those with negative response, POR = 2.60, CI = 1.63 – 4.17; and (e) Social media were about 3 times as likely as those with negative response, POR = 2.96, CI = 1.85 – 4.73.

Table 5 presents the multivariable logistic regression analysis. It showed that study participants with positive response for TV were 4 times as likely as those with negative response to perceive childhood immunization risks, APOR = 4.35, CI = 0.10 – 0.74. Study participants with positive response for Social media were 3 times as likely as those with negative response to perceive childhood immunization risks, APOR = 3.20, CI = 1.54 – 6.68. Study participants with positive response for receiving information on the radio were 73% less likely to perceive childhood immunization risks compared with those that gave negative response APOR = 0.27, CI = 0.10 – 0.74.

Discussion

One major goal for public health has been to find better ways of informing the public about the evidence surrounding vaccination [17, 18]. In this study, we assessed the potential predisposing factors to vaccine hesitancy, by characterizing our sample and testing some relevant hypotheses on potential predisposing factors to vaccine hesitancy.

There are a few relevant findings in our data. First, the result of this study showed that parents had the ability to accurately assess childhood vaccine hesitancy risks based on the probability of an incident and the possible consequences of the incidence. Secondly, parents reported positive attitudes about childhood vaccines. Most of them indicated confidence in childhood vaccine safety and felt that vaccines were important to the health of their children. This finding corroborated with previous data in other samples but similar setting [19 – 21].

Further, the findings in this study highlighted the process used to address parents’ vaccines-specific concerns and questions, even among parents with high overall vaccines confidence plus the impact of the efforts. Given the strong role that the media and social media play in influencing people’s perspectives on vaccination, a point of emphasis was related to the way in which public health agencies communicated the risks and benefits of vaccination. Communication needs to carefully and transparently convey risks as well as benefits, and that health agencies should seek to establish roles as ‘honest brokers’ who seek to neutrally and objectively communicate facts; thus exclude grounds for distrust.

Our data suggested the need for health professionals to provide more balanced information to parents and discuss with them that immunization was the right choice. The work established the importance of viewing parental childhood vaccination decision-making as a continuum, through which people were largely ambivalent about their personal choices to vaccinate or not. The concerns parents had about

immunizations likely propelled some of their interactions with people they seek out and listen to and their information-seeking behaviors, which is a social phenomenon.

In today's digital age, many participants unequivocally identified the internet and social media as having great influence on public vaccines opinion. Developing means for campaigning and monitoring vaccine confidence via social and mass media, as well as better understanding the role of influential websites become increasingly important for assessing the dynamics of vaccine hesitancy.

Our findings have little precedent. However, our data are consistent with the results of a few previous researches on parental vaccine attitudes [22]. Freed et al [22] found that confidence in the necessity of vaccines to protect children's health was high among parents of young children and adolescents, yet concerns about issues such as potential adverse effects were common. Past research reports have suggested the need for communication approaches that recognized individual information needs ([22, 23].

Increasing immunization rates is a public health priority because adequate immunization protects children against a number of infectious diseases that once were common. Immunizations improve quality of life, increase productivity, and prevent illness and death. Vaccines are cost-effective in preventing diseases.

Strengths and limitations

This current study has some strengths and limitations. Regarding its strengths: (a) the use of accurate point prevalence estimate (prevalence odds ratio, POR) in a cross-sectional survey research method to examine the association between the independent and dependent variables. POR does not inflate the effect size compared with odds ratio [24, 25], and (b) the ability to identify parental perception of childhood immunization risk determinants/factors in the sample, which have neither been studied nor documented as far as we knew, implying the sufficient sample size ($n=450$) and the statistical power ($1-\beta=0.8$, 80%)...

Despite the strengths of this study there are some limitations. First, because the attitudes and concerns were self-reported, they were subject to social-desirability bias. The respondents may feel compelled to give a socially expected and acceptable answers and incomplete responses, considering perceived socioeconomic position when discussing their children's health rather than report their actual attitudes or behaviors.

Secondly, this study has restricted generalizability due to the variation in participants' experiences, as well as the education level of the sample. The study was limited to Nigerians in the southwestern state of Osun, a heterogeneous population. In effect the inference on the nonrandom sample is representative of those who completed the survey and not Nigerians as a whole. As a cross-sectional study, this work is short of temporal sequence and incapable of establishing causal association [26, 27].

Thirdly, the findings may be subject to potential selection bias as women and men who refused to participate in the survey may have differed from respondents. The accuracy of the study depended on the authenticity of the responses given by the participants.

Finally, like most non-experimental studies, unmeasured confounding may influence the findings, as well as residual confounding which may arise from design and multivariable or stratification analysis, since no matter how sophisticated a statistical package used to control for confounding, residual confounding remains [28]. However, it is highly unlikely that our findings are driven solely by unmeasured and residual confounding.

Conclusion

In summary, health messages about the risks of opting out of childhood vaccination programs which public health professionals communicated via TV to parents resonated and yielded remarkable impacts on infant vaccination hesitancy risks. In this sample, parents generally perceived the messages as believable and relevant to healthier children.

Table 1. Study Characteristics

Variable	Number	Percentage	Variables	Number	Percentage
Tribe			Marital Status		
Yoruba	320	89.0	Single/Never Married	81	22.5
Hausa	1	0.3	Legally Married	254	70.7
Igbo	15	4.3	Cohabiting	3	0.8
No Response	23	6.4	Separated	1	0.3
Total	359	100	Divorced	8	2.2
Age (Years)			Widowed	2	0.6
<21	13	3.6	No Response	10	2.8
21 – 25	24	6.7	So' of Incom: 30 days		
26 – 30	34	9.5	A job	194	54.0
31 – 35	46	12.8	Spouse/sex partner(s)	18	5.0
>35	183	51.0	Other family members	29	8.1
No Response	59	16.4	Friends	15	4.2
Total	359	100	Trade sex for money	8	2.2
Education Level Attained			Other illegal sources	0	0
No Formal Education	2	0.6	No Income	57	15.9
Primary School	4	1.1	No Response	38	10.6
Some Secondary School	12	3.3	Total	359	100
Secondary School Graduate	33	9.3	Income Last 30 days		
Some Post Sec Sch (Uni, NDs)	110	30.6	No Income	62	17.3
Post Sec Sch Gra (Univ, NDs)	148	41.2	<N30,000	83	23.1
Postgraduate (Masters, PhD)	19	5.3	N30,000 – N50,000	63	17.5
No Response	31	8.6	>N50,000	109	30.7
Total	359	100	No Response	42	11.7
CV Knowledge			Total	359	100
A lot	297	82.7	State of Origin		
Some	62	17.3	Osun	249	69.4
None at all	0	0	Oyo	12	3.3
Total	359	100	Ondo	5	1.4
Religious Affiliation			Kwara	5	1.4
Christianity	248	69.1	Ogun	5	1.4
Muslim	68	19.4	Ekiti	3	0.8
Other	1	0.3	Delta	13	3.6
None	4	1.2	Imo	11	3.1
Total	359	100	Rivers	22	6.1

Work Situatn last 30 days			No Response	34	9.5
Unemployed	32	8.9	Total	359	100
Full time work	221	61.6	Gender		
Part time work	27	7.5	Male	110	30.6
Occasional work	23	6.4	Female	223	63.5
Retired	1	0.3	No Response	21	5.9
Disabled	1	2.3	Total	359	100
Home maker	4	1.1			
Student	20	5.6			
No Response	30	8.4			
Total	359	100			

Notes and abbreviations: Sec = Secondary, Sch = School, Gra = Graduate, Uni = University, NDs = National Diplomas, PhD = Doctor of Philosophy, Situatn = Situation, So' of Incom: 30 days = Source of income last 30 days

Tables 2a. Parents' childhood vaccine-related, beliefs, attitudes, behavioral intentions, behaviors, concerns

Covariates	Number	%	Covariates	Number	%
Vaccination is a highly effective method of preventing certain infectious diseases			Vaccines are generally very safe		
Strongly Agree	246	68.5	Strongly Agree	237	66.0
Agree	99	27.6	Agree	101	28.1
I Don't Know	4	1.1	I Don't Know	9	2.5
Disagree	2	0.6	Disagree	8	2.2
Strongly Disagree	0	0	Strongly Disagree	1	0.3
No Response	8	2.2	No Response	3	0.8
Total	100	100	Total	359	100
Childhood immunization is a cost-effective approach to public health			Routine immunization programs protect most of the world's children from a number of infectious diseases that previously claimed millions of lives each year		
Strongly Agree	222	61.8	Strongly Agree	267	74.4
Agree	72	20.1	Agree	73	20.3
I Don't Know	23	6.4	I Don't Know	5	1.4
Disagree	15	4.2	Disagree	4	1.1
Strongly Disagree	20	5.6	Strongly Disagree	2	0.6
No Response	7	1.9	No Response	8	2.2
Total	359	100	Total	359	100
There is a lot of benefit from vaccinating a child against vaccine-preventable diseases			How likely are you to vaccinate your child as at when due?		
Strongly Agree	251	69.9	Extremely Un Likely	25	7.0
Agree	77	21.5	Unlikely	5	1.4
I Don't Know	14	3.9	I Don't Know	24	6.7
Disagree	1	0.3	Likely	13	3.6

Strongly Disagree	2	0.6	Extremely Likely	243	67.7
No Response	14	3.9	No Response	49	13.6
Total	359	100	Total	359	100
How likely will you vaccinate each of your children against vaccine-preventable diseases when you have them			How determined are you to be faithful to vaccinate your child against vaccine-preventable diseases as at when due?		
Very Likely	174	48.5	Very Determined	293	81.6
Likely	47	13.1	Determined	51	14.2
I Don't Know	61	17.0	I Don't Know	4	1.1
Unlikely	3	0.8	Not Determined	0	0.0
Very Unlikely	8	2.2	Not Very Determined	1	0.3
No Response	66	18.4	No Response	10	2.8
Total	359	100	Total	359	100

Tables 2b. Parents' childhood vaccine-related, beliefs, attitudes, behavioral intentions, behaviors, concerns continues

Covariates	Number	%	Covariates	Number	%
How important is it to vaccinate the child as at when due?			ReLeader can influence my decision to vaccinate child		
Not Very Important	23	6.4	Strongly Agree	105	29.2
Not Important	7	1.9	Agree	159	44.3
I Don't Know	7	1.9	I Don't Know	29	8.1
Important	35	9.8	Disagree	28	7.8
Very Important	268	74.7	Strongly Disagree	4	1.1
No Response	19	5.3	No Response	34	9.5
Total	359	100	Total	359	100
Parents can influence my decision to vaccinate child			PHP can influence my decision to vaccinate child		
Strongly Agree	185	51.5	Strongly Agree	180	50.1
Agree	127	35.4	Agree	110	30.6
I Don't Know	13	3.6	I Don't Know	14	3.9
Disagree	3	0.8	Disagree	16	4.5
Strongly Disagree	1	0.3	Strongly Disagree	2	0.6
No Response	30	8.4	No Response	37	10.3
Total	359	100	Total	359	100
PCP can influence my decision to vaccinate child			Not vaccinating a child against vaccine-preventable diseases is life threatening for the child		
Strongly Agree	179	49.9	Strongly Agree	215	59.9
Agree	106	29.5	Agree	92	25.6
I Don't Know	7	1.9	I Don't Know	13	3.6
Disagree	31	8.6	Disagree	25	7.0
Strongly Disagree	1	0.3	Strongly Disagree	4	1.1
No Response	35	9.8	No Response	10	2.8

Total	359	100	Total	359	100
An unvaccinated child against VPDs diseases is susceptible to those diseases at any time			There is a lot of benefit from vaccinating a child against vaccine-preventable diseases		
Strongly Agree	204	56.8	Strongly Agree	251	69.9
Agree	116	32.3	Agree	77	21.5
I Don't Know	18	5.0	I Don't Know	14	3.9
Disagree	6	1.7	Disagree	1	0.3
Strongly Disagree	2	0.6	Strongly Disagree	2	0.6
No Response	13	3.6	No Response	14	3.9
Total	359	100	Total	359	100
Not vaccinating a child against vaccine-preventable diseases can result in disability for life			The consequences of not vaccinating a child against VPDs are severe		
Strongly Agree	285	79.4	Strongly Agree	182	50.7
Agree	44	12.3	Agree	108	30.1
I Don't Know	11	3.1	I Don't Know	35	9.8
Disagree	2	0.6	Disagree	17	4.7
Strongly Disagree	0	0.0	Strongly Disagree	12	3.3
No Response	17	4.7	No Response	5	1.4
Total	359	100	Total	359	100

Notes and abbreviations: ReLeader = Religious Leader, PCP = Primary Care Physician, PHP = Public Health Practitioner, VPDs = Vaccine-preventable diseases

Tables 2c. Parents' childhood vaccine-related, beliefs, attitudes, behavioral intentions, behaviors, concerns continues

Covariates	Number	%	Covariates	Number	%
The health of a family is the family's wealth			Childhood vaccination is essential for the child's health thru 'out life		
True	349	97.2	True	335	93.3
False	4	1.1	False	15	4.2
No Response	6	1.7	No Response	9	2.5
Total	359	100	Total	359	100
I intend to ensure all my children are vaccinated			I will vaccinate each of my children against vaccine-preventable diseases as at when due		
Yes	322	89.7	Yes	342	95.3
No	15	4.2	No	9	2.5
No Response	22	6.1	No Response	8	2.2
Total	359	100	Total	359	100
I will encourage my neighbors to vaccinate their children against			All my children received all the		

vaccine-preventable diseases as at when due			childhood vaccines appropriately		
Yes	346	96.4	Yes	309	86.1
No	8	2.2	No	11	3.1
No Response	5	1.4	Not Applicable	22	6.1
Total	359	100	No Response	17	4.7
My child's wellbeing is important to me			I will encourage any pregnant teenager to ensure they vaccinate their children against vaccine-preventable diseases when due		
Yes	340	94.7	Yes	349	97.2
No	3	0.8	No	5	1.4
No Response	16	4.5	No Response	5	1.4
Total	359	100	Total	359	100
The injection is painful for a child			The vaccines will improve/help the conditions		
Yes	192	53.5	Yes	312	86.9
No	158	44.0	No	32	8.9
No Response	9	2.5	No Response	15	4.2
Total	359	100	Total	359	100
The disease conditions are dreadful/terrible			The vaccines are too many		
Yes	290	80.8	Yes	188	52.4
No	63	17.5	No	164	45.7
No Response	6	1.7	No Response	7	1.9
Total	359	100	Total	359	100
The diseases are real (exist)			The diseases are a hoax (deception, fraud, trick)		
Yes	296	82.4	Yes	106	29.5
No	52	14.5	No	243	67.7
No Response	11	3.1	No Response	10	2.8
Total	359	100	Total	359	100

Table 2d. Summary of parents' childhood vaccine-related, beliefs, attitudes, behavioral intentions, behaviors, concerns. When asked specific questions to measure the beliefs, attitudes, and behaviors the affirmative responses were

Covariate	Percentage
The health of the family was the wealth of the family	97
Vaccines are effective against childhood vaccine-preventable diseases	96
Confident childhood vaccines are protective and safe	95
Concerned about the child's pain from the shots	53
Too many shots in one doctor's visit	52
The disease conditions are dreadful/terrible	81

I will encourage any pregnant teenager to vaccinate child against VPDs when due	97
I will encourage my neighbors to vaccinate children against VPDs as at when due	96
I will vaccinate each of my children against VPDs as at when due	95
The health of a family is the family's wealth (Benefits of childhood vaccine)	97
Childhood vaccination is essential for the child's health throughout life	93
I am determined to be faithful to vaccinate my child against VPDs as at when due	96
The consequences of not vaccinating a child against VPDs are severe	81
There is a lot of benefit from vaccinating a child against VPDs	91
Not vaccinating a child against VPDs can result in disability for life	91
Refusal to vaccinate children against VPDs is a health risk for the children for life	87
The vaccines will improve/help the conditions	87
Childhood immunization is a cost-effective approach to public health	82

Table 3. Parents' Sources of Information about Childhood Vaccination

Covariates	No	%	Covariates	No	%
Television			Radio		
Yes	266	74.1	Yes	274	76.3
No	93	25.9	No	85	23.7
Total	359	100.0	Total	359	100.0
Newspaper			Magazines		
Yes	177	49.3	Yes	152	42.3
No	182	50.7	No	207	57.7
Total	359	100.0	Total	359	100.0
A relative or friend			Workplace		
Yes	216	60.2	Yes	211	58.8
No	143	39.8	No	148	41.2
Total	359	100.0	Total	359	100.0
Schools			Clinic		
Yes	184	51.3	Yes	240	66.8
No	175	48.7	No	119	33.2
Total	359	100.0	Total	359	100.0
Billboard			*Other Sources		
Yes	117	32.6	Yes	83	23.1
No	242	67.4	No	276	76.9
Total	359	100.0	Total	359	100.0

*Other Sources mentioned included

1. Seminars/Workshops
2. Market places
3. Town Announcers/Criers
4. Internet
5. Worship Centers (Church/Mosques).

Table 4. Univariable Logistic Regression Analysis of the Medium of Communication of Childhood Immunization

Potential Predictors of Childhood Immunization Risk Perception	Prevalence Odds Ratio (POR)	95% Confidence Interval (CI)
There is enough prompt to VPDs information action on the radio in Nigeria		
No	1.0 (reference)	ref
Yes	1.29	0.65 – 2.58
There is enough prompt to VPDs information action on TV in Nigeria		
No	1.0 (reference)	ref
Yes	2.63	1.53 – 4.51
There is enough prompt to VPDs information action on the news media in Nigeria		
No	1.0 (reference)	ref
Yes	2.24	1.38 – 3.62
There is enough prompt to VPDs information action on the Internet		
No	1.0 (reference)	ref
Yes	2.60	1.63 – 4.17
There is enough prompt to VPDs information action on Social media		
No	1.0 (reference)	ref
Yes	2.96	1.85 – 4.73

Notes and abbreviations: VPDs = Vaccine-preventable diseases

Table 5. Multivariable Logistic Regression model of the Medium of Communication of Childhood Immunization

Potential Predictors of Childhood Immunization Risk Perception	Adjusted Prevalence Odds Ratio (APOR)	95% Confidence Interval (CI)	Wald test (Z)	p-value Z ($\alpha < 0.05$)
There is enough prompt to VPDs information action on the radio in Nigeria	0.27	0.10 – 0.74	-2.56	0.01
There is enough prompt to VPDs information action on TV in Nigeria	4.35	1.56 – 12.13	2.81	0.00
There is enough prompt to VPDs information action on the news media in Nigeria	0.57	0.22 – 1.48	-1.16	0.25
There is enough prompt to VPDs information action on the Internet	1.12	0.48 – 2.60	0.25	0.80
There is enough prompt to VPDs information action on Social media	3.20	1.54 – 6.68	3.10	0.00

Notes and abbreviations: VPDs = Vaccine-preventable diseases, TV = Television

References

- [1]. Bond L, and Nolan T. Making sense of perceptions of risk of diseases and vaccinations: a qualitative study combining models of health beliefs, decision-making and risk perception. *BMC Public Health*, 2011; 11:943.
- [2]. Coggon D, Barker D, and Rose G. *Epidemiology for the uninitiated* (Chapter 8, "Case-control and cross-sectional studies"). (5th Ed.), London: BMJ (British Medical Journal) Publishing; 2003.
- [3]. Drehob PA, Roush SW, Stover BH, et al. Public Health Surveillance Workforce of the Future. *CDC Scientific Education and Professional Development Program Office and National Center for Immunization and Respiratory Diseases*, 2012;61(03):25 – 29
- [4]. Dubé E, Vivion M, and MacDonald NE. Vaccine hesitancy, vaccine refusal and the anti-vaccine movement: influence, impact and implications. *Expert Review of Vaccines*, 2015; 14(1):99–117.
- [5]. Dubé E, Gagnon D, Nickels E, et al. Mapping vaccine hesitancy – country-specific characteristics of a global phenomenon. *Vaccine*, 2014;32(49):6649–6654
- [6]. Dubé E, Gagnon D, Zhou Z, et al. Parental Vaccine Hesitancy in Quebec (Canada). *PLOS Currents Outbreaks*, 2016 1st Ed doi: 10.1371/currents.outbreaks.9e239605f4d320c6ad27ce2aea5aad2
- [7]. Dubé E, Laberge C, Guay M, et al. Vaccine hesitancy: An overview. *Human Vaccine Immunotherapeutic*, 2013; 9(8):1763 – 1773.
- [8]. Frenk J, Chen L, Bhutta ZA, et al. Health professionals for a new century: transforming education to strengthen health systems in an interdependent world. *Lancet*, 2010; 376:1923 – 1958.
- [9]. Freed GL, Clark SJ, Butchart AT, et al. Parental vaccine safety concerns in 2009. *Pediatrics*, 2010;125(4):654–659
- [10]. Gellin BG, Maibach EW, and Marcuse EK. Do parents understand immunizations: A national telephone survey. *Pediatrics*, 2000;106(5):1097–1102
- [11]. Gust D, Brown C, Sheedy K, et al. Immunization attitudes and beliefs among parents (beyond a dichotomous perspective). *American Journal of Health Behavior*, 2005; 29:81 – 92.
- [12]. Holmes L, (Jr), Chan W, Jiang Z, et al. Effectiveness of androgen deprivation therapy in prolonging survival of older men treated for locoregional prostate cancer. *Prostate Cancer Prostatic Disease*, 2007; 10(4):388 – 395.
- [13]. Kapp C. Nigerian states again boycott polio-vaccination drive. Muslim officials have rejected assurances that the polio vaccine is safe—leaving Africa on the brink of re-infection. *Lancet*, 2004;363:709
- [14]. Kestenbaum LA, and Feemster KA. Identifying and addressing vaccine hesitancy. *Pediatrics Annals*, 2015;44(4):e71–75
- [15]. Leask J, Braunack-Mayer A, and Kerridge I. Consent and public engagement in an era of expanded childhood immunisation. *Journal of Paediatrics and Child Health*, 2011;47:603–607
- [16]. Larson HJ, Jarrett C, Eckersberger E, et al. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. *Vaccine*, 2014; 32(19):2150–2159.
- [17]. MacDonald NE, Smith J, and Appleton M. Risk perception, risk management and safety assessment: what can governments do to increase public confidence in their vaccine system? *Biologicals*, 2012; 40:384 –388.
- [18]. Neuwirth K, Dunwoody S, and Griffin RJ. Protection Motivation and Risk Communication. *Risk Analysis*, 2000; 20(5):721–734.
- [19]. Poland GA, Jacobson RM, and Ovsyannikova IG. Trends affecting the future of vaccine development and delivery: the role of demographics, regulatory science, the anti-vaccine movement, and vaccinomics. *Vaccine*, 2009; 27:3240 – 3244.
- [20]. Peretti-Watel P, Larson HJ, Ward JK, et al. Vaccine hesitancy: clarifying a theoretical framework for an ambiguous notion. *PLoS Currents*, 2015; 7.
- [21]. Prentice-Dunn S, and Rogers RW. Protection motivation theory and preventive health: Beyond the health belief model. *Health Education Research*, 1986; 1(3):153–161.
- [22]. Poland GA, and Jacobson RM. The age-old struggle against the antivaccinationists. *New England Journal of Medicine*, 2011; 364(2):97 – 99.
- [23]. Reynolds B, and Seeger MW. Crisis and Emergency Risk Communication as an Integrative Model. *Journal of Health Communication*, 2005;10:43–55

- [24]. Reynolds B, and Seeger MW. Crisis and Emergency Risk Communication. US Department of Health and Human Services, Centers for Disease control and Prevention. 2012. Available at https://emergency.cdc.gov/cerc/resources/pdf/cerc_2012edition.pdf Accessed November 16, 2016.
- [25]. Siddiqui M, Salmon DA, and Omer SB. Epidemiology of vaccine hesitancy in the United States. *Human Vaccine Immunotherapeutics*, 2013; 9(12):2643 – 2648.
- [26]. Salmon DA, Dudley MZ, Glanz JM, et al. Vaccine hesitancy: causes, consequences, and a call to action. *American Journal of Preventive Medicine*, 2015; 49(6 Suppl 4):S391–398.
- [27]. Trochim WMK, and Donnelly JP. *The research methods knowledge base*. (3rd Ed.), New York, NY: Atomic Dog; 2006.
- [28]. Wilson RJ, Paterson P, Jarrett C, et al. Understanding factors influencing vaccination acceptance during pregnancy globally: A literature review. *Vaccine*, 2015;33(47):6420–6429