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Barriers and Potential in the Final Stage of Global Polio Eradication Initiative, NDHS 2008

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Master of Public Health

Georgia State University

School of Public Health

A Thesis Submitted to the Graduate Faculty
Of Georgia State University in Partial Fulfillment
Of the
Requirements for the Degree
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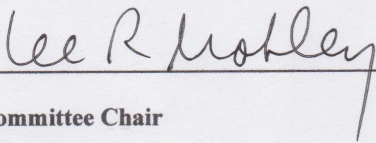
APPROVAL PAGE

**BARRIERS AND POTENTIAL IN THE FINAL STAGE OF GLOBAL POLIO
ERADICATION INITIATIVE, NDHS 2008**

By: Sarah Safi

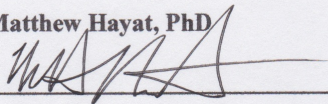
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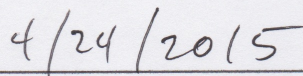


Committee Chair

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Committee Member



Date

Abstract

Background: Poliomyelitis is a viral disease that causes temporary or permanent paralysis among children less than five years of age; however, the virus can infect adults, too. There is no cure for poliomyelitis. The only possible way to save the children under the age of five from the disease is to get them vaccinated against the poliovirus. The Global Polio Eradication Initiative (GPEI) aimed to eradicate the poliovirus by the year 2000. Unexpectedly, even today there are still three polio-endemic countries in the world: Afghanistan, Pakistan, and Nigeria. The main hypothesis of the current paper was that mothers with higher levels of education and wealth index are more likely to get their children vaccinated against poliovirus, as compared to the ones with less education and lower wealth index. Also, it is hypothesized that Muslim communities are more reluctant to polio vaccines as compared to non-Muslim communities.

Methods: First, the 2008 Nigeria Demographic and Health Surveys (NDHS) data for Nigeria was analyzed to explore a binary outcome (whether or not the child had polio vaccination). The outcome was explained by categorical variables related to the mother's SES and religion. Next, Seven reasons given by mothers who did not vaccinate their children and who lived in either rural or urban settings was analyzed. The reasons included: Lack of information, fear of side effects, fear that child will get disease, vaccines do not work, post too far and child was absent

Results: Results of the study indicated a statistically significant and direct association between the Nigerian mothers' level of education and the odds of getting their child vaccinated. It was also suggested that the odds of getting the polio vaccines were higher between the Nigerian Catholic and other Christian communities as compared to the Muslim communities. Lack of information was the number one reason for not getting the child vaccinated between mothers in rural settings (24%) while fear of side effects and span of vaccination posts stood second and

third. Among mothers in urban settings fear of side effects was the main reason (16%) while lack of information and religious reasons were the number two and number three reasons.

Conclusion: The study findings suggested that mothers' SES could affect the likelihood of getting their children vaccinated, suggesting that the governments of polio endemic countries should consider women's education and empowerment as part of their health promotion policies and strategies. In addition, study findings were consistent with other related literature in pointing out the need for raising awareness regarding the goals of GPEI and adopting community-based strategies to combat the existing sensitivity against the polio eradication campaigns. Further research needs to be conducted to assess the vaccination related behaviors and attitudes related to mothers' SES with a special focus on Muslim communities where higher reluctance were experienced against polio vaccines as compared to the non-Muslim communities. Nevertheless, the odds of getting their children vaccinated were lesser among the Traditionalists as compared to Muslims. Less has been written about the vaccination disparities among this religious minority in Nigeria. Future research is recommended to explore the factors that influence polio immunization refusals among the mentioned group.

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Acknowledgement

I would like to thank my thesis chair Dr. Lee Rivers Mobley and my thesis committee member Dr. Matthew Hayat for their guidance, support, encouragement and endless patience. I so appreciate your generously offering your valuable time whenever I needed it and for answering my questions in the best possible manner. This simply wouldn't have been possible without the two of you. Thank you Dr. Mobley for showing me the light whenever I was lost. Apart from doing my research I learned one more thing from you and that is how to always think about possibilities. My special thanks goes to all my instructors throughout the MPH program and the GSU-School of Public Health administration. I enjoyed being part of the GSU family.

Dedication

I dedicate this work to my amazing mother who is my inspiration, my father who is no more with me but his guidance lightens my way whenever I felt lonely, my sister Tahmina jan, who is my hero and who has stood by me no matter, my brother Suleman jan for being my best friend and for the beautiful smiles of my sister Marwa jan and My brother Noman jan. Thank you for believing in me; I am blessed to have you all. I also thank all my dear friends who supported me throughout this journey. I so need you all and appreciate your being part of my life.

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Chapter I

1.0.0. Background

Poliomyelitis, as the Global Polio Eradication Initiative (GPEI) defined it, is a viral disease that causes temporary or permanent paralysis among children less than five years of age; however, the virus can infect adults, too. Young children before being toilet trained are vulnerable to the disease and can be a potential source of its transmission (GPEI, 2015). As reported by the World Health Organization, the main sources for disease transmission are dirty water and food. Symptoms of the disease are similar to that of other infectious diseases, such as fever and gastrointestinal discomfort. In a number of cases the virus that can cause paralysis affects the nervous system. The paralysis can be short-term or can cause lifetime disability. According to the World Health Organization (WHO), one in 200 of the children who are infected by the poliovirus will develop paralysis and the mortality rates among those with paralysis are 5-10%. There is no cure for poliomyelitis. The only possible way to save the children under the age of 5 from the disease is to get them vaccinated against the poliovirus (WHO, 2014).

The Global Polio Eradication Initiative (GPEI) is an extraordinary movement that aims to eliminate the poliovirus from the surface of the earth. The initiative was started back in 1988. It has been incredibly successful in decreasing the cases of the disease from 125 endemic countries by up to 99%, when compare to the estimated >350,000 cases back in 1988. It was initially intended that polio would be eradicated by the year 2000, while the certification of eradication would be obtained by 2005. Unexpectedly, even today there are still three polio-endemic countries in the world: Afghanistan, Pakistan, and Nigeria. The consequences for incomplete eradication can be drastic. Today, if only one single case of the disease remains, in 10 years, it can result in 200,000 new cases of it each year. Having polio eradicated today would save \$40-\$50 billion in the global economy within 20 years, as well as ensuring a healthier

global population. Figure 1, below, shows current poliovirus reported to WHO from 01 January-24 March, 2015.

Circulating Vaccine-derived Poliovirus (cVDPV): “Is a factor for continued circulation of WPV and can be a cause of paralytic poliomyelitis. The biological structure of cVDPV is similar to that of WPV. It is differentiated from Sabin vaccine–related poliovirus isolates by its specific genetic properties that suggest prolonged transmission (“Progress toward poliomyelitis eradication," 2013).

Definition of Acute flaccid paralysis (AFP): As defined by Marx et al. (2000) AFP is a clinical syndrome characterized by rapid onset of weakness, including (less frequently) weakness of the muscles of respiration and swallowing, progressing to maximum severity within several days to weeks. The term "flaccid" indicates the absence of spasticity or other signs of disordered central nervous system motor tracts such as hyperreflexia, clonus, or extensor plantar responses.” (Marx et al. 2000, p. 298).

Circulating Vaccine-derived polioviruses (VDPVs): As defined by the GPEI (2014) “are rare strains of poliovirus that have genetically mutated from the strain contained in the oral polio vaccine.” (GPEI, 2014, para. 1). VP1 is a type of the poliovirus type1 capsid proteins as reported by the GPEI (2014).

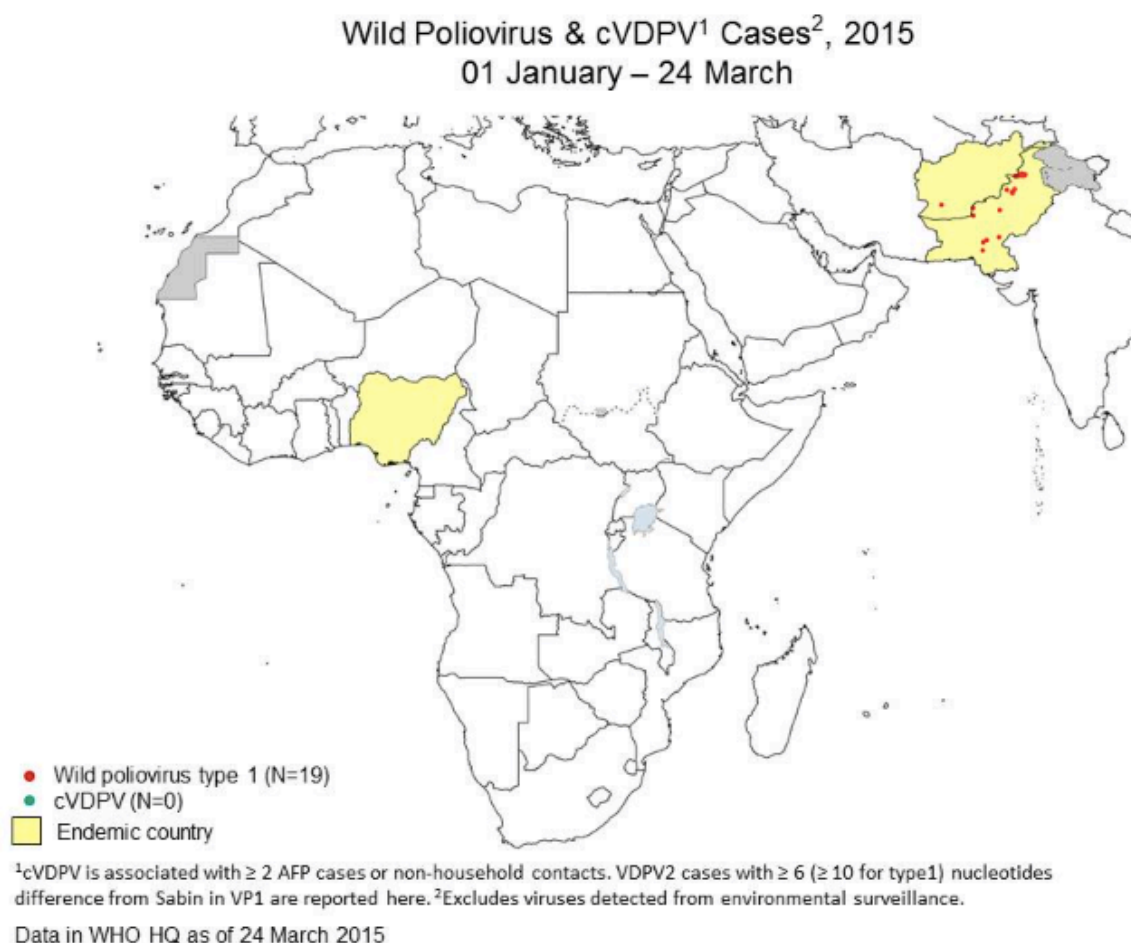


Figure 1. Polio cases by country (Screenshot from GPEI, 2015)
<http://www.polioeradication.org/Dataandmonitoring.aspx>

1.1.0. History

Before 1955 when inactivated polio vaccine (IPV) was first introduced, every year about half a million people were either killed or paralyzed due to poliomyelitis. Utilization of IPV in the United States was a success story. In the 1950s, there were 20,000 cases of poliomyelitis that decreased to 1000 cases by the 1960s, marking a decrease of 90% in the incidence of the disease (Salk, 1980). In 1979, the introduction of oral polio vaccines (OPV) and adoption of mass vaccination campaign strategies that aimed to provide two doses of trivalent OPV (tOPV, types 1, 2, and 3 at birth and at ages 6, 10, and 14 weeks) for all children under the

age of five stopped the transmission of poliovirus in the United States (Sabin, 1979). The Pan American Health Organization initiative promoted polio eradication in the Americas by 1990, by conducting in Latin America a similar vaccination campaign as done in the United States. In 1988, the World Health Assembly (WHA) in association with Rotary International and full support of its member countries for the first time launched the largest global public health intervention, the global polio eradication initiative (GPEI), with a vision of a polio-free world by 2000 (WHA, 1988).

Today, the GPEI is a joint venture of the WHO, Rotary International, the US Centers for Disease Control and Prevention (CDC), and the United Nations Children's Fund (UNICEF), in collaboration with global partners such as the United States Agency for International Development (USAID), the Bill & Melinda Gates Foundation, the ministries of health of the countries where polio is prevalent, and other public and private agencies (GPEI, 2015). GPEI was successful in eliminating the poliovirus from the Americas and the Western Pacific Region by the year 2000 (Adams, 2000). The European Region was certified polio-free in 2002. By the year 2008 in the most parts of the world polio had been eradicated (Murakami et al., 2014).

The initiative had achieved dramatic success when it reduced the number of polio cases from 350,000 in 1988 to 416 in 2013 (BBC, 2014). In the context of developing countries, the progress of GPEI was most spectacular in countries like those in Latin America with efficient healthcare infrastructures. The British Broadcasting Corporation (BBC) reported the CDC that, from the three types of wild poliovirus, type 2 and type 3 have already been interrupted. The elimination of type 3—the most common cause of polio that more frequently caused paralysis among children—has recently been declared, as no new cases have been reported within three years (BBC, 2014). The last case of wild poliovirus type 3 (WPV3) was last detected in Pakistan

in November 2012. This achievement is a milestone for GPEI but there is still a long way to go since at least one more year is needed for the GCC to declare the WPV3 eradicated. The cases of WPV1 have decreased from 53 to 6 cases in 2013.

Definition and Criteria for Poliomyelitis Eradication Certifications

The WHO defines Global Polio Eradication (GPE) as the attainment of zero wild poliovirus (WPV) incidence in the world. The live oral poliovirus vaccine (OPV) was solely endorsed by the GPEI for the purpose of making this goal achievable for the low and middle-income countries where the GPEI promoted it (WHO, 1988). A study by Smith, Adams, and Tangermann (2004) asserted that promoting further the WHO definition, the Global Commission for the Certification of the Eradication of Poliomyelitis (GCC) specified that polio vaccine-induced infections will not invalidate certification. The GCC requires countries to meet some specific criteria before being considered for global polio-free certification. Those criteria are:

“To show first, absence of wild poliovirus, isolated from the cases of acute flaccid poliomyelitis (AFP) (suspect polio), healthy individuals, or environmental samples, in all WHO regions for a period of at least three years in the presence of high-quality, certification standard surveillance and second the containment of all wild poliovirus stocks in laboratories through completion of the requirements of the WHO—global action plan for laboratory containment of wild poliovirus ” (p. 25).

The containment of wild poliovirus is required, because infections can easily cross national borders and contaminate the polio-free regions. Laboratory containment of the poliovirus has not been completed in any of the three regions of WHO so far (Smith, Adams, Tangermann, 2004).

According to UNICEF (2003), in India polio was more prevalent among children under five years of age living in the poor Muslim communities with inadequate sanitation settlements. Although the parents were aware of the importance of polio vaccinations their children were more likely to miss many of the repeated rounds of oral polio vaccines (OPV). Parents were not convinced that multiple rounds of polio drops are needed in order to get the child fully protected against the poliovirus. It was hard for an average person in the Muslim community to understand why the healthcare system was investing so much on multiple rounds of polio vaccination campaigns, while they felt there were many more important social problems (such as shortage of health care providers and bad road conditions) that needed to be addressed.

“There is no vaccine against resistance or refusals that are rooted in social-cultural, religious and political contexts. No supply chain can overcome issues of gender-based decision-making in households. Medical approaches alone cannot address certain community concerns (i.e. why OPV is brought to their door when many other services are not available).” (Obregon et al. 2009, p. 630).

The lack of awareness of communities about the purpose of polio eradication initiative generated misconceptions such as: OPVs are not effective, are not good for the child’s health, and polio vaccine campaigns are part of some scheme to sterilize the Muslim kids so as to suppress the Muslim population as compared to Hindus (Obregon et al. 2009).

1.3.0. Introduction

“ISLAMABAD, Pakistan — Gunmen attacked a vehicle carrying a polio vaccination team in northwestern Pakistan on Saturday, killing the driver and wounding a health care worker, according to police officials.” Masood (2015, para. 1) is the description of New York Times headlines published on the 14th February this year that reads “Polio Team Attacked in Pakistan”.

These types of headlines and news descriptions are certainly not what the global polio eradication committee would expect when in 1988 they first set their target to eliminate the poliovirus by the year 2000.

Despite the commendable success, the GPEI has been facing unexpected barriers. Today, it is going through its most challenging stages when it is facing difficulties in reaching the most marginalized and poor populations who live in remote areas in three countries (Afghanistan, Pakistan and Nigeria) where poliomyelitis is still endemic (Obregon et al. 2009). Today, Pakistan is of utmost concern for the GPEI, because the cases of WPV1 have increased from 59 to 236 in 2014, accounting for the 85% of the new cases of the disease worldwide. Even more problematic is the fact that the virus is contaminating the provinces of Karachi and Punjab, where no incidence of the disease had been seen in the past few years. This portends that the disease is spreading to other parts of the world, as it did in 2013 when it travelled from Pakistan to Syria (BBC, 2014). The total number of WPV new cases in Pakistan reported by the WHO was 306 (WHO, 2014).

The purpose of this paper is to discuss the nature of the several challenges and the potential for successful eradication of polio worldwide, considering evidence from the best available real world example. This is the polio eradication initiative in Nigeria that with an evidence-based and step-by-step community-oriented approach appears to be successful in polio eradication. A decreasing number of new polio cases (discussed in detail below) of wild poliovirus (WPV) are an indicator of this success.

First, the 2008 Demographic and Health Surveys (DHS) data for Nigeria will be analyzed to explore a binary outcome (whether or not the child had polio vaccination). The outcome will be explained by categorical variables related to the mother's socio-economical

status (SES). Next, the reasons given by mothers who did not vaccinate their children and who lived in either rural or urban settings will be analyzed. Findings will suggest the greatest barriers to compliance with WHO vaccination guidelines.

Hypothesis: The main hypothesis is that mothers with higher levels of education and wealth index are more likely to get their children vaccinated against poliovirus, as compared to the ones with less education and lower wealth index. Also, it is hypothesized that Muslim communities are more reluctant to polio vaccines as compared to non-Muslim communities.

Objectives:

- To explain the existing association between Nigerian mothers' level of education, wealth index and religion the odds of getting their children vaccinated against polio;
- To explain the percentage of each reason that Nigerian mothers living either in rural or urban areas provided for not getting their children vaccinated;

To achieve the aforementioned objectives the current paper will answer the following questions:

- How do the odds of mothers getting their child vaccinated differ by varying level of education and wealth index?
- How do the odds of mothers getting their child vaccinated differ by varying religions?
- How the percentage of reasons provided by the mothers who did not vaccinate their child against polio and who lived either in rural or urban settings differ?

Chapter II

2.1.0. Progress in the Polio Eradication Initiative

Since the 1980s, approximately 20 billion doses of polio vaccine have been provided to at-risk children globally, as part of a cumulative global attempt to interrupt the transmission of wild poliovirus transmission (Closser et al., 2014). This extraordinary global collaboration was built based on the findings of a large-scale research study that showed improvement in primary care in the Americas, due to massive polio eradication initiatives. However, those countries had a more solid healthcare infrastructure as compared to the Asian and African countries where poliovirus is epidemic today. Closser et al. (2014) conducted a mixed-method study to examine the impacts of the large-scale polio eradication interventions on strengthening the routine immunization (RI) and primary health care (PHC). The quantitative part of their study was a cross-national time series analysis. The qualitative part of it was a case study analysis of data collected from 8 districts of Africa and South Asia. Their findings showed that polio eradication could mobilize support and allocate resources for RI and PHC, in the form of educating the marginalized groups about the benefits of breastfeeding and RI as well as its availability and increasing awareness of the importance of hand washing and surveillance for other diseases (Closser et al., 2014).

Mbaeyi et al. (2014) explained that the states of conflict and political instability lead to a fragile healthcare infrastructure, which mainly affects the most vulnerable groups. The authors analyzed the WHO data on Somalia and discussed Somalia's polio eradication program that, despite the political instability and unrest going on in the country, interrupted the wild poliovirus circulation. However, this interruption was followed by two imported and successive outbreaks—one was still continuing at the time this paper was being written, and 173 new cases of poliomyelitis were reported. According to the authors there were three reasons for this

outbreak: the ban of polio eradication initiatives in some areas leaving a huge population of children susceptible to contamination; poor sanitation due to population density in some areas; and humanitarian crises due to natural disasters and displacements as a result of conflicts that left many children malnourished. Mbaeyi et al. (2014) emphasized the importance of sustainable mechanisms and strategies for eradicating the poliovirus transmission and maintaining the polio-free status of the war-affected country.

According to Etsano et al. (2014), wild poliovirus (WPV) in Nigeria has been transmitting to 26 other countries where polio has already been eradicated. Thus, WHO pronounced the international circulation of polio a Public Health Emergency that is threatening the world. Etsano et al. (2014) discussed the progress of Nigeria in achieving the country's strategic goal of eradicating wild poliovirus type 1 (WPV1) by the end of 2014. Apparently, improved quality of supplemental immunization activities (SIAs) and a significant increase in the proportion of coverage of oral polio virus vaccine (OPV) campaigns in the local government areas (LGAs) within the 11 high-risk states had a powerful impact on decreasing the incidence of WPV cases. In the time period from January 2013 until the end of September 2014 only six WPV new cases were reported as compared to 49 new cases of the same within the mentioned time period in 2013. However, a drastic increase in the incidence of circulating vaccine-derived poliovirus type 2 (cVDPV2) - that was only four in 2013 and 21 in 2014- was a matter of concern. The authors claim that effective practices included quality assurance initiatives for the acute flaccid paralysis (AFP) surveillance, increasing and enhancing the routine immunization services to increase coverage, strengthening multi-level leadership support, and carrying out innovative intervention to get the children in the areas of unrest (northeast areas the country) vaccinated (Etsano et al., 2014).

According to Obregon et al. (2009) refusals to OPV is a barrier to GPEI, and evidence-based and strategic communication can be used to combat this issue. The authors defined public health communication “as the strategic design, application and evaluation of communication interventions (i.e. social mobilization, interpersonal communication, mass or local media and advocacy) to achieve public health objectives” (p. 625). Social mobilization is a powerful tool that requires wide-scale community involvement to engage highly motivated independent public efforts for achieving well-defined development goals. Community participation means involvement of stakeholders at various levels of community-based structures: local, state level, national governments, subject matter experts, practitioners or service providers, as well as popular news or social media. The authors analyzed the documents related to the polio communication efforts in Pakistan and India. Their primary and secondary data sources consisted of research, evaluation and technical reports, randomized before and after reports of local and national agencies, policy, theme and work related documents. Their data were in the form of surveys, interviews, and other related research papers. Not all the research papers were peer-reviewed. Obregon et al. (2009) concluded that special changes in communication methods are required to meet the needs of the dynamic nature of challenges amid polio eradication efforts. The authors recommended that the polio-endemic countries put together a national polio eradication agenda, ensure buy-in, increase vaccination booth show-ups during the national immunization days, and utilize effective strategies for social mobilization through networks and community partnership to achieve the goals of universal coverage. Effective communication was considered the key to overcoming the resistance against polio vaccination among the under-served population.

According to the authors, 75% of polio incidence was among the children less than two

years of age who lived in low-income Muslims communities. The question was why the repeated rounds of immunization campaigns do not cover these children. UNICEF (2004) reported the emergence of misconceptions related to polio vaccinations among the Muslim population of India that caused considerable resistance among parents and guardians for getting their children vaccinated against the poliovirus. People could not understand the rationale behind the multiple rounds of polio vaccines; while there were other significant social and health related issues that they were expecting their government to pay attention to. There were myths spreading around stating that the polio vaccines cause illness among the children, are not effective and can cause infertility—it was assumed that it is Hindu government's scheme to stop Muslim population's growth (UNICEF, 2004).

Murakami et al. (2014) conducted mixed methods research to explore the community perception of the prevalence of OPV refusal in the Swat valley and Khyber Pakhtunkhwa province of Pakistan. They conducted six focus group discussions with the lady health workers that, in addition to their traditional tasks as midwives, played a vital role in polio vaccination initiative. Also, focus groups were conducted with the mothers who had children younger than 1 year of age. The staff and managers of the various local health units were recruited for the key informant interviews. Questionnaire surveys were conducted among the 200 lady health workers and 630 mothers of children younger than one year.

The findings of the grounded theory approach of the qualitative part of the Murakami et al. (2014) indicated the perceptions of the residents of the Swat of Khyber Pakhtunkhwa province regarding the OPV that would result in OPV refusal. Reasons for OPV refusals at the demand side were discussed by the authors and are mentioned here. OPV was officially boycotted in the northern Nigeria that worked as one of the main influence for the community

resistance against the OPV among the residents of Swat valley, Pakistan. Also, too frequent vaccination rounds, misconceptions like OPVs contain birth control elements (there are beliefs that birth control is against Islamic law), and myths like OPVs contain infections and pork (Muslims are forbidden to eat pork). The percentage of OPV refusal encounters among the lady health workers was 42%. The qui-square test did not show statistically significant relation between the two main reasons for OPV refusals: 1) Disapproval of religious leaders the OPV 2) the perception that OPVs contained birth control substances.

On the supply side, the stigma attached to the mobile female vaccinators who worked for the vaccination campaign and their job required them to travel without having their husbands escorting them. Sometimes the community found this immoral and did not allow the female vaccinators to enter their houses and vaccinate their children. Due to cultural taboos against allowing male vaccinators to enter the female quarter of the households, talk to the mothers or vaccinate the children - the help of the lady health workers was sought to address the issue. Consequently, negative sentiments evolved against the lady health workers working away from their residence while their husbands did not escort them. However, the survey results suggested that a significantly low percentage of mothers refused OPV for their children (3.3% in Swat, 0.5% in Buner and 5.7% in Shangla). Some of the methodological limitations of the study were over-representation of the lady health workers opinions relative to those of the mothers. Also, quota sampling rather than simple random sampling was utilized to recruit the mothers for the survey (Murakami et al., 2014).

2.2.0. Polio Eradication Efforts in Nigeria

The report “Progress toward poliomyelitis eradication – Nigeria (2009)” named Nigeria as a reservoir to WPV worldwide, due to the country’s reputation in high incidence of WPV and large numbers of children who never received any kind of polio vaccines or who were under-

vaccinated. In 2008, compared to all the other countries, incidents of poliomyelitis in Nigeria were 798, the highest in the world. In 2009, this number declined to 388 that contributed to 24% of the cases of the disease anywhere in the world. The country reported its lowest number of WPV cases during January-June 2010 when there were only 3 new cases. The incidence of cVDPV2 that in Nigeria was first diagnosed in 2005 declined from 148 cases in 2009 to only eight cases during first six months of 2010. It is good news for the polio eradication initiative when the proportion of children with non-polio acute flaccid paralysis (AFP) who never received any vaccines against polio declines. In Nigeria, this proportion was 17.6 in 2009 and it declined to 10.7 in 2009, marking a success story. This achievement was credited to the active and meaningful engagement of community and religious leaders for winning the trust of the public and reducing the negative sentiments and propaganda against the polio vaccines. Also, implementation of improved surveillance mechanisms, as well as, enhancing and promoting SIAs to ensure the quality of service and improved emergency response mechanisms were proved effective (Progress toward poliomyelitis eradication – Nigeria (2009)). The report noted that in Nigeria, there were supplementary immunization activities such as using monovalent OPV type 1 (mOPV1), monovalent type 3 (mOPV3), bivalent OPV types 1 and 3 (bOPV), or tOPV. (Progress toward poliomyelitis eradication – Nigeria (2009), p. 802).

Two years later, the report “Progress Toward Poliomyelitis Eradication—Nigeria (2011)” noted that, due to the continuation of WPV circulation, as well as, cVDPV2 transmission, 12 northern states and one Federal Capital of Nigeria were declared high-risk states during 2005-2011. There was a dramatic decline of 95% in the number of WPV cases reported in 2010 (288 cases reported in 2009 decreased to 21 cases in 2010). Also, a decline in the cVDPV2 cases was also impressive (154 cases reported in 2009 decreased to 27 cases in 2010, a decrease

of 82%). The country was hoping to eliminate WPV circulation by the end of 2011 through addressing the surveillance sensitivity issues and enhancing immunization efforts (Progress Toward Poliomyelitis Eradication—Nigeria (2011)).

The next year, “Progress Toward Poliomyelitis Eradication —Nigeria (2012)” reported an increase in the number of WPV cases in 2011 in Nigeria. In 2010, there were 21 cases while in 2011 the count jumped to 62. From September to January 2012 the total number of reported WPV cases was 99, marking a twofold increase in the cases of the disease that had numbered only 42 during the same time period in 2011. Also, the number of cVDPV2 cases almost doubled during the aforementioned time period, from 18 in 2011 to 32 in 2012. It was noted that although overall the country was making progress in fulfilling the requirements of the AFP surveillance system’s main indicators, and the results of sequence analysis indicated progress in reducing the level of negative sentiments attached to polio vaccine, there were differences in the level of sensitivity attached to the AFP surveillance initiatives in some of the local government areas or among some minority populations that resulted in surveillance gaps. Existing challenges hindered reaching the goals of high-quality routine vaccinations and widespread supplemental immunization activities were reinforced by the instability that started by the end of 2011, which added to the concerns of various stakeholders involved in polio eradication efforts in Nigeria. As part of the Polio Eradication Emergency Plan (PEEP), in 2012, the government of Nigeria took innovative steps to ensure high-level political support, and their involvement in close monitoring of the process hoped to ensure efficiency and accountability and enhanced effective management. Also, special attention of the government authorities at all levels in collaboration with the international agencies like WHO and UNICEF on the deployment of trained staff in the areas with immediate needs (specifically the high-risk states) was promised. With the help of

personnel who had related knowledge and expertise, reviewed, comprehensive and validated house-to-house supplemental immunization activities micro plans were implemented to cover the children that were constantly missed during supplemental immunization activities. Also, the technical staff played a significant role in ensuring the utilization of valid criteria while selecting the vaccinators, as well as ensuring the effectiveness of training for the vaccination teams. In addition, size and structure of the vaccination teams were revised while special attention was paid on pinpointing and reaching the vulnerable populations. Satellite mapping was used to specify demarcation of local government areas, ward, and team boundaries for the polio vaccination teams. This approach helped in identifying locations that were not covered during the previous supplemental immunization activities. Utilization of volunteers for the enforcement of community mobilization was used to address the issue of vaccine refusal in the areas with the high rates of polio cases. As mentioned before a lack of security was a huge challenge hindering the polio eradication initiative, and enhancing community engagement was proposed for reaching the children that were missed (Progress Toward Poliomyelitis Eradication —Nigeria, 2012).

Since 2003 Nigeria was the source for WPV reinfections in countries where the virus had already been eliminated, hence, the government of Nigeria introduced an emergency operations center to implement a national emergency action plan (Etsano, 2013). In 2013, some priority goals were set for enhancing the effects of the supplemental immunization activities, promoting innovative initiatives for reaching the underserved populations, as well as those residing in the areas of unrest, strengthening emergency response mechanisms, enhancing routine immunizations in a manner that fills the gap between supplemental immunization activities, and emphasizing the improved surveillance system. During the time period from

September to January 2013, there were 49 new cases of WPV reported from 26 local government areas. The number of new poliomyelitis cases almost doubled during the same time period in 2012 when 70 new cases of the disease were reported from 13 local government areas and the total number of new cases of polio during the same year was 122.

Another important achievement of the polio elimination initiatives in the country was the absence of poliovirus in the northeast parts of the country, a new situation never experienced before. The ongoing conflict in some parts of the country, misconceptions and negative sentiments attached to polio eradication campaigns and poor implementation of SIAs in some areas were considered as some of the barriers to polio interruption. Polio vaccination staff has been victims of target killings in some parts of the country, and the issue was addressed by engaging the community leaders for advocacy purposes. As part of community mobilization efforts in the areas where resistance levels against polio vaccines were high, polio survivors were deployed for providing the community with living examples and help them realize the risks of the disease. Also, health camps—mobile health units - were used to provide the underserved communities with basic healthcare services. Given the importance of the role of religious leaders in traditional contexts, strong partnerships were built with the aforementioned leaders and teachers of Koranic schools (schools where students are taught how to recite the Koran) to build trust and strengthen support. To improve the performance of SIAs several strategies were adapted that included: monitoring and supervision of SIAs throughout the process, ensuring financial transparency by appointing “management and accountability officers” to overlook the funding procedures, and expenditure allocation for the utilization of global positioning system (GPS) to keep the track of vaccination personnel (Etsano, 2013).

Etsano (2014) examined Nigeria’s progress in polio eradication-related activities during

January 2013–September 30, 2014. The authors reported that in order to achieve one of the GPEI’s main objectives (Polio Eradication and Endgame Strategic Plan for 2013–2018), one of the major strategic goals was eradication of WPV1 in Nigeria by the year 2014. Results of ‘lot quality assurance sampling’ indicated that there was an improvement in the quality of supplemental immunization activities. These included conducting multiple rounds of polio immunization campaigns insuring that all the children <5 got one dose of OPV regardless of their immunization history, adoption of multifaceted strategies for reaching the children in remote areas and decreased vaccine refusals, which resulted in almost a twofold increase in the proportion of local government areas within 11 high-risk states that were covered by the OPV immunization rounds (from 36% to 67%). In addition, the aforementioned efforts led to a considerable decline in the number of new poliomyelitis cases, a promising sign for the country in achieving its main strategic goals. During January 2013 to the end of September 2014 there were only six new cases of WPV, while there were 49 during the previous time period in 2013. This decrease in the number of cases was significant during the high transmission season (June–September) when there was only one reported case, as compared to the previous year’s record, when there were 24 cases reported during the high transmission season. These facts mark a decrease of 96% in the incidence of wild poliovirus cases during the high transmission season. Nevertheless, the number of circulating vaccine-derived poliovirus type 2 (cVDPV2) cases reached 21, up from only four cases in 2013, a matter of concern. Also, a shortage of genomic sequencing analysis was noted while environmental surveillance was still tracing WPV1. The authors came up with specific recommendation for enhancing and strengthening the polio eradication initiative in Nigeria:

- Interrupting the circulation of cVDPV2;

- Providing high quality and standardized acute flaccid paralysis surveillance;
- Enhancing the routine immunization services to increase overall immunization coverage;
- Consistent and effective government support to strengthen and monitor the efficiency of the initiative, with special attention to underserved children living in the areas of conflict in the Northeast part of the country;

Despite significant improvement in the proportion of children who received all the required vaccinations, and the ones who received oral polio vaccine 3 (OPV3) the coverage of routine vaccination still remains low especially in the hard-to-reach areas (Etsano, 2014).

Routine immunization against polio in Nigeria consists of trivalent OPV (tOPV, types 1, 2, and 3) at birth and at ages 6, 10, and 14 weeks (Progress Toward Poliomyelitis Eradication – Nigeria (2009, p. 802)).

2.3.0. Polio Eradication Efforts in Afghanistan and Pakistan

The literature reviewed below reveals that polio eradication was not successful in Pakistan due to a common epidemiologic reservoir between Pakistan and Afghanistan. Increased incidence of poliomyelitis cases in Pakistan results in increased incidence of the disease in Afghanistan. The report “ Progress Toward Poliomyelitis Eradication (2009)” stated that in 2008, there was an increase in the number of new WPV cases in Pakistan and Afghanistan. In 2007, the number of new cases in both the countries was 49 while in 2008 the number jumped to 149. Pakistan had a greater contribution to this number by reporting 118 new cases while in Afghanistan the number of cases was 31. Ongoing conflict and lack of security in the shared border between the two countries that limited access of polio vaccination teams to a considerable number of children, who never received any polio vaccine, was reported as a reason for the drastic increase in the number of WPV cases. Operational issues associated with the delivery and

coverage of polio vaccination campaigns adversely affected the quality of supplemental immunization activities, resulting in unexpectedly large numbers of disease incidents (Progress Toward Poliomyelitis Eradication (2009)). Figure 2, below, displays the border between Afghanistan and Pakistan, highlighting the Southern Afghanistan where incidence of poliovirus has been reported among Pakistani immigrant children.



Figure 2 Border between Afghanistan and Pakistan, showing Southern Region of Afghanistan where incidence of polio has been reported that were mostly among Pakistani immigrants children (Tribal Alliance And The Taliban, 2011)

Source: <http://www.npr.org/templates/story/story.php?storyId=127597808>

The report “Progress Toward Poliomyelitis Eradication (2010)” indicated that in 2009, the number of WPV cases decreased from 118 to 89 cases in Pakistan; however, continued transmission of the disease was reported in the areas of unrest on the border between Afghanistan and Pakistan. The report pointed out the strategies that the two countries used for improving the supplemental immunization activities’ coverage in a manner that reaches the children who were never immunized against the poliovirus. Those strategies included:

- Discussing the issue with both sides of the conflict and negotiating security periods with them, so that the polio teams will get a chance to reach vulnerable children;

- Using the opportunity provided by the security periods to administer one ‘short interval additional dose’ one to two weeks after they receive primary vaccination;
- Networking with the religious and community leaders for the purpose of advocacy;
- And providing complementary primary care services along with the polio vaccination rounds as an incentive to encourage the parents to vaccinate their children.

The report “ Progress Toward Poliomyelitis Eradication (2010)” recommended that both the countries continue their efforts for ensuring the security of polio teams and making arrangements for them to cover the children who missed vaccinations.

According to report “ Progress Toward Poliomyelitis Eradication (2011)”, in 2010 there were 25 new cases of WPV reported in Afghanistan. The country reported 42 new WPV cases during the first nine months of 2011, while numbers of cases were low during the same time period in 2010 (19 cases). Most of the cases were found in the Southern Region of the country sharing a border with Pakistan) that is an area of unrest, as well as some provinces in the Western Region that are in the Southern Region. In Pakistan, the number of new WPV cases increased from 144 in 2010 to 198 in 2011. During the first eight months of 2010 there were 30 new reported cases of WPV while the number was 88 during the same time period in 2011. Both the countries were urged to review their national emergency action plans. To enhance the quality of the SIAs, fidelity monitoring of the polio eradication efforts by the local and national level authorities that require strong political commitment was recommended by the report. Also, providing protection for the polio teams was recommended.

The report “ Progress Toward Poliomyelitis Eradication (2012)” noted that in 2011, there were 80 new cases of poliomyelitis both in Afghanistan and Pakistan. The number of new cases during this year was 80 in Afghanistan and 148 in Pakistan, not a promising indicator for

GPEI. The report discussed the reasons for this drastic increase in the incidence of the disease. One was the targeted killing of polio teams that had previously only occurred in Afghanistan. The report recommended both the affected countries to review their national emergency and prioritize the security of polio staff (Progress Toward Poliomyelitis Eradication (2012)).

In 2012, the number of polio cases were 37 in Afghanistan and 14 cases of circulating vaccine-derived poliovirus type 2 (cVDPV2) were detected in the Southern Region of the country (Progress Toward Poliomyelitis Eradication (2013)).). Nine new WPV cases were detected in the Southern Region of Afghanistan; reportedly the misplaced families from Pakistan transmitted the virus. In 11 low performing districts, the government of Afghanistan innovated some strategies to improve the quality of supplemental immunization activities to strengthen polio eradication initiative. They recruited new staff, improved management and performance by providing supervisory training; enhanced immunization rounds by conducting The Short Interval Additional Dose, and appointed polio teams in the areas of unrest where access was limited. They also provided permanent polio vaccination teams that would vaccinate the children every quarter (Progress Toward Poliomyelitis Eradication (2013)). In Pakistan, 84 percent of 110-reported polio cases were in the areas of unrest that include Federally Administered Tribal Areas and the Khyber Pakhtunkhwa province. Also, 30 cases out of 52 cVDPV2 incidents occurred in Federally Administered Tribal Areas. Reportedly since mid-2012 the local authorities banned vaccinations, as a result, around 350,000 children in certain districts were not covered by the supplemental immunization activities. Also, supplemental immunization activities were compromised during the same time because of attacks that happened against the polio teams. Enhancing the polio eradication efforts by placing the polio teams in the transitional areas and also providing The Short Interval Additional Dose to complement supplemental immunization

activities whenever they get access to the areas of conflict was recommended to avoid spreading of the virus in other parts of the country (Progress Toward Poliomyelitis Eradication (2013)).

The report “Progress Toward Poliomyelitis Eradication (2014)” noted that the number of polio cases decreased in Afghanistan in 2013 (14 new cases), while it increased in Pakistan (93 new cases). During the first six months of 2014, the number again increased dramatically (170 reported cases). The continued bans on polio vaccinations in some areas of Pakistan were still a factor. The objectives of the Polio Eradication and Endgame Strategic Plan for 2013-2018 recommended that the countries negotiate the access of polio teams to the areas of unrest, improving the quality of their individual program performances, strengthen meaningful political commitment to include supporting the programs financially, and full implementation of the recommendations provided by the external advisory bodies. The two countries will benefit from coordinating the vaccination activities on the two sides of the border, as well as strengthening their surveillance and emergency response mechanisms (Progress Toward Poliomyelitis Eradication (2013)).

2.4.0. Summary

Figure 3 (below) summarizes the annual counts of the WPV cases in three polio endemic countries: Afghanistan, Pakistan and Nigeria from 2008 to 2014. The chart indicates decrease in the number of cases of the disease within the mentioned time period in Nigeria while the count drastically increased in Pakistan.

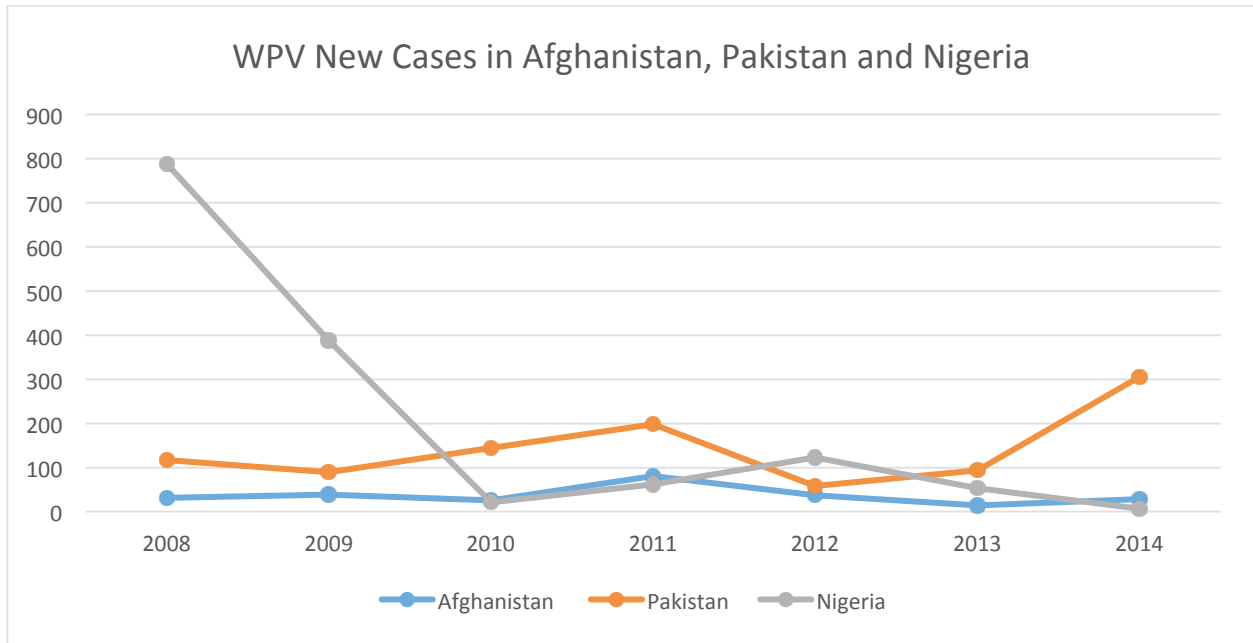


Figure 3. WPV New Cases in Afghanistan, Pakistan and Nigeria. (The chart was created using data from WHO (2014). Retrieved from: <https://extranet.who.int/polis/public/CaseCount.aspx>)

Chapter III

3.0.0. Methodology

To achieve the objectives of the current study, Nigeria Demographic and Health Surveys (NDHS) data for the year 2008 was utilized. Although Nigeria is a success story, compared to others (Figure 3), data for other countries were not available. Our goal is to see what we can learn from Nigeria that might help there as well as in related countries.

3.1.0. Data Source

The DHS program is initially funded by the United States Agency for International Development (USAID) and is supported by other international agencies, as well as, the host countries. Since its establishment in 1984 the DHS program has been successful in collection, analysis and dissemination of nationally representative and valid population's health related data in more or less 90 countries. More information about the DHS program can be found by following the link: <http://www.dhsprogram.com/#sthash.fQQxNEJi.dpuf>.

The NDHS (2008) is the fourth survey of its kind conducted as part of USAID's DHS program to represent the country's health indicators at national, state and zonal levels utilizing the country's 2006 population and housing census. There were 33,385 women between the ages of 15-45 participating in NDHS (2008). The primary sampling units (PSU)—referred to as clusters—were enumeration areas (EAs) based on the 2006 censuses of Nigeria. For the purpose of NDHS (2008) cross sectional study, 888 clusters were selected by utilizing a stratified two-stage cluster design strategy. The rural areas were over sampled as 602 rural clusters were selected as compared to 268 urban clusters. From a complete list of households within all the selected clusters 36,800 households were selected for the survey. Within each cluster 41 households were selected using equal probability systematic selection criteria. Any woman between the age of 15-49 who was a resident of the selected household or who spent the night before the survey in the mentioned household was eligible to participate in the study. The women were asked about the

survival and health status of each of their children born during or after 2003 that gave us the information we need regarding the target population of our current study that are Nigerian children under the age of five who are vulnerable to poliovirus infection. A total number of 36,298 households were selected of which 34,644 households were occupied while 34,070 households were interviewed, yielding 98% response rate.

3.2.0. Data Obtaining Method

For achieving the objectives of current study, initially, authorization for downloading the NDHS (2008) data was obtained. Next, data related to Nigerian mothers' SES and religion, as well as, the fact that either or not they got their children vaccinated against poliovirus were downloaded from the DHS website. In addition, variables related to the reasons that mothers provided for not getting their children vaccinated were included. After dichotomizing the variables of interest 28,438 observations were included in the study.

3.3.0. Dichotomization Process

The following variables were included in the current research paper: received polio vaccine, level of education, type of place of residence, wealth index, religion, main reason for no vaccination was lack of information, main reason for no vaccination was fear of side effects, main reason for no vaccination was fear that child will get disease, main reason for no vaccination was myth that vaccines do not work, main reason for no vaccination were religious reasons, main reasons for no vaccinations were post too far, main reason for no vaccination was absence of child. The received polio vaccine variable does not originally exist in the NDHS dataset. Considering the specific needs of the current paper the mentioned variable was created based on some criteria that will be described below.

3.3.1. Received Polio Vaccine

In the original NDHS (2008) data set there were four variables reporting the polio vaccination status of Nigerian children, at birth, in the age of two months, in the age of four months and in the age of 6-18 months. For the purpose of our paper we wanted to see if the children ever received the polio vaccine. Therefore, the variable received polio vaccine was created using the four variables marking children's polio vaccination status at different ages. The child was considered vaccinated if the following were true:

- In addition to a check mark (pointing that the child was vaccinated) the vaccination date was also mentioned on the vaccination card;
- There was a check mark on the vaccination card (pointing that the child was vaccinated); however, vaccination date was not recorded;
- Oral report of the mother claiming that the child was vaccinated;

Thus, negative response or the "I don't know statement" was considered as no vaccination.

Missing data is kept into consideration and will be reported.

3.3.2. Wealth Index

Studies show that population health indicators can be associated to that particular population's wealth index; it has been included as a potential variable in the current study. Wealth index was used as an indicator of background characteristic of survey respondents that helps measure their long-term living standards. To construct the index each household was scored based on their ownership of consumer goods, type of residence place, water and sanitation facilities and other characteristics that could be associated to that particular household's SES. Through principal component analysis, standardization and sum-up of the mentioned factor-score each household was assigned a particular wealth index and individual observations were

ranked based on the wealth index of the household they were residing. It is a five level categorical variable, level one being the poorest and level five being the richest. Missing data is the last response category for this variable.

3.3.3. Level of Education

Individuals' educational level is a significant indicator of his/her life style and SES and can strongly influence their health conditions. Thus, level of education was included in the study to examine the mentioned association. Education in Nigeria is structured in a three-tier system that includes: 1) primary education that lasts for six years; 2) junior secondary education that lasts for three years; and 3) senior secondary school that lasts for three years. Once completed the secondary school individuals can attend vocational or higher educational institutes or universities of their choice that can last from two to seven years based on the type of diploma or certificate and the field of study (NDHS Final Report, 2008). Level of education is a categorical variable of four levels, consist of no education, primary education, secondary education and higher education and missing.

3.3.4. Type of Place of Residence

Type of residence can be an important indicator of population's SES, as well as, education or literacy level. In addition, access to healthcare facilities, as well as attitudes towards health indicators might vary depending on individual's type of residence, whether it is a rural or urban setting. It is a categorical variable with three categories: rural, urban and missing.

3.3.5. Religion

Multiple studies reviewed as part of the literature review for this paper suggested higher resistance against polio vaccines within Muslim (follower of Islam religion) communities due to existing misconceptions. Also, there is another variable included in this study that highlights religious reasons as a barrier to polio vaccination. Therefore, religion has been included in the

current research paper. It is a categorical variable that includes six categories: Catholic, other Christian, Muslim, Traditionalist, other religion, and missing.

3.3.6. Main Reason for No Vaccination Was Lack of Information

Level of information and awareness of target population is important for the success of health-related interventions. It can increase buy-in for that particular program within the community. Thus, the study has included this categorical variable. Responses are consist of Yes/No and missing categories.

3.3.7. Main Reason for No Vaccination Was Fear of Side Effects

There are side effects associated with any type of therapy and medicine including vaccinations. It will be helpful for achieving the objectives of the current paper when we include this variable to assess attitudes towards side effects of polio vaccines.

3.3.8. Main Reason for No Vaccination Was Fear that Child Will Get Disease

The literature review suggested that in certain communities there are misconceptions associated with polio vaccination campaigns. For example, myths like polio vaccine will cause infertility for the child in future can affect parent's decision for vaccinating the child. Thus, this categorical variable that consists of Yes/No and Missing response has been included in the study.

3.3.9. Main Reason for No Vaccination Was Myth that Vaccines Do Not Work

This categorical variable has been included to assess the misconceptions associated with effectiveness of polio vaccines. Response categories are Yes/No and missing.

3.3.10. Main reason for no vaccination were religious reasons

A number of studies discussed reluctance against polio vaccines with certain religious groups and this variable will help examine the issue. It is a categorical variable that includes Yes/No and missing.

3.3.11. Main Reasons for No Vaccinations Were Post Too Far

Accessibility of healthcare services is an important factor in society's health indicators.

This is a categorical variable that will assess even distribution of polio vaccination posts.

Response categories are Yes/No and missing.

3.3.12. Main Reason for No Vaccination was Child Was Absent

It will be intriguing to see if absenteeism is a factor in polio eradication initiative, so that effective mechanisms can be adopted to address it. This categorical variable includes Yes/No and missing response categories.

4.0.0. Data Analysis Strategy

For the data analysis purposes SAS 9.3 software package was used. The percentage of each response category for every categorical variable was calculated. A binary logistic, multivariate regression model was estimated to determine associations between the dependent and independent variables. Proportions were created from the non-vaccinator subset to show the percentage of reasons provided stratified by rural or urban settings.

Chapter IV

5.0.0. Results

A sample size of 28,438 participants was included in the study. Percentages of each response category were provided to summarize the data. Several variables were included in a binary logistic regression model to control for covariates. The binary outcome variable was received polio vaccine (yes/no). Secondary analysis used a cross tabulation to describe the relationship between the type of place of residence and the reasons that mothers did not vaccinate their child.

Sample statistics are provided in Table 1, below. When the frequency of mother's level of education was calculated by whether or not they got their child vaccinated against polio the total number of mothers who said yes were 16,441, while the frequency of missing values was 3664. This made up to 65.83% positive response to vaccination as compare to 34.17% negative responses. The same response rate applied when the frequency of wealth index and type of place of residence was examined by the polio vaccination rates (Table.1). When vaccination rate was evaluated based on mothers' religion the frequency of mothers who vaccinated their child was 16,360 while 3,603 observations were missing. This would encompass to 65.87% positive response rates as compared to 34.13% negative responses. 25% of Nigerian mothers who got their child vaccinated never went to school while 17% had primary education. The percentage of secondary education among mothers who vaccinated their child was 19% while the percentage of higher education among the same was 5% only. From the respondents whose children were vaccinated 13% and 14% belong to the poorest and poorer wealth index categories respectively while 6% of the same belong to the middle category. Only 4% fell in the richer and 2% in the richest category. Religion of 7% of the mothers with a positive response to polio vaccination was Catholic while 27% were other Christian. 31% of the same were Muslims. Traditionalists encompass to only 1% of those who got their children vaccinated while 0.08% belong to other

religions. 21% of mothers whose response was yes to the polio vaccination question lived in the urban settings while 45% lived in the rural settings.

Table 1. Sample Statistics by Polio Vaccination Response Group in Nigeria, 2008.

	<i>Received Polio Vaccine</i>	
	<i>Yes</i>	<i>No</i>
	16,441	8,533
<i>Level of Education</i>		
<i>No School</i>	24.85%	24.61%
<i>Primary School</i>	16.95%	5.97%
<i>Secondary School</i>	19.33%	3.30%
<i>Higher</i>	4.70%	0.28%
<i>Wealth Index</i>		
<i>Poorest</i>	13.05%	13.01%
<i>Poorer</i>	13.64%	9.92%
<i>Middle</i>	5.99%	13.36%
<i>Richer</i>	3.75%	13.2 %
<i>Richest</i>	1.50%	12.52%
<i>Type of Place of Residence</i>		
<i>Urban</i>	21.29%	6.23%
<i>Rural</i>	44.54%	27.94%
<i>Total</i>	65.83%	34.17%
<i>Religion</i>		
	<i>Yes</i>	<i>No</i>
	16360	8475
<i>Catholic</i>	7.01%	1.65%
<i>Other Christian</i>	26.63%	6.40%
<i>Muslim</i>	31.22%	25.03%
<i>Traditionalist</i>	0.94%	0.98%

<i>Other Religion</i>	0.08%	0.06%
<i>Total</i>	65.87%	34.13%

5.1.0. Binary Logistic Regression

A binary logistic regression model was utilized to examine the association between various covariates that affected Nigerian mothers' decisions on polio vaccinations. Initially the association of all three SES related variables (level of education, wealth index and type of place of residence) and the religion variable were assessed in the regression model. However, due to the existing high levels of correlation between the wealth index and type of place of residence (the fact that people with higher wealth index usually reside in the urban settings while the opposite is true about the people with lower wealth index) the variable 'type of place of residence' was dropped from the regression. A criterion for statistical significance was determined using a level of significance of 0.05. Results from the regression are presented in Table 2 (below).

When the association between the categories of level of education and polio vaccination was examined, given that higher education was the reference group, its association with no school response group was statistically significant (OR= 0.175, CI: 0.134,0.227, p-value <.0001). The association remained significant with the group of mothers with primary education (OR= 0.326, CI: 0.251,0.424, p-value <. 0001). It was also significant for the mothers who completed secondary school (OR= 0.480, CI: 0.371,0.621, p-value <.0001). Evaluation of wealth index response groups with maternal decision regarding polio vaccination with the wealthiest group as a reference, a significant association was found between the poorest group (OR= 0.334, CI: 0.292,0.383, p-value <.0001). The binary outcome of polio vaccination was also significantly associated with the poorest group of individuals (OR= 0.399, CI: 0.349,0.457, p-value <.0001).

The same association remained significant for the middle and wealthiest populations (OR= 0.523, CI: 0.456,0.599, p-value <.0001) and (OR= 0.643, CI: 0.560,0.738, p-value<.0001) respectively.

Table 2. Multivariate Binary Logistic Regression Model (n=28,438): Predictors of Polio Vaccination in Nigeria, 2008

Variable	Odds Ratio	Confidence Limits		P Value
Level of Education				
0	0.175	0.134	0.227	<.0001
1	0.326	0.251	0.424	<.0001
2	0.480	0.371	0.621	<.0001
3	Reference			
Wealth Index				
1	0.334	0.292	0.383	<.0001
2	0.399	0.349	0.457	<.0001
3	0.523	0.456	0.599	<.0001
4	0.643	0.560	0.738	<.0001
5	Reference			
Religion				
1	1.857	1.643	2.099	<.0001
2	1.662	1.538	1.796	<.0001
4	0.800	0.662	0.968	0.0215
96	0.619	0.310	1.239	0.1756
3	Reference			

Level of Education 0-3 (0= No School - 3=Higher Education)

Wealth Index 1-5 (1= Poorest - 5= Richest)

Religion 1-4 and 96 (1= Catholic, 2=Other Christian, 3=Muslim, 4= Traditionalist, 96= Other Religion)

Using Muslims as the reference group, evaluation of association of Catholic religion with the odds of polio vaccination was statistically significant (OR= 1.857, CI: 1.643,2.099, p-value <.0001). This association remained significant for the other Christian category as well (OR= 1.662, CI: 1.538,1.796, p-value <.0001). It was also significant for the Traditionalists as

compared to Muslims (OR= 0.800, CI: 0.310,1.239, p-value <.0001). However, while the mentioned association was significant for the Traditionalists the odds of getting their children vaccinated was less than the Muslims (OR= 0.619, CI: 0.310, 1.239, p-value =0.0215). There was no statistically significant association between the odds of Muslims getting their children vaccinated and the other religion variable.

5.2.0. Evaluation of Nigerian Mothers' Reasons for Not Vaccinating their Child by the Type of Residence

The results of the secondary crosstab analysis of reasons not to vaccinate, stratified by urban-rural residence, are presented in Table 3. Evaluation of the reasons behind Nigerian mothers' reluctance against polio vaccines indicated that lack of information was the rural population's number one reason (24%). This number would encompass for the highest percentage among all the reasons being indicated in the crosstab. Fear of side effects (16%) and span of vaccination posts (13%) were the number two and number three reason respectively within the same setting. In the rural settings, two of the variables (fear child will get disease and religious reasons) showed equal results in terms of percentage (4.6%). There was very small difference between the percentage of child's absence within both urban and rural settings (6.0%) and (6.7%) respectively. The same was true for fear that vaccinations do not work, (2.4%) in urban settings and (2.1%) in rural settings. In urban settings fear of side effects was the number one reason that made the Nigerian mothers reluctant to get their children vaccinated (19%) while lack of information (16.4%) and religious reasons (7.3%) stood number two and three. The number four reason for no vaccination in urban settings was fear that child may get disease (6.2%).

Table 3. Reasons for Mothers' Reluctance against Polio Vaccines by Type of Residence (n=8,533) in Nigeria, 2008

Type of Place of Residence	Main Reasons for No Vaccination														Total
	Lack of Information		Fear of Side Effects		Fear Child Will Get Disease		Fear Vaccines don't work		Religious Reasons		Post too Far		Child Was Absent		
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	
Urban	16.4	83.6	19.0	81.0	6.2	93.8	2.4	97.6	7.3	92.7	4.2	95.8	6.0	94.0	100.0
Rural	23.7	76.3	16.1	83.9	4.6	95.4	2.1	97.9	4.6	95.4	13.8	86.2	6.7	93.3	100.0
Total	22.4	77.6	16.6	83.4	4.9	95.1	2.1	97.9	5.0	95.0	12.1	87.9	6.6	93.4	100.0

Chapter V

Discussion

The first objective of the thesis was to explain the existing association between Nigerian mothers' level of education, wealth index and religion and the odds of getting their children vaccinated against polio. Results of the logistic regression model suggest there are important associations between the level of education and mother's propensity to get her child vaccinated. The mothers' propensity to vaccinate increased steadily with level of education, with the poorest group the least likely to vaccinate. This outcome is consistent with the existing literature (Sheeba et al., 2013; Aslam et al, 2012; Parashar, 2005) that suggests a direct association between mother's level of education and polio vaccinations. Sheeba et al. (2013) examined the socio-economic factors associated with polio vaccinations in Pakistan and found a strong association between a mother's level of education and their tendency to get their children immunized against the poliovirus. They explained that the higher a mother's level of education, the more likely they were to get their child vaccinated. The authors indicated that the risk of no immunization was three times higher among mothers who never went to school while compared to the mothers who had secondary education or higher (Sheeba et al. 2013).

Another study that was conducted in Pakistan by Aslam et al. (2012) examined the association between parental education and their health seeking behaviors. The indicator for the mentioned behavior was children's vaccination status. Results of their study showed that the father's education was directly associated with child's immunization status while the mother's education was essential to ensure long-term health outcomes.

In a multilevel analysis, Parashar (2005) evaluated the association between women's literacy and the complete immunization status of children at the district level in India. The author

concluded that at community level, the mother's literacy, and at the individual level, mother's access to higher education resulted in higher immunization coverage.

Our study results also showed statistically significant and direct association between mother's wealth index and polio vaccination. This outcome is consistent with the findings of the study by Sheeba et al. (2013). The authors urged that polio immunization coverage improved with increasing wealth index of households. It was assumed that this association was linked to improved access to higher education among communities with higher wealth index and ultimately improved knowledge of the importance of polio immunization. Furthermore, Egondi et al. (2015) examined the degree of immunization disparities among the poor children who lived in urban settings. The wealth index was used to determine SES. They found that urban poor children are less likely to receive adequate immunization coverage as compared to rich. In addition, Ravi and Abhishek, (2013) assessed the existing disparities in utilization of selected maternal and child health care services among urban poor and non-poor population in India. The status of being poor and non-poor was indicated by wealth index. The study suggested that urban poor children were under-vaccinated as compared to their non-poor counterparts (Ravi and Abhishek, 2013).

Findings of our binary logistic regression model indicate a resistance against polio vaccines among the Muslim population of Nigeria, as compared to Catholic and Other Christian variables. This finding is consistent with a UNICEF (2004) report showing an emergence of misconceptions related to polio vaccinations among the Muslim population of India that caused considerable resistance among parents and guardians for getting their children vaccinated against the poliovirus. Moreover, Murakami et al. (2014) indicated that in 2004, polio vaccine was officially boycotted in the northern Nigeria that worked as one of the primary influence for the

community resistance against the OPV among the residents of Swat valley, Pakistan. Also, too frequent vaccination rounds, misconceptions like OPVs contain birth control elements (there are beliefs that birth control is against Islamic law), and myths like OPVs contain infections and pork (Muslims are forbidden to eat pork). In addition, some of the study participants believed that OPVs were a Western conspiracy against Muslims or it was central government's scheme for reducing the population growth. Some of the participants found vaccinations against the guidelines of the Islam religion as the community religious leaders suggested (Murakami et al., 2014).

This thesis also includes a secondary, subgroup analysis to examine reasons why vaccinations were not allowed, among women who did not allow them. Results of crosstab evaluating the reasons for vaccination dropouts by the type of residence showed that a high percentage of mothers both in rural and urban settings described lack of information as a reason that they did not vaccinate their child. This issue has been raised in most if not all the literature reviewed in this paper. Most of the studies emphasized on mother's education and the importance of their awareness of life-saving effects of polio immunizations, as a result of which parental health seeking behaviors can change. Also, within the rural areas lack of access to the vaccination posts due to extensive distances was one of the main reasons for missing immunizations. Sheeba et al. (2013) as well discussed that in the rural parts of Pakistan lack of access to vaccination post is an issue that needs to be addressed. Fear of side effects was the number one reason for vaccination dropouts in urban settings while it stood second in rural Nigeria. The issue was discussed by Favin et al. (2012) who reviewed a large number of documents from the global grey literature to assess the barriers to immunization for eligible children. Results of their study showed that fear of side effects were one of the main reasons that

eligible children missed vaccination worldwide. Furthermore, Panna et al. (2011) conducted a research to get pediatrician's opinions on the barriers hinder polio eradication initiative in India. Findings of their study indicated that lack of information, fear of side effects, religious reasons and superstitions were among the most common barriers hinder polio eradication.

Limitations And Recommendations

Like any study our current research paper has its limitations that are as follows:

- The study findings are based on secondary data that were not specifically collected for the purpose of assessing the potential and barriers in polio eradication initiative;
- The data are not very recent (NDHS 2008). However, these are the only data available to us. The 2008 NDHS data were selected for the purpose of current study because it includes multiple covariates that could be used to determine why eligible children miss vaccinations. Conducting further studies of this nature, using more recent data as they come available and from different countries, if possible, is recommended for all the polio endemic countries.

Conclusion

The study findings suggested that mothers' SES could affect their likeliness of getting their children vaccinated, suggesting that the governments of polio-endemic countries should consider women's education and empowerment as part of their health promotion policies and strategies. In addition, study findings were consistent with other related literature in pointing out the need for raising awareness regarding the goals of GPEI and adopting community-based strategies to combat the existing sensitivity against the polio eradication campaigns. Furthermore, improved access to vaccination in the rural areas and within resource poor communities is recommended. Further research needs to be conducted to assess the

vaccination related behaviors and attitudes related to mothers' SES with a special focus on Muslim communities where higher reluctance were experienced against polio vaccines as compared to some of the other non-Muslim communities. Nevertheless, the odds of getting their children vaccinated were lesser among the Traditionalists as compared to Muslims. Less has been written about the vaccination disparities among this religious minority in Nigeria. Future research is recommended to explore the factors that influence polio immunization refusals among the mentioned group. Continued surveillance is needed for more recent years and all affected countries until polio is finally eradicated from the world.

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