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Population-based Childhood Immunization Education Intervention Program: Did Parental Hesitancy Risk Perception Translate to Risk Avoidance?

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Abstract

Introduction: *Vaccines are the most effective prevention tools to eliminate or significantly decrease the incidence of many prevalent vaccine-preventable diseases (VPDs). Risk factors associated with parents' child immunization hesitancy constituted a major difficulty to routine immunization program to prevent and control infant VPDs. Earlier, we reported that parents' risk perception of infancy vaccination doubtfulness was remarkable after proper evidence-based information, parental infant immunization indecision risks perception translation to strong-willed early-days immunization behaviors remains unsubstantiated.*

Methods*: We used cross-sectional research method with pilot tested behavioral theories-informed tool to judge whether the observed parental infancy immunization risk acuity actually transformed into risk avoidance to vaccinate their children.*

Results*: The results of this study (N = 359) showed that all respondents had significant awareness of childhood immunization. Among the respondents, 95% reported high school and above education levels and 54% gainfully employed. After correction for confounding with multivariable logistic regression analysis, study participants that had good risk perception were 4 times as likely to vaccinate their children compared with participants with poor perception, adjusted POR (APOR) = 4.05, CI = 1.12 – 14.73.*

Conclusions*: The activities of public health professionals empowered parents to progressively perceive and avoid childhood vaccination risks relevant to healthier children. The findings from this study have far-reaching implications for broad beneficial and effective infant morbidity and mortality reduction. Addressing parents' specific questions and concerns adequately helped make more informed choices to improve complete wellbeing.*

Keywords*: Parental childhood vaccination hesitancy; effective risk-benefit communication; information seeking/processing; risk perception, Protection motivation; risk avoidance.*

Introduction

Scientists have established vaccination as the most cost-effective achievements of public health investments of the 20th century [1 – 3]. Vaccines are the most effective prevention tools to eliminate or significantly decrease the incidence of many once prevalent VPDs [4 – 7]. The proportion of parents that used to engage in behaviors that reduce the risks of infant VPDs was low considerably [8, 9]. Widespread parents' child immunization hesitancy and the associated risk factors constituted a major difficulty to routine immunization program for the prevention and control of infant VPDs [10 – 13].

Parental doubtfulness about the safety and usefulness of childhood vaccines were the main cause of the drop-in vaccination coverage against infectious diseases at infancy. The scenario inevitably threatened infant vaccination programs and led to reduced herd immunity and large-scale outbreaks of serious early life diseases; some of which resulted in infant mortality and lifelong disability in others

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[14 – 16]. Parental apprehensions about the safety of polio vaccine in Nigeria, for instance, led to a regional outbreak and severely set back a polio elimination program [17]. Such indecision behaviors played into the inability to achieve the Millennium Development Goals (MDG) for healthier children in Nigeria.

The average parent was unclear about the risk of adverse events due to obtainable conflicting information. Available information about risks was about average risk. What the parent wanted to know was not general risk to children but what the risk to their particular child was.

Investigators have advanced convincing proofs of the value of vaccines to avoid infant infectious diseases and ensure healthier children [18 – 24]).

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 [25]. Given the pervasiveness and broad societal impact due to non-vaccination of children, scientists recognized and proffered solutions to it as a public health problem. Public health professionals have educated parents to prevent the occurrence or persistence of the age long risks due to parental childhood vaccine hesitancy.

Descriptive results presented in our previous study indicated a momentous improvement in the perception of the risks of opting out of childhood vaccination programs among parents [26]. The overarching objective of this thesis was to use cross-sectional research method and inferential statistics to judge whether parents' childhood vaccination diffidence risks perception actually transformed into risk avoidance behaviors by unwaveringly vaccinating their children.

Materials and methods

Appropriate theoretical model or framework to underpin health and risk communication and/or interventions is sure to (a) be more effective for empowering people to decide on suitable actions and (b) help to elucidate and explain behaviors change [27 – 31]. After obtaining informed consent from each participant, the authors of this paper administered pilot tested, 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 to meet set objectives. We used the constructs of subjective risk perception and decision-making theories, such as Protection Motivation Theory, Health Belief Model, and Theory of Planned Behaviors, to build the pilot tested tool in order to measure the mediating factors that (a) empowered parents to overcome the risks of opting out of childhood vaccination, and (b) aroused, sustained and directed protective childhood vaccination behaviors accurately thus address the objectives of this study [32 – 39].

Inclusion Criteria: Potential participants were required to:

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

Exclusion criteria: Participation was restricted from individuals who were:

a. Mentally incapable of providing response
b. Previously sampled by the same questionnaire
c. Outside the scope of the inclusion criteria

Data analysis

The data analyses in the study were in three stages: (a) tabulation of the response to each relevant variable, (b) test of association, (c) univariate and multivariable logistic regression. We performed a pre-analysis screening to summarize the categorical data using frequency and percentages as well as assess the missing data. We completed the hypothesis-specific analysis using Chi square (χ^2) statistic; Mantel-Haenszel stratified analysis and unconditional univariate logistic regression model at $p < 0.05$ significance level.

Prior to the application of multivariable logistic regression model, we assessed the exposure variables for their potential confounding effect by determining whether or not they were associated with the outcome variable in the first place and then with the independent variables. The association in these circumstances qualified the exposure variable as a confounder.

Finally, we forward loaded all variables with $p< 0.25$ and backward eliminated those that did not fit the model to build the unconditional multivariable logistic regression model and presented our findings as adjusted prevalence odds ratio (APOR). All statistical tests were two tailed, at $p<0.05$ significance level as type I error tolerance and all tests were 2-tailed. We performed all analyses using STATA statistical software, version 13.0 (STATA Corp, College Station, TX).

Variable ascertainment

Dependent/outcome variables

The outcome variables were (a) parental childhood immunization risk perception; beliefs about the chance of occurrence of a risk; and understanding and appraisal of present risk exposure. We measured this variable with the item, *"If one does not vaccinate the child faithfully as at when due, how likely would the child's health improve?"* The choices were "*Extremely unlikely*", "*Unlikely*", "*I don't Know*", "*Likely*", or "*Extremely Likely*" and (b) "*How confident are you to vaccinate your child against VPDs as at when due?* The responses were *"Very confident, "Confident", "I don't know", "Not so confident", or "Not at all confident"*. The responses were further recoded into binary scale for statistical analysis.

Independent/predictor variables

We chose the main independent variables from the tool that associated significantly with the outcome variables and helped to address the objectives of the study.

Results

Table 1 presents the socio-demographic 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 marred, 63% were female and 54% were gainfully employed.

Table 2 shows test of association between study characteristics and parents' childhood vaccination risk perception

Table 3 summarizes parents' childhood vaccine-related, beliefs, attitudes, behavioral intentions, behaviors, concerns.

Table 4 illustrates the univariable logistic regression analysis in which study participants that had good childhood vaccination risk perception were 6 times as likely to vaccinate their children compared with participants that had poor perception, prevalence odds ratio (POR) = 6.30, 95% Confidence Intervals (CI) = 1.93 – 20.56.

Table 5 presents the multivariable logistic regression analysis in which study participants that had good childhood vaccination risk perception were 4 times as likely to vaccinate their children judged against participants that had poor perception, adjusted POR (APOR) = 4.05, CI = 1.12 – 14.73.

Discussion

Risk communication makes a major impact on how well society is prepared to cope with risk and react to crises and disasters [40 – 46]. Various investigators supported the fact that 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 [47 – 49].

Elsewhere, we reported that the health messages about the risks of opting out of childhood vaccination programs which public health professionals communicated to parents in our sample empowered them to overcome the shades and uncertainties that played into their vaccination decision-making behaviors. Our study revealed that parents had high confidence in childhood vaccine safety and perceived the messages as believable and relevant to healthier children [26].

The goal in the present study was to judge whether the consequential childhood vaccination hesitancy risk perception of parents as a result of risk-benefit communication of public health professionals actually transformed into risk evasion exemplified by heroically vaccinating their children. In this study, our multivariate unconditional logistic analyses to correct for potential

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confounding showed that study participants that had good childhood vaccination risk perception were four times as likely to vaccinate their children judged against participants that had poor perception. Components of vaccine beliefs were significant predictors of vaccine-related behaviors, including discussing information about vaccines with others and reported dogged approval of infant immunization.

Results of this study (N = 359) signified that providing information about the severity of the consequences associated with infant vaccination hesitancy produced (a) adequate risk perception, (b) greater information seeking, (c) heuristic and systematic information processing, and (d) willingness to take actions designed to avoid the hazard among parents. The results provided general support for Protection Motivation Theory (PMT).

Rogers [32] proposed the PMT to provide conceptual clarity to the understanding of fear appeals. Rogers [33] extended the theory to a more general theory of persuasive communication, with an emphasis on the cognitive processes mediating behavioral change. The core assumption of the PMT is that threat and coping appraisal processes result in either intention to perform adaptive responses (protection motivation) or maladaptive responses (health risk-taking impetus e.g. childhood vaccination risk-taking behaviors).

The coping appraisal depends upon (a) one's perceived severity of a threatened event (e.g., childhood VPDs); (b) one's perceived probability of the occurrence, or vulnerability (e. g. the perceived vulnerability of the child to infant VPDs); (c) the individual's expectancy that carrying out the recommended preventive behavior can remove the threat (the perceived response efficacy); (d) one's perceived self-efficacy (i.e., the level of belief and confidence in one's ability to initiate, undertake, and complete the recommended preventive/adaptive behavior successfully), and (e) an estimate of the costs associated with a particular course of action (response costs) [50].

This study showed how appropriately designed vaccine risk communication influenced parents' reasoning proficiency and transformed childhood vaccination risk perception into risk avoidance. According to Briggs [51]), public participation, stakeholder involvement, and the formal (horizontal and vertical) structures within which the risk occurred were dimensions that played into forestalling the risk.

Providing evidence-based information about the severity of the consequences of a risk generated superior information-seeking [52]. Our findings are not unique. Studies have shown that combined information about levels of risk, severity, and efficacy jointly produced greater rates of heuristic and systematic information-processing resulting in willingness to take actions designed to avoid the hazard [53, 54]. Enabling a person to discover or learn something for themselves by having "hands-on" or interactive approach is the essence of heuristic learning [55]

Theoretically-based activities that promoted evidence-informed risk communications accentuated public's perceptions of the risks and benefits of childhood vaccines [56, 57]. Risk communication enables stakeholders and civil society to balance accurate knowledge about risk with personal interests, concerns, beliefs and resources, and make informed choices about risk, when they are themselves involved in risk-related decision-making.

Strength and limitations

The findings in this study are subject to several potential 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 research lacked generalizability due to the variation in participants' experiences. The study was limited to Nigerians in Osun state in the southwestern part of the country, a heterogeneous population. Conclusions on the nonrandom sample are representative of those who completed the survey and not the Nigerians as a whole.

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 with respect to parental perception of

childhood immunization. The accuracy of the study depended on the authenticity of the responses given by the participants.

Since the survey did not attempt to verify the immunization status of the respondents' children, we did not know if or how a respondent's vaccine attitudes or concerns affected their actual behavior. This was a quantitative (subjective) cross-sectional study. Cross-sectional studies are short of temporal sequence and incapable of estimating any causal association.

Unmeasured confounding might have influenced the findings, which is common in non-experimental social epidemiologic designs. However, we do not think that unmeasured or residual confounding solely drove our findings. We used multivariable logistic regression analysis to correct for any confounding.

In spite of these limitations, this research had strength, including (a) the use of accurate point 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 [58, 59], and (b) the ability to identify parental perception of childhood immunization risk determinants/factors in the Nigerian sample, which have neither been studied nor documented as far as we knew. This study had enough statistical power to test the hypotheses given the plans for reasonable sample size.

We chose a cross-sectional research method because the study aimed to describe the characteristics of a population and relationship between a health-related state and other factors of interest as they existed in the specified Nigerian population at a particular point in time. We assumed the population sample to be typical of the whole group, without regard for what may have preceded or precipitated the health status found at the time of the study.

Conclusion

In this study, we finished off with the fact that perception of risks associated with opting out of childhood vaccination explained risk avoidance among parents. This showed that the messages about the pre-existing risks of opting out of childhood vaccination programs which public health professionals communicated to parents yielded remarkable positive impacts, social changes and actions for healthier children.

Tables

Table 1. Demographic characterization of the participants

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

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No Formal Education	2	0.6	No Income	57	15.9
Primary	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

Table 2. Test of association between study characteristics and parents' childhood vaccination risk perception (Chi square (χ^2) statistic; Mantel-Haenszel stratified analysis at $p < 0.05$ significance level)

Covariates	**Childhood Vaccination Risk Perception**						
	Poor		**Great**		χ^2	**df**	***p*-value**
	Number	**%**	**Number**	**%**			
Refusal to vaccinate children against VPDs is a health risk for the children throughout life					12.3	5	0.04
Strongly Agree	72	66.7	177	70.5			
Agree	23	21.3	41	16.3			
I Don't Know	4	3.7	17	6.8			
Disagree	4	3.7	11	4.4			
Strongly Disagree	1	0.9	5	2.0			
No Response	4	3.7	0	0.0			
Not vaccinating a child against VPDs is life threatening for the child					10.7	5	0.05
Strongly Agree	61	56.5	154	61.4			
Agree	31	28.7	61	24.3			
I Don't Know	6	5.6	7	2.8			
Disagree	3	2.8	22	8.7			
Strongly Disagree	1	0.9	3	1.2			
No Response	6	5.5	4	1.6			
How determined are you to be faithful to vaccinate your child against VPDs as at when due?					25.2	4	<0.001
Very determined	78	72.2	215	85.7			
Determined	17	15.7	34	13.5			
I don't know	3	2.8	1	0.4			
Not at all determined	1	0.9	0	0.0			
No Response	9	8.4	1	0.4			
I will vaccinate each of my children against VPDs as at when due					18.3	2	<0.01
Yes	95	88.0	247	98.4			
No	7	6.5	2	0.8			
No Response	6	5.5	2	0.8			
Childhood vaccination is essential for the health of the child throughout life					10.0	2	0.01
Yes	97	89.8	238	94.8			
No	4	3.7	11	4.4			
No Response	7	6.5	2	0.8			
I will encourage any pregnant teenager to ensure they vaccinate their children against VPDs as at when due					18.0	2	<0.01
Yes	99	91.7	250	99.6			
No	5	4.6	0	0.0			
No Response	4	3.7	1	0.4			

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Abbreviations: CVRP = Childhood Vaccination Risk Perception, df = degrees of freedom, χ^2 = chi square, (CVRP = If one does not vaccinate the child faithfully as at when due, how likely would the child's health improve), VPDs = Vaccine-preventable diseases

Table 3. 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 4. Univariable Logistic Regression Analysis of the Predictors of Risk Perception and Vaccine Behavior

	Risk Perception		**Vaccination Behavior**	
Potential Predictors of Childhood Immunization Risk Perception and Vaccination Behavior	**Prevalence Odds Ratio (POR)**	**95% Confidence Interval (CI)**	**Prevalence Odds Ratio (POR)**	**95% Confidence Interval (CI)**
Childhood vaccination is essential for the health of the child throughout life				
No	1.0 (ref)	ref	1.0 (ref)	ref
Yes	2.08	0.90 – 4.79	13.62	4.27 – 43.46
Vaccination is a highly effective method of preventing certain				

infectious diseases				
No	1.0 (ref)	ref	1.0 (ref)	ref
Yes	7.51	1.99 – 28.34	16.85	4.35 – 65.32
Vaccines are generally very safe				
No	1.0 (ref)	ref	1.0 (ref)	ref
Yes	3.36	1.37 – 8.23	11.42	3.43 – 38.04
Childhood vaccines are successful in preventing disease				
No	1.0 (ref)	ref	1.0 (ref)	ref
Yes	4.47	1.46 – 13.68	8.28	2.02 – 33.95
Vaccines protect 100% of the recipients				
No	1.0 (ref)	ref	1.0 (ref)	ref
Yes	4.36	1.67 – 11.40	5.61	1.42 – 22.11
I will encourage any pregnant teenager to ensure they vaccinate their children against VPDs as at when due				
No	1.0 (ref)	ref	1.0 (ref)	ref
Yes	22.73	2.84 – 181.74	2.96	1.85 – 4.73
If one does not vaccinate the child faithfully as at when due, how likely would the child's health improve				
Likely			1.0 (ref)	ref
Unlikely			6.30	1.93 – 20.56

Notes and abbreviations: VPDs = Vaccine-preventable diseases, ref = reference

Table 4. Multivariable logistic regression analysis of the predictors of vaccine behavior

	Vaccination Behavior	
Potential Predictors of Childhood Immunization Behavior	**Adjusted Prevalence Odds Ratio (APOR)**	**95% Confidence Interval (CI)**
If one does not vaccinate the child faithfully as at when due, how likely would the child's health improve		
Likely	1.0 (ref)	ref
Unlikely	4.05	1.12 – 14.73
Childhood vaccination is essential for the health of the child throughout life		
No	1.0 (ref)	ref
Yes	8.60	2.32 – 31.85
Vaccines protect 100% of the recipients		
No	1.0 (ref)	ref
Yes	4.65	0.62 – 34.86
Childhood vaccines are successful in preventing disease		
No	1.0 (ref)	ref
Yes	1.45	0.15 – 14.27

Notes and abbreviations: VPDs = Vaccine-preventable diseases, ref = reference, Vaccination behavior = "I am determined to be faithful to vaccinate my child against VPDs as at when due"

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