The Introduction of the Pneumococcal Conjugate Vaccine into Cameroon's Expanded Programme on Immunization: *Would every child be reached?*

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Abstract

Pneumonia like many other communicable infections is vaccine-preventable, but the increasing death toll resulting from the disease globally is a call for concern; partly attributed to the incomplete vaccine coverage in children. There are several factors why vaccines have failed to reach every child. Most of these include the perceptions, knowledge, attitudes and practices of parents/guardians and healthcare providers. Previous studies on the introduction of new and under-utilized vaccines as is the case with the Pneumococcal Conjugate Vaccine (PCV) have focused on experimental trials, coverage figures and vaccine efficacy in developed countries. Little attention has been given to the factors which may hinder the implementation process despite the great challenges this may encounter in developing countries.

The present study explored the essential issues in the introduction of the PCV in two health districts in Yaounde, Cameroon to ensure that every child is reached. The objectives of the study were to describe the knowledge, attitude and practices of parents/guardians on pneumonia and immunisations/EPI vaccines. It also aimed to identify the parental socio-economic/demographic characteristics that are predictive of good knowledge on pneumonia infections and EPI vaccines. Finally, the study described health center personnel perceptions about immunisations prior to the PCV introduction into the EPI.

A cross sectional study design was adopted and targeted parents/guardians (n=205) of children aged 0-59 months and health centre personnel (n=13) directly involved with vaccination activities in two health districts in Cameroon. The WHO's immunisation coverage cluster survey design was used to select the subjects with a response rate of 79.3%. The study was conducted between July-September 2010. Descriptive statistics and multivariate logistic models were used to analyse the parental/guardian data while the health personnel data was only analysed descriptively. SPSS version 17.0 was used as the analytical tool.

The knowledge, attitudes and practices of the respondents were found to be generally good and positive about pneumonia disease burden and immunisations/EPI vaccines. However, only 19% of the parents/guardians were aware of the availability of the PCV. Most parents/guardians were of the opinion that increased sensitisation/mass vaccination campaigns would remain essential for the PCV to reach every child. Logistic modelling identified associations between; - educational level and parental knowledge on the consequences/seriousness of pneumonia infections, income and parental knowledge on pneumonia causes/risk factors, occupational level and parental knowledge on pneumonia prevention beside that of region of origin and parental knowledge on the availability of the PCV. Also, a friendly attitude from health personnel was thought to motivate parents/guardians to respect vaccination schedules.

According to parents/guardians, the strongest factors promoting wide access to the PCV are public sensitisation/mass vaccination campaigns and use of social network avenues. Hence, a short and clear message on the dangers of pneumonia and the need for prevention provided to parents/guardians by health personnel during sensitisation/out-reach campaigns would be primordial, if the PCV is to reach every child.

Key words: knowledge, attitudes, practices; parents/guardians; health personnel; PCV; EPI; new vaccine introduction; pneumonia; Cameroon; vaccinations/immunisation, Sub-Saharan Africa

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LIST OF COMMONLY USED ABBREVIATIONS

AAP:	American Academy of Pediatrics
AIDS:	Acquired Immune Deficiency Syndrome
AOR:	Adjusted Odds Ratio
ARIVAC:	Acute Respiratory Infection Vaccine
CDC:	Center for Disease Control, Atlanta-USA
C2D:	Debt Reduction Development Agreement
DALYs:	Disability Adjusted Life Years Lost
DHS:	Demographic and Health Surveys
EPI:	Expanded Programme on Immunisation
Epi-25x10:	The Cluster sampling technique used in the study
GAVI:	Global Alliance on Vaccines and Immunisation
HIV:	Human immuno-deficiency Virus
HSS:	Cameroon Health Sector Strategy: 2001 – 2015
IFORD:	Institute for research and demographic studies
INS:	National Institute of Statistics
IPD:	Invasive Pneumococcal Diseases
IVB:	Immunization, Vaccines and Biologicals of the WHO
LQAS:	Lot Quality Assurance Sampling
MINEPAT:	Ministry of Economy, Planning and Territorial Development
MINSANTE:	Ministry of Public Health
MMWR:	Morbidity and Mortality Weekly Report
PCV:	Pneumococcal Conjugate Vaccine
THL:	The Finnish National Institute for Health and Welfare
UNICEF:	United Nations Children Fund
USA:	United States of America
WER:	Weekly Epidemiological Report from the CDC
WHO:	World Health Organization
WHOSIS:	WHO Statistics and Information Systems

1.0 Introduction

Acute Respiratory Infections (ARI), account for some 6.3% of Disability Adjusted Life Years Lost (DALYs) in children under-five worldwide (WHO, 2009). The incidence of these infections are rapidly increasing and causing a heavy economic and social toll on households (Lindstrand, 2006). One of the most prolific and forgotten killers to children in the class of ARI is pneumonia. According to a joint WHO/UNICEF report in 2006, pneumonia, more than any other illness, is confirmed to be a mass killer of children – in effect, more than AIDS, malaria and measles combined. This situation is most likely to persist, as it appears that, the advent of HIV/AIDS and the increasing focus on communicable diseases, to say the least has partly contributed to the little attention given to pneumonia.

The situation is even more precarious in low-income countries particularly in Sub-Saharan Africa where about two million who die from the disease yearly are concentrated. This represents about a fifth of under-five deaths worldwide (O'Brien et al. 2003; WHO/UNICEF, 2006). In Cameroon alone, pneumonia is responsible for between 19-21% of under-five deaths (UNICEF, 2007; WHO, 2008).

Pneumonia, like many other communicable infections is vaccine-preventable but the increasing death toll from the disease is a call for concern. The mean vaccination coverage for the last decade in Cameroon stands at approximately 80% (WHO/WHOSIS 2009). There are an estimated 20% of children who fail to get immunised; and as such, do not get any benefits from the government's investment. It is even likely that the 80% mean national immunisation coverage may not reflect the actual picture in the field, as huge disparities still exist between the proportion of unimmunised and immunised children within different regions, divisions, health districts and communities in most parts of Sub-Saharan Africa (WHO, 2009; Mutua et al., 2011). This is evident as the World Health Organization points out that an estimated 1.4million children die yearly from vaccine-preventable infections such as measles, yellow fever, pertusis, tetanus, poliomyelitis and Haemophilus influenzae type B (Hib). This paints a vivid picture of the incomplete coverage and under-utilization of existing vaccines in many parts of the world, with the most of this in resource-poor settings (WHO, 2004; Tove et al., 2008).

Hence, the introduction of the Pneumococcal Conjugate Vaccine (PCV) into Cameroon's national Expanded Programme on Immunisation (EPI) adds yet another challenge. And the worrying fact in the mind of many is whether and how every child, including the most vulnerable and hard-to-reach populations, who need these vaccines most, would be served.

Nonetheless, the introduction of the PCV will not occur in isolation, because a committed effort is required in the process from both the demand and supply sides for a successful immunisation strategy. As indicated by Tove et al., (2008), improvement over the last thirty years in immunisation programmes has stemmed mainly from the beneficiary community and health service collaboration. Thus, an understanding of the health needs of a community and the knowledge, attitudes and practices of both the beneficiaries (through their caretakers) and providers of health care has to be holistic (Smailbegovic et al., 2003).

This is crucial, particularly as a major impact of vaccination relies greatly on the potential of immunisation schemes to reach every targeted individual and thereby limiting the disease burden (Tove et al., 2008). It is for these reasons and more that; this study proposes to explore essential issues prior to the introduction of the PCV. Specifically, this study attempts to address the following questions:

- What are the demand-side (parental) socio-economic and socio-demographic factors hindering vaccinations reaching children?
- What are the perceptions of health care providers (supply-side) about immunisations prior to the PCV introduction?
- What are the opinions and experiences of parents/guardians on pneumonia disease burden and prevention/immunisation?
- What are the essential issues to explore when introducing the PCV?
- How best could the PCV be made to reach every child in Cameroon?

It is hoped that, these life-saving vaccines together with those already on the EPI schedule will help to substantially reduce the burden of morbidity and mortality of children under-five in the country. This goal accomplished, will help to accelerate the pace of Millennium Development Goal number four (MDG4), with its target of the reduction by 2/3 the under-five mortality rate by 2015 in reference to the 1990 level.

2.0 Literature Review

The introduction of health service interventions such as under-used and newly licensed vaccines into developing countries is a welcome agenda. However, this agenda will remain incomplete if evidence on the implementation challenges, including the knowledge, attitudes and experiences of health providers and beneficiaries is not assured prior to the bringing in of any such interventions. In Cameroon, the introduction of the Pneumococcal Conjugate Vaccine (PCV) has stemmed from evidence on the burden of pneumonia disease in children less than five years old; and this has been helped by new funding streams (www.gavialliance.org).

There are many factors why introducing the PCV may face challenges in reaching every child. Among these factors are low income levels of < US $1000 per capita, more than 1% of HIV/AIDS prevalence in adult population aged 15-44years (WHO, 2004); are other population-related challenges. It also seems that, the focus on the epidemiological variations within and without the communities and the interactions between the socio-economic and demographic factors in addition to personnel and other infrastructural barriers have almost been neglected.

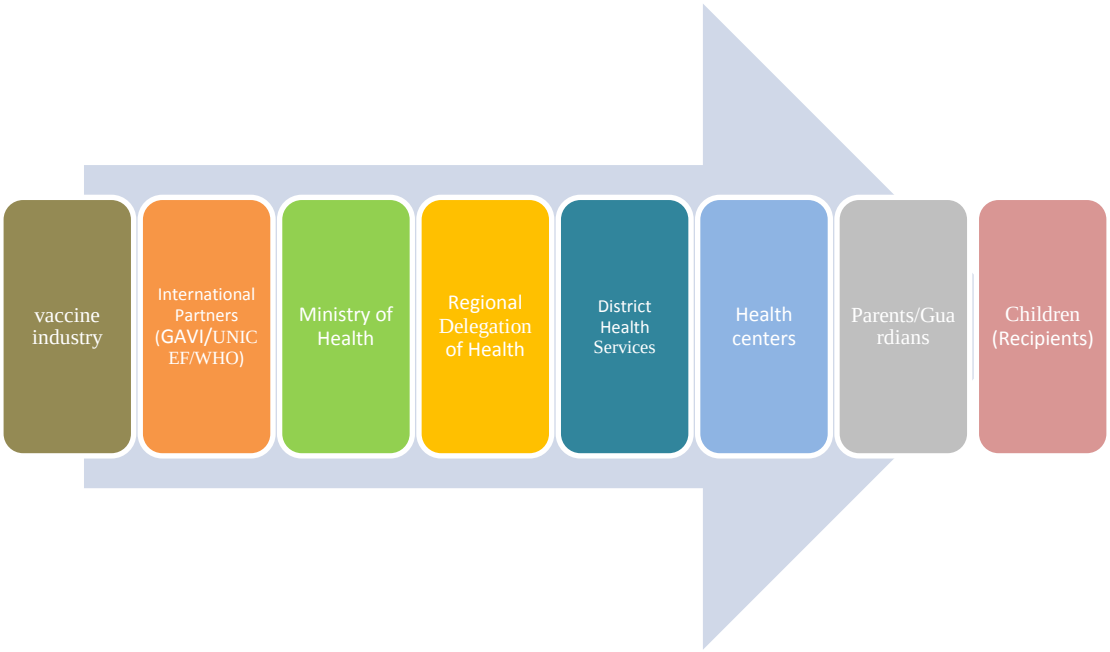

Figure 1: Model Flow chart of the vaccine supply chain in Cameroon (by John Libwea)

Therefore, it is essential to focus on the factors which are associated with how these vaccines would actually get to the recipients despite these challenges. Figure 1 above is a model pathway of the vaccine delivery process from the industry to the children.

Thus, as this study stands out to explore the issues which are essential when introducing the Pneumococcal Conjugate Vaccine, the literature review will focus on factors which are influential on parental 'demand'- and health provider 'supply'- side factors linked with vaccine delivery. The emphasis will rely on the interaction between the health providers at the health centres and the children, cutting across the parental pathway as outlined in Figure 1 above.

2.1 Materials and Methods to Literature Review

Information was obtained through the Medline and Pub-med databases, science direct, the University of Tampere Health Science library (tertio/TAMCAT), literary books and the Google search engine. The keywords used for the search were United Nation's Children Fund (UNICEF), GAVI Alliance, Vaccinations/Immunisations, Expanded Programme on Immunisation, New vaccines introduction in developing countries, Cameroon, parental and health personnel knowledge, attitudes and perceptions/practices, World Health Organization (WHO), and Pneumococcal Conjugate Vaccines.

2.2 Definitions and some major highlights

2.2.1 Immunisation/ Vaccination

Vaccination as defined by the Mosby's Medical Dictionary (2009) and the free online medical encyclopaedia, "is any injection of attenuated or killed microorganisms, such as bacteria, viruses, or rickettsia, administered to induce immunity or to reduce the effects of associated infectious diseases." Introduced in the West in 1796 by Edward Jenner, it is widely used today and has contributed enormously in preventing many infectious diseases including smallpox which has already been eradicated. Meanwhile, basically the process of protecting against an infectious disease by "priming" the immune system with material - the immunogen (vaccine), designed to stimulate an immune response to the infectious agent is known as immunisation. However, in daily practice just like in this write-up vaccination and immunisation are basically synonymous.

2.2.2 Rationale of the Pneumococcal Conjugate Vaccine (PCV)

The PCV is a vaccine designed for the protection of infants and younger children against bacterial infections especially pneumonia caused by *Streptococcus pneumoniae* (the pneumococcus). Prior to the licensing of the first conjugate vaccines against pneumonia in 2000, the sole licensed vaccine against the disease was the pneumococcal polysaccharide vaccine (PPV) (Bridy-Pappas et al., 2005). Both PPV and PCV are derived from the capsular polysaccharide (PS) of the Streptococcus bacterium. However, while the PPV stems from a direct refining of the capsular polysaccharide, the PCV is derived through chemical conjugation of the capsular polysaccharide to a protein carrier (Chu et al., 1983).

In circulation worldwide are over ninety different serotypes (disease-causing strains) of the Streptococcus pneumoniae, and the formulation of vaccines against pneumonia is based on the most prevailing pathogenic serotypes. In this regard, PPV either marketed as Pneumovax23TM or Pneumo23TM contains 2micrograms each of the purified capsular PS of the 23 different serotypes of the Pneumococcus which are cumulatively implicated for 90% of severe pneumococcal incidence and mortality (Fiore et al., 1999).

Meanwhile, the first conjugate vaccine was licensed in the United States in 2000 with the trade name of Prevnar TM or PrevenarTM. It is constituted of seven polysaccharides from the Streptococcus pneumoniae serotypes (4, 6B, 9V, 14, 18C, 19F and 23F) coupled to a genetically detoxified *diphtheria toxin* CRM_{197} carrier protein (Schuerman et al., 2007). There are other licensed formulations of the PCV such as the PCV-10 with the following serotypes (1, 4, 5, 6B, 7F 9V, 14, 18C, 19F and 23F) or the PCV-13 containing 13 serotypes (1, 3, 4, 5, 6B, 6A, 7F, 9V, 14, 18C, 19A, 19F and 23F) (WHO, 2009). As observed from these compositions, PCV-10 and PCV-13 contain serotypes 1 and 5 which are most prevalent in developing countries (Esposito et al., 2007) and it is expected that, the conjugate vaccines will provide optimal coverage of the prevailing serotypes in Sub-Saharan Africa. It is further hoped that, the vaccines introduced would reduce the pain, disabilities, sickness and deaths resulting from pneumonia in resource-poor regions. To this end, Cameroon plans to introduce the PCV-13 into its Expanded Programme on Immunisation for childhood vaccinations (MINSANTE/EPI, 2011 updates).

The Pneumococcal Conjugate Vaccines are most preferable since they have a good safety profile, well tolerated and effectively activate higher antibody titres in children younger than two years of age and upwards, the elderly and immuno-compromised

individuals besides the reduction of nasopharyngeal carriage than the Pneumococcal Polysaccharide Vaccines (Esposito et al., 2007; Vila-Córcoles, 2007). The conjugate vaccines in effect according to studies (Vestrheim et al., 2008), have proven to be most suitable in limiting pneumococcal bacterial spread in the community both to the vaccinated and unvaccinated through the generation of herd immunity. The vaccine currently available is well tolerated, has a good safety profile and is highly immunogenic in all age groups. The vaccine also reduces nasopharyngeal carriage and has a secondary, albeit very important, beneficial effect on herd immunity and confers about 90% of protection against invasive diseases (Vestrheim et al., 2008).

2.2.3 Expanded Programme on Immunisation (EPI)

The Expanded Programme on Immunisation (EPI) is a programme of the World Health Organization which was established in 1974 with the vision to develop and expand immunisation programmes for vaccine-preventable infections worldwide (Jamison et al., 2006).

Table 1: Previewed Vaccination calendar in Cameroon as from July 2011

Contact period	Vaccines	Route of administration	Site of administration
At birth	-BCG -OPV 0	Strictly Intradermal Oral	Upper-left arm muscle In the mouth
At 6weeks after birth	-OPV 1 DTP1-HeB1-Hib1 Pneumo- 10/13.1*	Oral Subcutaneous Intramuscular	In the mouth Left deltoid muscle Left thigh
At 10weeks after birth	-OPV 2 DTP2-HeB2-Hib2 Pneumo- 10/13.2*	Oral Subcutaneous Intramuscular	In the mouth Left deltoid muscle Left thigh
At 14weeks after birth	-OPV 3 DTP3-HeB3-Hib3 Pneumo- 10/13.3*	Oral Subcutaneous Intramuscular	In the mouth Left deltoid muscle Left thigh
At 9months	Measles Yellow fever Vitamin A	Sub-cutanous Sub-cutanous Oral	Left deltoid muscle Left thigh In the mouth

Source: Adapted from MINSANTE/EPI, 2010 (PCV Introductory Plan document) **(1st, 2nd & 3rd doses of either PCV-10 or PCV-13), DTP=diphtheria, tetanus &pertusis, OPV= Oral Polio vaccine, Heb = Hepatitis B, Hib= Haemophilus influenzae type b*

The name “expanded” resulted from the inclusion of the measles and polio vaccines to the initial Bacile Calmette-Guerin (BCG), diphtheria, pertusis and tetanus (DTP) vaccines. The goals of the EPI include the prevention of childhood diseases with existing vaccines, the provision of high-quality vaccines and disease monitoring and surveillance. Since its inception, the EPI has achieved remarkable successes in global public health though much is still to be realised (Osman, 2008).The EPI in Cameroon began in 1981 (MINSANTE/EPI, 2010) and besides routine immunisation services, it also conducts supplementary and preventive immunisation activities wherever the need arises. To better serve the public, it has a national calendar of vaccination activities as shown in Table 1.

2.3 Pneumonia

Pneumonia is a disease which usually attacks organs of the lower respiratory tract especially the lungs resulting in its inflammation. It can be caused by a series of infective agents including viruses, bacteria and other pathogens including those from the environment and fungi. However, the most common causative agents are *Streptococcus pneumoniae* and *Haemophilus influenzae* which accounts for the first and second leading causes of bacterial infections in children. While the respiratory syncytial virus is the most common viral cause of pneumonia, the *Pnuemocystis jinoveci i*s most implicated for at least ¼ of all pneumonia deaths in HIV-infected infants (Wardlaw et al., 2006).

The characteristic feature of pneumonia disease lies in its diverse routes of transmission and aetiology. The viruses and bacteria can be located around the nose or throat of an individual from where; it can easily infect the lungs when inhaled. Otherwise, airborne droplets or blood specimens especially in the course of delivery are potential routes of spread of the infection. The commonest symptoms usually include; persistent cough, fast or difficult breathing, fevers, chills, headaches, loss of appetite and wheezing. However, radiological examinations of the chest and laboratory tests are reliable diagnostic tools for the confirmation of the causative agent and extent of the pneumonia infection (Rudan et al., 2004). Antibiotics are effective in the treatment of pneumonia particularly before it gets to the very severe stages. Although nutrition, malaria case-management, environmental hygiene and sanitation are vital considerations (Källander et al., 2004), vaccinations remain ideal in preventing pneumonia from devastating the lives of children.

In effect, as the world awaits further evidence on the aetio-pathogenesis of pneumonia and a more defined transmission route (John et al., 1991), safer and effective methods which exist for treatment and prevention should be made accessible and affordable to the vulnerable and high-risk populations.

Consequently, new generational antibiotics and vaccines which have this far proven some degree of reliability in the developed world can equally bring good prospects to the developing world, where not every child who needs these medicines is able to get them as in most poverty stricken populations (Williams et al., 2002). This may otherwise imply that, millions of vulnerable children worldwide will remain continuously under the brim of the ravaging effects of the disease and its impact on public health remains yet another concern.

2.3.1 The Global, Regional and National Public Health burden of Pneumonia

It has for a long time remained a challenging task to make a near estimate of the main causes of death in children younger than five years old worldwide.

Table 2: Regional distribution of pneumonia (%) as a main cause of death in children under the age of five globally.

Region	Pneumonia	Neonatal complicated infection (mainly from sepsis/pneumonia)
South Asia	21	13
Sub-Saharan Africa	21	7
Middle East & North Africa	15	11
East Asia & Pacific	15	9
Latin America & Caribbean	14	8
Central & Eastern Europe and the Commonwealth of Independent States	13	8

(***Source**: Adapted from UNICEF, 2004: % of under-five deaths by WHO regions)*

However, thanks to the work of WHO coordinated Child Health Epidemiology Reference Group (CHERG) in 2001, an attempt to update data on the main causes of child death was established. According to this report (Bryce et al., 2001), pneumonia,

diarrhoea, malaria and measles are said to be the leading causes (73% in total) of death in children less than five years.

Pneumonia solely, is implicated with a proportion of 19%, followed by diarrhoea with 17%, malaria with 8%, measles 4%, injuries 3%, HIV/AIDS 3% and others 10%. Besides, 10% of neonatal deaths results from complicated sepsis/pneumonia, as preterm delivery (10%), and asphyxia in the course of birth (8%), equally have a quota in infant mortality (WHO/UNICEF, 2006). The report further substantiates that within deaths in children less than five years of age, 42% and 29% originate from the WHO Africa and South-East Asia regions respectively.

Related studies on the global burden of childhood illnesses and mortality (Rudan et al., 2004; Singh, 2005; Scott et al., 2008) have reported similar findings which indicate pneumonia as the principal cause of 5-21% of death in this age group in the different WHO regions worldwide.

Nonetheless, despite its global occurrence and its non-respecter of age as it is prevalent amongst the young just like in the elderly, the disease and death burden of pneumonia vary across and within regions. As earlier indicated (Bryce et al., 2001), over 70% of the occurrence of pneumonia is in children younger than five years of age located in Africa and Southeast Asia. It is this vulnerable age group which suffers most, yet not getting much of the desired remedy. In the same perspective, Fuchs et al., (2005) undertook a study on the burden of pneumonia in children in the Latin American and the Caribbean regions. It revealed that, though not the best, the burden of the disease falls between those of developing countries and the developed world as some countries have witnessed a decline in mortality from Acute Respiratory Infections (e.g. Chile & Uruguay with 5-10%), others such as Bolivia, Peru and Guyana, the magnitude is reportedly high, 15-20% (Fuchs et al., 2005).

Moreover, related data on the variation within the six countries in the Central African Monetary and Economic Community (CEMAC) sub-region where Cameroon is found (in the WHO Africa Region), shows a mean of 21.2% attributed cause of death in children due to pneumonia. As such in the CEMAC zone, pneumonia represents the main cause of under-five death in the Central African Republic (19%), Cameroon (19%), Congo (16%), Equatorial Guinea (12%), Chad and the Democratic Republic of Congo each (20%) respectively and Nigeria (16%) which shares a long-western and porous border with Cameroon (WHO,2008). In a nutshell, the joint WHO/UNICEF

report (2006) gives a comprehensive knowledge of the global distribution of the disease burden of pneumonia as shown in Table 2 above.

In the light of these regional figures, it is important to take an in-depth look into the national public health burden of pneumonia in Cameroon. It is common understanding that, just like in many resource-poor settings, diagnoses of pneumonia via chest x-ray and/or laboratory examinations is a far-fetched agenda in the peripheries but rarely available in health services around the cities (John et al., 1991). Thus, most of the information provided on the causes of death resulting from pneumonia in the country is based on clinical symptoms (WHO/UNICEF, 2006). This notwithstanding, the major causes of death in children under-five in Cameroon include;- malaria (19%), pneumonia (19-21%), diarrhoea (16%), prematurity 8%, birth asphyxia 8% and 10% (WHO, 2008) as the list remains inexhaustible. However, with much emphasis by the state on the provision of cheap generic drugs against malaria and free distribution of mosquito bed nets to pregnant mothers (MINSANTE, 2011 updates); it is presumed that pneumonia still plays a central role in the death of children in Cameroon.

As such, if the 2008 UNICEF report on the State of the World's Children is anything to go by, then it is important to have in mind that Cameroon's under-five mortality rate stood at 149/1000 live-births, and pneumonia case-fatality was 22% from the eighty four thousand (84000) under-five deaths in a population of two hundred and thirty four thousand (234000) children younger than five years old (DHS, 2004).

This explains why one of the major priorities in the Cameroon Health Sector Strategic plan (HSS) for 2001 – 2015 (revised in 2008) is the introduction of new vaccines by the end of 2011 amongst which are the Pneumococcal Conjugate Vaccine (against the pneumococcocus) and vaccines against rotaviruses implicated in diarrhoea infections.

2.3.2 New perspectives in Pneumococcal Vaccinations

There are many studies reporting that pneumonia is the leading cause of morbidity and mortality in children worldwide (WHO, 2007). At this rate, nothing may be short of declaring pneumonia the "world's number one enemy". Astonishingly, though most of the reports indicate that the burden of the disease is anchored in the poorest 20th percentile of the world notably in Sub-Saharan Africa and Southeast Asia (WHO/UNICEF, 2006; Rudan et al., 2004; Bryce et al, 2001; WHO, 2007), there seem to be an inverse proportion in efforts to alleviate the situation. In view of this, it is

peculiar to note that for reasons which may include economic and financial (Sinha et al., 2007); which are primarily beyond the scope of this study, the most affected and high-risk populations get the least in medicines affordability and accessibility; while the least affected have large quantities of medicines against pneumococcal diseases at their disposal.

However, with the emergence of renewed initiatives from the GAVI Alliance (previously known as was the Global Alliance for Vaccines and Immunisations), there are prospects of a changing tide. It is essential to recognise that, the GAVI Alliance – is a not-for-profit organisation which seeks to foster Public-Private-Partnerships (PPP) to create a global access to vaccine. Since its conception a decade ago, GAVI is now more committed to its mission of saving the lives of children and the protection of peoples' health via immunisation mostly in low-income nations. The organisation which came into the lime-light in the year 2000, includes amongst its membership WHO, UNICEF, The World Bank, Non-Governmental Organisations, the vaccine industry, research and technical agencies, the Bill & Melinda Gates Foundation, the civil society, developing country and donor governments (GAVI, 2010 updates).

Indeed, though the GAVI Alliance seeks to save and protect lives, its actions are evidence and policy-based (Bliss et al., 2008; WHO, 2007). As such, following the licensing and use of the first pneumococcal conjugate vaccine (PCV-7) in the year 2000, substantial evidence proved in the United States that there was over 75% decrease in invasive pneumococcal diseases (IPD) in children younger than five years old and close to 40% decrease in hospital admission amongst those under-two years of age (CDC/MMWR, 2008; Grijalva et al., 2007). Furthermore, clinical trials with PCV-9 in two studies conducted in Africa equally confirmed the efficacy of the conjugate vaccines against pneumonia and IPDs (Madhi et al., 2008).

This certainly gave a strong signal to WHO and UNICEF that the conjugate vaccines could bring the much desired relief against the pneumonia burden of disease particularly as the vaccines were declared safe and effective. Hence, the recommendation of their inclusion into the national immunisation programmes of its member states (WHO, 2007; Bliss et al., 2008). Admittedly, recommendations do not usually accompany the much needed logistic, technical and/or financial support. Thus, by the third quarter of 2008, the twenty six nations which were already implementing this WHO/UNICEF recommendation came from the industrialised world with a lesser burden of the disease (< 2%) and none of the countries with heaviest burden (≥19%) could afford to procure these vaccines (CDC/MMWR, 2008).

It is against this background that in respect to its mission, the GAVI Alliance through well-defined mechanisms and partnerships in 2006 galvanised and made available funds on the demand of poor countries, to assist in introducing the PCV. The most prominent in these mechanisms are the Advanced Marketing Commitment (AMC) and the Pneumonia Accelerated Development and Introduction Plan (PneumoADIP). While the AMC focuses on energizing the development and production of pneumococcal vaccines for developing countries, PneumoADIP ensures that sufficient research is available on the epidemiology of pneumococcal infections and accesses the urgency of immunisation.

However, this perspective which is a laudable endeavour had some conditions to qualify countries as either eligible for the GAVI Alliance Funds or otherwise. These eligibility conditions apart from a gross national per capital income of < $ 1000 based on The World bank estimates in 2003 (HDR, 2010) includes; - a country mortality rate above 50/1000 live births among children under-five years, have over 10% of deaths in children aged less than five years as pneumonia case-fatality and more than 1% prevalence HIV infection in adults aged between 15 and 49 years (WHO/WER, 2008). On these bases, 72 countries met the aforementioned criteria and are now described as GAVI-eligible countries (see Table 3).

Cameroon falls amongst the GAVI-eligible countries in view of a 5.5% prevalence of HIV infected adults in the age range of 15-49, 19-21% attributed under-five deaths due to pneumonia and a mortality rate of 149 per 1000 live births among children younger than five years old (DHS, 2004; UNICEF, 2006; WHO, 2007). The government through the Ministry of Health tendered a request in May 2008 for assistance to introduce the PCV in its national Expanded Programme on Immunisation (www.gavialliance.org; MINSANTE/EPI, 2008).

Hence, it is through this perspective that the Pneumococcal Conjugate Vaccine (PCV) is to be added into the Expanded Programme on Immunisation in Cameroon. Prior to this, the Republic of Rwanda stands as the first country in Sub-Saharan Africa to have introduced the PCV for childhood immunisation via this perspective in April 2009 followed by the Gambia later in the same year (GAVI, 2010 updates). Many other GAVI-eligible countries such as Kenya just like Cameroon have anticipated or deferred their plans in the last years but it is hoped that 2011 will be a glorious year for the PCV introduction "as the fight against pneumonia seems to be unstoppable now" (*excerpts from Orin Levine – Director of PneumoADIP).*

Table 3: Number of countries that plan to have introduced Pneumococcal Conjugate Vaccine by the end of 2009, by WHO Regions

WHO Regions	No. of member state in Region	No. of countries using Pneumonia vaccine (% of total) in 2009	No. of GAVI-eligible countries in Region	No. of GAVI-eligible countries using Pneumonia vaccine (% of total) in 2009
AFR	46	3(5%)	36	2(6%)
AMR	35	13(37%)	6	3(50%)
EMR	21	4(19%)	6	0(0%)
EUR	53	16(30%)	8	0(0%)
SEAR	11	0(0%)	9	0(0%)
WPR	27	4(15%)	7	0(0%)
Global	193	40(21%)	72	5(7%)

Source: WHO/IVB 2009 (*N.B: AFR=Africa Region, AMR=American Region, EMR=Eastern Mediterranean Region, EUR= European Region, SEAR=Southeast Asian Region, WPR= Western Pacific Region*)

N.B: The Democratic Republic of Congo (DRC), Kenya, Yemen, Guyana, Nicaragua and Sierra Leone are the first GAVI-eligible countries to have finally introduced the PCV to their national immunisation programmes between 2010 and June 2011 (GAVI updates, 2011).

2.3.3 Outlook of the Cameroon's PCV introduction plan

In May 2008, the government expressed her intentions to introduce the *Streptococcus pneumoniae (pneumococcus)* vaccine into its Expanded Program on Immunisation. This was initially planned for January 2010 and later moved to July of the same year but due to some reasons (including logistics and financial), it is now previewed for July 2011.

At the backbone of this, is an assessment of the growing partnership in which the country recounts to have benefitted to its EPI programme implementation. Since 2001, Cameroon has received GAVI immunisation services support , injection safety support from 2003 to 2005, and support for introducing new vaccines into the EPI—namely; the yellow fever vaccine in June 2004, tetravalent viral hepatitis B (DTP-HepB) vaccine in 2005, and Pentavalent *Haemophilus influenzae* type b (DTP+HepB +Hib) vaccine in January 2009.

The assistance from GAVI has helped to improve the performance both qualitatively and quantitatively, most particularly as the national immunisation coverage witnessed a sharp increase from 43% in 2001 to 82.49% in 2007 (reference antigen DTP+HepB3). The number of health districts with over 80% immunisation coverage continues to grow (56% in 2007). The wastage rate for DTP+HepB was 12% for 98 out of 167 health districts in 2006, and 10% for 86 of 171 in 2007.

With this in mind, the desire of the EPI to achieve a 90% national immunisation coverage as early as 2010, with at least 80% per antigen in each district and a vaccine wastage rate of 5% for DTP+HepB seemed to be a far-fetched agenda as the PCV introduction may only be realistic a year later.

Nonetheless, efforts to help reduce infant mortality and morbidity in accordance with MDG4, are elaborated in a revised 2007-2018 complete Multi-year Plan (cMYP) for the EPI. This multi-year plan amongst other virtues, seeks to pursue the introduction of new vaccines (notably rotavirus vaccine in 2011), as well as the pneumococcal vaccine on which the present study has its basis.

The epidemiological context of *Streptococcus pneumoniae* in the sub-region and in Cameroon with a prevalence of between 16 – 22% (WHO, 2008) calls for the introduction of this vaccine. Its delivery will follow the normal immunisation schedule for the Pentavalent (DTP+HepB+Hib), i.e., at 6, 10 and 14 weeks for the three doses required for children less than one year of age.

According to the 2007-2018 complete Multi-year Plan submitted to the GAVI secretariat and other partners (WHO/UNICEF), includes a section on strategies for the program's financial sustainability. As such, there is alot of emphasis to strengthen advocacy with the government for sustained immunisation independency. The good news for parents is that, the vaccines will be given free of charge to infants just like the already existing vaccines at least for as long as until 2015 which coincides with the available funding dispositions from the GAVI Alliance.

The addition of the PCV brings to ten the total number of compulsory antigens (vaccines) for childhood immunisation in Cameroon. The others include BCG (against tuberculosis), DTP (against diphtheria, tetanus & pertusis), Hep B (against Hepatitis B), Hib (against Haemophilus influenza type b), OPV (against poliomyelitis), YF (against Yellow Fever) and the measles vaccine besides vitamin A supplementation. In addition, the tetanus toxoid (TT) vaccine is made available to pregnant and post-partum women.

Moreover, the plan also draws inspiration from previous experiences and lessons on the introduction of new vaccines in the country. Thus, it is thought that, the main implementation strategies recommended for successful introduction of the Pneumococcal Conjugate Vaccine would include:

-Establishment of a sustained financing mechanism for immunisation;

-Strengthening of communication/social mobilization;

-Improvements in quality of services and strengthening of the advanced strategy for immunisation;

-Strengthening of staff capabilities;

-Steady supply of vaccines and inputs;

-Reliable management of vaccine stock and monitoring of usage;

-Strict enforcement of injection safety and waste management;

-Stepped-up surveillance of pneumococcus in the EPI;

-Strengthening of monitoring, supervision and Applied research.

In effect, an estimated sum of €3million is required to finance the planned introduction of the PCV keeping the cost of vaccines and miscellaneous aside. This outline and more constitute the progressive steps leading to the introduction of the PCV into the national childhood immunisation scheme of Cameroon.

2.3.4 The experiences of Pneumococcal Conjugate Vaccine introduction in other Expanded Programmes on Immunisation

Obviously, it is not the first time a new vaccine is being introduced in Cameroon and at the forefront are concerns with logistics. This certainly brings into reckoning the issue of challenges facing new vaccine introductions in developing countries (Mahoney et al., 1998). Unarguably true, results indicate the impact of the conjugate vaccines introduction in the United States which first used the PCV-7 in the year 2000 for instance, witnessed a drastic reduction in the number of hospital admissions from pneumonia and invasive pneumococcal diseases within two years (Whitney et al., 2003). The story is similar across Europe (Markus et al., 2009; Cartwright, 2002), and with clinical trials conducted in Gambia and South Africa (Oosterhuis-Kafeja et al., 2007). However, the challenges of introducing the PCV in Cameroon go beyond experimental trials or the successes registered in developed countries introduction. As such, it would have been paramount to take an evaluation of the experiences the Republic of Rwanda (the first low-income African country to introduce the PCV) witnessed along the line, but such a literature may not be yet available.

As a way forward, it will appear the need for translational research is essential in the absence of data on the experiences of PCV introduction in developing countries (Clemens et al., 1996). No doubts, a part of the translation research could be identified through the GAVI Alliance initiatives (PneumoADIP and AMC) coupled with the recommendations from the World Health Organisation (WHO, 2007) on the inclusion of the PCV into national childhood immunisation of its member states. Thus, alot has been touched on research and funding and much is still to be considered on the challenges in the distribution process; most especially on the perceptions and opinions of parents/guardians and health personnel. In effect, the WHO long objective and slogan

of vaccines “Reaching Every District” (WHO/AFRO, 2004) may have to be redressed into “Reaching Every Child” if a complete coverage is to be attained. The success of this slogan, is dependent on the knowledge, attitudes and practices of parents/guardians and health providers.

2.4 Essential factors to explore which are associated with the parental demand and health provider’s supply for vaccines

2.4.1 Knowledge, attitudes and practices of parents/ guardians

Immunisation in the last three decades has proven to be of substantial importance in healthcare particularly in the reduction of the vaccine-preventable disease burden (Tove et al., 2008). It has been and will continue to be helpful in the lives of millions of children worldwide (GAVI, 2010 updates). However, despite the benefits of immunisation, there are groups of persons who for one reason or another still will not accept immunisations for their children or relatives. This brings to light the question on what characteristics prompt the desire of parents to either accept or refuse vaccines (Doren et al., 2004). A mirage of suggestions have been advanced in earlier studies with much weighing on the balance of forces on the knowledge-attitudes-practices (KAP) of parents and their overall perceptions on vaccinations.

In a study conducted in the United States, it was observed that although refusal rates are relatively low (Doren et al., 2004); both qualitative and quantitative data expressed some concerns from parents about certain (new) vaccines on unknown adverse effects. Therefore, the knowledge or cognitive process of parents is considered as a vital factor to the demand for specific vaccines (Meszaros et al., 1996). This is obvious since parents in particular and mankind in general act on the basis of information available to them. As Meszaros and peer (1996) noted, parents who for example, do not demand varicella vaccines may not consider chicken pox as harmful. Besides, there are also philosophical reasons why parents do not ask for vaccines. A parental survey carried out in the mid-nineties indicated that close to 20% of the sampled population did not seek immunisation as a shared belief in homeopathy (Simpson et al., 1995). A lot of people keep distancing themselves from modern medical care, while others, either knowingly or unknowingly belief in the philosophy of herd immunity (Sinha et al., 2007). This belief exposed their children to possible benefit from the secondary coverage of the vaccinated population. More so, the cultural and religious beliefs or practices of a

community may influence their demand for immunisations particularly in most rural societies were cultural and/or religious heritage interact with their health seeking behaviour (Calderón-Ortiz et al., 1996).

However, as the world is evolving towards a global village, the attitudes of such societies too are changing. Many now appreciate the value of conventional healthcare and gradually understand the benefits health service interventions like vaccinations could bring to their children and families. This process needs to be accelerated and as such, a rapport has to be established between the communities and the health service providers in order to bring vaccinations closer to the communities. Studies in Nigeria (Oruamabo et al., 1987), Mexico (Calderón-Ortiz et al., 1996), and Papua New Guinea (Alto et al., 1989) have all indicated greater increases in vaccine uptake with community involvement as their religious or cultural affiliations were not reported to have any interference with conventional medicines and vice versa.

Moreover, demand may be increased if there is a proper communication process. As observed in a Philipino study, the community needs to be fully aware and informed of the benefits of vaccination and be given the opportunity to participate in the process (Zimicki et al., 1990). Out-reach programmes such as mass vaccination campaigns usually have potentials to a wider audience and this too is dependent on the media. With diverse media organs today, it has become commonplace for the public to be exposed to all sorts of information particularly as everyone is in a state of permanent alert when matters of health are concerned (Doren et al., 2004). Thus, Zimicki and colleagues (1990) highlighted that a sufficiently informed media on specific health issues can stimulate demand for vaccinations in the society via local radio and television programmes, community leaders or other available means. A similar approach involving inter-personal communication targeting mothers in a social network was used in Bangladesh and this greatly improved vaccination uptake and coverage rate (Amin et al., 1997). Again, the training of community members on the importance of vaccination is another channel which could be exploited to increase demand. These community members understand their societies better than health personnel (who most often are from diverse cultural backgrounds) and if properly drilled, they can help in reminding parents even on the respect of vaccine schedules (Tulchinsky et al., 1997).

Added to this is the aspect of incentives dished out to parents most especially mothers to motivate their visits to immunisation services. These incentives are sometimes financial or in kind. In a Nicaraguan study, the introduction of food incentives to create demand for immunisation witnessed over 100% vaccine coverage despite a possible over-

reporting arising from limitations attributed to the census data (Loevisohn et al., 1986). In general, the understanding and improvements of the underlying factors which tailor the demand and supply of vaccines will not only benefit the immunisation chain but equally lead to the development of a sustainable health system (Tove et al., 2008); where the contributions of the health personnel is inevitable.

2.4.2 Knowledge, attitudes and practices of health personnel

The increase in the demand for vaccines does not only depend on cognitive processes of parents but the perceptions and manner of approach from health care workers as well (Pickering, 2000). Thus, how the health personnel attend to parents will have an influence on the uptake of vaccines. This is obvious if one tries to understand why most often than not, children are not fully vaccinated (Berhane & Pickering, 1993). Considering the case of the three doses of DTP (diphtheria, tetanus & pertusis), it is not unlikely to find a steady drop in coverage figures from the first through the third dose - DTP1, DTP2 and subsequently DTP3. This situation is attributed partly to the practices of health personnel and facility allocations (Tove et al., 2008). Thus, an improvement in this area could catalyse the utilisation of vaccines. In view of this, a study in Ethiopia aimed to understand the reasons for frequent dropouts and children who are brought in for immunisation but could not be vaccinated. The results indicated that, using devices like reminder stickers helped parents to respect the dates of DTP2 after DTP1 (Berhane & Pickering, 1993). This considerably reduced the dropout rates.

Another approach involves getting the immunisation services to where the children are residing. This may be via a door-to-door technique where each household in the community is frequently visited by mobile vaccination teams. Nonetheless, an easier way is getting the immunisation team closer to the consultation room. These approaches increase the chances of unvaccinated children who report for curative care to be vaccinated (Loevinsohn & Gareaballah, 1992). More so, the issue of long-waiting time for parents in the health system in a nutshell has been detrimental to an effective supply chain particularly to the immunisation unit (Ekunwe, 1984). Thus, it may be argued that, an improvement in the clinical procedures will spare the concerns of time-wasting of parents and likely to motivate their consistency with vaccination timelines. Besides, it is important for the health personnel to adopt an appropriate management vaccination plan. This will permit the creation of specific targets which could be evaluated on progress made or modified as the circumstances prevail. The experience of Papua New

Guinea for instance, where health personnel in a province consulted on how best to provide services resulted in 25% increase within four years of coverage figures of DTP2 (Van Zwanenberg & Hull, 1988).

Furthermore, the training and skills of health personnel will also have an impact on the services they render. Highly qualified health personnel are not usually evenly distributed (if available) in most resource poor settings nor are there sufficient means for the re-training of those currently present. The balance of probability in shortcomings could be easily weighed. However, studies in Indonesia where experienced nurses in well-performing health units voluntarily trained their peers in poorly-performing units brought an improvement in coverage figures (Robinson et al., 2001). Similar studies in Madagascar with the training of health staff on the use of auto-disposable syringes reduced their workloads and even motivated them to work on extra days (Drain et al., 2000). This strategy ensured a reduction of missed vaccination opportunities and a consequent increase in coverage rates.

Moreover, putting all the aforementioned aspects in place is a good endeavour which should be complemented by the attitudes of the health center staff. To this effect, combining their knowledge and skills with a high sense of humour and friendliness to parents would be outstanding to influence both the demand and supply of vaccines. Indeed, though the relationship between patients and health personnel is sometimes complex, it is essential for the health personnel to adopt an approach which is effective and empathetic as this will reduce vaccine risk communication and misinformation while assisting parents in understanding the ultimate need of immunisations (Pickering, 2000).

2.4.3 Immunisation Financing: Infrastructural/logistic disposition (including cold chain space, vaccine procurement)

Immunisation has proven to be one of the most cost-effective interventions in healthcare; regardless of the high cost new vaccines may entail (WHO/UNICEF/The World Bank, 2009). However, the too much focus on the interplay between health providers and beneficiaries of healthcare does not in any sense neglect the importance of what it takes to assure the demand and supply of vaccines. There are many challenges in this regard, but the tip of the iceberg is geared towards the aspects of logistics and funding of new vaccine introduction into developing countries (Hausdorff, 1996). A comparative analysis on the vaccine procurement budgets between some developing

countries and their developed counterparts reflects a large disparity (Mahoney et al., 2000). In a 1988 pilot model, it was estimated that, the United States allocates close to 0.035% annually of its Gross National Product (GNP) to immunise about 4million newborns (meaning a complete dose of vaccine stands at US$670/child). Canada allocates about 0.0175% while the United Kingdom's allocation is about 0.0163%.

Most developing countries with a per capita GNP of < $3000; allocate roughly 0.13% of GNP on immunisation services (Salisbury, 1999; Duclos, 1999). This implies that, each live birth in a developing country could only get an average of US$3 as opposed to US$670 in the USA. This factor explains the under-utilisation of vaccines in resource-poor settings (Tove at al., 2008). Thus, developing countries already carry a heavier burden in providing standard EPI vaccines (including DTP, Measles, Polio, Hib, Tuberculosis and Hep. B). The worrisome questions have remained when and how do they get prepared to accommodate new vaccines (Mahoney et al., 2000)?

The principal concern here is the cold chain space and vaccine procurement. Vaccines particularly are temperature sensitive and the addition of the PCV for instance, means an equal expansion of the cold chain logistics for proper conservation and eventual transportation to the peripheries. This places a widened pressure on the already over-burdened current EPI vaccine supply services which demands for more investments. These required investments could not easily be achieved considering the current global economic landscape (Duclos, 1999).

It is against this backdrop that WHO and UNICEF (2008) publication, stated that attaining the Global Immunisation and Vaccines Strategy (GIVS) goals will require US$76 billion. More so, the 72 GAVI-eligible countries need a little over half of this (US$35 billion) to ensure the protection of more than 70million vulnerable children (Wolfson et al., 2008). As earlier indicated, Cameroon has benefited from GAVI funds since 2000 in the improvement of its EPI activities and the health system as a whole. Hence, the introduction of the PCV and its eventual sustainability will be assured by funds from GAVI Alliance partnership initiative which since 2005 opts for co-financing between the state and GAVI Alliance (MINSANTE/EPI, 2008; WHO, UNICEF & World Bank, 2009).

Prior to the emergence of the GAVI Alliance initiative, the financing of vaccines and immunisation in resource-low countries has been achieved basically from international bilateral and multilateral health assistance (Lydon et al, 2008). This brought important developments in logistics and infrastructure from the mid-seventies when the EPI was inaugurated until the nineties when the goal to reach universal child immunisation was

fixed. After this period, multilateral funding witnessed a decline while many beneficiary governments at the same time lacked the motivation to spearhead payments for their essential vaccines and immunisation. The effects were far-reaching and catastrophic on vaccination coverage figures in countries of Sub-Saharan Africa and Southeast Asia which had no access to regional funding mechanisms as those in the Americas (Lydon et al., 2008).

However, since 2005, most of the funds from the international donors are now channelled through GAVI Alliance which conceived the broad-based Public-Private-Partnership to support the health sector as a whole; and accelerate the introduction of new and under-used vaccines into developing countries in particular (GAVI, 2010 updates).

Moreover, since its inception the GAVI Alliance is in the second phase of its action plan which extends from 2006 to 2015 where the focus is on financing the addition of the rotavirus and pneumococcal vaccines. Besides, the first phase which preceded the period 2000 to 2005, concentrated on funding immunisation services and vaccines against hepatitis B and Hib in Pentavalent combinations (DTP+HepB+Hib). Nonetheless, to ensure financial sustainability all the countries receiving assistance from GAVI were obliged to develop Multi-Year Plans ($_C$MYP) which outlines a country's mechanism to financially sustain immunisation and vaccines procurement.

And as earlier stated, GAVI equally established a co-financing system as a component of the current phase II plan. It demands that eligible governments contribute in the payment of vaccines provided through the Alliance according to their GNI per capita. Thus, from this perspective, national governments of these GAVI-eligible countries are expected to take responsibility on forty percent (40%) of the cost of immunisation in the course of this second phase of GAVI action plan. With respect to this, it entails that of the estimated €3million cost required for the PCV introduction (MINSANTE/EPI, 2010); the government of Cameroon will disburse from the state coffers about €1.3million while €1.7million will come from the GAVI Alliance. Interestingly, the vaccines will be given free of charge to children between 0-11 months and as part of routine EPI activities.

3.0 Basic Background Information about Cameroon and its Healthcare System.

3.1 A summary presentation of the historical, geographical, political, socio-economic/demographic and cultural dynamics of Cameroon and its people.

3.1.1 Historical and Geographical perspectives

Figure 2: The map of Cameroon (courtesy: www.nationsonline.org/oneworld/map/cameroon)

Initially colonised by the Germans in the 1800s that lost their mandate after the Second World War, Cameroon was latter shared in a United Nation Trusteeship arrangement between the French and the English. The French ruled the East while the English ruled the West. She got her independence in 1960 and became the Federal Republic of Cameroon, made up of the former East and West Cameroons. She later became the Republic of Cameroon in 1972.

Cameroon is a Central African Country situated at the end of the Gulf of Guinea, between latitudes 2° and 13° north of the equator and longitudes 9° and 16° east of the Greenwich meridian. It covers a surface area of 475.440 Km² and has a triangular shape with a height of about 1,200 km from North to South and a base of 800 km from West to East. To the West the country is bordered by Nigeria; to the North-East by Chad; to the East by the Central African Republic; to the South by Congo, Gabon and Equatorial Guinea; and finally to the South-West by the Atlantic Ocean.

The natural environment is highly diversified with numerous ecosystems:

- The Central Plateau is a dense forest zone with a vast hydrographical network, a warm and humid climate, and abundant rainfall;
- The Coastal Plain is a low-lying region characterised by the presence of mangrove swamps and abundant rainfall;
- The Western Highlands have sparse vegetation, a cold climate and volcanic soils;
- The Adamawa Plateau, on the contrary, has a rather temperate Sudano-Sahelian climate and is covered by shrubby savannah and gallery forest;
- The Benue Plain is covered predominantly by grassy savannah dotted with Steppes and has a Sahel-type climate. The climate becomes hot and dry, with scarcity of rainfall towards Lake Chad.

3.1.2 The demographic and socio-economic perspective

Cameroon is a human mix, with over 200 ethnic groups and almost as many national languages. The population was estimated at some 20 million inhabitants as at January 2010 with an average density of 39 inhabitants per km². The population growth rate stands at 2.6% per year (BUCREP, 2010).

According to the 2004 Statistical Yearbook of Cameroon (MINEPAT/INS, 2004; 2001-2015 HSS), the structure of the increasingly youthful population is as follows:

- Less than five (05) years: 16.3%
- 5-14 years: 28.3%
- More than 65 years: 3.8%

The potentially active age bracket (15-49) represents 43%.

The bulk of this population lives in rural areas. However, there is growing urbanisation as urban dwellers represent 48.2% of the entire population in 2010 with a high concentration in Douala (about 2million inhabitants) and Yaounde (with over 1.8million people). Several other cities have more than a hundred thousand inhabitants each, for instance Garoua, Maroua, Bamenda, Bafoussam, Kumba, Nkongsamba, and Ngaoundere (BUCREP, 2010).

In general, the average size of households is 4.4 persons (DHS III, 2007) against an average of 5 (DHS II, 2001). More than 4 out of 10 persons live in nuclear or single-person households. *(NB: nuclear family= parents + children living in close neighbourhood; single households= family homes/households isolated from familiar neighbourhoods)*

Nonetheless, in view of its rich agricultural potential, Cameroon is an important pillar in the Central Africa Economy and Monetary Community (CEMAC) sub-region. In 2008, its GDP was estimated at CFA 10 434 thousand million francs, representing 30.82% of that of the sub-region (CFA 33 855.70 thousand million francs) (MINEPA, 2010). The sound implementation by Government of macro-economic and structural reform programmes since 1996 with the support of its development partners enabled Cameroon to reach the decision point of the Heavily Indebted Poor Countries (HIPC) Initiative in September 2000. The implementation of the Poverty Reduction Strategy Paper (PRSP), approved by the Britton Woods institutions, culminated in the attainment of the completion point of the HIPC initiative in April 2006 (MINEPAT, 2010).

Through the HIPC scheme, social sectors, including health, then benefited from numerous funding opportunities such as the C_2D and the MDRI. In addition, there are emerging innovative health financing mechanisms such as the International Finance Facility for Immunisation (IFFIm), Advanced Market Commitments (AMCs), the Global Fund to fight against AIDS, Tuberculosis and Malaria, GAVI (Global Alliance for Vaccines and Immunisation) amongst others.

According to statistics from the 2010 Human Development Report (HDR, 2010), between 1980 and 2010 Cameroon's Human Development Index (HDI) rose by 0.9% annually from 0.354 to 0.460 presently, which gives the country a rank of 131 out of 169 countries with comparable data. The HDI of Sub-Saharan Africa as a region increased from 0.293 in 1980 to 0.389 based on the current figures, and this aligns

Cameroon above the regional average. However, between 1991 and 2004 Data from DHS II and III had earlier revealed an improvement in the population's access to potable water (45 to 53%) and electricity (41 to 47%).

3.1.3 Administrative, political and cultural perspectives

The modification of the 1972 constitution in 1996 (Law No. 96-06 of 18 January 1996) outlined provisions for the administrative re-organisation of Cameroon. This carved out the country into regions, divisions and sub-divisions. Pending the full implementation of the instrument, the country now has 10 Regions (formerly provinces), 58 divisions, 306 sub-divisions, 54 administrative districts and 339 councils. The political landscape numbers more than 200 political parties. The country has two official languages: English and French. About 70% of the people are Christians while 21% are Muslim. Cameroon is a democratic state with a presidential political system. The other arms of power are Legislature (with National Assembly and a not-yet functional Senate) and Judiciary. The president appoints the Prime Minister and Head of Government who in consultation with the latter appoints the ministers. There are about 40 ministries including the Ministry of Public Health (MINSANTE).

3.2 The organisational frame of the Cameroon Healthcare system*

The Ministry of Public Health (MINSANTE) has as principal responsibility to ensure a sustainable management of the healthcare system. The organisational chart involves essentially three distinct levels; - Central, Intermediary and Operational levels from a top-to-bottom pyramid as shown in Figure 3. The Ministry of Public Health has both internal and external services with respect to the health system pyramid. The internal services basically constitute the Central Level while the external services are made up of the Intermediary and Operational levels. At the operational level, there are 179 health districts (D.H.S) each of which is sub-divided into many health areas (HA). Each HA has one or more health establishments (HC). There are 179 district hospitals, 97 district medical centres, 1570 public health centres and 470 private confessional health centres. At the intermediary level, there are 10 Regional Delegations of Public Health (RDPH), 12 Regional hospitals and related structures. The peak of the pyramid is made up of the central services (directorates) and others structures ranking as such (e.g. 7 reference hospitals).

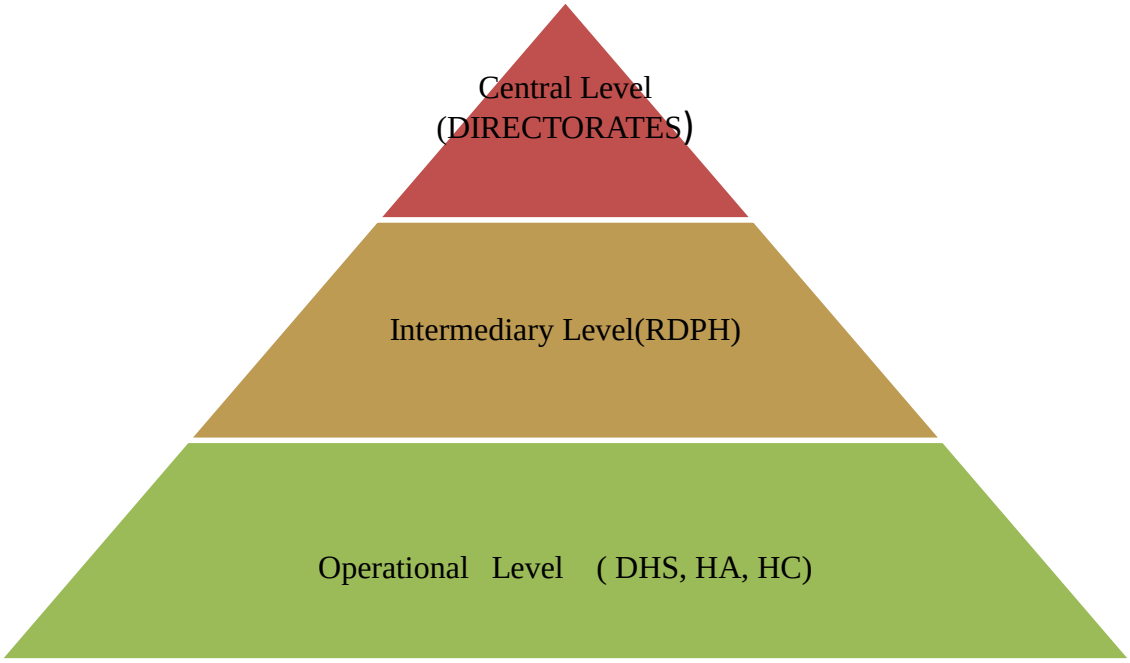

Figure 3: *Flow diagram showing the organisational chart of Cameroon's Health System pyramid* [RDPH= Regional Delegation of Public Health, DHS= District Health Service, HA= Health Area, HC= Health Center] (by John Libwea).

The conception and elaboration of the national health policy strategy stems from the central level. There are dialogue structures (local health management boards) at each level of the health pyramid.

Until 2001, Cameroon's health policy evolved through four major stages: (i) the colonial period or the peak of Eugene Jamot's strategy, (ii) The post-independence or experimentation period, (iii) The post Alma Ata: Primary Healthcare, (iv) Reform of the Health Sector through the Reorientation of Primary Healthcare. This reform was developed and made public in 1989 but was officially adopted in 1992 through the Declaration of Health Sector Policy, and in 1993 the declaration of implementation of the "***Reorientation of Primary Healthcare***." This concept has as basic elements the principles listed below:

- Community participation for self-empowerment with regard to their health problems;
- The highlighting of the inseparable link between health and development;
- The respect of Human Rights such as the right to information, to individual integrity as well as freewill.

Within the framework of this reform, the Health Centre was assigned the role of interface between the community and health services and was to serve as the locus for integrated, continuous and comprehensive healthcare with the District hospital as first level of referral.

The Reorientation of Primary Healthcare induced a number of legal changes in the sector:

- the Framework Law on Health (January 1996);
- the various laws and regulations relating to cost recovery;
- instruments reorganising the country into health districts

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*(*extracts from the Cameroon Health Sector Strategy (HSS) 2001-2015)*

4.0 Objectives

4.1 The general objective

The government of Cameroon expressed its interest in introduction of the Pneumococcal Conjugate Vaccines (PCV) into its National immunisation programme (MINSANTE/EPI, 2008; GAVI, 2008 updates). Consequently, the main objective of the study was to explore how best the PCV could be made to reach every child.

4.2 Specific objectives

To meet the general objective, the study focused on the following specific objectives;

a) To describe the knowledge, attitude and practices of parents/guardians on pneumonia and immunisations/EPI vaccines,

b) To identify parental socio-economic/demographic characteristics that are predictive of good knowledge on pneumonia infections and EPI vaccines, and

c) To describe health center personnel perceptions about immunisations prior to Pneumococcal Conjugate Vaccine introduction into the EPI

5.0 Materials and Methods

5.1Materials

5.1.1 Selection of study site

The study was undertaken in a densely populated semi-urban-slum zone in Yaoundé, the national and political capital of Cameroon. Two health districts (described as "Non-Performant") in the Centre Region were selected using convenience sampling. These are the Biyem-Assi and the Cite Verte Health Districts. However, participants were recruited randomly within twenty-five clusters by the researcher.

The districts were selected from the Lot Quality Assurance Sampling (LQAS) data compiled by the National Institute of Statistics (Cameroon) following a rapid evaluation of the vaccination coverage on the first phase of the National Immunisation days against Polio and Yellow Fever of 4-9 May 2009. Health districts were classified as "Performant" or "Non-Performant" (INS, 2009; Pezzoli et al., 2011). The Performant health districts were described as having high vaccination coverage figures (≥80%) while the Non-Performant ones had low figures (≤60%) with reference to the 80% mean estimated target (INS, 2009; Pezzoli et al., 2011).

Yaoundé is located between Latitude 3^0 52' N and Longitude 11^0 31'E. It is one of the most populated cities in Cameroon with many urban-slum dwellings and a population of over 1.8 million inhabitants (BUCREP, 2010). Cameroon's capital city, Yaounde, which in the local *beti* language is translated to mean "the city of seven hills", is situated in the heart of the Centre Region (one of 10 regions) with a population of over 3.5million people (BUCREP, 2010). The Region's expanding timber and agriculture industries are attracting many people from other Regions to come, live and search for job opportunities. The Centre Region occupies a surface area of 69000 square kilometres of the central plains of the country and bordered to the north by the Adamawa Region, to the south by the South Region, to the East by the East Region and to the west by the Littoral and West Regions.

The two health districts included in this study, the Biyem-Assi and the Cite Verte health districts are situated about 25 kilometres away from the Yaounde city center. The Biyem-Assi health district is divided into four (04) health areas which include the Mvog-Betsi, Mendong, Melen and Acacias (Biyem-Assi) with a total population of about 169000 inhabitants (MINSANTE/BUCREP, 2010). A similar partitioning into health areas exist for the Cite Verte health district which has a population of over

150000 inhabitants (MINSANTE/BUCREP, 2010). However, for the purpose of the study, the Cite Verte Health district was considered as a fifth health area in the Biyem-Assi health district out of which it was created.

5.1.2 Study population

The participants consisted of parents/guardians of children and health personnel living and/or working in Biyem-Assi and Cite Verte health districts of Cameroon with a population of over three hundred thousand inhabitants. This population includes 18% of children under-five years old (BUCREP, 2010).

5.1.3 Recruitment of participants

Participating parents/guardians were recruited based on the EPI-25 x 10 cluster sampling technique (adapted from WHO's Standard Reference Sampling Technique). Those eligible were identified from the vaccination booklets (cards) of their children and /or health center registers. Health center staffs were simultaneously recruited from these health areas. It was initially planned to recruit only parents/guardians with children between 0-59months. This was not entirely practical given the socio-cultural concept of the country. During the second pilot phase (in Cameroon), it became apparent that the other age groups could be included. As such, parents/guardians with grown-ups were also sampled. Thus, a primary analysis was made to exclude those who did not meet all the selection criteria for the study and others included. Participants were informed via the media and community leaders, but all of those recruited consented to participate verbatim after being explained the purpose of the study.

5.1.4 Inclusion and exclusion criteria

i) Inclusion criteria

- Proof of being a parent/guardian of at least one child,
- Residence in the selected locality for at least six months,
- Child is/has been eligible for routine vaccines scheme, and
- Skilled health care personnel i.e. advanced diploma in nursing/health sciences + ≥ 5years professional experience on vaccination-related activities.

ii) Exclusion criteria

- Failure to give consent to participate,
- Lack of proof to confirm Parenthood/ guardianship,
- Health staff without adequate medical skills/training, and
- Health personnel not directly involved with vaccination activities.

5.2 Methods

5.2.1 Methods used for data collection

The study adopted a cross sectional design. A multi-disciplinary approach with three different arms which consisted of:

i) Parental survey (using structured questionnaires with closed and open-ended questions),
ii) Health center staff survey (via questionnaires with closed-ended questions only), and
iii) Participant observation.

The Lot Quality Sampling (the Epi-25x10) methodology (cluster sampling) was applied in the five constituted health areas to collect the primary data. For Biyem-Assi health district, four lots were drawn from which 50 households were sampled randomly in each lot, and a similar procedure was applied to the fifth health area (Cite Verte health district from which one lot was drawn involving 50 households). Each lot was then subdivided into five clusters. The procedure involved the researcher taking a central position (most often a health center) in a cluster, tossed a bottle and began collecting data from the first home towards the direction which the bottle head pointed. After the first home, the researcher moved five households away to collect the second sample, and thereafter, until the 10^{th} household was sampled in a cluster. Thus, 50 households were sampled in a health area with 10 each from the middle, then moved up-ward to sample the second 10-households, west to sample the third 10-households, then south for the fourth 10-households and finally eastward for the fifth 10-households in each of the five designated health areas (Mendong, Melen, Mvog-Betsi, Acacias and Cite Verte).

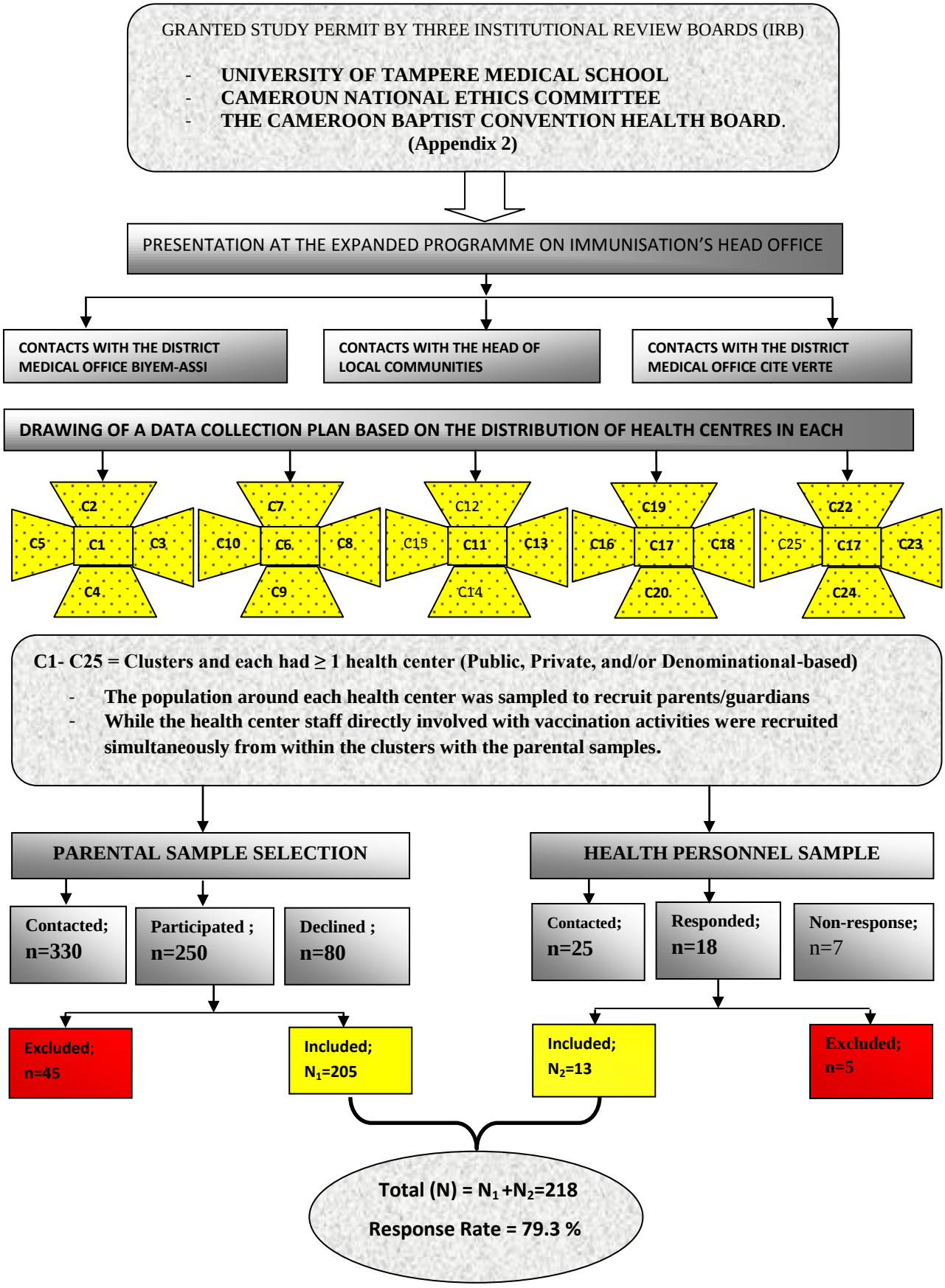

Figure 4: Outline of the study process and data collection procedure

Figure 4 presents an outline of the study process and data collection procedure. As such, we collected data in total 25 clusters in the Biyem-Assi (20 clusters) and Cite Verte (5 clusters) health districts respectively as shown above.

The data collection instrument was a questionnaire (appendix 1) which consisted of five sections; -A) parental demographic/socioeconomic characteristics (13 questions), B) information on parental knowledge, attitude and practices on immunisation and pneumonia disease burden (15 questions), C) information on the perceptions of health center personnel on immunisation (9 questions).

The questionnaire had both English and French versions and interviews were conducted using the language of choice of the respondent. The researcher personally assisted the parents/guardians to fill in the questionnaires based on their responses. No sequential order was respected in filling the questionnaire as the interaction between the researcher and respondent was a determinant from which angle to begin. It took, on average, 25minutes to completely answer a questionnaire and respondents were at the same time being sensitized on the disease burden and prevention of pneumonia.

Meanwhile, questionnaires (attached to the study protocol) were given to health personnel directly involved with immunisation activities simultaneously as the data for parents were being generated. Some of the health personnel were keen to fill and return the questionnaires immediately while others promised to do so later; but not all of them respected this promise. Since participation was voluntary, if a household member or health personnel declined to participate, it was registered in the researcher's diary and we moved to the next one until the expected target in a cluster/lot was attained.

However, it is not very clear why some decided not to participate but according to previous studies (Edwards, 2002), people tend to decline when being questioned on sensitive issues. Nonetheless, two of the seven non-respondents from the health personnel sample said they were interested in the study but had no authorisation to speak in the absence of their bosses who were called out for other duties (a cholera outbreak was under investigation during this period). This may be a potential source of selection bias but these people were excluded on the grounds of not being directly involved with vaccination activities. It is apparent that those who again declined were a matter of logistics not principle. The total number of valid sample obtained after which scrutiny was done based on the inclusion and exclusion criteria, is outlined in Figure 4. A total of 218 participants (including 205 parents/guardians and 13 health personnel)

were included in the study while 50 (45 parents/guardians and 5 health personnel) were excluded following the inclusion and exclusion criteria earlier mentioned.

5.2.3 Methods used for protecting against bias

The participants were selected carefully ensuring they met all of the inclusion criteria and none of the exclusion criteria. A pre-test of the questions was done both in Finland (with students of the Master of Health Sciences programme, most of whom were parents) and in Cameroon with some members of the study sample. This minimized the problems which arose in administering the questionnaires as most of the ambiguities were corrected. The questionnaires were also reviewed and face-validated by the supervisors (Professor Hanna Nohynek & Dr. Marie Kobela) and two public health experts familiar with immunisation-related studies in Cameroon. The interview guide was also scrutinized before being used for interviews with health personnel. It was only after making the necessary revisions that the final versions of the questionnaires/interview guide were produced and used (see appendix 1).

5.3 Research design

The research design used is Cross-sectional Cluster survey.

5.4 The sample size calculation and its justification

This calculation is based on WHO recommended technique (C_3 on the immunisation coverage cluster survey - Reference manual available at www.who.int/vaccines-document), employed in the estimation of immunisation coverage in an area. As such, a desired precision of ±10%, a design effect of 2 and a confidence level of 95% have been assumed (WHO/IVB/04.23, 2005). The five health areas emanating from the two districts were divided into 5 clusters each given a total of 25 clusters to be sampled. Thus, understanding that the mean vaccination coverage of the country stood at 80%; cross-referencing (as shown on table C3 of the WHO Reference manual), will imply that, at least 7 participants or households are expected to be sampled in each cluster.

Hence, minimum sample size = **[Number of participants per cluster]** x [**number of clusters]** .i.e. 25 x 7 = 175.

Therefore, getting a validated sample size of 218 out of 275 participants for this study and a 79.3% response rate is justified by WHO standards as it exceeds the expected minimum value of 175.

5.5 Analytical approach

5.5.1 Statistical methods

Three software programmes were used in data processing. Prior to this, a coding guide was prepared with each variable assigned a specific code to facilitate the data entry process and to minimize errors. The raw data (quantitative) was entered using the Microsoft office Access 2007 software application, and then exported to Microsoft office Excel 2007 before it was entered into the Statistical Package for Social Scientists (SPSS version 17.0) for analysis. The implication of the Access, Excel and SPSS software programmes was an efficient way to enter and cross-check the data which contained a lot of qualitative responses derived from open-ended questions. The data was checked in SPSS and the few errors found were then cleaned in Access and the file re-exported to SPSS via Excel. Thus, two sets of data (one containing parental sample and the other health center staff sample) were saved as separate SPSS files.

Descriptive statistics and multivariate logistic regression models were used to analyze parental samples while the health center staff data has been analyzed solely using descriptive statistics.

5.5.2 Statistical analyses: Measurements and description of associations between variables

i) Measurements and description of parental variables

Prior to the analyses, the most important baseline characteristics of the study were defined and some re-categorized in order to get a uniformly-distributed data. Gender had its unique categories (males or females); age variable was categorized into three - <25years, between 25 and 30 years and >30years; indigenous status defined as either participants were indigenes or non-indigenes of the study area; region of origin categorized into four pools (*Pool 1*: Adamawa, North & Far North added to which were three foreigners from the Republic of Chad; *Pool 2*: Centre, South & East regions, *Pool 3*: Littoral & Southwest; and *Pool 4*: Northwest & West regions); Education re-categorized into those with ≤ primary school, secondary/vocational education and those

with university education; monthly disposal income regrouped into 1st tertile(<€76), 2nd tertile(€76-107) and 3rd tertile(> €107). The occupational categories varied from housewife (48%), farming (1%), trading (9%), civil servant (5%), teaching (9%) and healthcare (5%) all regrouped as (Unemployed) to student (12%), and others (6%). Membership in a social group is defined in context as a formal or informal affiliation of the participant to any local, national or international social network. Most mentioned included association of village members (21%), community of women (12%), and others (cooperatives, professional groups, friendship unions) representing 14%. Religious membership though another form of social networking was separately categorized into Christianity and others (Muslim, Buddhist and non-Christians).

The essential outcome (dependent) variables used included:

a) Parental knowledge of pneumonia symptoms categorized as (answered correctly and don't know). When questioned to suggest what and how they perceived symptoms of pneumonia in a child, parents/guardians who could recall at least one characteristic symptom (which include persistent cough, fast or difficult breathing, fevers, chills, headaches, loss of appetite and wheezing) were considered to have correct knowledge. While those who gave a wrong symptom or said they had no idea, were categorized as "don't know".

-b) Parental knowledge on pneumonia disease burden was categorized as (good and little or don't know). Here, parents were asked to freely express how much or little knowledge they have about pneumonia diseases. Those who gave a well informed opinion (such as ≥2correct symptoms, causes/risk factors, seriousness/consequences and treatment/preventive methods) were considered as having good knowledge. Whereas, those with little, very little or no idea were categorized as little or don't know).

-c) Parental knowledge on the seriousness/consequences of pneumonia if neglected was an open-ended question that stemmed from variable (b) above. It sought to understand what experiences or opinions parents had as dangerous effects of pneumonia disease. These ranged from complicated pulmonary infections, poor child growth and development, mental retardation, weight lost to increase economic/financial costs and consequently death. Thus, parents who stated or explained ≥1 of these or related consequences were belief to have answered correctly and don't know for those who did not state any.

-d) Parental knowledge on the causes/risk factors of pneumonia was categorized in a similar way like the precedent variable on knowledge on seriousness/consequences. Pneumonia maybe (caused by a series of infective agents including viruses, bacteria and other pathogens including those from the environment(dust, smoke, contaminated liquids, gases or food) and fungi. While risk factors include medical conditions such as diabetes, emphysema, heart disease, HIV/AIDS or sickle-cell disease amongst others, the main microbial agents are the *Streptococcus pneumoniae* and *Haemophilus influenzae*. Parents who mentioned ≥1 causes/risk factors were described as having "answered correctly" and those with no idea as "don't know".

-e) Parental knowledge on how to prevent pneumonia was equally another open-ended question which was a follow-up question from the preceding variables. The aim was to identify how parents can relate their understanding of pneumonia causes/risk factors and seriousness/consequences to treatment and prevention. The variable was categorised as "answered correctly" if parents indicated one or more preventive measures (such as warm clothing, avoid cold weather, vaccinations, good hygiene/sanitation, use of antibiotics, avoid allergens e.g. smoke, dust or very cold foods/drinks) which were suggested responses from the open-ended questions and "don't know"(if the respondent could not recall any means of prevention).

-f) Parental knowledge on the availability of the Pneumococcal Conjugate Vaccines was geared at describing the proportion of parents who were informed by any means, on the new pneumonia vaccines to be introduced. I specifically asked parents/guardians about the PCV since there are other vaccines which also confer a degree of protection against pneumonia such as Haemophilus influenza type b (Hib). It was categorised into three i.e. Yes (for those who were aware), No (if parents thought no such vaccines existed) and don't know (when parents could not chose between either yes or no).

-g) The next set of five questions was to measure the attitude/practice variables of parents about immunisations. Attitudes here mean one's feelings about vaccinations while practice refers to actions towards the use of vaccines. Since attitudes/practices are emotional tendencies questions were drawn and placed in a Likert scale for respondents to indicate their feelings by checking the categories on the scale. The questions were; (i) to allow the child to be vaccinated ensures adequate health, (ii) to allow the child to be vaccinated is against my religious belief, (iii) immunisation of children saves me money to be spent on medication, (iv) to allow the child being vaccinated is against the habit (cultural practice) of my community, and (v) to take a child to the health center for vaccination is a time-wasting exercise. While the Likert-scale was categorized from

strongly agree to strongly disagree. However, in the analyses all the responses were dichotomized into agree or disagree.

ii) Measurements and description of health centre personnel variables

In this section, all the questions which were basically placed on a Likert scale with five categories of responses range from strongly accepted to strongly unaccepted. However, due to its small sample size, the responses were re-categorized into two - accepted and unaccepted as shown in Table 10.

iii) Measurements and description of association between predictive parental socio-economic/demographic variables and good knowledge on pneumonia infections and immunisation/EPI vaccines

This was to address the study specific objective of identifying parental socio-economic/demographic characteristics that are predictive of good knowledge on pneumonia infections and EPI vaccines. The aim was to identify independent socioeconomic/demographic factors which are positively associated to parental knowledge on pneumonia disease burden and prevention, while considering their knowledge of existing Expanded Programme on Immunisation vaccines.

This was attained through the application of logistic regression analyses using three models. *Model 1* representing the bivariate analyses using $p \leq 0.20$ as elimination point, *model* 1^a for the multivariate or multinomial analyses where the stepwise backward logistic regression method was implicated and finally *model* 1^b in which positively identified candidate predictor socio-economic/ demographic variables (with $p \leq 157\%$) were adjusted for age, parity and religion (these were not included in the stepwise multivariate analyses model) based on the Akaike Information Criteria (AIC). The variables of age, religion and parity used for adjustment are important potential confounders when considering the relationship between the socio-economic/demographic characteristics and the outcomes in the study. The outcomes sought from the models for included parental knowledge on: (i) pneumonia diseases, (ii) seriousness/consequences, (iii) causes/risk factors, (iv) prevention and (v) availability of vaccines against pneumonia infections. The gender variable was sidelined in the multivariate analyses since the proportion of female respondents was higher than the males. As such, no major difference could be drawn with reference to gender. In the reporting, emphasis has been on the results of the adjusted models even though some results from the bivariate analyses and confounders have been commented upon.

Assumption 1: In the multivariate analyses, a *p-value* of 0.157 has been blindly used for variables with either binary or polynomial categories (degree of freedoms) as this has not considerably changed the end results. Usually, in the AIC different p-values are used routinely as cut-off points for statistical significance depending on the degrees of freedom of the variables as shown in Table 4.

Assumption 2: Possible dependencies due to clustering were not taken into account in the analyses. Actually, the use of several clusters requires a used factor which takes into account the clustering or at least standard errors modified to account for dependency within people in the clusters. Since the study was exploratory rather than confirmatory, we assumed any such dependency-effects will not alter the trend of results.

The application of the $p \leq 0.157$ is based on the Akaike Information Criterion (AIC) methodology which attempts to find the model, amongst a candidate set of models which best explains the data with the fewest free parameters. This is in contrast with more traditional approaches to modelling which usually begin from a null hypothesis (Akaike, 1974; Steyerberg, 2009).

Table 4: P-value associated with Akaike's Information Criteria (AIC) for selection of candidate predictors with different degrees of freedom (*df*)

df	***X^2* has to exceed 2times *df***	**P-value**
1	2	0.157
2	4	0.135
3	6	0.112
4	8	0.092
5	10	0.075

Source: Steyerberg et al., 2000 (x^2 = *Chi-square*)

The choice of using the AIC is dependent on the fact that, there is no specific reason to stick to a p -value of 0.05, or low p -values as implied by applying Bayesian Information Criteria (BIC). Using AIC has been recommended (Ambler et al., 2002) and the utilisation of even higher p -values (p <0.20 or p <0.50) have been found to provide more power for the selection of predictors with relatively weak effects (Lee et al., 1997), and to provide better predictions in small data sets with a set of established candidate predictors (Steyerberg et al., 2000).

5.6 Data handling and record keeping

The data has been handled anonymously and no participant would be identified, nor would any information they have provided be used for any other purpose than for which it is intended. Based on the information gathered from the interviews and questionnaires, an electronic data base has been established. All data stored on the researcher's computer and other devices shall be safely locked-up at researcher's home for as long as possible.

5.7 Ethical considerations

5.7.1 General Principles

Ethical guidelines defined in the Declaration of Helsinki (adopted by the World Medical Association (WMA) in 1964 and as amended by the WMA in 2008) have been respected throughout the process. This study which considered both quantitative and qualitative approaches was subjected to approval and authorization by three independent organs i.e. the Department of International Health in the University of Tampere Medical School (Finland), the Cameroon Baptist Convention Health Board and the Cameroon National Ethics Committee.

5.7.2 Informed consent Principles

The principle of "Informed Consent" was equally respected as all eligible participants were accorded explanation on the purpose of the study, and were assured on the confidentiality of the information they provided. Besides, no participant was required to identify him/herself in the course of responding to the questionnaire.

Although legal and formal information about the study was made via radio communiqués, administrative authorities and community leaders, the participants consented only during a face-to-face encounter. Hence, they verbally consented and did not fill or sign any consent form. All the participants understood the purpose and voluntary nature of the study, the right to ask for information, and the option to either continue or withdraw from it.

5.8 Funding

This study was self-funded but a substantial financial support came from my supervisor: Professor Hanna Nohynek (THL and ARIVAC allocations) and the University of Tampere International Office stipends on data collection for thesis abroad.

6.0 Results

6.1 Outline of the excluded and included participants (parental sample only)

A total of 341parents/guardians (with 250 respondents and 91 non-respondents) were contacted in the study population. Figure 5 shows the details on the parental/guardian selection process.

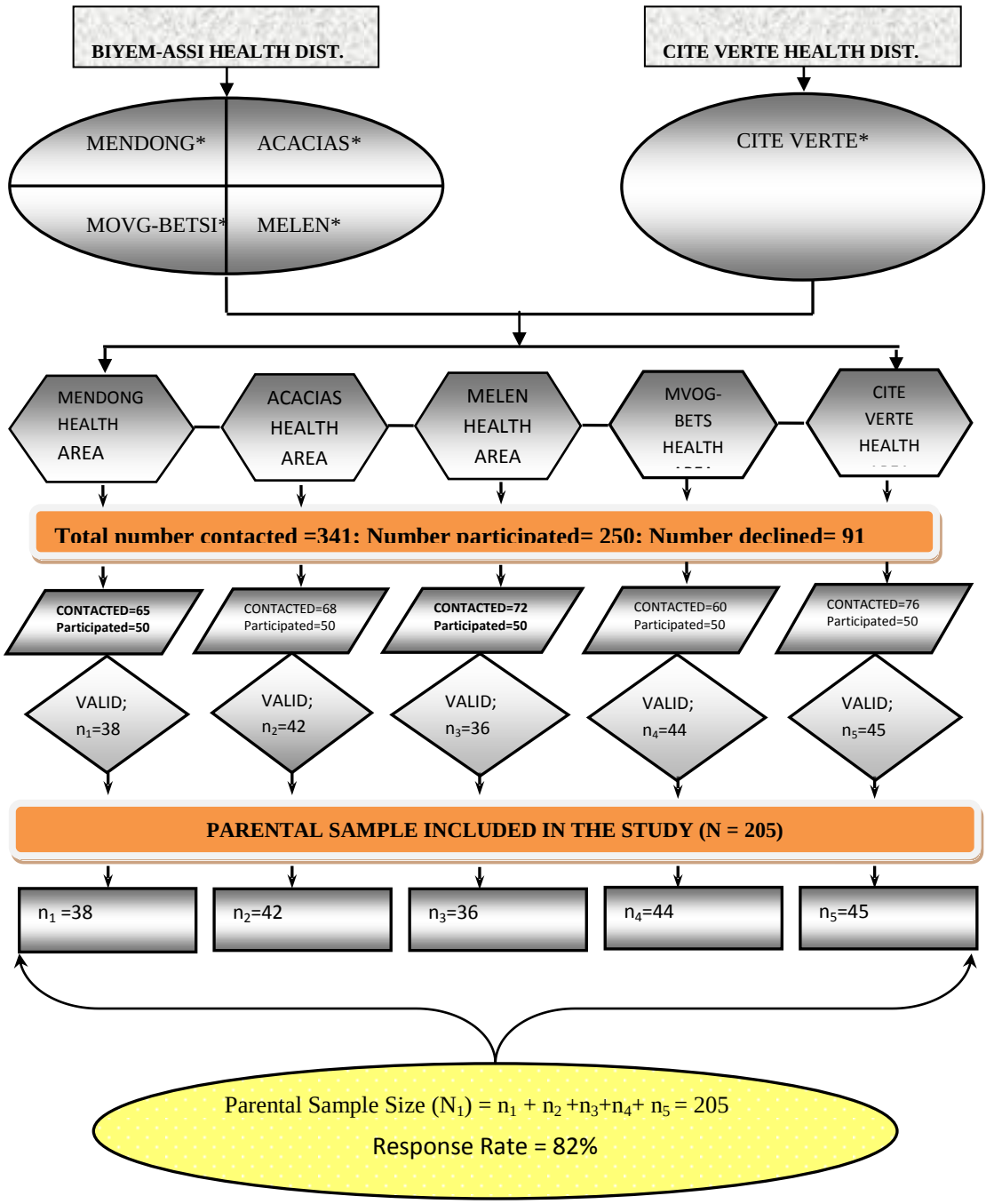

Figure 5: Flow chart of study participants from parental data (* = health area)

6.2 Basic characteristics of the study population

Of the 205 parents who were analysed, majority were females, and 45% were in the 25-30 years age group (age range: 17-55; median age=27years). Forty percent of the subjects live in households of four persons, 91% of them were non-indigenes, 48% unemployed, and 36% had a monthly disposal income within the second tertile. Most of the non-indigenes had migrated from the Northwest and West regions. More than half of the study population had attended secondary/vocational education while 54% were not members of any social group. Most of them were Christians (Table 5).

Table 5: **Basic demographic & socio-economic characteristics of the study population (data for parents only, N=205)**

Panel.1:Demographic variables	**n**	**%**
Gender		
Male	9	4.4
Female	196	95.6
Age of respondents (in years)		
<25	59	28.8
25-30	93	45.3
>30	53	25.9
No. of persons/household		
</=4 persons	82	40.0
Either 5 or 6 persons	67	32.7
≥7persons	56	27.3
Indigenous status		
Indigene	18	8.8
Non-indigene	187	91.2
Region of origin		
AD, NO & FN Regions + foreigners	50	24.4
CE, SU & ES	44	21.5
LT & SW Regions	19	9.2
NW & OU Regions	92	44.9

Panel.2:Socio-economic variables	**n**	**%**
Educational level		
≤ Primary education	45	22.0
Secondary/ vocational education	111	54.1
≥ University education	49	23.9
Monthly disposal income (in Euros)		
1st Tertile (< €76)	70	34.1
2nd Tertile (€76-107)	73	35.6
3rd Tertile (> €107)	62	30.3
Major occupation		
Unemployed	98	47.8
Student	24	11.7
Employed	83	40.5
Membership in a social group		
Yes	95	46.3
No	110	53.7
Church/Religious membership		
Christians	191	93.2
Others	14	6.8

AD=Adamawa, NO=North, FN=Far North, CE=Centre, SU=South, ES=East, LT=Littoral, SW=Southwest, NW=Northwest, OU= West

6.3 Parental knowledge, attitudes/practices about pneumonia and opinions on immunisation/PCV

Ninety four percent of the parents who participated in the study said they knew the types of vaccines their children had taken, while 6% had no knowledge (*results not tabulated*). The current EPI vaccines which parents most often remembered that their children had taken or were due to take included: BCG, Polio, DTP (diphtheria, tetanus, and pertusis), measles and the yellow fever vaccines. This also applied to vitamin A supplements.

Table 6: Parental knowledge, attitudes/ practices and opinions about pneumonia and immunisations/PCV (n= 205)

Panel 3: knowledge variables	n	%
1≥ symptoms of pneumonia		
Answered correctly	142	69.3
Don't know	63	30.7
Disease burden		
Good	39	19.1
Moderate	112	54.6
Don't know	54	26.3
1≥ Seriousness/consequences		
Answered correctly	128	62.4
Don't know	77	37.6
1≥ Causes/risk factors		
Answered correctly	135	65.9
Don't know	70	34.1
1≥ Prevention method		
Answered correctly	198	96.6
Don't know	7	3.4
Availability of vaccines		
Yes	38	18.5
No	25	12.0
Don't know	142	69.5

Panel 4: Attitude/practice & opinion variables	n	%
Child vaccination protects health		
Agreed	199	97.1
Child vaccination is against my religious belief		
Agreed	2	1.0
Child immunisation reduces expenses on medication		
Agreed	171	83
Child immunisation is against the cultural practice of my community		
Agreed	3	1.5
To take a child for vaccination is a time-wasting exercise		
Agreed	32	15.6
Parental impression on health personnel		
Impressive	163	79.5
Not impressive	20	9.8
Others	22	10.7

From Table 6, sixty-nine percent of the respondents knew at least one symptom of pneumonia (the most cited symptoms were persistent cough, fast or difficult breathing, fevers, chills, headaches, loss of appetite and wheezing) but only 19% had a good knowledge of the actual disease condition (*Panel 3*). Two-thirds answered correctly that they knew about the consequences/ seriousness (most cited were child death, pulmonary infection, poor growth and weight lost) and the causes/risk factors (most cited were cold weather, dust, smoke, cold food and drinks) for pneumonia respectively. Also, 97% knew at least one correct means on how to prevent the causes/risk factors of pneumonia (commonly cited were to avoid cold food & drinks, keep the child away from smoke and dust, keep the child warm and the use of antibiotics), and only 19% knew that vaccines (PCV) against pneumonia were available (*Panel 3*).

6.4 Parental attitudes, practices and opinions about immunisations and PCV

A majority of the respondents were of the opinion that immunisation ensures adequate health protection to the child (*Panel 4).* Equally, most of them did not think that vaccinations were against their religious and cultural practices. However, some further explained that, "this maybe a common practice in some religious sects or culture but nowadays, everyone sees the importance of vaccinations". A larger proportion of the parents thought that immunisation reduces expenses on medication. Also, 84% of them thought that taking the child for vaccination is not a time-wasting exercise and most added that the "health of the child is a major priority and has no price-tag as prevention is better than cure". Only a few of them expressed worries about the attitude of some health personnel at the vaccination units. However, a greater number of these parents were impressed with the attitudes of nurses (health personnel) during the vaccination process of their children. While some 10.7% were of the opinion that, the attitudes are dependent on certain factors including individual or institutional aspects and 9.8% mentioned they were not impressed with the nurses' attitudes.

When the respondents were questioned on what they thought could be done for the PCV to effectively reach every child, their responses (*not tabulated*) were diverse. Ninety three percent (*respondents gave more than one answer)* of the sampled parents gave varying opinions while 7.0% of them mentioned they had nothing to suggest. Of those who gave suggestions, their responses included increase sensitisation/campaigns (56%), health information-education-communication (25%), free vaccines (12%), improved

accessibility (9%), creation of more health centres (7%), recruitment of more personnel (2%), motivating vaccinators (2%), no realistic solution based on the current socio-economic/political context (12%) and others e.g. social mobilisation/communication strategy (30%).

6.5 Association between parental socio-economic/demographic characteristics and good knowledge of pneumonia infections and prevention

6.5.1 Association between parental socio-economic/demographic factors and having good knowledge of pneumonia disease burden

Results from bivariate and multivariate logistic regression models of the association between parental socio-economic/demographic characteristics and good knowledge on pneumonia disease burden are presented in Table 7.

In the bivariate analyses, of all the socio-economic/demographic variables fitted in the model only age and membership were identified as candidate predictor variables ($p<0.20$) associated with good parental knowledge of pneumonia disease burden. However, only membership in a social group was identified as a significant predictor, as age, parity and religion were confounders. Thus, no stepwise analyses were done.

Table 7: Association between socioeconomic/demographic variables and good parental knowledge on pneumonia disease burden: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socioeconomic/demographic variables	Bivariate analyses			Multivariate analyses		
	OR	**95%CI**	**P-value**	**AOR**	**95%CI**	**P-value**
Age in years			0.137			0.285
< 25	0.52	0.21 – 1.28	0.153	0.52	0.16 -1.64	0.262
25 – 30	0.45	0.20 – 1.02	0.057	0.46	0.17 – 1.22	0.117
>25	1.00	reference	Reference	1.00	reference	reference
Membership in a social group						
Yes	1.89	0.92 – 3.81	0.081	1.57	0.70 – 3.50	0.274
No	1.00	Reference	Reference	1.00	Reference	Reference
Religion						
Christians	1.44	0.31 – 6.72	0.641	1.30	0.27- 6.20	0.743
Others	1.00	Reference	Reference	1.00	Reference	Reference
Parity			0.921			0.742
One child	0.85	0.38 – 1.92	0.696	1.40	0.51 - 3.88	0.518
Two children	0.88	0.36 – 2.17	0.775	1.46	0.81 – 4.18	0.478
3 ≥ children	1.00	Reference	1.00	1.00	Reference	Reference

*[“*don’t know” is the reference category; AOR= Adjusted Odds Ratio*]

When membership in a social group was adjusted for age, religion and parity; membership in a social group was positively associated parental knowledge on

pneumonia disease burden. Thus, parents who were members of a social group had increase odds of having "good knowledge" on pneumonia disease burden by nearly 60% (OR=1.57, CI=O.70-3.50) than those who were not members in a social group. There was a 30% difference between bivariate odds ratio and that of the adjusted odds ratio.

6.5.2 Association between socio-economic/demographic factors and having good parental knowledge on the seriousness/consequences of pneumonia infections

Table 8 presents results of the bivariate and multivariate logistic regression analyses of the association between parental socio-economic/demographic factors and good knowledge on the seriousness/consequences of pneumonia infections.

Table 8: Association between socio-economic/demographic variables and correct parental knowledge on the seriousness/consequences of pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Bivariate analyses*			Multivariate analyses*		
	OR	**95%CI ;**	**P-value**	**AOR**	**95%CI;**	**P-value**
Age in years			0.812[a]			
< 25	0.88	0.41- 1.89;	0.750	0.74	0.28 - 1.98;	0.551
25 – 30	1.10	0.55 - 2.23;	0.786	0.88	0.39 - 1.98;	0.876
>30	1.00	reference		1.00	reference	
Education			0.013[b]			
≤primary	0.29	0.12 - 0.69;	0.005	0.32	0.13 - 0.78;	0.013
Secondary/vocational	0.67	0.32 - 1.40;	0.286	0.73	0.34 - 1.57;	0.726
University	1.00	reference		1.00	reference	
Religion						
Christians	3.26	1.05 - 10.11;	0.041[c]	3.04	0.95 - 9.69;	0.061
Others	1.00	reference		1.00	reference	
Parity			0.533[d]			
One child	1.12	0.58 - 2.15;	0.743	1.05	0.44 - 2.50;	0.907
Two children	1.52	0.72 - 3.23;	0.271	1.28	0.53 - 3.10;	0.581
3 ≥ children	1.00	reference		1.00	reference	

["don't know" is the reference category; AOR= Adjusted Odds Ratio; a, b, c & d = overall p-values*]

In the bivariate analyses, education was the only candidate predictor ($p < 0.20$) associated with parental knowledge on the seriousness/consequences of pneumonia infections, therefore no stepwise multivariate logistic analyses was performed here. When education was adjusted for age, parity and religion; education was associated with a decreased odd of having good knowledge on the consequences/seriousness of pneumonia infections. Therefore, the odds of parents/guardians with ≤primary education of having good knowledge on the consequences/seriousness of pneumonia infections are 68% (OR= 0.32, CI = 0.13 - 0.78) less than those with university backgrounds. Likewise, the odds of parents/guardians with secondary/vocational education to have good knowledge on the consequences/seriousness of pneumonia infections are 27% (OR=0.73, CI = 0.34 – 1.57) less than those with university education.

6.5.3 Association between socioeconomic/demographic factors and having good parental knowledge on the causes/risk factors of pneumonia infections

Table 9 shows the results of the association between parental socioeconomic/demographic characteristics and good knowledge on causes/risk factors of pneumonia infections.

In the bivariate analyses; only education and income level were identified as candidate predictor variables (with $p<0.20$) associated with good parental knowledge on causes/risk factors of pneumonia infections.

A stepwise backward logistic regression analysis was performed with these two candidate predictors using the Akaike Information Criteria.

When they were adjusted for age, parity and religion; both lower education and lower income level were associated with decreased odds of good parental knowledge on the causes/risk factors of pneumonia infections. Thus, the odds of parents/guardians with lower incomes to have good knowledge on the causes/risk factors of pneumonia were 55% (CI=0.20 - 0.99) less than those in the 3rd tertile income level.

More so, the odds of parents/guardians with ≤ primary education having good knowledge on the causes/risk factors of pneumonia infections is 76% (CI=0.09-0.64) less, than in those with university education.

Table 9: Association between socio-economic/demographic variables and correct parental knowledge on the causes/risk factors for pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Bivariate analyses*		Multivariate analyses *	
	OR	**95% CI; P-value**	**AOR**	**95%CI; P-value**
Age in years		0.916		
< 25	0.92	0.42 - 2.03; 0.838	1.17	0.69 - 1.98; 0.560
25 – 30	0.86	0.42 - 1.76; 0.677	¥	¥
>30	1.00	reference	1.00	reference
Education		0.002		0.008
≤primary	0.20	0.08 - 0.51; 0.001	0.24	0.09 - 0.64; 0.004
Secondary/voc.	0.56	0.25 - 1.24; 0.152	0.64	0.28 - 1.49; 0.302
University	1.00	reference	1.00	reference
Monthly disposal income		0.053		0.145
1st Tertile	0.40	0.19 - 0.85; 0.017	0.45	0.20 - 0.99; 0.050
2nd Tertile	0.65	0.31 - 1.40; 0.269	0.63	0.28 - 1.40; 0.258
3rd Tertile	1.00	reference	1.00	reference
Religion				
Christians	2.03	0.68 - 6.04; 0.203	0.62	0.20 - 1.96; 0.418
Others	1.00	reference	1.00	
Parity		0.474		
One child	1.15	0.59 - 2.24; 0.676	0.89	0.56 - 1.42; 0.625
Two children	1.61	0.75 - 3.48; 0.226	¥	¥
3 ≥ children	1.00	reference	1.00	reference

*["*don't know" is the reference category; AOR= Adjusted Odds Ratio*]; ¥ = no values were computed

6.5.4 Association between socio-economic/demographic factors and having good parental knowledge on the prevention against pneumonia infections

The results of the association between parental socio-economic/demographic factors and knowledge on pneumonia prevention are shown in Table 10. In the bivariate analyses; education and occupation were identified as candidate variables associated with parental knowledge on pneumonia prevention. Moreover, when these two variables were included in the multivariate stepwise logistic model, only occupation was positively associated and thus retained.

Table 10: Association between socio-economic/demographic variables and correct parental knowledge on the prevention against pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Bivariate analyses		Multivariate analyses	
	OR	**95%CI; P-value**	**AOR**	**95%CI; P-value**
Age in years		0.314		0.062
< 25	1.12	0.22 - 5.80; 0.893	27.04	0.95 - 768.50; 0.053
25 – 30	5.52	0.56 - 54.67; 0.144	28.71	1.54 - 534.05; 0.024
>30	1.00	Reference	1.00	reference
Occupation		0.069		0.124
Unemployed	1.19	0.16 - 8.60; 0.867	0.38	0.04 - 4.19; 0.433
Student	0.17	0.03 - 1.10; 0.063	0.03	0.001 - 0.92; 0.045
Employed	1.00	reference	1.00	reference
Parity		0.557		0.234
One child	0.30	0.03 - 2.70; 0.280	0.15	0.01 - 2.55; 0.189
Two children	0.39	0.03 - 4.40; 0.445	0.09	0.01 - 1.45; 0.086
3 ≥ children	1.00	reference	1.00	reference

*[“*don’t know” is the reference category; AOR= Adjusted Odds Ratio*]

When occupation was adjusted for age, parity and religion; being a student was associated with parental knowledge on pneumonia prevention. Hence, the odds of parents/guardians in the student occupational group to have good knowledge on pneumonia prevention methods is 97% (OR=0.03, CI=0.001-0.92) less, than with those employed. Though a confounder, there was a positive association between age and parental knowledge of pneumonia preventive methods. Parents in the < 25years category, had 270% odds of having good preventive knowledge than those aged above 30years old. However, there is a more than 25-fold increase in the adjusted odds ratio from that obtained in the bivariate analyses.

6.5.5 Association between parental socioeconomic/demographic factors and having good knowledge on the availability of vaccines (PCV) against pneumonia infections

Table 11 presents the results of the association between parental socio-economic/demographic factors and knowledge on the availability of vaccines against pneumonia. In the bivariate analyses, Region of origin, educational level, income and occupation were identified as candidate predictors (with p<0.20) associated with parental knowledge on the availability of vaccines against pneumonia. However, when these variables were fitted in the multivariate stepwise logistic model, only Region of origin was positively associated.

Table 11: Association between socioeconomic/demographic variables and positive parental knowledge on the availability of vaccines (PCV*) against pneumonia infections: Odds Ratio (OR*) and 95% Confidence Interval (95% CI)

Socioeconomic/ demographic variables	Bivariate analyses				Multivariate analyses			
	Yes		**No**		**Yes**		**No**	
	OR	95%CI; P-value	OR	95%CI; P-value	AOR	95%CI; P-value	AOR	95%CI; P-value
Age in years		0.000		0.001				
< 25	1.04	1.39 - 2.80; 0.940	0.68	0.24 -1.92; 0.466	1.12	0.31 - 4.10; 0.856	0.40	0.10 -1.39; 0.144
25 – 30	1.01	0.41 - 2.46; 1.000	0.35	0.12 - 1.00; 0.050	0.77	0.27 - 2.22; 0.627	0.25	0.07 - 0.83; 0.024
>30	1.00	reference	1.00	reference	1.00	reference		
Region of origin*		0.000		0.000				
Pool 1	3.41	1.39 - 8.36; 0.007	0.40	0.11 - 1.47; 0.168	3.67	1.47 - 9.20; 0.006	0.48	0.13 - 1.81; 0.274
Pool 2	2.05	0.75 - 5.57; 0.160	0.85	0.30 - 2.40; 0.764	1.96	0.72 - 5.36; 0.191	0.89	0.31 - 2.55; 0.821
Pool 3	1.24	0.31 - 5.02; 0.766	∞	∞	1.22	0.30 - 4.97; 0.786	∞	∞
Pool 4	1.00	reference	1.00	Reference	1.00	reference	1.00	reference
Religion								
Christians	1.51	0.32 - 7.13; 0.602	2.02	0.25 -16.34; 0.512	1.79	0.37 - 8.77; 0.471	1.68	0.20 - 4.28; 0.634
Others	1.00	reference	1.00	reference	1.00	reference	1.00	reference
Parity		0.000		0.000				
One child	0.92	0.38 - 2.19; 0.842	1.45	0.53 - 3.96; 0.471	0.80	0.26 - 2.46; 0.693	2.33	0.65 - 8.32; 0.192
Two children	1.52	0.62 - 3.72; 0.363	1.20	0.37 - 3.88; 0.761	1.49	0.52 - 4.26; 0.457	2.39	0.60 - 9.50; 0.215
3 ≥ children	1.00	reference	1.00	Reference	1.00	reference	1.00	reference

["don't know" is the reference category; AOR= Adjusted Odds Ratio; PCV=Pneumococcal Conjugate Vaccine; Pool 1= Adamawa, Extreme North & North regions+ foreigners; Pool 2= Center, East & South region;, Pool 3= Littoral & Southwest regions; Pool 4= Northwest and Western regions*]

When it was adjusted for age, parity and religion, there was a positive association between Region of origin and good knowledge on the availability of vaccines against pneumonia infections. Parents who originate from Pool 1 had increased odds (OR=3.67,

CI=1.47-9.20) of having good knowledge on the availability of pneumonia vaccines than those from Pool 4.

6.6 Outline of data selection process for health personnel

A total of 25 health personnel were contacted and 18 of these participated (with 13respondents and 5non-respondents). Figure 5 shows details of the included and excluded health personnel. Sixteen percent of them were males while the remainder were females.

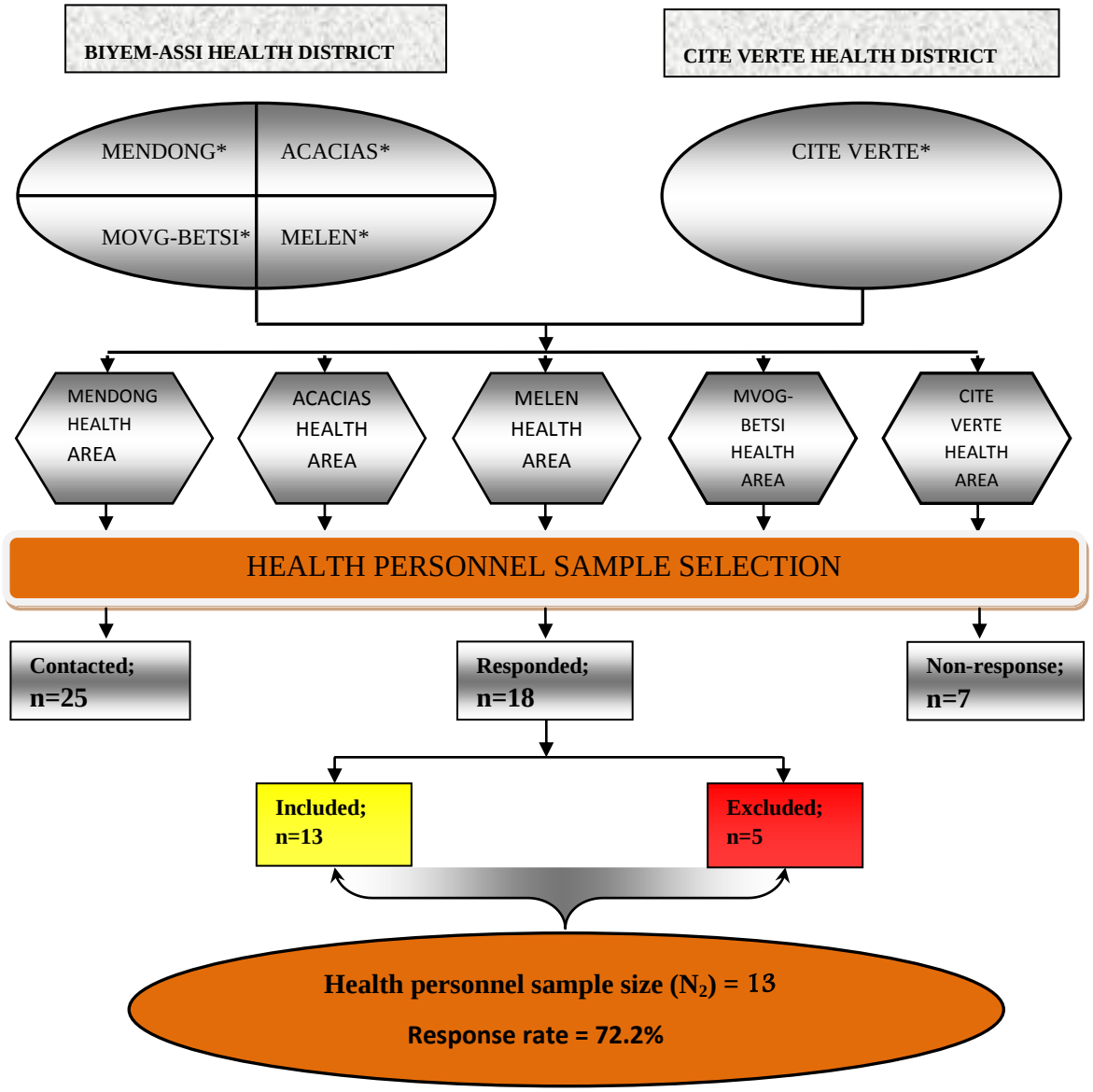

Figure 6: Flow chart of study participants (health personnel, only)

Their ages ranged between 32 and 49 years (median age=40.5years), minimum and maximum working experience 10 and 26 years, respectively, and they all have been involved with vaccination activities for at least five years. Besides, they all had certificates in nursing sciences (state registered nurse), while 20% of them had obtained a University degree in social/health sciences.

6.7 Description of the perception of Health Center personnel on immunizations.

In the Table 12, all the health center staff sampled perceived that long waiting-time is discouraging to parents. Thirty-one percent of them acknowledged it was necessary to scold at parents when they don't respect vaccination schedules and 92% who think friendliness to parents and the children is a good practice.

Table 12: Perceptions of Health Personnel about immunizations (N=13)

	Accepted N (%)
Understanding the socio-cultural context of a community is important to ensure increase vaccination coverage	13 (100%)
The fact that a health center personnel is known in the community may increase vaccine uptake	13 (100%)
Understanding the religious context of a community can affect vaccine coverage	12 (92.3%)
Friendliness to parents/children is a motivating factor for them to respect vaccination timelines	12 (92.3%)
Greater sensitisation of the population would increase their acceptability of vaccines	13 (100%)
Educating parents on the advantages of new vaccines will encourage their use of the PCV	12 (92.3%)
To scold at parents when they fail to respect the vaccination calendar is a good practice	4 (30.8%)
Having a trained community member to publicise campaigns is a good practice	13 (100%)
Long waiting time on parents prior to vaccinating their children is encouraging	0 (0%)

The frequency of responses from the health personnel about their knowledge, attitude and practice (KAP) about childhood immunisations are summarized in Table 12.

7.0 Discussion

7.1 Objectives and summary of main findings.

The study explored the essential issues in the introduction of the PCV in two health districts in Yaounde, Cameroon to ensure that every child is reached. The objectives of this study were to describe the knowledge, attitude and practices of parents/guardians on pneumonia and immunisations/EPI vaccines. It also aimed to identify the parental socio-economic/demographic characteristics that are predictive of good knowledge on pneumonia infections and EPI vaccines. Lastly, the study described health center personnel perceptions about immunisations prior to the PCV inclusion into the EPI.

The main findings:

Firstly, there is a generally high level of awareness regarding the perceptions and opinions of respondents about pneumonia disease burden and immunisations/EPI vaccines.

Secondly, in multivariate adjusted models, parental educational level, income level, membership status in a social group and Region of origin were identified as important socio-economic/demographic predictors of knowledge of pneumonia disease burden, prevention and immunisations/EPI vaccines.

Furthermore, the empirical results show that, a friendly attitude from health personnel is a good practice that will motivate parents/guardians to respect vaccination schedules.

7.2 Scientific conclusions and possible explanations

The results indicate that knowledge, attitudes and practices of parents/guardians involved in the study were found to be generally good and positive about pneumonia disease burden and immunisations/EPI vaccines. A majority of those studied had a good knowledge of the symptoms of pneumonia. Despite the fact that sixty-nine percent of the respondents knew at least a single symptom of pneumonia, only 19% of the participants had good knowledge of the actual disease condition. It is difficult to understand why the community knowledge about pneumonia disease is low, but a likely

understanding in different appellations between the scientific world and the local communities may be explicit (for example, it seems difficult for the locals to distinguish between symptoms of bronchitis and persistent cough from those of pneumonia). However, this needs to be addressed to gain more understanding. Likewise, two-thirds of them had a good knowledge on the consequences/seriousness and causes/risk factors for pneumonia respectively. Compared to the ninety-seven percent who knew at least one good method to prevent the causes/risk factors of pneumonia, only nineteen percent of them had knowledge on the availability the Pneumococcal Conjugate Vaccine. The lack of parental information on the existence of the PCV may be attributed to the low degree of social mobilisation and insufficient Information-Education-Communication (IEC) from the health providers. A natural explanation is that, the officials had planned to roll out with this IEC earlier but there has been a delay in introducing the PCV. More so, a majority of the parents/guardians were aware of the types of vaccines their children had taken and/or were due to receive within the Expanded Programme on Immunisation scheme. This may be indicative of the willingness of parents to accept and participate in vaccines uptake by their children, although "antivaccinists" are extremely knowledgeable but they do not want vaccines.

Moreover, the results show that vaccines were generally accepted in the community. Most of the respondents were of the opinion vaccinations were not only beneficial to the health of the child, but also saves money (and other scarce resources) which should have been spent on medications. Childhood vaccinations did not interfere with the religious or cultural practices of the studied population. Again, most of the parents did not think it a time-wasting exercise to take their children to be vaccinated. In their own words "the health of a child is a major priority and has no price-tag as prevention was better than cure". A greater proportion of the parents had a positive impression about the attitudes of health personnel at the vaccination units.

The findings further indicate that, a majority of the parents/guardians were of the opinion that the best way the Pneumococcal Conjugate Vaccines could be made accessible to every child will be an increase in public sensitisations and mass vaccination campaigns. Important alternatives included an increase in the level of health information-education and communication, and an improvement in the social mobilisation/communication strategy. However, a synergy of these alternatives could yield fascinating outcomes to improve on vaccine coverage.

In addition, results of multivariate models show differences in the association between socio-economic/demographic characteristics and parental knowledge outcomes. In the

first analyses on associations, it was found that parents/guardians who were members to a social group had a greater chance of having good knowledge on pneumonia disease burden than those who were not members in any social group. This explains the positive effects of social networking in community health care.

The second analyses show there is an association between education and parental knowledge on the consequences/seriousness of pneumonia infections. As such, parents/guardians with lower education equally had decreased odds of having knowledge on the seriousness/ consequences of pneumonia. This is obvious as parents/guardians with low educational background are not usually expected to depict a high level scientific understanding.

Similarly, in the third analyses the results show an association between income level and parental knowledge on the causes/risk factors of pneumonia. However, this association was not independent because, it was correlated with education. Thus, parents/guardians in the lower income tertile and those with ≤ primary education were identified with reduced odds in having good knowledge on the causes/risk factors of pneumonia infections. The study did not measure the strength of the interaction between education and income level, but it is most likely that those who were more educated had greater probability to have more income than the others.

Fourthly, parents/guardians in the student occupational group were less likely to have good knowledge on the prevention against pneumonia. It appears that, as a parent there is already the responsibility to look after the child. To be a parent and student simultaneously increases parental responsibilities coupled with other socio/economic challenges, and the tendency to neglect little tips on disease prevention is likely to become higher.

Fifthly, there is a close association between parental Region of origin and their knowledge on the availability of vaccines against pneumonia infections; with those from the Adamawa, North and Far North Regions having greater odds of having good knowledge on the availability of pneumonia vaccines than those from the other regions. A likely explanation stems from the potential of people from these three regions in creating and promoting social network activities within and out of their home regions. They are collectively referred to as The Nordists. Otherwise, it may be that public health services in their regions are more aware of public sensitisation. However, this too has to be independently considered.

Finally, the findings of the study indicate that the health center personnel had the perception that long waiting-time will discourage parents to bring children for vaccinations. More so, a majority of the health personnel thought showing a friendly attitude to parents and children was primordial to increase vaccine uptake. However, thirty-one percent of them thought instituting disciplinary measures (like scolding) was necessary when parents don't respect vaccination schedules.

7.3 Strengths of the study

This can be seen on the choice of the study, selection of the study population and site. Therefore, this study adds to any existing literature to what is known about the PCV introduction. However and as earlier mentioned, the purpose of this study was to explore the issues that were essential prior to the introduction of the PCV into national immunisation scheme of Cameroon. Hitherto, plans in the introduction agenda have solely focused on evidence from the burden of pneumonia disease in children less than five years old. This has been supported by new funding streams (www.gavialliance.org). The income level of < US $1000 per capita income together with over 1% of HIV/AIDS prevalence in adult population aged 15-44years (WHO, 2004) were other parameters used as basis for the PCV introduction. Other population-related challenges such as socio-economic and demographic characteristics of parents/guardians, interactions between their knowledge, attitudes and practices on pneumococcal diseases and prevention and perceptions and opinions of health providers on immunisations (and the forthcoming PCV introduction) have almost been neglected (Mahoney et al., 1998; Andre, 2003; Mahoney et al., 2000). Therefore, it is essential to consider the question on how the PCV would actually get to the recipients despite apparent challenges.

The study objectives and documentation /literature review have been done in a manner to provide sufficient insight in the context of new vaccine introductions into operational health structures and systems of developing countries. This cuts across the epidemiology of pneumonia disease burden, the rationale of the pneumococcal conjugate vaccines, vaccines financing and the definition of frequently used terms amongst others. Although literature on the implementation experience of the PCV in other developing countries is scarce, the depth of the present study is a gateway to the understanding of the association between parental socio-economic/demographic factors which are interconnected with knowledge on pneumonia disease burden and prevention

and the perceptions and opinions of health personnel. A good estimate of such associations between elements is vital in identification of optimal implementation markers in the PCV introduction process. The actual goal is to prevent pneumonia and other infectious diseases. This will buttress the opportunities for secondary and tertiary prevention measures.

Both qualitative and quantitative data were generated via open- and close-ended questions in the parental data collection process but only with close-ended questions in the health personnel primary data collection. The analytical processes have been effectively verified and the results presented could more likely be applied beyond the population used in the study.

7.3.1 Reliability

The core concept of this study has been exploratory and as such no priori hypotheses were set. This notwithstanding, the use of multivariate logistic regression models in the analyses provided a good basis for statistical testing of findings. In the build-up to the analyses, the data for the study were generated through the use of the researcher-assisted filled parental and self-filled health personnel questionnaires. The questionnaires received face-validity from four immunisation-related and public health experts both in Finland and Cameroon before and after two sets of pilot studies in the two countries, respectively. Several pre-reviews were done to make sure that the questions were accurate and easily understood. Those who pre-reviewed the questions included: thesis supervisor (Professor Hanna Nohynek) - vaccine safety officer with the National Institute of Health and Welfare in Finland and Co-supervisor (Dr. Marie Kobela) - manager of the EPI in Cameroon, Dr. Emah Irene Yakana (responsible for the routine immunisation/monitoring at Expanded Programme on Immunisations- Cameroon) and Mr. Pascal Mvondo (District Health/immunisation Officer at the Ministry of Public Health- Cameroon).

The data collection procedure was based on the World Health Organisation's reference quality sampling cluster technique characteristically used in the estimation and assessment of vaccine coverage figures. The procedure in generating the data via structured questionnaires and face-to-face interviews, and participant observation also enhanced the quality of the data collection (Dewalt et al., 1998). Participant observation involves not only observing people doing their activities, but also interacting with

people and engaging in their activities (Spradley, 1980). Despite the close to 80% response rate, there was no way to be absolutely sure I understood the full profile of those who were excluded or refused to respond. It is difficult to say if their absence does not carry any selection bias. Also, those who responded were likely not doing so in an entirely neutral situation since the investigator was on sight. It could not be determined if their responses should have been different without the researcher being there.

The data entry and analyses were checked and cross-checked by the researcher and further verified by a set of statisticians at the Tampere School of Public Health and the National Institute for Health and Welfare (THL). I understand the near impossibility of getting a hundred percent accuracy, but these are credible personalities and institutions whose assessment of the reliability of the study data has been accurately justified.

7.3.2 Internal validity

Internal validity, just like reliability, is a core fundamental research concept which is vital in order for accurate application and interpretation of findings. In this regard, the clarity and response-friendly attitude shown by the participants coupled with a 78.9% response rate indicate the extent to which the study objectives have been measured by the questionnaires. In the constructive phase of the questionnaires, a social researcher at the University of Tampere International School of Social Sciences was consulted to rate the validity of the questions. This was preceded by the first phase of the pilot study with a group of six participants (4 students and 2 lecturers who were all parents from different low, middle and high income countries) in the Master of Health Sciences class. It was equally subjected to a critical review during the Master's Thesis seminars and all the suggestions or comments advanced were considered in drawing-up of the tentative questionnaire version used in the second pilot study in Cameroon.

The second pilot study involved eight potential participants (seven parents and one health personnel within the study area). After this pilot study, a revised version of the questionnaire was developed and presented to my supervisors and two public health experts in vaccination-related activities in Cameroon. Their comments and suggestions were taken into consideration prior to the production of the final version of the questionnaires used in the collection of the primary data.

There were some open-ended questions in the parental questionnaires. This led to at times a wide range of discussion (answers and questions) which showed the interest of

the participant in the study. In the cover letter to the questionnaire, the researcher had expressed the desire to share any information related to the study with the participants. As such, while their opinions were got, they were sensitized on the forthcoming introduction of the PCV and the benefits this may add to the health of their children. This was necessary since it provided another opportunity for participants to clarify their answers (Boynton & Greenhalgh, 2004). It increased the response rate as well. These clarifications were taken into consideration and have been included in the results and explained in the scientific conclusion section.

7.3.3 External validity

This stems from the internal validity of the study and deals with how far the results can be generalized from the sample to the entire population. Based on the overall and specific objectives to the study earlier mentioned, it is likely that the findings will occur in other health districts with similar characteristics across the country. While the study participants included persons (parents/guardians and health personnel) from different regions of the country (and some from neighbouring countries), they were of different socio-economic/demographic background, educational level, age, occupation and multiculturalism amongst others. The findings are estimates of the population variables used.

Furthermore, in the multivariate logistic models, the main outcome (dependent) variable was good parental knowledge on pneumonia disease burden and prevention. However, the researcher was not limited on the single outcome variable but asked respondents to give an assessment of their knowledge of pneumonia causes/risk factors, seriousness/consequences, prevention and their knowledge on the availability of vaccines against pneumonia diseases particularly the PCV. This led to clarity of responses and as earlier indicated, contributed in the high response rate (Boynton & Greenhalgh, 2004).

Although a high response rate eliminates the constraints associated with poor representativeness, the study does not minimise contributions which should had come from those who declined to participate or were excluded. It is not entirely understood why some of those contacted declined to participate in the study. Three health personnel said they were not authorised to respond to questions in the absence of their bosses. The excluded health personnel were not directly involved with vaccination activities. The

reason some people declined to participate in the parental sample may be the absence of a well-informed parent/guardian at the household at the time of the study. The rest of those excluded were on grounds of not meeting all of the inclusion criteria.

Nonetheless, considering the wide scope of those included in the study, it is unlikely that any differences between those who were excluded or declined to participate and the included participants will bias or hamper the credibility of the results. In view of this, the fact that respondents made important contributions to the measurement variables meant they had a high interest in the study. The questions on what could be done for vaccines to effectively reach every child and that of parental impression on nurses resulted from the recommendation of the participants.

Briefly, the concept of external validity is hard to completely achieve. However, the researcher is convinced that the random-cluster sampling technique used in the selection of participants has greatly improved the external validity of the study. As such the results are more likely to be generalised under conditions similar to those of the study.

7.4 Limitations of the study

7.4.1 Limitations with the scope of the study area (Delimitation)

The study, like any human endeavour involving people of all works of life in a cosmopolitan and urban-slum community, could hardly go smoothly. The first shortcoming is in the scope of the study area, which covers only two out of the 179 health districts in Cameroon. Initially, the intention was to undertake the study in three regions of the country: one with a high vaccine coverage rate, the second with a low vaccine coverage rate and the third at the national level. With this in mind, it should have been interesting to compare the vaccine distribution process and challenges from the national level to a high and a low vaccine coverage health districts. Unfortunately, this was not feasible due to financial constrains. However, the choice by convenience of these two health districts for the study in a semi-urban cosmopolitan zone in the national capital Yaounde has satisfactorily fulfilled the set objectives considering that participants originated (by chance) from many Regions.

Moreover, it would have been interesting to get a detailed study on the experiences and opinions of health personnel. In this case, a qualitative approach should have been ideal

in order to get an in-depth analysis of the pitfalls and progress made prior to the introduction of the PCV into the country. This was thought of but could not be realized due to logistic and financial reasons. In the absence of this qualitative part and the lack of carrying out proper focus group discussions, the quantitative analysis summarily describes a real life scenario of the perceptions of health personnel on immunisations and how increased coverage figures with the PCV could be attained. This explains why the question on parental impression about nurses and that on the attitude of health personnel to parents/children during vaccination was important.

Some of the respondents were not able to read and /or understand the content of the survey instrument. This problem was solved by the researcher assisting in filling parental questionnaires, after which their responses were read to them for confirmation. Some misconstrued the purpose of the study or were tired of always attending to interviews, while others felt that by responding, their educational deficiencies in the subject matter would be exposed through the research. This to my opinion did not motivate them to participate or furnish the necessary information in the primary data, and this certainly had an effect on the sample size despite the high response rate recorded. However, the researcher minimized the above limitations by approaching community leaders in advance to sensitize the population (parents and civil society) on the purpose of the study prior to starting the primary data collection. Besides, the investigator was always ready to address urgent explanations to the respondents when and where possible.

7.4.2 Limitations of the questionnaire

The data collection instrument (questionnaires) was considered to be appropriate for the study after undergoing two trial phases and a face validity. However, during the coding and the preceding analytical stages, some deficiencies were observed with a number of variables. The first of these was with the variable (question 6) on parental educational level attained. Respondents were expected to select only one amongst the seven categories which included: no certificate (adult & non-formal education), primary, secondary, vocational, high school, University or others (to be specified by the respondent in case it has not been listed). However, those who had attained secondary and/or vocational education ticked primary education as well. The same was the case with those who had attained high school or above. To this regard, prior to the analyses we were obliged to re-categorize this variable into three smaller levels i.e. a) ≤ primary education (for those with no certificate and primary education), b)

secondary/vocational/high school as combined since they occurred above primary education and c) University education was placed in an independent level since it occurred after secondary and high schools. Hence, only the highest educational level of the participant was considered in the analyses.

Another limitation was observed with question 14 (which stated: Do you take or make available your child for vaccination? A= Yes, B= No). Here, the response was over 98% "Yes". In effect, the intention here was to measure the level of adequate and inadequate use of the EPI vaccines in an effort to identify where emphasis should be laid prior to the PCV introduction. A parent who respects all the doses of a particular vaccine (e.g. the reference vaccine DTP 1, 2 & 3) is described as adequately using the EPI vaccines while that who takes DTP 1 or 2, and fails to make the child takes the third dose is described as inadequately using vaccines. With this in mind, two groups (the adequate users and the inadequate users) were to be identified and comparisons drawn to understand the factors affecting the usage of EPI vaccines. This was not possible and as such, question 15 (on reasons if "NO") could not be analysed. The fact that most parents could recall the vaccines their children had taken or were to take indicated they had a good knowledge on the existing EPI vaccines and this compensated for the aforementioned limitation.

The next set of constraints involved question 17 (on knowledge of pneumonia symptoms), question 19 (seriousness/consequences of pneumonia) and question 20 (on causes/risk factors of pneumonia). These were all open-ended questions and it turned out to be cumbersome to analyse the outcomes efficiently. Thus, since the priori intention was not to get an expert knowledge from the participants from these questions, their responses were then analysed using two categories i.e. "Answered correctly" for those who gave at least a single correct symptom, seriousness/consequences, causes/risk factors or prevention method as the case may be. While "Don't know" described those who gave wrong answers or said they had no idea.

7.5 Relation to other studies

Although studies on the introduction of the PCV are either scarce or still in gray literature to the best of my knowledge, the findings obtained here are matched with those of immunisation-related studies reported. Thus, a comparative view of related studies on beneficiaries and health providers' opinions, knowledge, attitudes and

practices with regards to health service interventions such as immunisations in developing countries and apart had been taken into consideration.

In view of this, the results obtained on the knowledge, attitudes and practices of parents/guardians on pneumonia and immunisations/EPI vaccines involved in the study which were found to be generally good and positive, correlates with those presented by Olumuyiwa et al.(2008). In a study "on the determinants of vaccination coverage in rural Nigeria" involving 339 mothers, it was shown that most mothers (87%) had very positive attitudes and more than half of them were generally knowledgeable about the symptoms of vaccine preventable disease except for difficulty in breathing (Olumuyiwa et al., 2008). According to the study, cough was the most correctly cited symptom (84%) and almost all (99%) of the sampled mothers thought that vaccinations were beneficial to the child and community at large. This is in accordance with 97% of the parents/guardians in the present study who were of the opinion that, childhood vaccination ensures adequate health protection.

The significantly higher levels of knowledge on the symptoms of pneumonia (69%) and a prevention method (97%) found amongst parents/guardians which is similar to those obtained amongst mothers in the study of Olumuyiwa & colleagues (2008); maybe attributable to the content of information given to them during antenatal visits. The fact that only 19% of the sampled parents/guardians were aware of the availability of vaccines (PCV) against pneumonia infections in our study stresses the need for an improvement in the quality of health information on pneumonia disease burden and prevention. A similar finding on a limited maternal awareness level about vaccine preventable diseases (except for poliomyelitis) had been reported in a study on maternal knowledge and perceptions about routine immunisation programme in a semi-urban area of Rajasthan- India (Manjunath & Pareek, 2003).

This notwithstanding, the degree of knowledge of parents/guardians on pneumonia disease burden in the studied community or the level of awareness of mothers reported in the study by Olumuyiwa et al. (2008) differs from the low rate (4%) of knowledge about Oral Polio Vaccine (OPV) reported in a Niger study (Kobayashi et al., 2003) and the low rate of awareness (1%) that measles was vaccine-preventable in another study in Nigeria (Ambe et al., 2001).

It is also important to note that the high and positive levels of awareness and knowledge stated above could not be attributable to the content of information provided during antenatal visits only. Other socio-economic and demographic factors equally play a vital

role. As such, over seventy-eight percent of the parents/guardians sampled in our study had obtained educational levels above primary school. This too is an effect of free and compulsory primary education instituted in Cameroon since the early nineties, and the adult literacy rate were reportedly high (67% for females and 81% for males) based on studies conducted by the Institute for the Training and Demographic Research (IFORD *for its French acronym*) in 2004.

Similarly, just as in our study, Olumuyiwa et al.(2008) did not report any interference between vaccinations and the religious or cultural beliefs of the studied community in Nigeria although such controversies were a subject of contention in most parts of Nigeria (Olumuyiwa et al., 2008). Most parents/guardians did not think that to take their children to be vaccinated was a time-wasting exercise. And as they stated, "the health of a child is a major priority and has no price-tag since prevention was better than cure". On the contrary, the issue of long-waiting time was mentioned as a potential risk factor on why children fail to get immunised in an Egyptian study to evaluate coverage of the National Immunisation Days (Reichler et al., 1995). A related finding was reported in a recent study at Ibadan-Nigeria, which took an assessment of "what reasons and beliefs do mothers have for children not receiving adequate vaccination". Of the 248 studied mothers, 52% believed that taking the child to the clinic for immunisation wasted alot of time (Oladokun et al., 2010).

A greater proportion of the parents/guardians in the study had a positive impression about the attitudes of health personnel at the vaccination units. Inversely, a Greek study reported that unfriendly health provider attitude and poor organisation at preventive service had contributed in an increase in unvaccinated children (Danis et al., 2010). However, if this situation was not evident in our study, it does not cancel the existence and needs to be seriously considered. For it maybe likely that, as some respondents stated the attitudes of the health personnel (nurses) at the vaccination units is also dependent on the institution on the one hand and the individual on the other. For as some parents mentioned, "Nurses in privately-managed and denominational health institutions usually have a friendlier and caring attitude than those at the public health facilities".

Another aspect for comparison is parental opinions on how best the PCV could be made to reach every child. In this study, 56% of them suggested an increase in public sensitisations and mass vaccination campaigns. A similar study on Mothers' knowledge, attitudes, practices and expectations (KAPE) from immunisation in India showed that

57% of the 166 mothers requested increased sensitisations and door-to-door vaccination campaigns (Manjunath & Pareek, 2003). Although alternatives include increase in the level of health information, education and communication, and improvement in the social mobilisation/communication strategy, a synergy of these population-based opinions and alternatives could yield fascinating outcomes in attaining high vaccine coverage.

Results of the association between parental socio-economic/demographic characteristics and knowledge outcomes obtained in the multivariate analyses could be compared with findings on vaccination-related studies. Firstly, parents/guardians in our study who were members in a social group were more likely to have good knowledge on pneumonia disease burden. This agrees with a study conducted in Bangladesh in which interpersonal communication was used among mothers in a social network resulting to significant improvement in vaccination uptake and coverage rate (Amin et al., 1997).

In the second analyses on the association between parental socio-economic/demographic characteristic and knowledge about pneumonia infections, parents with lower education were found to have decreased odds to knowledge on the seriousness/ consequences of pneumonia. The most associated predictor of knowledge on the seriousness/consequences of pneumonia found in the multivariate analysis was education, and this has been confirmed by other researchers in a related study (Chhabra et al., 2007).

Thirdly, parents in the lower income tertile and those having primary education or below were associated with reduced odds to good knowledge on the causes/risk factors of pneumonia infections. The relationship of education as a predictor to knowledge on immunisation-related aspects had earlier been emphasised (Mutua et al., 2011; Nankabirwa at al., 2010; Olumuyiwa et al., 2008; Chhabra et al., 2007; Mathew et al., 2006). While in a study on the determinants of the influenza vaccination in hard-to-reach urban populations in the United States, lower annual income was amongst the factors significantly associated with an interest of being vaccinated (Bryant et al., 2006). It is evident in relation to our study that parents/guardians in the lower income level may equally have an interest in the pneumococcal conjugate vaccines for their children but this maybe handicapped by their limited knowledge on the causes/risk factors and the dangers of pneumonia. As such, it will be essential to design a specific health information package on pneumonia disease burden and prevention for parents/guardians in the lower educational and income tertile levels.

Fourthly, results of the multivariate analysis on the association between parental socio-economic/demographic characteristics and parental knowledge on pneumonia infections show that, parents/guardians in the student occupational group were less likely to have good knowledge of the prevention against pneumonia. This is unexpected given that the student group, more educated than the average, is expected to be more knowledgeable on the matter. In related studies, parental occupation defined as the socio-economic condition of the household was shown to have statistically significant association with acceptance (and by implication, knowledge) of immunisation (Mathews & Diamond, 1997; Bhuiya et al., 1995). This was in contrast to our finding. Previous studies had shown that higher caretakers educational background was associated with increase knowledge and opportunity to get their children vaccinated (Nankabirwa at al., 2010; Masaharu et al., 2007). However, there comes a disparity when caretakers have a dual responsibility of child care, pursuing personal studies or working to sustain the household as it was peculiar in our study community.

The last results of the multivariate analysis indicate that there is close association between parental Region of origin and their knowledge on the availability of vaccines against pneumonia infections. Parents from the Adamawa, North and Extreme North Regions were likely to be more aware than those from the other regions. In two separate studies in Bangladesh and Ghana, similar association between parental region of residence and their knowledge and acceptance of vaccination was reported (Bhuiya et al., 1995; Brugha & Kenvany, 1995). Although this may be attributed to many factors, a striking observation in our study is the concept of social networking (parental membership in a social group). As a personal experience, it is likely that people from these three Northern Regions (residing within or out of their communities) are believed to establish and propagate strong social network groups in which developmental issues of their localities and other matters are usually discussed on weekly or monthly basis or as may be necessary. Hence, it is not uncommon to share information on health especially with regards to immunisations.

The results of the study also indicate that health personnel knowledge, attitudes and practices are in agreement with those reported in a related study conducted in the United States on the Knowledge, Attitudes and Beliefs (KAB) of school personnel (including nurses and non-nurses) who work with parents on immunisation issues (Daniel et al., 2004). Despite the overall positive perception on childhood immunisation in our study, disparities in opinions from the respondents were common and this is consistent with findings of other studies (Ekunwe, 1984; Drain et al., 2000; Pickering et al., 2009). For

instance, thirty-one percent of the health personnel perceived that to scold at parents (or threaten parents with disciplinary measures) when they do not respect vaccination schedules (or in the event of a missed vaccine/dose) was associated with discouraging parents from taking their children again to vaccination units. This is a factor likely to increase missed and low vaccine uptake rates by desiring children. However, a friendly attitude to the parents/children during a vaccination session has been reported to motivate them and conversely increase demand for vaccines (AAP/Pickering, 2000).

This is especially true as is with the present context of this study, where most of the parents/guardians (70%) were under a monthly disposal income of less than €107, and forty-eight percent of them unemployed (majority of whom were housewives with a principal source of income being petty trading and/or farming; a phenomenon commonly referred to in Cameroon as *buyam-sellams*). Thus, when parents/guardians are being scolded or perceived the nurses' (health personnel) attitude to be unfriendly, it is likely to push them away from such untoward experiences. And they would rather focus on their numerous daily chores. Regardless of these, for an optimal uptake of the PCV, it would be vital for health personnel to adopt an approach which is effective and empathetic as this will reduce vaccine risk communication and misinformation while assisting parents in understanding the ultimate need of immunisations (Pickering et al., 2009).

7.6 Potential public health implications of the study

There is an acute need for knowledge on the demand and supply-side constraints on immunisation in developing countries as earlier studies have focused on the efficacy and effectiveness of new or under-utilized vaccines (Andre, 2003), vaccine finance (Mahoney et al., 2000), and time span for vaccines to reach developing countries (Mahoney et al., 1998) amongst others. The knowledge-attitudes of parents/guardians on pneumococcal infections and prevention coupled with predictor socio-economic/demographic factors to good knowledge of pneumonia disease burden and PCV/EPI vaccines in developing countries have not been documented. Thus, the results of the study will provide information useful to improve intervention measures to reduce child morbidity and mortality caused by vaccine-preventable infectious diseases in Cameroon. Hence, accelerating the pace of attaining the Millennium Development Goal-4, this calls on the reduction of under-five mortality up to two-thirds by 2015, with reference to the 1990 levels. Furthermore, the study results would help identify some of

the operational challenges of the national EPI which are essential to address prior to the introduction of PCV.

7.7 Future/possible research areas

As mentioned earlier while addressing the shortcomings associated with the questionnaire, it would have been vital to measure the determinants of the adequate or inadequate use of vaccines in the community. Thus, this is a possible research area which could furnish details on the reasons why some children are adequately vaccinated while others are not. This will help in tailoring specific measures to meet identified challenges and consequently boost vaccination coverage. Another possible research domain is an extensive analysis via a qualitative study on the experiences and opinions of healthcare providers on the supply side-constraints with vaccination activities in Cameroon. Such a study will provide information on the operational challenges facing new vaccine introductions and EPI activities across the three-tier health system structure of the country.

8.0 Conclusions and recommendations

Childhood immunisation against vaccine-preventable infections has remained a major cornerstone and the most successful of all health interventions in global health endeavours (WHO, 2009; Mutua et al., 2011). Nonetheless, millions of children worldwide and particularly in resource-poor settings including Cameroon, still suffer from the burden of such vaccine-preventable diseases especially those resulting from *Streptococcus pneumoniae* and *Haemophilus influenza type b (Hib)* than their counterparts in the developed world (Bryce et al., 2001; UNICEF/WHO, 2006). Thus, the planned introduction of the PCV into the national Expanded Programme on Immunisation of Cameroon is a welcome agenda. How successful the PCV would be made to reach every child depends on the health system, the health providers and the parents/guardians who carry the greater proportion of the challenge.

The decision-making involving the health care of children should be shared between the health personnel and the parents/guardians; but parental consent is most required before children receive health interventions such as vaccinations (Daniel et al., 2004). The decision of parents/guardians relies heavily on some prevailing socio-economic/demographic characteristics, their knowledge and attitudes/practices about immunisations based on findings from this study. Thus, for the PCV to effectively reach every child parents/guardians would need updated information tailored to their understanding about pneumonia disease burden and prevention .This information must be provided by well informed and experienced health personnel.

This could be achieved through increased sensitisation and mass vaccination campaigns, and social networking (membership in a social group). It is recommended that health personnel design and provide parents/guardians with short and clear message about pneumonia disease burden and prevention. Educating parents on risks and dangers associated with pneumonia infections to the health and development of their children would always remind them of the necessity to prevent the disease via vaccines.

While public sensitisations and mass vaccination campaigns are conducted on specific periods, social networking could be intensified on a regular basis rather than close to the bi-annual National Immunisation Days. Social mobilisation teams should engage a communication strategy which targets parents/guardians from the largest to the smallest groups in the community. This may involve sending instant text messages to parents via mobile telecommunication networks, extending specific health promotion messages to village/local developmental associations, women's associations, churches and other

related groups. There is a lot of interaction within and without social groupings and a health promotion message with the content of consequences/seriousness of pneumonia if not prevented/treated coupled with the availability of free vaccines at health units, will help to ensure that the PCV reaches every child.

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10.0 APPENDICES

APPENDIX 1: Questionnaires

Respondent's code No....

Instructions: Please, you may have to indicate your response by TICKING from given options, and in some cases you are to STATE your response.

THIS SECTION IS ONLY FOR PARENTS

Part A: Demographic / Socio-economic Information

1) ***What is your gender? (Tick)***

M_____ ( ) ***F_____ ( )***

2) ***What is your age_____ (in years)?*** State

3) How many children do you have? Give ages separately for boys and girls.

Ages of boys_____ **Ages of girls** _____

4) ***Where were you born?***

Village/city: ***Region:***

5) How long have you been living in this community?

_____

6) ***Which of the following educational levels did you attain? (Tick)***

a) No certificate (adult & non-formal education)_____( )

b) Primary_____ ( )

c) Secondary_____ ( )

d) Vocational training_____ ( )

e) High School_____ ( )

f) University_____ ( )

g) Others (specify please) _____

7) **What is your monthly disposal income? (In CFA FRS**)_____ (Please state)

8) ***What is your major occupation***? State only ONE.

_____

9) ***What are your minor (secondary) occupations?***

_____

10) ***Are you a member of any social group or union? (Tick)***

a) Yes_____ ( ) b) NO_____ ( )

11) ***If YES, state the name(s) of the social groups (or union) to which you are a member***.

_____

12) ***To which Faith do you belong (church member)? Tick***

a) Christianity_____ ( )

b) Muslim_____ ( )

c) Buddhist_____ ( )

d) Others_____ (Specify)

e) None_____ ( )

13***) How many people are living in your home (household) permanently? State the composition.***

Part B: Information related to the utilization of vaccine

14) ***Do you take your child or make your child available for vaccination? (Tick***)

(i) Yes (ii) No

15) ***If NO to question (14), please state why?***

---

16) Do you know the types of vaccines your child has taken following the table above? (State)

i) Yes_____( )
ii) No_____( )

Part C: Information related to the knowledge, attitudes and practices of parents on immunisation and pneumonia disease burden.

17) ***What are the symptoms of Pneumonia?***

_____

18) ***How much knowledge can you say you have about Pneumonia diseases? Tick***

i) Very much_____ ( )

ii) Much_____ ( )

iii) Little_____ ( )

iv) Very little_____ ( )

v) I don't know_____ ( )

19***) What is the seriousness of the illness of Pneumonia and consequences if not treated?***

_____

20) ***What do you think is the cause of Pneumonia? State***

_____

21) ***How can Pneumonia be prevented? State***

_____

22) ***Is there a vaccine against Pneumonia? Tick***

a) Yes b) No

In questions (23 - 27), describe how best can you express your feelings about the following statements?

23) ***To allow the child been vaccinated ensures adequate health protection***.

i) Strongly Agree_____ ( )

ii) Agree_____ ( )

iii) I don't know_____ ( )

iv) Disagree_____ ( )

v) Strongly Disagree_____ ( )

24) ***To allow the child been vaccinated is against my religious belief.***

i) Strongly Agree_____ ( )

ii) Agree_____ ( )

iii) I don't know_____ ( )

iv) Disagree_____ ( )

v) Strongly Disagree_____ ( )

25) ***Immunisation of children saves me money to be spent on medication.***

i) Strongly Agree_____ ( )

ii) Agree_____ ( )

iii) I don't know_____ ( )

iv) Disagree_____ ( )

v) Strongly Disagree_____ ( )

26) ***To allow the child been vaccinated is against the habit (cultural practice) of my community***.

i) Strongly Agree_____( )

ii) Agree_____ ( )

iii) I don't know_____ ( )

iv) Disagree_____ ( )

v) Strongly Disagree_____ ( )

27) ***To take a child to the health center for vaccination is a time-wasting exercise***.

i) Strongly Agree_____ ( )

ii) Agree_____ ( )

iii) I don't know_____ ( )

iv) Disagree_____ ( )

v) Strongly Disagree_____ ( )

27) What to your opinion needs to be done in order for vaccines to reach every child? _____

28) What are your impressions about nurses during the vaccination of your child? _____

THIS SECTION IS ONLY FOR HEALTH CENTER PERSONNEL

<u>Part D: Information on the opinions, knowledge, attitude and practices of Health Center personnel on immunisation</u>.

Against each statement on the following questions (36 - 41), please tick the one which best expresses your opinion:

1***) Health personnel living in a community will understand better the socio-cultural background important to ensure massive vaccination coverage.***

i) Firmly Accepted_____. ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____ ( )

2) Health personnel known by the community is helpful to ensure increase vaccination up-take.

i) Firmly Accepted_____. ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____ ( )

3) ***For health personnel to understand the religious background of a community is important to ensure higher uptake.***

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____ ( )

4***) Treating parents and their children in a friendly manner will motivate parents to bring their children for vaccinations.***

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____( )

v) Firmly Unaccepted_____. ( )

5) ***Education awareness on vaccinations to the population will increase their utilization of these vaccines***

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____ ( )

6) ***Sensitization of the community on the importance vaccination will prepare them in advance on the forthcoming new vaccines against Pneumonia diseases***.

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

5iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____(

7) ***To threaten parents with disciplinary measures when they fail to get a specific vaccine or dose for their children is a good means to get vaccinate their kids?***

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____( )

8) ***Having a trained community member to publicize vaccination campaigns is a good measure to inform the community when and where vaccines will be available.***

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted_____ ( )

v) Firmly Unaccepted_____ ( )

9) ***Long-waiting time imposed to parents/ guardians in order for their children to get vaccinated will encourage people to always come for vaccinations***.

i) Firmly Accepted_____ ( )

ii) Accepted_____ ( )

iii) Undecided_____ ( )

iv) Unaccepted _____ ( )

v) Firmly Unaccepted_____ ( )

APPENDIX 2.1: Research Permit from the University of Tampere

TAMPEREEN YLIOPISTO
LÄÄKETIETEEN LAITOS

UNIVERSITY OF TAMPERE
MEDICAL SCHOOL

Prof. Kaptue Lazare.
President,
Cameroon Ethics Committee

Mr. John Njuma Libwea, who is my student in the Master's Degree Program in International Health at the University of Tampere Medical School, Finland, has submitted for ethical review his plan for Master's thesis with title "Introducing the pneumococcal conjugate vaccine into Cameroon's Expanded Program on Immunisation: Would the needy be reached?". I have reviewed this study plan with submitted attachments, and I wish to inform the following.

The main rule at the University of Tampere is that the supervisors will instruct the students to follow good ethical principles and practice in their research for completing Master's thesis. Students' supervisors are responsible to oversee that these good ethical principles are being followed by the students. Only in exceptional cases are plans for Master's thesis submitted to the Ethical Review Committee.

Based on my review I conclude that Mr. John Njuma Libwea's proposed study follows ethically sound research practice, and does not cause any danger or risk to the study participants. Therefore I do not see any reason to submit this study proposal for the Ethical Review Committee of Tampere University. As one of the supervisors Prof. Hanna Nohynek will (on the behalf of Tampere University) instruct and monitor that the implementation of the proposed study will be ethically sound.

As is the practice in Cameroon with externally initiated research, the study plan will be reviewed by the Cameronian ERB, and there will also be a local supervisor, i.e. Dr. Marie Kobela who is affiliated with the University of Yaounde.

Tampere, Finland, 1 June 2010

Sincerely yours,

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APPENDIX 2.2: Research Permit from the Cameroon National Ethics Committee

COMITÉ NATIONAL D'ETHIQUE
NATIONAL ETHICS COMMITTEE

- N° d'enregistrement : FWA IRB00001954 BP 1937, Yaoundé, Tel: (237) 22 21 12 84
- Arrêté N° 079/A/MSP/DS du 22 octobre 1987 portant création et organisation d'un Comité d'Ethique de la Recherche (CER) impliquant les êtres humains
cnecprot@yahoo.fr

Yaoundé, le 18 juin 2010

AUTORISATION N°119 /CNE/SE/2010

CLAIRANCE ETHIQUE

Le Comité National d'Ethique a examiné ce jour, le projet de recherche intitulé: ***"Introduicing the pneumococcal conjugate vaccine (PCV) into the expanded programme on immunisation"*** soumis par **l'etudiant John Njuma Libwea,** Investigateur Principal.

Le sujet est digne d'intérêt. La procédure de recherche prévoit l'administration des questionnaires aux participants. Ceci expose les participants au risque de dommage psychologique non négligeable, et à une rupture de confidentialité. Toutefois, les procédures décrites pour l'obtention du consentement éclairé et aussi pour la préservation de la confidentialité des données collectées présument le respect de l'autonomie et de la sphère privée des participants, minimisant ainsi la probabilité de survenue du risque suscité. Le CV de l'investigateur le décrit capable de mettre en oeuvre l'étude. Pour toutes ces raisons, le comité a approuvé pour une période d'un an cette version du protocole.

L'investigateur principal est responsable du respect scrupuleux du protocole approuvé et ne devra y apporter aucun amendement aussi mineur qu'il soit sans avis favorable du comité d'éthique. Il est appelé à collaborer pour toutes descentes du Comité National d'Ethique pour suivi de la mise en œuvre dudit protocole. Les rapports annuels et le rapport final du projet devront être soumis au comité d'éthique et aux autorités sanitaires du Cameroun à la fin de l'étude.

La présente clairance éthique peut être retirée en cas de non respect de la réglementation en vigueur et des recommandations sus-évoquées.

En foi de quoi la présente Clairance Ethique est délivrée pour servir et valoir ce que de droit.

LE PRESIDENT

COMITE NATIONAL D'ETHIQUE NATIONAL ETHICS COMMITTEE LE PRESIDENT CAMEROUN

Pr Lazare KAPTUE

APPENDIX 2.3: Research Permit from the CBC Health Board

CAMEROON BAPTIST CONVENTION HEALTH BOARD
INSTITUTIONAL REVIEW BOARD
Baptist Centre, Nkwen, P.O. Box 1, Bamenda, Northwest Region

11 August 2010

To: John Njuma Libwea

Re: IRB20010-15, "INTRODUCING THE PNEUMOCOCCAL CONJUGATE VACCINE INTO CAMEROON'S EXPANDED PROGRAMME ON IMMUNISATION: *Would the needy be reached?* "

Dear Mr. Libwea:

The Institutional Review Board for the Cameroon Baptist Convention Health Board has received your research protocol with the above title. We have given your study the number IRB2010-15. You wish to do interviews and questionnaires with parents of young children, and health services staff, as well as ministry officials, and Etoug Ebe Baptist Health Centre is one of the chosen sites.

Your study has received our expedited review and found to be exempt from our IRB oversight, because you are not taking down any names or other identifying information from the study participants. The final approval will be granted when the full Board meets, but with this expedited exempt approval, you may begin your research. Even thought your study is exempt from IRB oversight, we will appreciate a copy of your final thesis for our files and information.

Since you will not take any identifying information and there is no risk to the participants, it is deemed that agreeing to participate in the interview, focus group, and/ or questionnaire is the same as signing an informed consent form. Therefore, verbal consent is all that is required by our IRB. Nevertheless, if you choose to use a signed informed consent form which you have included to us, please add your phone number as well as the name and contact number of someone on our IRB: "In case of any question or complaint regarding this study, you may contact Professor Tih Pius, CBC Health Board Ethics Committee member, 77.76.47.81. "

The Board grants protocols approval for a one year time period. Thereafter, before August 2011, please complete the attached renewal form and return it to me and to the secretary. If your study has ended before the one-year timeframe, there is a place on the form to indicate that and request the file to be closed. The completed form must be reviewed and approved by the Institutional Review Board prior to the expiration date of the current approval period.

Your protocol has been assigned the above reference IRB protocol number. All correspondence to us should include 1) the IRB protocol number 2) Name of the principal investigator and 3) full title of the study.

Finally, all manuscripts, pertaining to the above protocol, must be submitted to the IRB for pre-publication approval. Any abstracts and/or presentations must also receive pre-approval prior to presentation.

Please feel free to contact me with any questions and/or concerns regarding the above. Copies of all correspondence regarding this proposal should be sent to me and to Ms. Esther Kuni, addresses below.

Sincerely,

Nancy Palmer, Ph. D.

CAMEROON BAPTIST CONVENTION INSTITUTIONAL REVIEW BOARD HEALTH BOARD

Nancy Palmer, PhD, Chairperson, palmernancylea@gmail.com
Esther Kuni, Secretary, cbchbirb@gmail.com

APPENDIX 3: Map of study site

APPENDIX 4: COMPLETE LOGISTIC REGRESSION TABLES

Table 7: Association between socio-economic/demographic variables and correct parental knowledge on pneumonia disease burden: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Assessing parental knowledge on pneumonia disease burden (modelling for "poor knowledge")								
	Model 1			Model 1[a]			Model 1[b]		
	OR	95%CI	P-value	AOR	95%CI	P-value	AOR	95%CI	P-value
Gender									
Male	2.22	0.53 – 9.31	0.275						
Female	1.00	Reference							
Age in years			0.137						0.285
< 25	0.52	0.21 – 1.28	0.153				0.52	0.16 -1.64	0.262
25 – 30	0.45	0.20 – 1.02	0.057				0.46	0.17 – 1.22	0.117
>25	1.00	reference	Reference				1.00	reference	reference
Educational level			0.783						
Low	0.75	0.27 – 2.44	0.574						
Medium	0.76	0.33 – 1.74	0.514						
High	1.00	Reference	Reference						
Monthly disposal income			0.993						
1st Tertile	0.95	0.40 – 2.27	0.950						
2nd Tertile	0.99	0.42 – 2.33	0.500						
3rd Tertile	1.00	Reference	Reference						
Occupation			0.313						
Unemployed	0.57	0.27 – 1.20	0.138						
Student	0.63	0.19 – 2.06	0.445						
Employed	1.00	Reference	reference						
Membership in a social group									
Yes	1.89	0.92 – 3.81	0.081	1.89	0.92 –3.81	0.081	1.57	0.70 – 3.50	0.274
No	1.00	Reference	Reference	1.00	Reference	Reference	1.00	Reference	Reference
Religion									
Christians	1.44	0.31 – 6.72	0.641				1.30	0.27- 6.20	0.743
Others	1.00	Reference	Reference				1.00	Reference	Reference
Parity			0.921						0.742
One child	0.85	0.38 – 1.92	0.696				1.40	0.51 - 3.88	0.518
Two children	0.88	0.36 – 2.17	0.775				1.46	0.81 – 4.18	0.478
Three or more children	1.00	Reference	1.00				1.00	Reference	Reference

Table 8: Association between socio-economic/demographic variables and correct parental knowledge on the seriousness/consequences of pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Assessment of parental knowledge on the seriousness/consequences of pneumonia infections (modelling for "don't know")								
	Model 1			Model 1[a]			Model 1[b]		
	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value
Gender									
Male	1.21	0.29-4.99	0.789						
Female	1.00								
Age in years			0.812						
< 25	0.88	0.41-1.89	0.750				0.74	0.28-1.98	0.551
25 – 30	1.10	0.55-2.23	0.786				0.88	0.39-1.98	0.876
>30	1.00						1.00		
Region of origin			0.301						
Pool 1	0.55	0.27-1.11	0.096						
Pool 2	1.09	0.51-2.35	0.828						
Pool 3	0.70	0.26-1.92	0.486						
Pool 4	1.00								
Educational level			0.013			0.013			0.028
Low	0.29	0.12-0.69	0.005	0.29	0.12-0.69	0.005	0.32	0.13-0.78	0.013
Medium	0.67	0.32-1.40	0.286	0.67	0.32-1.40	0.286	0.73	0.34-1.57	0.726
High	1.00	reference					1.00		
Monthly disposal income			0.272						
1st Tertile	0.56								
2nd Tertile	0.75	0.27-1.14	0.108						
3rd Tertile	1.00	0.37-1.55	0.439						
Occupation			0.282						
Unemployed	0.61	0.33-1.12	0.112						
Student	0.76	0.30-1.96	0.571						
Employed	1.00	reference							
Membership in a social group									
Yes	1.06	0.60-1.87	0.843						
No	1.00	reference							
Religion									
Christians	3.26	1.05-10.11	0.041				3.04	0.95-9.69	0.061
Others	1.00	Reference					1.00		
Parity			0.533						
One child	1.12	0.58 – 2.15	0.743				1.05	0.44-2.50	0.907
Two children	1.52	0.72 – 3.23	0.271				1.28	0.53-3.10	0.581
Three or more children	1.00	reference					1.00		

Table 9: Association between socio-economic/demographic variables and correct parental knowledge on the causes/risk factors for pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Assessment of parental knowledge on the causes/risk factors of pneumonia infections (modelling for "don't know")								
	Model 1			Model 1[a]			Model 1[b]		
	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value
Gender									
Male	0.40	0.1-1.53	0.179	0.28	0.07-1.16	0.078	0.26	0.05-1.21	0-086
Female	1.00	reference							
Age in years			0.916						
< 25	0.92	0.42-2.03	0.838				1.17	0.69-1.98	0.560
25 – 30	0.86	0.42-1.76	0.677				*	*	*
>30	1.00	reference					1.00	reference	
Region of origin			0.778						
Pool 1	0.69	0.34-1.41	0.690						
Pool 2	0.89	0.42-1.91	0.765						
Pool 3	0.99	0.35-2.89	0.997						
Pool 4	1.00								
Educational level			0.002			0.004			0.008
Low	0.20	0.08-0.51	0.001	0.23	0.09-0.58	0.002	0.24	0.09-0.64	0.004
Medium	0.56	0.25-1.24	0.152	0.60	0.27-1.35	0.215	0.64	0.28-1.49	0.302
High	1.00	reference							
Monthly disposal income			0.053			0.133			0.145
1st Tertile									
2nd Tertile	0.40	0.19-0.85	0.017	0.45	0.20-0.98	0.045	0.45	0.20-0.99	0.050
3rd Tertile	0.65	0.31-1.40	0.269	0.64	0.29-1.41	0.263	0.63	0.28-1.40	0.258
	1.00	reference		1.00			1.00		
Occupation			0.234						
Unemployed	0.58	0.31-1.09	0.089						
Student	0.77	0.29-2.03	0.593						
Employed	1.00	reference							
Membership in a social group									
Yes	1.35	0.76-2.42	0.310						
No	1.00	reference							
Religion									
Christians	2.03	0.68-6.04	0.203				0.62	0.20-1.96	0.418
Others	1.00	reference					1.00		
Parity			0.474						
One child	1.15	0.59-2.24	0.676				0.89	0.56-1.42	0.625
Two children	1.61	0.75-3.48	0.226				*	*	*
Three or more children	1.00	reference							

Table 10: Association between socio-economic/demographic variables and correct parental knowledge on the prevention against pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables	Assessment of parental knowledge on prevention against pneumonia infections (modelling for "don't know")								
	Model 1			Model 1[a]			Model 1[b]		
	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value
Gender									
Male	∞	∞	∞						
Female	1.00	reference							
Age in years			0.314						0.062
< 25	1.12	0.22-5.80	0.893				27.04	0.95-768.50	0.053
25 – 30	5.52	0.56-54.67	0.144				28.71	1.54-534.05	0.024
>30	1.00	reference					1.00		
Region of origin			0.641						
Pool 1	0.35	0.06-2.16	0.257						
Pool 2	0.96	0.08-10.83	0.971						
Pool 3	0.40	0.03-4.65	0.464						
Pool 4	1.00	reference							
Educational level			0.154						
Low	3.91	0.42-36.39	0.231						
Medium	4.84	0.86-27.40	0.074						
High	1.00	reference							
Monthly disposal income			0.876						
1st Tertile	0.74	0.12-4.61	0.751						
2nd Tertile	1.18	0.16-8.66	0.868						
3rd Tertile	1.00	reference							
Occupation			0.069			0.069			0.124
Unemployed	1.19	0.16-8.60	0.867	1.19	0.16-8.60	0.867	0.38	0.04-4.19	0.433
Student	0.17	0.03-1.10	0.063	0.17	0.03-1.10	0.063	0.03	0.001-0.92	0.045
Employed	1.00	reference		1.00	reference				
Membership in a social group									
Yes	1.16	0.25-5.31	0.851						
No	1.00	reference							
Religion									
Christians	0.00	∞	0.999						
Others	1.00	reference							
Parity			0.557						0.234
One child	0.30	0.03-2.70	0.280				0.15	0.01-2.55	0.189
Two children	0.39	0.03-4.40	0.445				0.09	0.01-1.45	0.086
Three or more children	1.00	reference					1.00	reference	

Table 11: Association between SED variables and positive parental knowledge on the availability of vaccines against pneumonia infections: Odds Ratio (OR) and 95% Confidence Interval (95% CI)

Socio-economic/demographic variables (SED)	Assessment of parental knowledge on the availability of vaccines against pneumonia (modelling for "don't know")																	
	Model 1						**Model 1[a]**						**Model 1[b]**					
	Yes			**No**			**Yes**			**No**			**Yes**			**No**		
	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value	OR	95%CI	P-value
Gender			0.000			0.000												
Male	1.26	0.24-6.50	0.783	0.94	0.11-8.20	0.959												
Female	1.00	reference																
Age in years			0.000			0.001												
< 25	1.04	1.39-2.80	0.940	0.68	0.24-1.92	0.466							1.12	0.31-4.10	0.856	0.40	0.10-1.39	0.144
25 – 30	1.01	0.41-2.46	1.000	0.35	0.12-1.00	0.050							0.77	0.27-2.22	0.627	0.25	0.07-0.83	0.024
>30	1.00	reference																
Region of origin			0.000			0.000			0.000			0.000						
Pool 1	3.41	1.39-8.36	0.007	0.40	0.11-1.47	0.168	3.41	1.39-8.36	0.007	0.40	0.11-1.47	0.168	3.67	1.47-9.20	0.006	0.48	0.13-1.81	0.274
Pool 2	2.05	0.75-5.57	0.160	0.85	0.30-2.40	0.764	2.05	0.75-5.57	0.160	0.85	0.30-2.40	0.764	1.96	0.72-5.36	0.191	0.89	0.31-2.55	0.821
Pool 3	1.24	0.31-5.02	0.766	∞	∞	∞	1.24	0.31-5.02	0.766	∞	∞	∞	1.22	0.30-4.97	0.786	∞	∞	∞
Pool 4	1.00	reference					1.00	reference										
Educational level			0.001			0.000												
Low	1.17	0.43-3.21	0.757	1.41	0.39-5.09	0.603												
Medium	0.76	0.32-1.85	0.566	1,21	0.40-3.61	0.739												
High	1.00	reference		1.00														
Monthly disposal income			0.000			0.000												
1st Tertile	0.92	0.38-2.19	0.842	1.53	0.51-4.55	0.449												
2nd Tertile	0.76	0.32-1.85	0.549	1.24	0.41-3.76	0.703												
3rd Tertile	1.00	reference																
Occupation			0.000			0.000												
Unemployed	0.92	0.43-1.95		0.53														
Student	0.56	0.15-2.16	0.820	0.69	0.21-1.34	0.182												
Employed	1.00	reference	0.401	1.00	0.18-2.71	0.692												
Membership in a social group																		
Yes	1.10	0.54-2.45	0.801	1.32	0.56-3.09	0.522												
No	1.00																	
Religion																		
Christians	1.51	0.32-7.13	0.602	2.02	0.25-16.34	0.512							1.79	0.37-8.77	0.471	1.68	0.20-4.28	0.634
Others	1.00	reference		1.00									1.00			1.00		
Parity			0.000			0.000												
One child	0.92	0.38-2.19	0.842	1.45	0.53-3.96	0.471							0.80	0.26-2.46	0.693	2.33	0.65-8.32	0.192
Two children	1.52	0.62-3.72	0.363	1.20	0.37-3.88	0.761							1.49	0.52-4.26	0.457	2.39	0.60-9.50	0.215
Three or more children	1.00			1.00									1.00			1.00		