REPUBLIC OF TURKEY
HACETTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCE

ROUTINE VACCINATION COVERAGE AND RELATED FACTORS AMONG CHILDREN AGED 12-23 MONTHS IN ONE RURAL AREA OF NANGARHAR PROVINCE-AFGHANISTAN

Dr. Mohammad Ibrahim SHERZAI

Epidemiology program
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Prof. Dr. Bahar GÜÇİZ DOĞAN

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Department	:	**Epidemiology**
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This study has been accepted and approved as a Master of Science thesis in the program of Epidemiology by the Examining Committee, whose members are listed below.

Chairman of the Committee:	**Prof. Dr. Birgül PİYAL** (Ankara University)
Advisor of the Thesis:	**Prof. Dr. Bahar GÜÇİZ DOĞAN** (Hacettepe University)
Member:	**Prof. Dr. Cengizhan AÇIKEL** (Gülhane Military Medical Academy)
Member:	**Porf. Dr. Elif ÖZMERT** (Hacettepe University)
Member:	**Assist. Prof. Dr. Mahmut Sadi YARDIM** (Hacettepe University)

APPROVAL

This thesis has been approved by the committee above in conformity of the regulations and by laws of Hacettepe University Graduate Programs and has been accepted by the Board of Directors of the Institutes of Health Sciences.

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ABSTRACT

Sherzai M I. Routine vaccination coverage and related factors among children aged 12-23 months in one rural area of Nangarhar Province, Afghanistan. Hacettepe University, Institute of Health Science, Epidemiology Program, Master of Science Thesis, Ankara, 2014. Vaccination has been shown to be one of the most cost effective health interventions worldwide, through which a number of childhood diseases have been successfully prevented or eradicated. The objectives of this study were to assess vaccination status of children aged 12-23 months living in a rural area, Kama District-Afghanistan, to identify the factors associated with full vaccination, and common reasons for non-vaccination. In this cross sectional survey the data were gathered via a structured pre-tested questionnaire form. Overall responses from 882 of the participants were analyzed by using IBM SPSS Statistics 21 Program. Findings were presented in marginal and contingency tables. Mainly Chi Square test was used with α=0.05 to find out significance level of differences and then binary logistic regression was used to assess the strength of association, between full-vaccination status and independent factors. Vaccination coverage with vaccination card plus mother's verbal report was higher than card only coverage and highest for OPV1 (92.3%; 59.3%), followed by BCG (90.8%; 59.2%), Penta1 (90.0%; 59.3%), OPV2 (87.9%; 57.4%), Penta2 (85.6%; 57.1%), OPV3 (77.2%; 52.7%), Penta3 (73.1%; 51.8%), and it was lowest for measles vaccine (70.9%; 49.8%). Drop-out rate for major antigens was much higher than the acceptable level. In total (card plus mothers' recall) out of 882 children, 69.7% were fully vaccınated (only card 48.9%; only mothers' recall 20.8%), 23.0%, were partially vaccinated (only card 10.5%; only mothers' recall 12.5%), and 7.3% (from mothers' recall) were non-vaccinated. Child sex, family size, maternal education, paternal education, utilization of maternal health services by mothers and existence of mothers' knowledge on vaccines and vaccination were the common predictors for fully vaccinated status of the children. The most common primary reason for non-vaccination was family problems (25.6%), followed by rumors (16.9%), and fear of side effects (16.6%).

Key Words: Children, Immunization, Mass vaccination, Afghanistan

ÖZET

Sherzai M I. Nangarhar-Afghanistanın bir kırsal alanında 12-23 aylık çocuklarda Rutin Aşı Programı kapsama düzeyi ve ilişkili faktörlerin değerlendirilmesi. Hacettepe Üniversitesi, Sağlık Bilimleri Enstitüsü, Epidemiyoloji Programı, Yüksek Lisans Tezi, Ankara, 2014. Aşılamanın dünyada en maliyet etkin sağlık müdahalelerinden biri olduğu gösterilmiştir aşılama yoluyla bir grup çocukluk çağı hastalığı başarıyla eradike veya önlenebilmiş edilmiştir. Bu araştırmada Afganistan'ın, Kama İlçesi' bir kırsal alanda yaşayan 12-23 ay arası çocukların aşılanma durumunun, ilişkili faktörlerin ve aşılanmama nedenlerinin incelenmesi amaçlanmıştır. Çalışma kesitsel tipte bir araştırmadır. Araştırma verileri yapılandırılmış ve ön testi yapılmış bir anket formu aracılığı ile toplanmıştır. 882 katılımcıdan yazı ile toplanan veriler IBM SPSS Statistics 21 Programı kullanılarak analiz edilmiştir. Bulgular tek ve iki boyutlu tablolar ile sunulmuştur. İlişkilerin değerlendirilmesinde Ki Kare testi (α=0,05), bağımlı ve bağımsız değişkenler arasındaki ilişkinin gücünü değerlendirmek için lojistik regresyon analizi kullanılmıştır. Çocukların aşıları tek tek değerlendirildiğinde aşı kapsayıcılığı, aşı kartı ek olarak annenin sözlü ifadesinden hesaplanan, sadece aşı kartına göre hesaplanandan daha yüksek bulunmuştur ve en yüksek yüzdenin, OPV1 (%92,3; %59,3), sonra BCG (% 90,8; %59,2), Penta1 (%90,0; %59,3), OPV2 (%87,9; %57,4), Penta2 (%85,6; %57,1), OPV3 (%77,2; %52,7), Penta3 (%73,1; %51,8), ve en düşük kızamık aşısında (%70,9; %49,8) olduğu belirlenmiştir. Aşı bırakma hızı (drop-out rate) kabul edilebilir seviyeden daha yüksektir. Toplam 882 çocukta, aşı kartı ek olarak anne %23,0 eksik aşılı (sadece aşı kartı %10,5; sadece annenin ifadesi %12,5) ve %7,3 (annenin ifadesi ile) aşısızdır. Ebeveyn eğitimi, hane halkı sayısının az olması, , annelerin ana sağlığı hizmetlerinden yararlanma ve annenin aşılar ve aşılama ile ilgili bilgi olması, çocukların tam aşılı olma durum ile ilişkili faktörler olarak saptanmıştır. Çocuklaın aşılanmaması ile ilgili sık belirtilen sebeplerden aileve sorunları (%25,6) aşılar ile ilgili söylentiler (%16,9), ve yan etkilerinden korku (%16,6) dur.

Anahtar Kelimeleri: Çocuklar, Bağışıklama, Genişletilmiş aşılama, Afganistan

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LIST OF ABBREVIATIONS

ACIP	Advisory Committee on Immunization Practices
AHS	Afghanistan Health Survey
AMICS	Afghanistan Multiple Indicators Cluster Survey
ANC	Antenatal Care
BCG	Bacille Calmette-Guerin
BHC	Basic Health Center
B&MGF	Bill and Melinda Gates Foundation
BPHS	Basic Package of Health Services
CHC	Comprehensive Health Center
CI	Confidence Interval
CSO	Central Statistics Organization
DH	District Hospital
DTP	Diphtheria, Tetanus, Pertussis
EPI	Expanded Program on Immunization
GAVI	Global Alliance for Vaccines and Immunization
GDP	Gross Domestic Product
GIVS	Global Immunization Vision and Strategy
GPEI	Global Polio Eradication Initiative
GVAP	Global Vaccine Action Plan
HC	Health Center
Hep B	Hepatitis B
Hib	Heamophilus Influenza type B
HMIS	Health Management Information System
Hos	Hospital
IPV	Injectable Polio Vaccine
MCV	Measles Containing Vaccine
MDG	Millennium Development Goals
MMRC	Measles Mortality Reduction Campaign

MNTE	Maternal and Neonatal Tetanus Elimination
MoPH	Ministry of Public Health
NGOs	Non-Governmental Organizations
NIDs	National Immunization Days
NMF	Nangarhar Medical Faculty
No.	Number
OPV	Oral Polio Vaccine
OR	Odds Ratio
OUT	Outreach
PCV	Pneumococcal Conjugate Vaccine
PEMT	Provincial EPI Management Team
Penta	Pentavalent
PHC	Primary Health Care
PNC	Postnatal Care
REMT	Regional EPI Management Team
SD	Standard Deviation
SIAs	Supplementary Immunization Activities
TBA	Traditional Birth Attendant
TT	Tetanus Toxoid
TV	Television
UN	United Nations
UNICEF	United Nations Children's Fund
VPDs	Vaccine Preventable Diseases
WHO	World Health Organization

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1. INTROCUCTION

Vaccines and vaccine preventable diseases are the major concerns of public health. Human being have benefited from vaccines for more than two centuries. The history of vaccines and immunization begins with Edward Jenner, who created the world's first vaccine for smallpox in 1790. The early years of 19th century saw widespread but haphazard use of Jenner's vaccine against smallpox. After successful vaccination campaigns throughout the 19th and the 20th centuries, World Health Organization (WHO) certified the eradication of vaccine preventable disease through immunization (1).

Vaccination has been shown to be one of the most cost effective health interventions worldwide, through which a number of childhood disease have been successfully prevented or eradicated (2). In 1978, the Declaration of Alma-Ata formally adopted primary health care (PHC) by the World Health Organization (WHO) as the means for providing a comprehensive, universal, equitable, and affordable health care services including childhood immunization for all countries (3). The Millennium Declaration signed by 189 countries in September 2000 set out to create an environment which is conducive to development and the elimination of poverty. The goals and targets are interrelated and several have bearing on childhood and maternal health status (4). Goal Four and Five lay specific emphasis on reducing child mortality through child survival interventions and improving maternal health in general which in turn recognizes immunization as key component in reducing vaccine preventable diseases. Failure to reach the Millennium Development Goal Four (MDG 4) for child survival will result in an estimated forty million children's lives lost by 2015 (5).

Despite global progress in providing vaccinations, there still remains a challenge in reaching those most vulnerable: the poorest, most disadvantaged and remote communities. Immunization coverage in low-income countries remains significantly below the levels in middle- and high-income countries (6). Globally, around 54.5 million people die each year. One in eight of these deaths occur in children under five year of

age. Most of these preventable deaths in children occur in low- and middle-income countries (7). WHO estimates that as many as 2.5 million deaths among under-5 children worldwide are averted annually by immunization against diphtheria, tetanus, pertussis, and measles (8) and it has been shown that children who receive all appropriate vaccinations by 9 months of age are less likely to die than those who do not (9). However, one-fifth of the world's children – about 22.4 million infants are not immunized against these fatal diseases. An estimated 1.5 million children died each year from vaccine-preventable diseases (8).

The routine childhood immunization program was launched by the World Health Organization (WHO) in 1974, following the successful program for the eradication of small pox. The program, known as the Expanded Program on Immunization (EPI), consists of regularly scheduled services that reach each new cohort of children less than one year of age with vaccines at health facilities, scheduled outreach sites, or from door to door (in special circumstances) (10). The program consisting of scheduled vaccination visits free of charge for children less than one year of age is operated by the Ministries of Health in respective countries and supported in some cases by international agencies such as WHO, the United Nations Children Fund (UNICEF) and the Global Alliance for Vaccines and Immunizations (GAVI) as well as various other donor agencies. The functions of national EPI are a series of inter-related components, i.e. vaccine supply and quality, surveillance, management, communication and advocacy, logistics and capacity building that aim to improve immunizations coverage and reduce child morbidity and mortality (10).

Improving access to childhood vaccines in low-income countries has been a major goal of public health services both at international and national levels. However, achieving high and equitable coverage remains a challenge in low-income countries (11). Immunization is not the only intervention with inequitable access in Afghanistan, but poor access to it contributes with other social determinants to poor child health in this area (12). A proportion of studies related to the integration of other primary health care services to EPI has been shown that "*this integration of services such as the*

distribution of insecticide-treated bed nets, vitamin A supplementation, and deworming of children, is likely to improve as immunization programs become stronger and better able to facilitate additional interventions besides scheduled vaccines" (13).

Through the EPI vaccinations against six target diseases (measles, polio, diphtheria, tetanus, pertussis and tuberculosis) were adopted in national immunization programs across the world. The program resulted in a significant increase in global vaccination coverage that leveled off during the 1990. In fact, many African and South East Asian countries faced a decline in national vaccination coverage during this period, partly due to reduced funding (14). Since 2000, WHO and UNICEF have made annual estimates of national infant immunization coverage for selected vaccines. A principal use of these estimates is to monitor international goals; for example, measles immunization coverage is an indicator for tracking progress towards the MDG 4, Reduction of Child Mortality (15).

New immunization goals endorsed by WHO and UNICEF were set up in 2005 to increase and sustain at least 90% national vaccination coverage by 2015 (16). Estimated global DTP3 (Diphtheria-Tetanus-Pertussis 3) coverage among infants aged less than 12 months in 2012 was 83%, ranging from 72% in the WHO African Region to 97% in the Western Pacific Region, and representing 110.6 million vaccinated children. Estimated global coverage with Bacille Calmette-Guérin (BCG) vaccine, Polio3, and MCV1 (measles-containing vaccine 1) were 89%, 84%, and 84%, respectively. During 2012, 131 (68%) countries achieved 90% or higher national DTP3 coverage, and 59 (30%) achieved 80% or higher DTP3 coverage in every district. DTP3 coverage was 80%–89% in 34 (18%) countries, 70%–79% in 13 (7%) countries, and less than 70% in 16 (8%) countries. Table 1.1 shows the routine vaccination coverage globally and in six WHO Regions (17).

Table 1.1. Vaccination coverage, by vaccine and WHO Region [a], worldwide, 2012 (17)

WHO Regions	Vaccination coverage (%)							
	BCG	**DPT3**	**Polio3**	**MCV1**	**HepB3**	**Hib3**	**Rota last**	**PCV3**
Total (worldwide)	**89**	**83**	**84**	**84**	**79**	**45**	**11**	**19**
African	82	72	77	73	72	65	5	21
American	96	93	93	94	91	91	69	77
Eastern Mediterranean	88	83	82	83	81	58	14	13
European	93	95	96	94	79	83	2	39
South East - Asian	88	75	74	78	72	11	-	0
Western Pacific	97	97	97	97	91	14	1	1

[a] Weighted regional average.

BCG = Bacille Calmette-Guerin; DTP3 = 3 doses of diphtheria-tetanus-pertussis vaccine; Polio3 = 3 doses of polio vaccine; MCV1 = 1 dose of measles-containing vaccine; HepB3 = 3 doses of hepatitis B vaccine; Hib3 = 3 doses of Haemophilus influenzae type b vaccine; Rota last = last dose of rotavirus series; PCV3 = 3 doses of pneumococcal conjugate vaccine.

EPI services were initiated in 1978 in different parts of Afghanistan, most of which concentrated in the urban areas. The goal of EPI in Afghanistan is to reduce morbidity and mortality due to vaccine preventable diseases among the target population and has objectives as to achieve and sustain 90% coverage of childhood immunization of all antigens among under one year old children and to interrupt poliovirus transmission (18). Vaccine preventable diseases like Measles, Neonatal Tetanus, Diphtheria, Pertussis, Hepatitis B, Polio, Tuberculosis and Hemophilouse influenza type-b are leading contributors to infant and under five years children morbidity and mortality in Afghanistan (18). EPI in Afghanistan covers the above mentioned eight vaccine preventable diseases. Table 1.2 provides an overview of the current EPI schedule in Afghanistan.

Table 1.2. Current EPI Schedule for Afghanistan (18)

Age	**Vaccines**
At Birth (0 – 11 months)	BCG
At Birth (as soon as possible within 14 days of life)	OPV0
At 6th week	DTPHepB-Hib 1, OPV1
At 10th week	DTP-HepB-Hib 2, OPV2
At 14th week	DTP-HepB-Hib 3, OPV3
At 9th month	Measles, OPV4
At 18th month	Measles

Note: DTP-HepB Hib, is a combined vaccine, called penta vaccine (Diphtheria, Tetanus, Pertusis, Hepatitis B and Heamophilus influenza type b)

Afghanistan is in the list of under-developed countries; there is no national survey or study to show the actual full vaccination coverage but it may be as low as in other developing countries. Afghanistan Multiple Indicators Cluster Survey (AMICS[1]) reported that, in 2010-2011 among children aged 12-23 months, full vaccination coverage was 30.0%. Coverage of BCG was 64.2%, polio1 71.4%, polio3 48.0%, measles 55.5%, DTP1 57.5%, and DTP3 coverage which is a key indicator for vaccination services was 40.2% (19). The Afghanistan Health Survey (AHS) which was conducted by MoPH in 2006, indicated routine vaccination coverage among children aged 12 – 23 months for BCG was 70%, DTP1 60%, DTP3 34%, OPV3 70%, Measles 63% and full vaccination coverage was 27% (20).

A country's public health system, including immunization programs, can be easily devastated by armed conflicts. More than thirty years conflict in Afghanistan has affected the quality of all health services, including immunization services. A study that analyzed reports of infant immunization from 331 districts across 7 regions of Afghanistan between 2000 and 2003 indicated a significant negative association between lack of security in the region and achievement of high coverage of vaccination

[1] MICS is an international household survey program developed by UNICEF. The Afghanistan MICS was conducted as part of the fourth global round of MICS surveys (MICS4).

regardless of available resources for immunization, while resource availability showed no relation to vaccination coverage (21).

The government of Afghanistan spends 10% of the real GDP on health service (22). Also, the Ministry of Public Health (MoPH) receives a major fund from international Non-Governmental Organizations (NGOs) for rapidly expanded the delivery of a Basic Package of Health Service (BPHS) aimed primarily on women and children (23). Despite the funding provided by the government and NGOs, Afghanistan has seen 163 outbreaks of measles and 20 outbreaks of pertussis in 2012, and has a high incidence and prevalence rate of tuberculosis (24). Also, Afghanistan is still among the three countries of the world with Nigeria and Pakistan where wild poliovirus remains endemic. Between January 1, 2001, and December 31, 2011, there were 173 cases of serotype-1 poliomyelitis, and 56 cases of serotype-2 poliomyelitis in Afghanistan (25).

The sustained effort of the Global Polio Eradication Initiative (GPEI) to vaccinate children in Afghanistan reduced cases of serotype 1 and 3 poliomyelitis between 2005 and 2007. However, since 2008, the annual incidence of poliomyelitis in Afghanistan and Pakistan has increased (25). The eradication of poliomyelitis in Afghanistan has been complicated by armed conflict, security concerns (e.g. areas being inaccessible to vaccination teams because of security concerns, and the movement of families to escape potential conflict), cultural barriers, and natural disasters that have limited accessibility of vaccination teams to target populations (21 & 25). Moreover, polio eradication in Afghanistan has been affected by weak service delivery (25).

Many studies have shown that the factors related to full vaccination are the presence of maternal or paternal education, good economic status, less number of children within the family, presence of knowledge on immunization, delivery at health facility, presence of post natal visits of mothers, and living in urban area. Also studies have shown that children with younger mothers, children of mothers with no formal education, children whose mothers were unemployed, children of mothers with no health

seeking behavior, and those who lived in rural areas were more likely to be not fully vaccinated (26-33).

1.1. Rationale of the Research

The national EPI policy specifies that each child should receive one dose of BCG at birth; three doses of DPT (at sixth, tenth, and fourteenth weeks); four doses of OPV (at birth, sixth, tenth, and fourteenth weeks); one dose of Measles (at ninth month); and a booster dose of Measles (at eight-tenth month). The most common childhood diseases namely measles, tuberculosis, diphtheria, poliomyelitis, tetanus and whooping cough which were and still are mainly responsible for the child morbidity and mortality in Afghanistan. Due to the introduction of immunization, these major causes of child mortality may be less reported in our health facilities but these are still the major public health problem in Afghanistan.

The efforts towards achieving healthier childhood days are very critical to all stakeholders or health partners. An assessment of the activities of the program is vital in realizing the extent to which the immunization services which are regarded as a child survival intervention are being utilized by the target population in the respective district (Kama). On the other hand, the actual routine vaccination coverage in Afghanistan is unknown because there does not exists a health recording system either a national survey or study to show it. Therefore efforts towards understanding or estimating the routine vaccination coverage are very important and should be made by the ministry of public health (MoPH).

All over the country, the total number of studies to assess the EPI service utilization is small. Research publications have an important role in the scientific process providing a key linkage between knowledge generation, uptake and use (34). In general, health research helps to answer questions, generate the evidence required to guide policy and identify new tools (10). The implementation of strategic immunization plans that the development is informed by available locally-relevant research evidence could improve vaccination coverage and prevent diseases, disability and death in Afghanistan.

Therefore, this study was undertaken to fill this gap by providing insights into vaccination coverage level and factors associated with childhood vaccination in the district (Kama). The researcher has expressed interest in knowing the problems that are associated with underutilization of services and to identify possible key factors for district health directorate to develop strategies for improving service utilization and consequently increase coverage levels.

The study will inform the district health management team, policy makers, funding agencies and other stakeholders on the management tools to employ for future increase in EPI services utilization and to reduce defaulter rates, increase coverage levels and finally reduce the incidence of vaccine preventable diseases in our societies. The research will set the platform for which further studies can be conducted for the purposes of improving EPI service utilization.

1.2.Objectives

It was aimed to study the vaccination status of children (fully, partially, and non-vaccinated) aged between 12-23 months living in one rural area of Afghanistan and to identify the factors associated with vaccination.

General Objective

To assess the EPI services utilization in Kama District-Nangarhar, Afghanistan.

Specific objectives

- To determine full vaccination coverage among children aged 12-23 months
- To determine some related factors with full vaccination
- To determine avoiding factors or barriers against vaccination

Midterm objectives

- To develop some recommendations in order to increase the prevalence of fully vaccinated children in Kama District-Afghanistan.
- To make recommendations for all stake holders and funding agencies how to improve EPI Services utilization by mothers and other concerned people.

Long term objective

- To obtain all children be vaccinated with routine vaccines up to age 12 months, in Afghanistan.

2. GENERAL INFORMATION

2.1. Immunity and Types of Immunity

The defense mechanism of the body or in other word the reaction of the body towards any foreign substance or non-self is called immunity. Immunity is no susceptibility (resistance) to a given disease or a given organism. This immune mechanism reacts with every foreign substance or invader whether it is visible or microscopic (35).

In general, immunity may be non-specific (innate) or specific (acquired). Nonspecific or innate immunity is present in all the living beings irrespective and can be initiated immediately against any invader without any previous contact. On the other hand specific or acquired immunity requires previous knowledge of the antigen, reacts specifically with the corresponding antigen and time is required to mount the attack. Specific immunity may naturally or artificially be acquired. Both type (naturally and artificially) acquired immunity may actively or passively be acquired. Figure.2.1 explains the types of acquired immunity (35).

Specific immunity to a disease is achieved through the presence of antibodies to that disease in a person's system. Antibodies are proteins produced by the body to neutralize or destroy toxins or disease-carrying organisms, and are disease-specific. For example, measles antibody will protect a person who is exposed to measles disease, but will have no effect if he/she is exposed to mumps (36). There are two types of specific immunity (active and passive). Active immunity results when exposure to a disease organism triggers the immune system to produce antibodies to that disease. Exposure to the disease organism can occur through infection with the actual disease (resulting in natural immunity), or introduction of a killed or weakened form of the disease organism through vaccination (vaccine-induced immunity). Either way, if an immune person comes into contact with that disease in the future; his/her immune system will recognize it and immediately produce the antibodies needed to fight it (36).

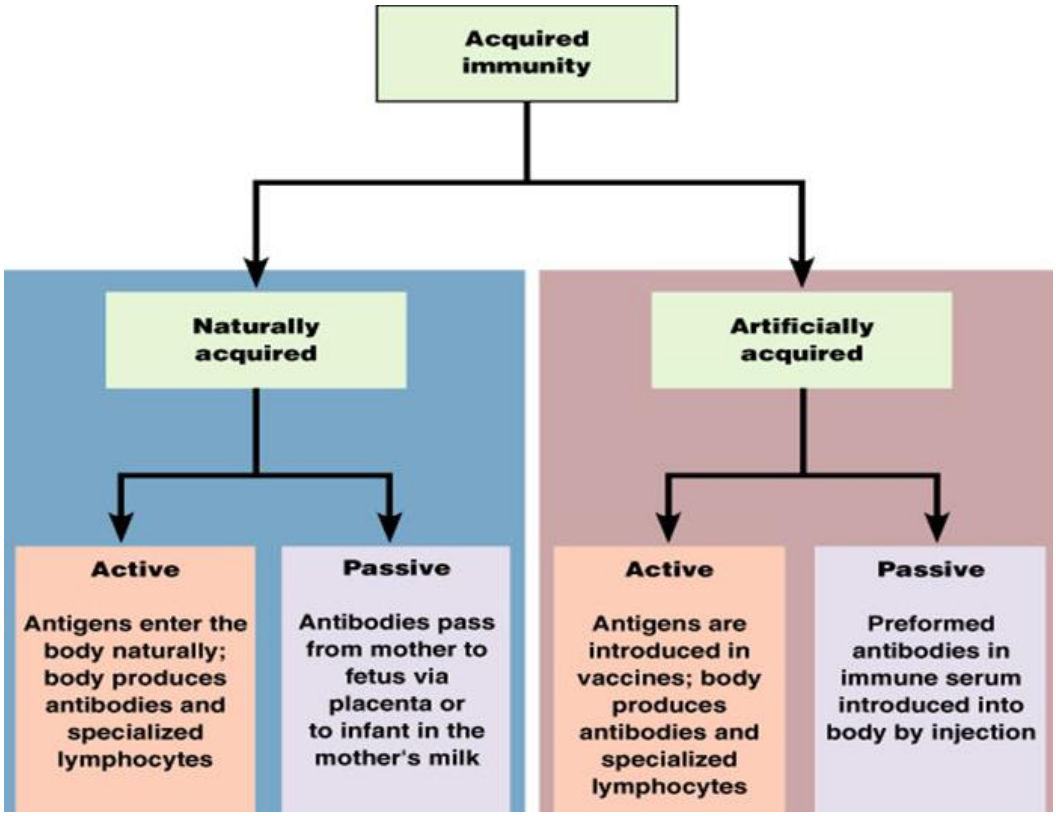

Figure 2.1. Types of Acquired Immunity (37)

Passive immunity is provided when a person is given antibodies to a disease rather than producing them through his/her own immune system. A newborn baby acquires passive immunity from its mother through the placenta. A person can also get passive immunity through antibody-containing blood products such as immune globulin, which may be given when immediate protection from a specific disease is needed. This is the major advantage to passive immunity; protection is immediate, whereas active immunity takes time (usually several weeks) to develop. However, passive immunity lasts only for a few weeks or months. Only active immunity is long-lasting (37). It is highlighted that immunity due to vaccination is an active acquired immunity.

2.2. Vaccine

Vaccine is a biological preparation that improves immunity to a particular disease. A vaccine typically contains an agent that resembles a disease-causing

microorganism, and is often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins. The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and remember it; so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters (36-37).

The word “vaccine” originates from the Latin *Variolae vaccinae* (cowpox), which Edward Jenner demonstrated could prevent smallpox in humans. Today, the term "Vaccine" applies to all biological preparations, produced from living organisms that enhance immunity against disease and either prevent (prophylactic vaccines) or, in some cases, treat disease (therapeutic vaccines). Vaccines are administered in liquid form, either by injection, by oral or by intranasal routes; they are composed of either the entire disease-causing microorganism or some of its components (36-38).

Vaccines and vaccination are at a turning point. Recent advances in microbial genetics and in immunology have greatly increased our understanding of microbial pathogenesis and of host defense mechanisms. As a result, within the last 10-15 years, a whole set of new preventive vaccines become available. These are not only used to prevent infectious diseases, but also for preventing neoplasms such as endocervical cancer. Also therapeutic vaccines are available to treat autoimmune diseases and allergic disorders (38).

2.3. History of Vaccines

The first attempts to prevent disease by using the disease-causing organism against itself are reported from 7th century in India where Buddhist monks drank snake venom in order to develop immunity against snake bites (38). Human being have benefited from vaccines for more than two centuries. The history of vaccines and immunization begins with Edward Jenner, who created the world’s first vaccine for smallpox in 1790. Edward Jenner, a country doctor living in Berkeley, England, took pus from a cowpox lesion on a milkmaid’s hand, and inoculated an eight-year-old boy. Six weeks later, Jenner variolated two sites on the boy’s arm with smallpox, yet the boy

was unaffected by this as well as subsequent exposures. Based on twelve such experiments and sixteen additional case histories he had collected since the 1770s, Jenner published at his own expense a volume that swiftly became a classic text in the annals of medicine: *Inquiry into the Causes and Effects of the Variolae Vaccine*. His assertion "that the cow-pox protects the human constitution from the infection of smallpox" laid the foundation for modern immunology (1).

Initially vaccines were considered a matter of national pride and prestige. They quickly became integral to utilitarian and public health notions of societal security, productivity, and protection. In Europe and North America during the nineteenth century, for instance, smallpox vaccination was made compulsory under state laws. In the twentieth century, as the standard battery of childhood immunizations (including diphtheria, measles, mumps, and rubella) was developed, vaccination was frequently managed or adjudicated by governmental entities (from the municipal to the federal) and eventually was required for public school attendance (38-39). Table.2.3.1 shows a short history of vaccines.

After the founding of the World Health Organization (WHO) and related organizations such as the United Nations Children's Fund (UNICEF), vaccine programs went global. In 1974, for example, the WHO launched the Expanded Program on Immunization (EPI), with the goal of dramatically increasing vaccination rates among children in developing countries. Perhaps the WHO's most spectacular achievement was the smallpox campaign of the 1960s and 1970s. Directed by Donald Henderson; this massive effort culminated in the last naturally occurring case of smallpox in Somalia in 1977 (40).

Table 2.3.1. Historic dates of development for some of the vaccines (39)

Vaccine-preventable disease	Type of vaccine	Year vaccine developed
Smallpox	live attenuated	1798
Rabies	inactivated	1885
	inactivated (cell culture)	1976
Pertussis	inactivated	1914
	purified protein	1981
Tuberculosis	live attenuated	1921
Diphtheria	toxoid	1923
Tetanus	toxoid	1926
Yellow fever	live attenuated	1932
Mumps	inactivated	1948
	live attenuated	1967
Polio	inactivated	1955
	live attenuated	1962
Measles	live attenuated	1963
Rubella	live attenuated	1969
Meningococcal	polysaccharide	1971
	protein conjugate	1999
Hepatitis B	plasma derived	1981
	recombinant protein	1986
Pneumococcal	23-valent polysaccharide	1983
	protein conjugate	2000
Heamophilus influenzae type b	polysaccharide	1985
	protein conjugate	1987
Hepatitis A	inactivated	1995
Rotavirus	live attenuated	2006
Human Papillomavirus	recombinant protein	2006

2.4. Types of Vaccines

Scientists take many approaches to designing vaccines against a microbe. These choices are typically based on fundamental information about the microbe, such as how

it infects cells and how the immune system responds to it as well as practical considerations, such as regions of the world where the vaccine would be used. The following are some of the options that researchers might pursue (35-41).

2.4.1. Live, Attenuated Vaccines

Live, attenuated vaccines contain a version of the living microbe that has been weakened in the laboratory so it can not cause disease. Because a live, attenuated vaccine is the closest thing to a natural infection, these vaccines are good "teachers" of the immune system: They elicit strong cellular and antibody responses and often confer lifelong immunity with only one or two doses (35-41). Live, attenuated vaccines usually need to be refrigerated to stay potent. If the vaccine needs to be shipped overseas and stored by healthcare workers in developing countries that lack widespread refrigeration, a live vaccine may not be the best choice. BCG and measles vaccines are the examples of live attenuated vaccines.

2.4.2. Inactivated Vaccines

Scientists produce inactivated vaccines by killing the disease-causing microbe with chemicals, heat, or radiation. Such vaccines are more stable and safer than live vaccines: The dead microbes cannot mutate back to their disease-causing state. Inactivated vaccines usually do not require refrigeration, and they can be easily stored and transported in a freeze-dried form, which makes them accessible to people in developing countries (35-39, 41-42). Polio and pertussis vaccines are the examples of inactivated or killed vaccines.

2.4.3. Toxoid Vaccines

For bacteria that secrete toxins or harmful chemicals, a toxoid vaccine might be the answer. These vaccines are used when a bacterial toxin is the main cause of illness. Scientists have found that they can inactivate toxins by treating them with formalin, a solution of formaldehyde and sterilized water. Such "detoxified" toxins called toxoids,

and are safe for use in vaccines. The immune system produces antibodies that lock onto and block the toxin. Vaccines against diphtheria and tetanus are examples of toxoid vaccines (35-39, 41-42).

2.4.4. Subunit / Conjugate Vaccines

Instead of the entire microbe, subunit vaccines include only the antigens that best stimulate the immune system. In some cases, these vaccines use epitopes—the very specific parts of the antigen that antibodies or T cells recognize and bind to. Because subunit vaccines contain only the essential antigens and not all the other molecules that make up the microbe, the chances of adverse reactions to the vaccine are lower. Conjugate vaccines are special type of subunit vaccine (35-39, 41-42). Hepatitis B and Haemophilus influenza type b are the examples of subunit or conjugate vaccines.

2.4.5. Recombinant DNA Vaccines

Once the genes from a microbe have been analyzed, scientists could attempt to create a DNA vaccine against it. When the genes for a microbe's antigens are introduced into the body, some cells will take up that DNA. The DNA then instructs those cells to make the antigen molecules. The cells secrete the antigens and display them on their surfaces. In other words, the body's own cells become vaccine-making factories, creating the antigens necessary to stimulate the immune system (35-39, 41-42). Hepatitis B vaccine is the example of recombinant DNA vaccines. Table 2.4.1 highlights the types and examples of vaccines shortly.

Table 2.4.1. Types and examples of vaccines (41)

Vaccine type	
Live, attenuated	BCG, Measles, Mumps, Rubella (MMR combined vaccine), Varicella (chickenpox), Influenza (nasal spray), Rotavirus
Inactivated/Killed	Polio (IPV), Typhoid, Cholera, Pertussis, Plague, Rabies, Intra-muscular influenza, Japanese encephalitis
Toxoid (inactivated toxin)	Diphtheria, tetanus (part of DTP combined immunization)
Subunit/conjugate	Hepatitis B polypeptide, Influenza (injection), *Haemophilus influenza* type b (Hib), Pneumococcal polysaccharide, Meningococcal polysaccharide
Recombinant DNA	Hepatitis B

2.5. Benefits of Vaccination

Vaccines are among the most effective tools available for preventing infectious diseases and their complications and squeals. High immunization coverage has resulted in drastic declines in vaccine-preventable diseases, particularly in many high- and middle-income countries. A reduction in the incidence of a vaccine-preventable disease often leads to the public perception that the severity of the disease and susceptibility to it has decreased. At the same time, public concern about real or perceived adverse events associated with vaccines has increased. This heightened level of concern often results in an increase in the number of people refusing vaccines. (43)

The international community has successfully promoted childhood vaccination as an essential public health intervention. This has been accomplished through efforts such as the WHO Expanded Program on Immunization and more recently, the establishment of the Global Alliance for Vaccines and Immunization (GAVI Alliance), a global health partnership committed to ensuring access to low-cost immunization in developing countries. While such global efforts have resulted in large increases in

vaccine coverage worldwide, there is still a large population that remains uncovered. Inadequate immunization coverage is apparent among middle-income countries. As middle-income countries do not receive support from the GAVI Alliance, lack of funds may account for low coverage, and vaccine delivery in these settings may suffer from inefficiencies that have been resolved in high-income countries. (44) Table.2.5.1 shows the impact of vaccines in the United State.

Table 2.5.1. Impact of vaccines in the United States (41)

Disease	Baseline 20th Century Pre-Vaccine Annual Cases	2009 Cases	Percent Decrease
Measles	503,282	71	99.9%
Diphtheria	175,885	0	100%
Mumps	152,209	1,991	98.7%
Pertussis	147,271	13,214	91.0%
Smallpox	48,164	0	100%
Rubella	47,745	3	99.9%
Haemophilus influenzae type b, invasive	20,000	35	99.8%
Polio	16,316	0*	100%
Tetanus	1,314	18	98.6%

2.6. The Expanded Program on Immunization (EPI)

In 1974, the WHO launched the Expanded Program on Immunization, to provide routine vaccinations against tuberculosis, polio, diphtheria, tetanus, pertussis and measles to all children. At that time, less than 5% of children worldwide were vaccinated against these diseases, but today, 83% of the world's children under-one year of age have received these life-saving vaccinations. Increasing numbers of countries, including low-income countries, are adding new and under-used vaccines, like hepatitis B, haemophilus influenzae type b (Hib) and yellow fever vaccine to their routine infant immunization schedules (45).

UNICEF works with governments and other partners including the World Health Organization, the World Bank, The Bill and Melinda Gates Foundation (B&MGF), the vaccine industry, civil society groups, and research and technical health institutes to make full immunization a part of every child's life. Priority is given to about 40 nations where routine vaccination coverage is lowest, and to the districts within those countries where children are least protected. These priority nations range from Indonesia and Sudan to India and Afghanistan (46). In these countries, UNICEF helps local health managers to improve the planning and supervision of immunization activities and ensure a regular supply of vaccines, supports training for health workers and works with local leaders and media to educate communities and promote immunization. Special efforts are made to continue routine immunization in regions with poor health infrastructure, inaccessibility or conflict (46).

2.6.1. Afghanistan's EPI Services

EPI services were initiated in 1978 in different parts of the Afghanistan; the goal of EPI in Afghanistan is to reduce morbidity and mortality due to vaccine preventable diseases. National EPI in Afghanistan covers eight vaccine preventable diseases (18) (Table 1.2).

EPI services in Afghanistan delivered by the Ministry of Public Health (MoPH), with the support of WHO, UNICEF and other NGOs. Afghanistan health system (Basic Package of Health Services) is implemented by different international and national NGOs in the different parts of the country. The MoPH is the main implementing agency of EPI services in Afghanistan. Through EPI, the Provincial EPI Management Teams (PEMTs) and the Regional EPI Management Teams (REMTs) have a capacity to store and manage vaccines and cold chain supplies as well as report on performance and outcomes. Simultaneously, through UNICEF and WHO regular programs, routine EPI are being supported and will take the place of campaigns. Though MoPH is currently unable to assume financial responsibility particularly at the provincial and district levels.

Therefore, external funding through major partners might be needed over the next 2-3 years as accountability mechanisms and management capacity are put in place (18).

Main responsibilities of the Afghanistan MoPH are: approval and issue policy/strategies, guidelines, setting priorities, providing human resources; training, monitoring, supervision and evaluation, provision of centers/places, security, and salary for national staff; leadership, coordination, communication and ensuring quality of immunization services; and MoPH implements program in areas not covered by Basic Package of Health Service (18).

Main responsibilities of the BPHS implementing NGOs are: program implementation under the leadership of REMT and PEMT; provision of technical/financial support; contribution in supervision, monitoring and evaluation. The responsibility for program implementation includes service delivery in the whole district and maintenance of cold chain with support from PEMT. The NGOs will work under the policy and guidance of MoPH and will strictly follow the rules and regulations of the government (18).

- BPHS Implementer provide monthly salary or incentive at least 6000 Af/Month.
- BPHS Implementer provide 200 Af for normal outreach and 500 Af for Mobile (stay night) activities.
- BPHS Implementer provides one EPI supervisor for 12-15 EPI fixed centers in respective area.
- BPHS Implementer covers all contracted district through fixed, outreach and Mobile activities (18).

The Donors responsibilities are fund provision and program audit, and the United Nations (UN) responsibilities are provision of technical support, capacity building, assisting MoPH in procurement of EPI equipment, spare parts, and supplies, logistics, and operational support (18).

Routine EPI Services (at all levels) are free and delivered only through the public sector as follows: fixed (at the health center), out-reach, mobile; areas which are not covered on daily outreach and need additional time for travel), Supplementary Immunization activities (SIAs); such as National Immunization days (NIDs), Measles Mortality Reduction Campaign (MMRC), and Maternal and Neonatal Tetanus Elimination (MNTE).

The EPI services provide by vaccinators. However other health workers in the health facility are trained and provide EPI services delivery as back up during vaccinators absence from the facility (18).

2.6.2. Structure of Afghanistan's EPI

Table 2.6.1. National EPI Structure in Afghanistan (18)

1 National EPI Office	National EPI Manager, Communication Officer, Training Officer, Monitoring and Evaluation Officer, Surveillance Officer, Admin /Finance Clerk, and two Drivers.
1 National Cold Room	National Cold Room Officer, four Cold Chain Technicians, two Guards, and one Driver.
5 Regional EPI Management Team (REMT)	Regional EPI Manager, two Supervisors, three Cold Chain Technicians, two Guards, and one Driver.
23 Provincial EPI Management Team (PEMT)	Provincial EPI Manager, one Supervisor, two Cold Chain Technicians, one Guard, and one Driver.

Afghanistan's EPI is structured from; National EPI Office, National Cold Room, Regional EPI Management Team (REMT), and Provincial EPI Management Team (PEMT). Supervision and management of EPI service delivery is provided by five REMT and 23 PEMT, each consisting of a mid-level EPI Manager, EPI Supervisor, and Cold Chain Manager. The REMT has an additional Assistant Manager, Supervisor and Cold Chain Technician as well as support staff. An important stabilizing factor in

Afghanistan EPI services has been the incentives provided by UNICEF to the REMT / PEMT staff and through them to the other EPI health workers (18).

2.7. Cold Chain System

Since most vaccines are sensitive to heat, an adequate cold-chain system often has to be created and maintained to preserve the quality of a vaccine before it is administered. Although emphasis has long been placed on avoiding high temperatures during vaccine storage and shipment, exposure to "subzero" temperatures (i.e. temperatures < 0 °C) can also damage and reduce the potency of the diphtheria, tetanus and pertussis (DPT), diphtheria and tetanus, tetanus toxoid, hepatitis B and pentavalent vaccines (47). WHO recommends (48) that all childhood vaccines except the oral polio vaccine should kept at 2–8 °C during their in-country distribution (at fixed center and outreach and mobile activities). It is difficult to keep vaccines cool in countries where the mean daytime temperature exceeds 30 °C, electricity is unavailable in rural areas and the cold chain infrastructure is inadequate (48-49). The challenge is all the more acute during mass vaccination campaigns, when a wide-reaching cold chain and logistics (CCL) system is necessary if the target population is to receive a vaccine that has not lost potency because of exposure to excessively high or low temperatures (50).

Based on the EPI logistic review done in 2002 the cold chain system in Afghanistan will have to be rebuilt, renovated, expanded, and sustained to address existing and future needs (18). All vaccines should preserved at national, regional and provincial level, according to the manufacturer guidelines. Now the computerized stock management system maintaine for vaccine and non-vaccine supply at national level. In Afghanistan, WHO and UNICEF supply vaccines to National EPI Program and the NGO responsible for BPHS implementation, provides the cold chain equipments (refrigerators powered by electericity, gas, kerosene or sollar depending on the available energy sources) in planning according to capacity required standard at each level, and manages (utilize and maintain) cold chain equipment based on their functionality, to ensure standard storage and transport of vaccines (18).

3. METHOD AND MATERIALS

3.1. Type of the Study

The study type was a cross sectional descriptive survey.

3.2. Profile of the Study Area

The study was carried out in one rural area (Kama District) of Nangarhar Province-Afghanistan in April 2014.

Afghanistan is a landlocked country located in southwestern Asia bounded; on the north by Turkmenistan, Uzbekistan, and Tajikistan; on the east by China and the part of the disputed territory of Jammu and Kashmir controlled by Pakistan; on the south by Pakistan; and on the west by Iran. Kabul is the capital and the largest city of Afghanistan. Afghanistan's area with square kilometer is 652,864, and high mountains cover much of the country. Figure 3.1 shows Afghanistan and it's neighbour countries.

The last official census in Afghanistan was conducted in 1979, when the population registered at 15,551,358. The total population of Afghanistan was estimated around 27 million at the year 2012. In total 51% of the population are males and 49% are females (figure 3.2). 72% people (19.4 million) live in rural areas, 22.5% people (6.1 million) live in urban areas, and in addition 5.5% people (1.5 million) live as Nomads. Afghan population has a very young structure and under 5 year population consists 20% of all population (51).

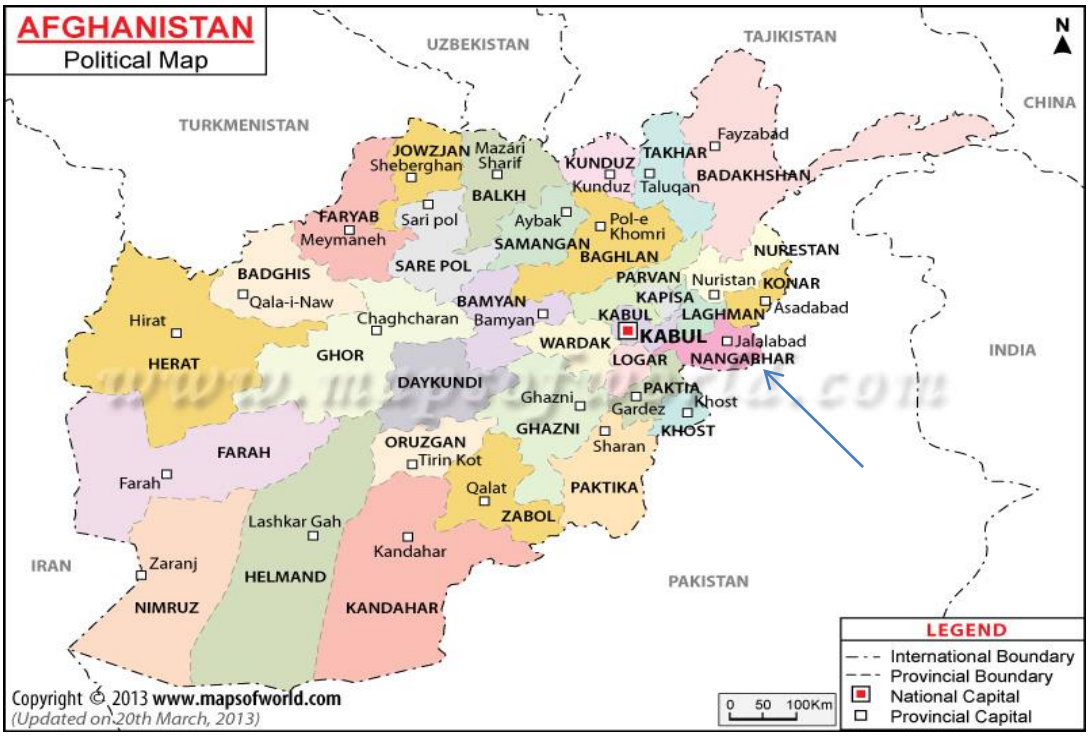

Figure 3.1. Map of Afghanistan and it's neighbor countries (51)

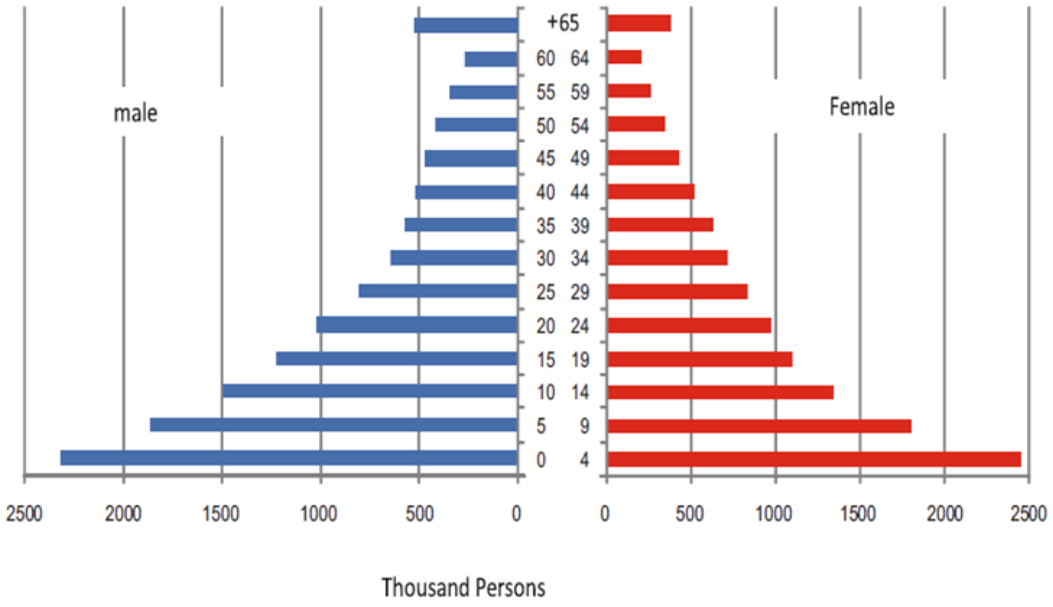

Figure 3.2. Settled population by sex and age groups, Afghanistan 2012-2013 (51)

Nangarhar Province is located in the eastern region of Afghanistan. Its area with square kilometer is 7,641.1, estimated total population is 1,775,401 and under 5 year population is 363,602. Nangarhar Province has 21 rural areas (districts). Jalalabad is the capital city of this province. Ethnic groups living in Nangarhar are Pashtun (90.1%), Pashai (3.6%), Arab (2.6%), Tajik (1.6%) and others (2.1%). Major occupations of the people are agriculture, animal husbandry, day labor, forestry, and nurseries. Overall literacy rate is 29% with a female, male ratio 1:3, little or no access to electricity outside of the Jalalabad (52).

As it is known the security situation is not good in all Afghanistan, especially in the southern and eastern parts of the country. Nangarhar is among one of the non-secure provinces of the country. Hence, going to each district of this province was very difficult. Therefore only four districts namely Behsud, Kuz Kunar, Kama and Dari Noor, which are more secure than other districts, were selected. For study purposes among these four districts, only one (Kama District) was selected randomly.

Kama District is located in the eastern part of Nangarhar province. It is about 20 kilometers far from the provincial central city (Jalalabad). Its estimated total population is 73,500, under 5 year population is 14,700, and the estimated number of children aged 12-23 months is 2,940 (24). Active health facilities in Kama District are: one Kama District Hospital (DH), with 2 female vaccinators working at hospital, not in the community; one Comprehensive Health Center (CHC) with 2 male vaccinators, working at the health center and in the community; one Basic Health Center (BHC) with 2 male vaccinators, working at the health center and in the community; one Sub Health Center (SHC) with no vaccinators and vaccination services (24).

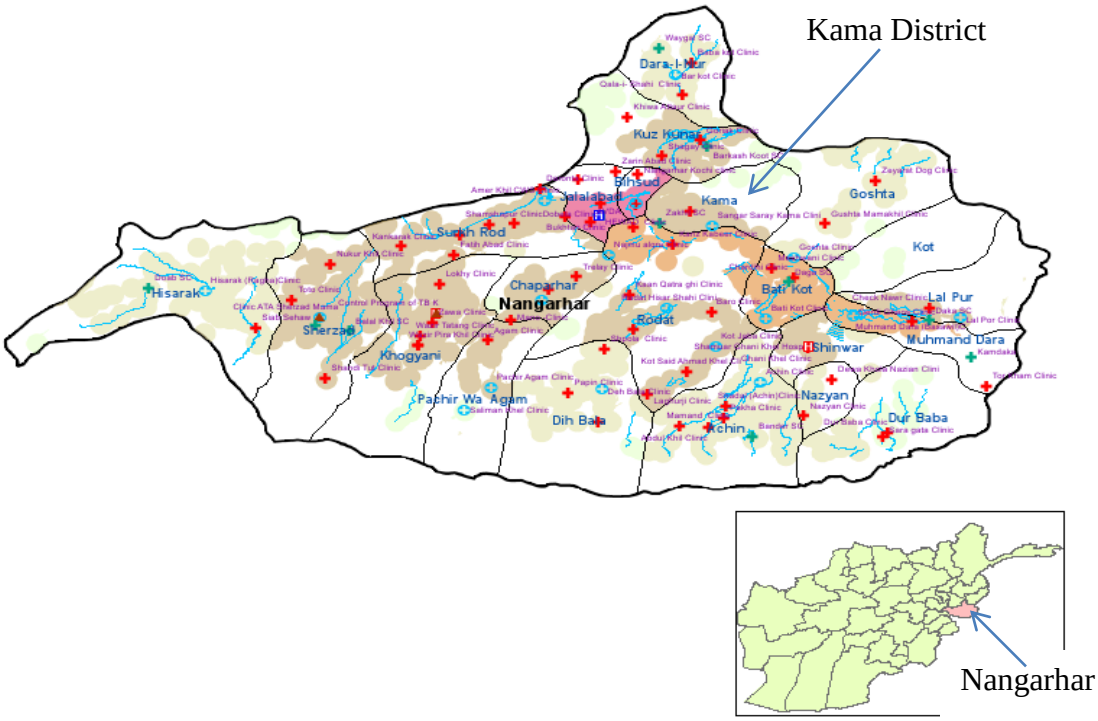

Figure 3.3. Map of Nangarhar Province-Afghanistan, 2012-2013 (52)

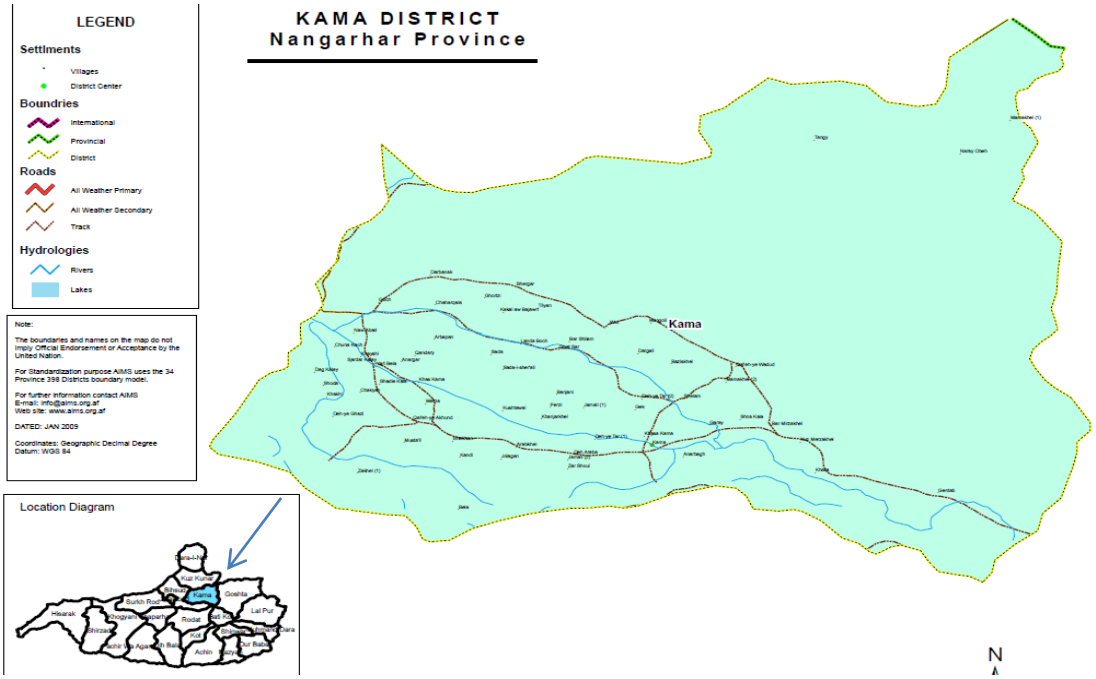

Figure 3.4. Map of Kama District, Nangarhar-Afghanistan (52)

3.3. Study Population and Sampling Frame

The study population included all mothers whose children are 12-23 months old within the catchment area of Kama District Health Directorate. Immunization services in the district level are delivered by a Basic Health Center (BHC) and a Comprehensive Health Center (CHC). Therefore the sampling frame comprised all thirty-five villages within the catchment area of Landabooch BHC and Sangarsary CHC.

3.4. Sample Size Estimation

The sample size was estimated using the following assumptions;

- Anticipated level of vaccination coverage: 50 percent
- Level of statistical confidence of the estimate (confidence interval): 95 percent
- Desired precision of the estimate is ±5 percent
- Magnitude of differences of coverage among and within the clusters: 2

With reference to these assumptions, the sample size was calculated using the formula:

$$\mathrm{n} = \frac{Z^2{}_{(1-\alpha/2)}\,\mathrm{P}(1-\mathrm{P})}{d^2} * \mathrm{DE}$$

Where:

n= minimum number of children sampled

Z= the desired confidence level (α)

P= expected coverage

d= the desired width of the confidence interval

DE= design effect, the ratio between the variance from the cluster design to the variance that would be obtained from a simple random sampling.

Assuming a design effect of 2, confidence level of 95 percent (for α= 0.05, Z=1.96), expected coverage (P) of 50 percent (0.5) and a desired width of the confidence interval of ±5 percent (d= 0.05), the minimum sample size was calculated as follows:

$$n = \frac{(1.96)^2_{(1-\alpha/2)}\, 0.5(1-0.5)}{(0.05)^2} * 2$$

$$n = \frac{0.9604}{0.0025} * 2$$

n= 768.32 ≈ 769 respondents

To increase the study power and cover the probable non-response rate, 15% increase in the minimum required sample size was calculated to be:

0.15 x 769 = 115.35 ≈ 116 children

Therefore the calculated number of children to be selected was 769+116 =885 mothers of children aged 12-23 months.

3.5. Sampling Strategy

Simple-one stage cluster sampling method was used for sample selection. For the purpose of sample selection, names of all thirty-five villages in Kama District were listed as clusters. Since there was no information about each village, it was assumed that, in Kama District the characteristics of the general population, socio- economic conditions, geographical conditions, health services facilities and population size are similar among all 35 villages. According to that assumption, the estimated number of eligible children in each cluster was calculated 84 (estimated number of children aged 12-23 months, divided by total number of villages, 2940/35=84).

According to the Afghanistan new health system (BPHS: Basic Package of Health Service) population to be covered by BHC is 15,000-30,000 and population to be covered by CHC is 30,000-60,000 (28). It means that the BHC and CHC population

coverage ratio is 1:2. Hence, out of 35 villages, four from the catchment area of Landabooch BHC, and eight from the catchment area of Sangarsary CHC were selected randomly (Table 3.5.1) and all children aged 12 – 23 months in the selected villages were covered in the study. In the selected 12 villages, all households were visited to find-out the eligible child/children into them.

Table 3.5.1. List of the randomly sampled villages (Kama District-Afghanistan, 2014)

Sampled village	Children incluled in the study					
	Male		Female		Total	
	n	%	n	%	n	%*
Peerzu	32	55.2	26	44.2	58	6.6
Merzakhil	36	52.9	32	47.1	68	7.7
Gaheek	33	54.1	28	45.9	61	6.9
Jamaly	39	53.4	34	46.6	73	8.2
Watapoor	35	50.0	35	50.0	70	7.9
Akhunqala	39	48.1	42	51.9	81	9.2
Sangarsaray	45	51.7	42	48.3	87	9.8
Mastaly	55	55.6	44	44.4	99	11.2
Shirgar	43	58.1	31	41.9	74	8.4
Sadaha	41	56.9	31	43.1	72	8.1
Zakhil	39	52.7	35	47.3	74	8.4
Landabooch	37	54.4	31	45.6	68	7.7
Total	474	53.6	411	46.4	885	100.0

* Collumn percentages; other are row percentages

3.5.1. Including and Excluding Critiria

Children aged between 12-23 months, have been living in the selected district at least for 2 years, and their mothers/ caregivers accept to participate were included in the study. Children younger than 12 months or older than 23 months, do not live or have been living for less than two years in the selected district area, and mothers/ caregivers do not accept to participate were excluded from the study.

In total 1,002 households were visited in the selected 12 villages to find-out 885 eligible children. Out of 1,002 households, in 26 households mothers did not accept to give interview; in 21 households mother was absent on the spot and she was un-likely to

return during the interviewers stay in the area; in 51 households the eligible child (aged 12-23 months) could not to be found; and 18 of the households were new migrated to the area (have been lived for less than tow years). As it was aimed, all interviews were done with children's mothers but in three cases, caregivers were interviewed because of the death of children's own mothers. These three cases were excluded for analysis purposes. As a result, responses from 882 of the participants were analyzed for this study. In general, respondents' participation in terms of giving responses to the questions and their readiness to make available vital documents like vaccination cards (where available) and recall history of child's vaccination (where cards not available) to the interviewers were highly acceptable and trustable.

3.6. Study Variables

3.6.1. Dependent Variables

Coverage Rate of Routine Childhood Vaccines (prevalance of Fully, Partially and Non-vaccinated children)

Reasons for non-vaccination: (Lack of information, Obstacles and, Lack of motivation)

3.6.2. Independent Variables

Socio-Demographic Characteristics of the Children: age, sex, number of the household members, and fathers' educational status.

Socio-Demographic Characteristics of the Children's Mothers: age, age at first marriage, number of parity, number of living children, working status, economic status, and educational status.

Utilization of Maternal Health Services by Mothers: antenatal care utilization, place of delivery, post natal care utilization, and receiving of tetanus toxoid vaccines.

Knowledge of Mothers on Vaccines and Vaccination: hearing the term ″Vaccine″, opinion on importance of vaccination, names of vaccines known by her, knowledge about childhood vaccination timing, source of information on vaccines, and opinion on immunization services in the area.

3.7. Terms and Criterias

The following operational definitions were used:

- **Fully vaccinated**: A child between 12-23 months old who received one BCG, at least three doses of Pentavalent (DTP-Hep B-Hib), three doses of OPV(OPV1-OPV3) and one dose of Measles vaccine.
- **Partially vaccinated**: A child who missed at least one dose of the above mentioned vaccines.
- **Non-vaccinated**: A child who does not receive any dose of the eight vaccines.
- **Coverage by card only**: Coverage calculated with numerator based only on documented doses, obtained from the vaccination card.
- **Coverage by card plus history**: Coverage calculated with numerator based on vaccination card and mothers' verbal report.
- **Drop-out rate:** Percentage difference in coverage between BCG and measles, and also between Penta1 and Penta3 (only card or card + mothers' recall).
- **ANC visits:** Mothers' visit with medical staff (doctor, midwife or nurse) during antenatal period. MoPH recommends a minimum of four antenatal visits based on a review of the effectiveness of different models of antenatal care.
- **PNC visits:** Mothers' visit with medical staff (doctor, midwife or nurse) during postnatal period. MoPH recommends a minimum of two postnatal visits.

Reasons for non-vaccination cllasified as:

- **Obstacles:** Family problem (including illness of mother, absence of mother during out-reach, restriction of mothers on going to outdoor), mother too busy, place of vaccination too far, child ill- not brought for vaccination, child ill- brought but not given vaccination and vaccinator absent.
- **Lack of information:** Unaware of need to return for 2nd or 3rd dose, unaware of need for vaccination, and fear of side reactions.
- **Lack of motivation:** No faith in vaccination, and rumors.

3.8. Data Collection Tool and Pre-testing

The data were gathered via a structured, pre-tested questionnaire form (Annex 1). The questionnaire form was fulfilled by the interviewers; it was translated from English to the national language Pashto, and administered in native language. Questionnaire form consisted of open-ended and pre-classified questions to obtain the key variables of the study that revealed the background information e.g. demographic characteristics of the child (age, sex and relation with inerviewee); socio-demographic characteristics of the mothers (MS1-MS13); utilization of maternal health services by mothers (MU1-MU8); questions telated to the caregiver (CG1-CG11); knowledge on vaccines and vaccination (MC1-MC7); and vaccination history of the child (V1-V11). (Look Annex 1)

The questionnaire was pre-tested at one village of Bihsud District, to identify potential problem areas. Pre-testing of the data collection procedure, was carried out on thirty mothers for one day by the researcher and three trained assistance (nurses). During pre-testing non of the questions found to be unclear and need modification.

3.9. Data Collection Procedure

Data was collected by the researcher himself with the support of trained- nurses. Three research assistants, two female and one male nurses, were recruited and trained by

the researcher in order to standardize data collection procedures. The following areas were covered under a three-days training; questionnaire fulfilment skills, interviewing skills, community entry skills and criteria for the selection of eligible children.

Firgure 3.5. Pictures from field during data collection (Kama District-Afhanistan, 2014)

In the selected clusters, two teams of interviewers (each team consisted of one male and one female interviewer) collected data from the mothers/caregivers of eligible children, by visiting every household. If on the spot the mother or caregiver could not to be found at the household, but she was likely to return during the interviewers stay in the area, the household was revisited once again.

3.10. Data Analaysis

Data was analyzed by using IBM SPSS Statistics 21. Data entry, cleaning, processing, preliminary analysis and final report writing was done by the researcher. Findings were presented in marginal and contingency tables. Cross tabulations of quantitative data were done in relation to the study objectives to find out associations or relationships amongst them. Summary of the various results were then tabulated. Binary logistic regression analyssi was used to assess the strength of association between dependent and independent variables. At bivariate analysis, all independent variables with a p-value less than 0.20 were included in the model. Odds ratio (OR) and 95%

confidence interval (CI) were calculated. A p- value <0.05 was considered as statistically significant (backward elimination method).

3.11. Ethical Issues

Ethical clearance for this research was obtained from the Research Committee of Nangarhar Medical Faculty (NMF) and also from the Regional Public Health Administration of Afghanistan (Annex 2). Circulars were sent to the Kama' District Hospital Directorate and related health centers (Sangarsary CHC and Landabooch BHC). Verbal consents were obtained from the chiefs of the communities as well as individuals involved in the research. (Meeting no 01, Decision no 08, 26/ 03/ 2014)

3.12. Assumptions

- It was assumed that all the respondents would understand and answer the questions correctly on the questionnaire.
- The sample size chosen makes the study obey the central limit theorem because the sample size was large to merit it.
- Further, it was assumed that all clusters were similar to one another.

3.13. Limitations of the Study

1. Some of the selected clusters were not similar to one another, therefore there could be a reflection of the variability across the total population, that is, inter-cluster heterogeneity, it might be that the variance for the cluster survey may be higher than required.

2. There could be biases emanating from absented children's mothers and from non-respondent mothers (mothers who were rejected to participate). Also, because of the difficulty in travelling long distances to reach respondents who were not present for interview at the first visit, the household was not revisited in another day which could have effect on the results.

3. The immunization services and vaccination status of children in other districts of the province may be very different than the selected district. As it was mentioned before, due to security problems, going to each district of Nangarhar province was very difficult, therefore out of twenty-one districts only four were more secure than other districts for conducting study and one of these four districts (Kama District) was selected randomly for study purposes. These four districts are quite different than others; these are much close to the central provincial city (Jalalabad). Living conditions in these districts are as much as same to the city and in each aspect (security, presence of the active health facilities, education, economic, etc.) these districts are more developed than other districts.

4. We were only able to assess the associations with vaccination coverage and could not examine the association with health outcomes such as vaccine preventable diseases or hospitalizations due to limited resources.

5. Household's distance form the health facilities was not asked. For analysis purpose the sampled villages were divided into two groups as villages within and outside the health center's area.

6. Finally, the percentage of vaccinated children could be overestimated as only surviving children included in the study and unvaccinated children who had died, have missed.

4. FINDINGS

In this cross sectional study which was performed to find out full vaccination coverage level and its related factors, the data gathered from eight hundred and eighty-two children was analyzed.

4.1. Demographic Characteristics of the Children

Table 4.1.1. Distribution of the children by age and sex (Kama District-Afghanistan, 2014)

Age (months)	Sex					
	Male		Female		Total	
	n	%	n	%	n	%
12	33	7.0	17	4.2	50	5.7
13	58	12.3	42	10.3	100	11.3
14	47	9.9	41	10.0	88	10.0
15	38	8.0	32	7.8	70	7.9
16	34	7.2	39	9.5	73	8.3
17	54	11.4	38	9.3	92	10.4
18	66	14.0	74	18.1	140	15.9
19	43	9.1	42	10.3	85	9.6
20	33	7.0	31	7.6	64	7.3
21	28	5.9	20	4.9	48	5.4
22	26	5.5	22	5.4	48	5.4
23	13	2.7	11	2.7	24	2.7
Total*	473	53.6	409	46.4	882	100.0

* Row percentages; others are column percentages.

The total number of male children in the study group was 473 which constitute 53.6% and the total number of female children was 409 which constitute 46.4%. One third of the children fell within the age interval 18-20 months (32.8 %) with the least at age interval 21-23 months (13.5 %). (Table 4.1.1)

Table 4.1.2. Descriptive statistics of the age of children (months) by their sex (Kama District-Afghanistan, 2014)

Statistics	Male (n=473)	Female (n=409)	Total (n=882)	p-value
Mean ± SD	16.8 ± 3.1	17.1 ± 2.9	16.9 ± 3.0	
Median	17	17	17	
1st Quartile	14	15	14	**0.252**
3rd Quartile	19	19	19	
Min-Max	12-23	12-23	12-23	

The mean age of the male children in the study group was 16.8 ± 3.1 months, and of female children was 17.1 ± 2.9 months. No statistically significant difference was observed between the age of male and female children (p=0.252). (Table 4.1.2)

Table 4.1.3. Distribution of the children by the number of household members (Kama District-Afghanistan, 2014)

Number of household members (family size) (n=882)	n	%
≤6	103	11.7
7-9	248	28.1
10-12	273	31.0
13-15	175	19.8
≥16	83	9.4
Total	882	100.0
Mean ± SD =10.7 ± 3.5; Median=11; 1st Quartile=8; 3rd Quartile=13; Min-Max=3-24		

The number of household members ranged from 3 to 24. Average number was 10.7 ± 3.5. Almost in one-third of the households (29.2%) there were thirteen or more than thirteen persons lived. (Table 4.1.3)

4.2. Socio-Demographic Characteristics of the Mothers

Socio-demographic characteristics of the mothers have been shown in Tables 4.2.1-4.2.7.

Table 4.2.1. Distribution of mothers by age (years)-(Kama District-Afghanistan, 2014)

Age (n=882)	n	%
=<19	12	1.4
20 – 24	208	23.6
25 – 29	383	43.4
30 – 34	208	23.6
=>35	71	8.0
Total	882	100.0
Mea ± SD =27.5 ± 4.1; Median=27; 1st Quartile=25; 3rd Quartile=30; Min-Max=18-42		

Table 4.2.1 showed that age of the mothers ranged from 18 to 42 years. The mean age of the mothers in the study group was 27.5 ± 4.1 years. Almost half of the mothers were in the age interval 25-29 (43.4 %) with the least at age group nine-teen years or less (1.4 %).

Table 4.2.2. Distribution of mothers by the age (years) at first marriage (Kama District-Afghanistan, 2014)

Age at first marriage (n=882)	n	%	Cumulative %
14	7	0.8	0.8
15	30	3.4	4.2
16	75	8.5	12.7
17	232	26.3	39.0
18	305	34.6	73.6
19	109	12.4	85.9
20	81	9.2	95.1
21	15	1.7	96.8
22	22	2.5	99.3
23	5	0.6	99.9
25	1	0.1	100.0
Mean ± SD=17.9 ± 1.5; Median=18; 1st Quartile=17; 3rd Quartile=19; Min-Max=14-25			

Age at first marriage of the mothers ranged from 14 to 25 years and their mean age at first marriage was 17.9 ± 1.5 years. Three fourth of the mothers (73.6%) were married at age eighteen years or less (Table 4.2.2).

Of the mothers, 842 (95.5%) were married for once and 40 (4.5%) were twice. The main reason for the second marriage was husband's death. Divorce was not reported in any case.

Table 4.2.3. Distribution of mothers by the numbers of pregnancies (Kama District-Afghanistan, 2014)

No. of pregnancy (n=882)	**n**	**%**
1-2	224	25.4
3-4	321	36.4
5-6	212	24.0
≥7	125	14.2
Total	882	100.0
Mean ± SD=4.1 ± 2.1; Median=4; 1st Quartile=2; 3rd Quartile=5; Min-Max=1-13		

Number of pregnancies of mothers ranged from one to thirteen. Average number of pregnancy was 4.1 ± 2.1, one fourth of the mothers (24.0%) had 5-6, and 14.2% had 7 or more pregnancies (Table 4.2.3).

Table 4.2.4. Distribution of mothers by the number of living children (Kama District-Afghanistan, 2014)

No. of live children (n=882)	**n**	**%**
1	94	10.7
2	185	21.0
3	201	22.8
4	188	21.3
≥5	214	24.3
Total	882	100.0
Mean ± SD=3.5 ± 1.6; Median=3; 1st Quartile=2; 3rd Quartile=4; Min-Max=1-9		

Mothers' number of living children ranged from one to nine. Average number of live children was 3.5 ± 1.6. One fourth of the mothers (24.3%) had five or more than five children alive (Table 4.2.4).

Table 4.2.5. Distribution of mothers by their working status (Kama District-Afghanistan, 2014)

Working status (n=882)	**n**		**%**
Not working	840		95.2
Working	42		4.8
Teacher	31	*	73.8
Midwife/nurse	4		9.5
NGO officer	4		9.5
Cleaner	3		7.2

* Calculated among working mothers (n=42)

Among 882 mothers, only forty-two (4.8%) of them were working currently. Almost three fourth of the mothers (73.8%) who were working at the time of study, were teachers (Table 4.2.5).

Table 4.2.6. Distribution of mothers' by their self-reported economic status (Kama District-Afghanistan, 2014)

Economic status (n=882)	**n**	**%**
Good	130	14.7
Average	515	58.4
Poor	237	26.9
Total	882	100.0

Economic status of the family was evaluated by the mother's opinion. According to their own evaluation, more than half of the mothers stated their economic status not too bad (58.4%), one-third (26.9%) stated as poor, and 14.7% as good (Table 4.2.6).

Table 4.2.7. Distribution of the parents by their educational status (Kama District-Afghanistan, 2014)

	Mothers (n=882)		Fathers (n=882)		
Educational status	**n**	**%**	**n**	**%**	**p-value***
Illiterate	718	81.4	483	54.8	
Primary school graduated	75	8.5	149	16.9	
Secondary school graduated	45	5.1	101	11.5	**<0.001**
High school graduated	39	4.4	108	12.2	
University graduated	5	0.6	41	4.6	
Total	882	100.0	882	100.0	

* McNemar test

Majority of the mothers were illiterate (81.4%). Of the mothers, almost one of 12 (8.5%) was primary school; one of 20 (5.1%) was secondary school; and one of 23 (4.4%) was high school graduated. Only five mothers (0.6%) were graduated from university. Father's educational status was better than mother's (54.8% were illiterate). Of the fathers, almost one of 6 (16.9%) was primary school; one of 9 (11.5%) was secondary school; one of 8 (12.2%) was high school; and one of 22 (4.6%) was university graduated. In general almost one of two fathers (45.2%) and one of five mothers (18.6%) were educated, and statistically significant difference was observed between parents (fathers and mothers) educational status ($p<0.001$). (Table 4.2.7)

4.3. Utilization of Maternal Health Services by Mothers

The purpose of this part is to understand the health seeking behavior of the mothers. This part explains the utilization of those health services which are directly and indirectly related to the children's health and were or were not received by mothers; these characteristics were asked only for children in the study group.

Table 4.3.1. Distribution of mothers by some characteristics related to ANC[a] visits (Kama District-Afghanistan, 2014)

Characteristics (mothers' self-report)	n	%
Status of ANC visits (n=882)		
No	472	53.5
Yes	410	46.5
Number of ANC visits (n=410)		
One	290	70.7
Two	83	20.3
Three	28	6.8
Four	9	2.2
Examined by (n=410)		
Doctor	380	92.7
Midwife	20	4.9
Nurse	10	2.4

[a] Antenatal Care

More than half of the mothers (53.5%) did not have any antenatal care (ANC) visit during the pregnancy period of the sampled child. Among those mothers who had at least one antenatal care visit (n=410), almost three fourth had only one visit (70.7%), and 2.2% of them had four visits. Almost all of the antenatal examinations were done by doctors (92.7%); that is may be due to the lack of knowledge of the mothers to distinguish midwife, nurse or doctor (Table 4.3.1).

Table 4.3.2. Distribution of children by the place of delivery (Kama District-Afghanistan, 2014)

Characteristics (mothers' self-report)	n	%
Place of delivery (n=882)		
Hospital/ Health center	412	46.7
Home	470	53.3
Attended by TBA	399	* 84.9
Attended by relatives/ friends	71	15.1

* Calculated among home deliveries (n=470)

Less than half of the mothers (46.7%) had delivered their children in a health facility and all these deliveries were assisted by health staff. On the other hand, more than half of the mothers (53.3%) had delivered at home. Majority of the home deliveries (84.9%) were assisted by skilled TBAs (Traditional Birth Attendant) and 15.1% were assisted by some other persons like family member, relative or female friend (Table 4.3.2).

Table 4.3.3. Distribution of mothers by some characteristics related to PNC[a] visits (Kama District-Afghanistan, 2014)

Characteristics (mothers' self-report)	**n**	**%**
Status of PNC visits (n=882)		
No	672	76.2
Yes	210	23.8
Number of PNC visits (n=210)		
One	181	86.2
Two	29	13.8
Examined by (n=210)		
Doctor	208	99.0
Midwife	2	1.0

[a] Postnatal Care

More than three fourth of the mothers (76.2%) had no post-natal care (PNC) visit. Among those mothers who had post-natal care visits, 86.2% had only one and 13.8% had two visits. Almost all of the post-natal examinations were done by doctors (99.0%); reason for this may be as same as mentioned for antenatal care visits (Table 4.3.1).

Table 4.3.4. Distribution of mothers by the status of TT[a] vaccination (Kama District-Afghanistan, 2014)

Status of TT vaccine (mothers' self-report)	n	%
No vaccine	17	1.9
1	7	0.8
2	44	5.0
3	149	16.9
4	213	24.2
5	406	46.0
Don't remember	46	5.2
Total	882	100.0

[a] Tetanus Toxoid

Small numbers of the mothers (1.9%) were not received any dose of TT vaccine, and less than half of the mothers (46.0%) were completed the basic five doses of the tetanus toxoid vaccine during their childbearing age (Table 4.3.4). The main reason for not receiving tetanus toxoid vaccine (17 mothers) was family problems (n=8), followed by fear of side reactions (n=4), no faith in vaccination (n=3) and unware of need for vaccination (n=2).

4.4. Knowledge of the Mothers on Vaccines and Vaccination

Knowledge of mothers on vaccines and vaccination has been shown in Table 4.4.1. All mothers (100%) in the study group stated that they have heard the term "Vaccine" before.

Table 4.4.1. Distribution of mothers by some knowledge on vaccines and vaccination (Kama District- Afghanistan, 2014)

Knowledge on vaccination (n=882)	n	%
Vaccination is;		
Important	756	85.7
Not important	47	5.3
Doesn't know	79	9.0
Names of VPDs[a]		
Polio	524	59.4
TB	329	37.3
Hepatitis	286	32.4
Measles	245	27.8
Tetanus	184	* 20.9
Pertussis	127	14.4
Hib	5	0.6
Diphtheria	3	0.3
Doesn't know	57	6.5
Vaccination starting age		
Knows	505	57.3
Doesn't know	377	42.7
Vaccination ending age		
Knows	302	34.2
Doesn't know	580	65.8

[a] Vaccine Preventable Diseases

*More than one answer; percentages calculated among the total (n=882)

Table 4.4.1 reveals that 85.7% of the mothers mentioned vaccination is important for their children to prevent diseases, however almost one of every ten mother (9%) stated that she had no idea about the importance of vaccination.

Majority of the mothers 93.5% knew at least one name of vaccine preventable diseases (VPDs). Most of the mothers identified poliomyelitis (59.4%) as the primary example of vaccine-preventable disease, followed by tuberculosis (37.3%), hepatitis (32.4%), measles (27.8%), tetanus (20.9%) and pertussis (14.4%). Diphtheria and Hib

were given less consideration as preventable diseases (0.6% and 0.3% respectively). During the interviews, mothers were asked that, "When should start and ended childhood vaccination?" So, 57.3% of the mothers knew childhood vaccination starting and 34.2% knew childhood vaccination ending age correctly.

Table 4.4.2. Distribution of mothers by the source of information on vaccination (Kama District-Afghanistan, 2014)

Source of information (n=882)	**n**	**%***
Health personals	656	74.4
Radio/ TV and posters	363	41.2
Female neighbors	263	29.8
Husband/ Family members	262	29.7
Community or religious leader	75	8.5

* More than one answer; percentages calculated form the total (n=882).

The most common source of information on vaccines and vaccination was health personals (74.4%), followed by mass media (41.2%), female neighbors (29.8%), husband or other family members (29.7%) and community or religious leader (8.5%). (Table 4.4.2)

Table 4.4.3. Distribution of mothers by their opinion on the immunization services given in their residential area (Kama District-Afghanistan, 2014)

Immunization services at the area	**n**	**%**
Good	444	50.3
Not too bad	226	25.6
Bad	19	2.2
Don’t know	193	21.9
Total	882	100.0

The mothers were asked to evaluate the immunization services on their own opinion, given in their residential area and the results are shown in Table 4.4.3. Only half of the mothers (50.3%) mentioned that immunization service delivery is good in their residential area, one-fourth (25.6%) thought that is not too bad, and more than one-

fifth (21.9) stated that they don't have any idea about the services, however nineteen mothers (2.2%) were complaining from the service.

4.5. Vaccination Coverage and Drop-out Rates of Recommended Antigens

Table 4.5.1. Distribution of children by the existence of vaccination card (Kama District-Afghanistan, 2014)

Vaccination card (n=882)	**n**	**%**
Exist	524	59.4
Not exist	358	40.6
Total	882	100.0

Vaccination card was existed with 524 children (59.4%) and was not existed with 358 (40.6%) children (Table 4.5.1). The existence of vaccination card was related to many factors as has been shown in Table 4.5.2.

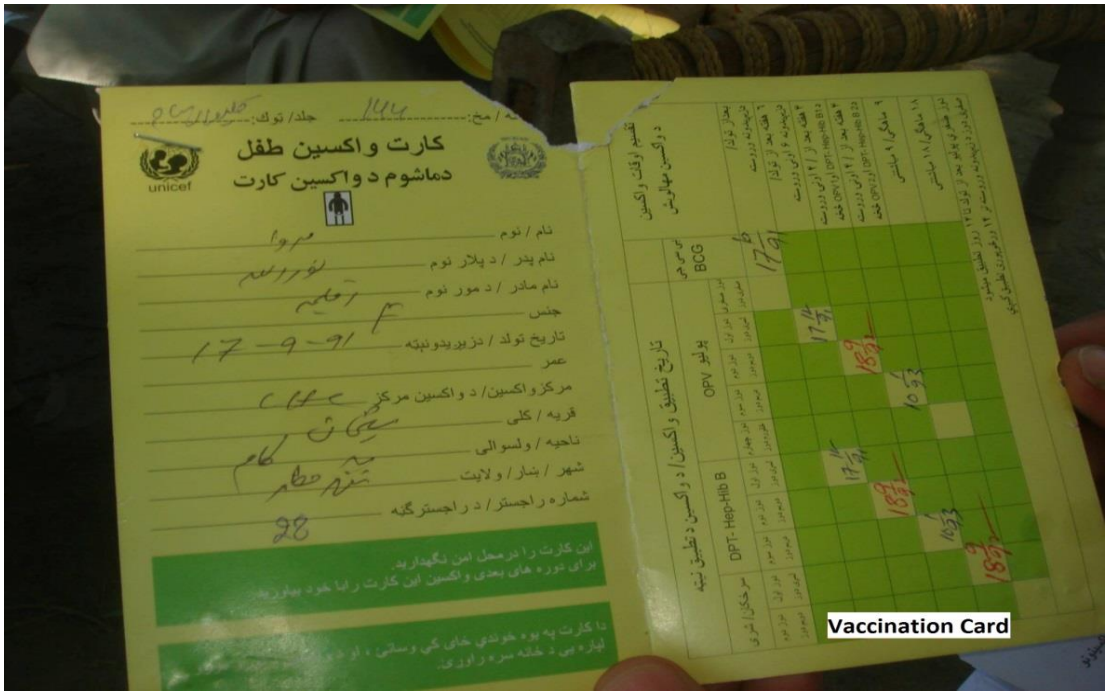

Figure 4.1. Sample of Vaccination Card, Afghanistan 2014

Table 4.5.2. Distribution of children by the existence of vaccination card, and some related factors (Kama District-Afghanistan, 2014)

(n=882)	Existence of the vaccination card (%)				
	Exist		Not exist		
	n	%	n	%	p-value
Child sex					
Male	278	58.8	195	41.2	0.681
Female	246	60.1	163	59.9	
Child age (months)					
12-14	177	74.4	61	25.6	**<0.001**
15-17	167	71.1	68	28.9	
18-20	151	52.2	138	47.8	
21-23	29	24.2	91	75.8	
Maternal education					
Illiterate	398	55.4	320	44.6	**<0.001**
Primary school	56	68.9	19	31.1	
Secondary school	31	74.7	14	25.3	
High school/ University	39	88.6	5	11.4	
Paternal education					
Illiterate	265	54.9	218	45.1	**<0.001**
Primary school	85	57.0	64	43.0	
Secondary school	63	62.4	38	37.6	
High school/ University	111	74.5	38	25.5	
Economic status					
Good	101	77.7	29	22.3	**<0.001**
Average	304	59.0	211	41.0	
Poor	119	50.2	118	49.8	
Family size					
≤6	71	68.9	32	31.1	**0.004**
7-9	163	65.7	85	34.3	
10-12	155	56.8	118	43.2	
13-15	96	54.9	79	45.1	
≥16	39	47.0	44	53.0	
Importance of vaccines					
Mothers know	491	64.9	265	35.1	**<0.001**
Mothers don’t know	33	26.2	93	73.8	

Of the male children 58.8%, and of the female children 60.1% had a vaccination card; and this difference was not statistically significant (p=0.681). By increasing the child's age, the existence of vaccination card decreased; of the children at age interval 12-14 months 74.4%, and of the children at age interval 21-23 months 24.2% had a vaccination card; and this difference was statistically significant (p<0.001). Maternal education was significantly associated to the existence of vaccination card (p<0.001); 88.6% of the children whose mothers were high school or university graduated, and 55.4% of the children whose mothers were uneducated had a vaccination card. Paternal education was also significantly associated to the existence of vaccination card (p<0.001); 74.5% of the children whose fathers were high school or university graduated, and 54.9% of the children whose fathers were uneducated had a vaccination card. While almost four-fifth (77.7%) children of the mothers with good economic status, and half (50.2%) children of the mothers with poor economic status had a vaccination card, and this difference was statistically significant (p<0.001). By increasing the family size significantly decreased the existence of vaccination card (p<0.001); in small families 68.9% of the children, and in large families 47.0% of the children had vaccination card. Also 64.9% of the children whose mothers knew, and 26.2% of the children whose mothers did not know the importance of vaccination had a vaccination card; and this difference was statistically significant (p<0.001). (Table 4.5.2)

Table 4.5.3. Distribution of children by single vaccine coverage level (Kama District-Afghanistan, 2014)

Vaccine (n=882)	Card only		Card + mothers' recall	
	n	%	n	%
BCG	522	59.2	801	90.8
Penta1	523	59.3	794	90.0
Penta2	504	57.1	755	85.6
Penta3	457	51.8	645	73.1
OPV1	523	59.3	814	92.3
OPV2	506	57.4	775	87.9
OPV3	465	52.7	681	77.2
Measles	439	49.8	625	70.9

Vaccination status of the children was learned from vaccination cards and from mother's verbal report (if card was not available). Singular vaccination coverage with only card and card plus mothers' recall has been shown in Table 4.5.3. As mentioned in methodology (3.7. Terms and Criteria), coverage with card only was calculated with numerator based only on documented doses. Coverage with card only was highest for OPV1 (59.3%), Penta1 (59.3%) and BCG (59.2%). The lowest coverage was reported for measles vaccine (49.8%). Vaccination coverage with vaccination card plus mother's verbal report was higher than card only coverage and highest for OPV1 (92.3%), followed by BCG (90.8%), Penta1 (90.0%), OPV2 (87.9%), Penta2 (85.6%), OPV3 (77.2%), Penta3 (73.1%), and it was lowest for measles vaccine (70.9 %) as in card only.

Scar of BCG vaccination was looked. As a fault, for children who were received vaccine it was written as ″Seen″ otherwise ″Not-seen″. So, it was not included in the analysis.

Drop-out or defaulter rates for major antigens calculated by the formula;

$$\frac{No.of\ children\ who\ received\ BCG - NO.of\ children\ who\ received\ Measles}{No.of\ children\ who\ received\ BCG}\ X\ 100 \qquad (53)$$

Also drop-out rate between Penta-1 and Penta-3 vaccines was calculated by the same formula (instead of BCG and Measles, Penta-1 and Penta-3). (Annex 3)

Table 4.5.4. Drop-out rates for major antigens (Kama District-Afghanistan, 2014)

	Drop-out rate for major antigens	
	BCG – Mealses	Penta1 – Penta3
From card only	15.9%	12.6%
Form card + mothers' recall	22.0%	18.8%

From card only, drop-out rates between BCG-Measles and Penta1-Penta3 were 15.9% and 12.6% respectively; from card plus mothers' recall, these were 22.0% and 15.9% respectively (Table 4.5.4). According to the WHO there is a problem with the immunization program whenever the drop-out rate or defaulter rate exceeds 10 percent (53). This study showed that in both status (card only and card plus mothers' recall) drop-out rate exceeds the WHO acceptable level.

Table 4.5.5. Distribution of the children by their vaccination status (Kama District-Afghanistan, 2014)

	Only Card		**Only Mothers' Recall**		**Card + Mother's Recall**	
Vaccination status	**n**	**%**	**n**	**%**	**n**	**%**
Fully-vaccinated	431	48.9	184	20.8	615	69.7
Partially-vaccinated	93	10.5	110	12.5	203	23.0
Non-vaccinated	-	-	64	7.3	64	7.3
Total*	524	59.4	358	40.6	882	100.0

* Column percentages; others are row percentages.

As it was mentioned before at the methodology (3.7. Terms and Criteria), a child between 12-23 months old who received one BCG, at least three doses of Pentavalent (DTP-Hep B-Hib), three doses of OPV and one dose of measles vaccine, considered as a fully vaccinated; a child who missed at least one dose of the above mentioned vaccines, considered as a partially vaccinated; and a child who did not receive any dose of the above mentioned vaccines, considered as a non-vaccinated. The study showed that from

card only, 48.9% children were fully and 10.5% were partially vaccinated; from only mothers' recalls, 20.8% children were fully, 12.5% were partially and 7.3% were non-vaccinated. In total (card plus mothers' recall) out of 882 children 615 (69.7%) were fully, 203 (23.0%), were partially, and 64 (7.3%) were non-vaccinated (Table 4.5.5).

Table 4.5.6. Distribution of children by the place of vaccination (Kama District-Afghanistan, 2014)

	Place of vaccination (card + mothers' recall)									
	Health center		Out-reach		Hospital		SIA*		Don't remember	
Vaccine	n	%	n	%	n	%	n	%	n	%
BCG (n=801)	347	43.3	172	21.5	229	28.6	-	-	53	6.6
Penta1 (n=794)	397	50.0	293	36.9	30	3.8	-	-	74	9.3
Penta2 (n=755)	371	49.1	286	37.9	24	3.2	-	-	74	9.8
Penta3 (n=645)	356	55.2	194	30.1	22	3.4	-	-	73	11.3
OPV1 (n=814)	397	48.8	293	36.0	30	3.7	20	2.4	74	9.1
OPV2 (n=775)	371	47.9	286	36.9	24	3.1	20	2.6	74	9.5
OPV3 (n=681)	356	52.3	194	28.5	22	3.2	36	5.3	73	10.7
Measles (n=625)	411	65.8	125	20.0	23	3.7	-	-	66	10.5

* Supplementary Immunization Activity

Out of 882 children, only for those who were vaccinated (BCG=801; Penta1=794; Penta2=755; Penta3=645; OPV1=814; OPV2=775; OPV3=681 and Measles=625) place of vaccination was written from vaccination card and from mothers' verbal report (if card was not available). Routine EPI Services (at all levels) are free and delivered only through the public sector via fixed (at the health center), out-reach and SIA. Table 4.5.6 shows the place of vaccination for each vaccine. The primary main

place of vaccination was health centers. Among the vaccinated children almost half of them were vaccinated at the health centers; e.g. BCG (43.3%), Penta1 (50.0%), Penta2 (49.1%), Penat3 (55.2%), followed by out-reach; BCG (21.5%), Penta1 (36.9%), Penta2 (37.9%), Penat3 (30.1%). Some of the children were received OPV vaccines from vaccination campaigns or SIA (OPV1=2.4%; OPV2=2.6%; OPV3=5.3%). Mothers could not remember the place of vaccination in different percentages for various vaccines (from 6.6% to 11.3%).

4.6. Factors Related to the Vaccination Status (card plus mothers' recall)

4.6.1. Demographic characteristics of the children

Table 4.6.1. Distribution of children by some demographic characteristics in relation to vaccination status (Kama District-Afghanistan, 2014)

Characteristic (n=882)	Vaccination status								p-value
	Fully		Partially		Non		Total		
	n	%	n	%	n	%	n	%*	
Child sex									
Male	344	72.7	100	21.1	29	6.1	473	53.6	0.098
Female	271	66.3	103	25.2	35	8.6	409	46.4	
Child age									
12-14	163	68.5	53	22.3	22	9.2	238	27.0	
15-17	161	68.5	55	23.4	19	8.1	235	26.6	0.647
18-20	202	69.9	69	23.9	18	6.2	289	32.8	
21-23	89	74.2	26	21.7	5	4.2	120	13.6	
Family size									
≤6	79	76.7	20	19.4	4	3.9	103	11.7	
7-9	190	76.6	49	19.8	9	3.6	248	28.1	
10-12	184	67.4	72	26.4	17	6.2	273	31.0	**<0.001**
13-15	117	66.9	43	24.6	15	8.6	175	19.8	
≥16	45	54.2	19	22.9	19	22.9	83	9.4	

* Column percentages; others are row percentages.

Some demographic characteristics of the children and their relation with the children vaccination status has been shown in Table 4.6.1. Of the male children 72.7%,

21.1% and 6.1% and of the female children 66.3%, 25.2% and 8.6% were respectively fully, partially and non-vaccinated. No statistically significant difference was observed-between the male and female children's vaccination status (p=0.098). Children within age group 21-23 months were more fully vaccinated (74.2%) than others. No statistically significant difference was seen between the different age groups of the children (p=0.647). By increasing number of family members, the percentage of fully vaccinated children was decreased; children with small number of family members (≤6) were more fully vaccinated (76.7%) than children with crowded families (54.2%), and this difference was statistically significant (p<0.001).

4.6.2. Socio-Demographic Characteristics of the Mothers

Table 4.6.2. Distribution of children by some socio-demographic characteristics of the mothers in relation to vaccination status (Kama District-Afghanistan, 2014)

Characteristic (n=882)	Vaccination status								p-value
	Fully		Partially		Non		Total		
	n	%	n	%	n	%	n	%*	
Mothers' age									
≤19	6	50.0	4	33.3	2	16.7	12	1.4	
20-24	140	67.3	50	24.0	18	8.7	208	23.6	
25-29	285	74.4	79	20.6	19	5.0	383	43.4	0.118
30-34	142	68.3	49	23.6	17	8.2	208	23.6	
≥35	42	59.2	21	29.6	8	11.3	71	8.0	
No. pregnancy									
1-2	168	75.0	56	25.0	-	-	224	27.7	
3-4	233	72.6	69	21.5	19	5.9	321	36.4	**<0.001**
5-6	141	66.5	40	18.9	31	14.6	212	24.0	
≥7	73	58.4	38	30.4	14	11.2	125	14.2	
No. live children									
1	72	76.6	22	23.4	-	-	94	10.6	
2	135	73.0	50	27.0	-	-	185	21.0	
3	153	76.1	38	18.9	10	5.0	201	22.8	<**0.001**
4	115	61.2	41	21.8	32	17.0	188	21.3	
≥5	140	65.4	52	24.3	22	10.3	214	24.3	
Working status									
Yes	42	100.0	-	-	-	-	42	4.8	<**0.001**
No	573	68.2	203	24.2	64	7.6	840	95.2	
Economic status									
Good	113	86.9	16	12.3	1	0.8	130	14.7	
Average	370	71.8	112	21.7	33	6.4	515	58.4	<**0.001**
Poor	132	55.7	75	31.6	30	12.7	237	26.9	

* Column percentages; others are row percentages.

Some socio-demographic characteristics of the mothers and their relation with the children's vaccination status have been shown in Table 4.6.2. Children of younger mothers (≤19 years) and children of older mothers (≥35 years) were less fully vaccinated (50.0% and 59.2%, respectively) than others. Children of 25-29 years old mothers were

more fully vaccinated (74.4%) than others. No statistically significant difference was observed in vaccination status of the children from different age groups of the mothers (p-value=0.118). Almost three-fourth of the children whose mothers had 1-2 or 3-4 pregnancies was fully vaccinated. While of the children that their mother had 5-6 pregnancies 66.5%, and of the children that their mothers had seven or more pregnancies 58.4% were fully vaccinated. The difference was statistically significant ($p<0.001$). With the decreasing number of living children the percentage of fully vaccinated children increased. In mothers with one living child 76.6%, and with five of more living children 65.4% were fully vaccinated. Statistically significant difference was observed in vaccination status of the different number of living children ($p<0.001$). All children (100%) of mothers with one or two living children were received at least one dose of the recommended vaccines (non-vaccinated child was not reported in this group). All children (100%) of the employed mothers were fully vaccinated, but of the un-employed mothers 68.2% were fully vaccinated, and this difference was statistically significant ($p<0.001$). Also children of mothers, who were rated their economic status as good, were more fully vaccinated (86.9%) than children of mothers with average and poor economic status (71.8% and 55.7%, respectively). Statistically significant difference was observed between the vaccination status of children from economically good and poor status ($p<0.001$).

Table 4.6.3. Distribution of children by the educational status of the parents in relation to vaccination status (Kama District-Afghanistan, 2014)

Educational status (n=882)	Vaccination status								p-value
	Fully		Partially		Non		Total		
	n	%	n	%	n	%	n	%*	
Mothers'									
Illiterate	462	64.3	192	26.7	64	8.9	718	81.4	
Primary	66	88.0	9	12.0	-	-	75	8.5	<**0.001**
Secondary	43	95.6	2	4.4	-	-	45	5.1	
High sch.+	44	100.0	-	-	-	-	44	5.0	
Fathers'									
Illiterate	298	61.7	136	28.2	49	10.1	483	54.8	
Primary	100	67.1	40	26.8	9	6.0	149	16.9	<**0.001**
Secondary	78	77.2	17	16.8	6	5.9	101	11.4	
High sch.+	139	93.3	10	6.7	-	-	149	16.9	

* Column percentages; others are row percentages.

Table 4.6.3 reveals that parents' education had statistically significant association with their children vaccination status ($p<0.001$). Of the children with, high school/university graduated mothers 100.0%; secondary school graduated mothers 95.6%; and primary school graduated mothers 88.0%, were fully vaccinated. Also of the children with, high school/university graduated fathers 93.3%; secondary school graduated fathers 77.2%; and primary school graduated fathers 67.1%, were fully vaccinated. While only 64.3% children of the illiterate mothers and 61.7% children of the illiterate fathers were fully vaccinated.

4.6.3. Utilization of Maternal Health Services by Mothers

Table 4.6.4. Distribution of children by the utilization of maternal health services by mothers in relation to vaccination status (Kama District-Afghanistan, 2014)

Characteristics (n=882)	Vaccination status								p-value
	Fully		Partially		Non		Total		
	n	%	n	%	n	%	n	%*	
ANC[1] visits									
No-visit	279	59.1	135	28.6	58	12.3	472	53.5	**<0.001**
≥1 visit	336	82.0	68	16.6	6	1.5	410	46.5	
Place of delivery									
Hos/ HC[1]	338	82.0	64	15.6	10	2.4	412	46.7	**<0.001**
Home	277	58.9	139	29.6	54	11.5	470	53.3	
PNC[1] visits									
No-visit	442	65.8	172	25.6	58	8.6	672	76.2	**<0.001**
≥1 visit	173	82.4	31	14.8	6	2.9	210	23.8	
TT[1] vaccine									
No-dose	4	23.5	3	17.6	10	58.8	17	1.9	
1-4 doses	255	55.6	154	33.5	50	10.9	459	52.1	**<0.001**
5 doses	356	87.7	46	11.3	4	1.0	406	46.0	

* Column percentages; others are row percentages.

[1] ANC: Antenatal Care; PNC: Postnatal Care; Hos/HC: Hospital/ Health Center; TT: Tetanus Toxoid

Utilization of maternal health services by mothers and its relation with the children's vaccination status has been shown in Table 4.6.4. Children of mothers with at least one antenatal care visit during pregnancy, were more fully vaccinated (82.0%) than children of mothers who had no visit (59.1%); children delivered at health facility were more fully vaccinated (82.0%) thane children delivered at home (58.9%); children of mothers with at least one post-natal care visit were more fully vaccinated (82.4%) than children of mothers who had no visit (65.8%); children of mothers who were completed five basic doses of tetanus toxoid (TT) vaccine, were more fully vaccinated (87.70%) than children of mothers who were not completed or never received (55.6% and 23.5%, respectively). All characteristics which are mentioned above had statistically significant association with children's vaccination status ($p<0.001$).

4.6.4. Knowledge of the Mothers on Vaccines and Vaccination

Table 4.6.5. Distribution of children by the mothers' knowledge on vaccines in relation to vaccination status (Kama District, Afghanistan, 2014)

Characteristic (n=882)	Vaccination status								p-value
	Fully		Partially		Non		Total		
	n	%	n	%	n	%	n	%*	
Importance of vaccines									
Know	582	77.0	161	21.3	13	1.7	756	85.7	
Don't know	33	26.2	42	33.3	51	40.5	126	14.3	**<0.001**
Name of VPD[1]									
Know	600	72.7	189	22.9	36	4.4	825	93.5	
Don't know	15	26.3	14	24.6	28	49.1	57	6.5	**<0.001**
Vaccination Starting age									
Know	409	81.0	93	18.4	3	0.6	505	57.3	
Don't know	206	54.6	110	29.2	61	16.2	377	42.7	**<0.001**
Vaccination ending age									
Know	257	85.1	43	14.2	2	0.7	302	34.2	
Don't know	358	61.7	160	27.6	62	10.7	580	65.8	**<0.001**
Vaccination card									
Yes	431	82.3	93	17.7	-	-	524	59.4	
No	184	51.4	110	30.7	64	17.9	358	40.6	**<0.001**
Immunization Services in area									
Good	371	83.6	67	15.1	6	1.4	444	50.3	
Not too bad	167	73.9	54	23.9	5	2.2	226	25.6	
Bad	3	15.8	13	68.4	3	15.8	19	2.2	**<0.001**
No idea	74	38.3	69	35.8	50	25.9	193	21.9	

* Column percentages; others are row percentages.

[1] Vaccine Preventable Disease

Knowledge of the mothers on vaccines and vaccination and its relation with children's vaccination status has been shown in Table 4.6.5. Children of mothers, who

knew the importance of vaccination, were more fully vaccinated (77.0%) than children of mothers, who did not know (26.2%). Children of mothers, who knew at least one name of vaccine preventable disease, were more fully vaccinated (72.7%) than children of mothers, who did not know (26.3%). Children of mothers, who knew vaccination starting and ending age, were more fully vaccinated (81.0% and 85.1%, respectively) than children of mothers, who did not know (54.6% and 61.7%, respectively). Children who had vaccination card were more fully vaccinated (82.3%) than children who did not have (51.4%). Children of mothers, who stated immunization service delivery is "Good" in their residential area, were more fully vaccinated (83.6%) than others, mothers who stated immunization service delivery is "Bad" in their residential area had 15.8% fully vaccinated children. All characteristics which are mentioned above had statistically significant association with children's vaccination status ($p<0.001$).

4.6.5. Closeness to the Health Centers (HCs)

For analysis proposes all the sampled twelve clusters (villages) were divided by the researcher into two groups. Villages within health centers (Sangarsary and Landabooch) were considered as close to health centers, and the remains were considered as far from health centers. Table 4.6.6 shows vaccination status of the children in these two groups of villages.

Table 4.6.6. Distribution of children by the closeness to health centers in relation to vaccination status (Kama District-Afghanistan, 2014)

Villages (n=882)	Vaccination status								p-value
	Fully		Partially		Non		Total		
	n	%	n	%	n	%	n	%*	
Close to HCs[1]	118	76.6	32	20.8	4	2.6	154	17.5	**0.027**
Far from HCs[1]	497	68.3	171	23.5	60	8.2	728	82.5	

* Column percentages; others are row percentages.

[1] Health Centers

Children who lived in the villages close to health centers were more fully vaccinated (76.6%) than others (68.3%). The difference was statistically significant (p=0.027).

Table 4.6.7. Multivariate logistic regression analysis for association between independent factors and fully vaccinated status of the children (Kama District-Afghanistan, 2014)

Factor (n=882)		**OR (95% CI)**	**p-value**
Gender	Female*	1	
	Male	1.85 (1.28-2.67)	**0.001**
Family size[1]	≥ 16*	1	
	13-15	1.89 (0.67-3.90)	0.432
	10-12	2.26 (1.25-4.08)	**0.007**
	7-9	3.32 (1.95-6.69)	**0.001**
	≤ 6	3.64 (1.62-7.28)	**<0.001**
Maternal Education	Illiterate*	1	
	Primary school	1.87 (0.81-4.28)	**0.140**
	Secondary school +	4.89 (1.09-21.91)	**0.032**
Paternal Education	Illiterate*	1	
	Primary school	1.11 (0.70-1.76)	0.667
	Secondary school	1.28 (0.67-2.41)	0.454
	High school +	3.11 (1.38-7.02)	**0.006**
Importance of vaccination	Mothers don't know*	1	
	Mothers know	3.65 (2.20-6.06)	**<0.001**
Maternal TT vaccination	Non-vaccinated*	1	
	1-4 doses	1.28 (0.35-4.67)	0.706
	5 doses	5.62 (1.49-21.16)	**0.011**
Mothers' opinion on immunization Service in the area	No idea*	1	
	Good	4.36 (2.80-6.88)	**<0.001**
	Not too bad	2.45 (1.51-3.99)	**<0.001**
	Bad	**0.11 (0.03-0.46)**	**0.003**

* Reference category

[1] Number of persons they live in a single household and share in various aspects of life with each other.

Logistic regression analysis was done to test the strength of association between some independent factors and full vaccination coverage. All independent variables with a p-value less than 0.20 at bivariate analysis, assumed to be associated with "Immunization coverage" (the results of univariate logistic regression analysis has been shown in Annex 4) and were included in the analysis. The analysis was performed by using binary logistic regression where backward conditional method was specified in order to identify confounders and/ or effect modifiers. Odds Ratio (OR) with corresponding 95% Confidence Interval (CI) was used to estimate the strength of association between the retained independent predictors of "Full immunization coverage", and the threshold for statistical significance was set at $p<0.05$. Table 4.6.7 shows the results of multivariate logistic regression analysis.

Factors which were predictors of fully vaccinated status of the children in Kama District area identified as; male sex (OR=1.85 CI=1.28-2.67), small family size (≤6 OR=3.64 CI=1.62-7.28; 7-9 OR=3.32 CI=1.95-6.69; 10-12 OR=2.26 CI=1.25-4.08), maternal education (secondary school or above OR=4.89 CI=1.09-21.91), paternal education (high school or above OR=3.11 CI=1.38-7.02), mother's knowing importance of vaccination (OR=3.65 CI=2.20-6.06), receiving basic five doses of TT immunization by mother (OR=5.62 CI=1.49-21.16), and good or not too bad opinion of the mother about immunization services in the area (OR=4.36 CI=2.80-6.88; OR=2.45 CI=1.51-3.99 respectively).

4.7. Reasons for Non-Vaccination

Mothers were asked for the reasons of non-vaccinating their children; it was difficult to remember the reason of non-vaccination for each vaccine. Hence recall's bias could be a major problem in such questions. However the most common primary reason for non-vaccination was family problems (25.6%), followed by rumors (16.9%), and fear of side effects (16.6%). Some of the respondents (9.1%) did not give specific reasons for not taking their children to health services in the area for vaccination (Annex 5, Table 1).

As mentioned in the methodology (3.7. Terms and Criteria), reasons for non-vaccination were classified as; ″Obstacles″, ″Lack of information″, and ″Lack of motivation″. After grouping the reasons, the major common reason for the children's non-vaccination status was obstacles (48.2%), followed by lack of motivation (23.4%), lack of information (19.3%) and at 9.1% of cases reason for non-vaccination was not specified by mothers clearly (Annex 5, Table 2).

5. DISCUSSION

It must be acknowledged that this study assessed the full-vaccination coverage and associated factors among children aged between 12–23 months in Kama District-Afghanistan. A total of 882 participants (children's mothers) were interviewed based on the objectives of the study.

It is found that in Kama District, full vaccination coverage (calculated from the data obtained either from vaccination card or mother's verbal report) was 69.7%, BCG-Measles drop-out rate was 22.0%, and Penta1 - Penta3 drop-out rate was 18.8%, which indicates poor performance. Among all vaccines measles vaccine had the lowest coverage rate of 70.9%.

5.1. Characteristics of the Children

Of the children in the study group 53.6% was male and 46.4% was female, male female ratio was 1.16: 1 and mean age of the children was 16.9 ± 3.0 months (Table 4.1.1). In these study findings, male ratio was greater than female as same as in Afghanistan's general population (51) and in Nangarhar Provincial population (52) which is 1.04:1.

The mean number of household members was 10.7 ± 3.5. Almost in one third of the households (29.2%) there lived thirteen or more persons (Table 4.1.3). This finding is in consistency with the previous studies findings, e.g. according to the Ministry of Rural Rehabilitation and Development (MRRD) publication, average number of the household members in Nangarhar Province was eight persons (52) our study finding covers this number only with ± one standard deviation (7.2-14.2); according to Afghanistan Multiple Indicators Cluster Survey 2010-11 (AMICS), in Afghanistan out of ten households only in one live less than five persons (10.5%); on the other hand out of four households (25.4%) in one live more than ten persons (19), which indicates that extended family type is common in Afghanistan. Moreover, in Afghanistan traditionally in order to be a good family all married brothers and their wives and children are living

together and extended families are more common in Pashtuns than in other ethnic groups, so of the Nangarhar population 90.0% are Pashtuns (51).

5.2. Characteristics of the Mothers

The mean age of the mothers in the study group was 27.5 ± 4.1 years. Almost 70% of the mothers were younger than 30 years (Table 4.2.1). The most striking feature of the afghan population is its very young age structure, in the rural areas, similar to this study findings, some 70% of the population are younger than 30 years, where elderly of 65 or over are around 4% (51). In Afghanistan, it is very difficult to understand the correct age of the mothers, because they do not know their exact birth date, very small number of the mothers have national identity card, and mothers usually tend to state their ages smaller than the actual age. Hence, only 71 (8.0%) of the mothers at the study group were 35 year or older.

Mean age of mothers at the time of first marriage was 17.9 ± 1.5 years. Almost two fifth of the mothers (39.0%) were married before the age 18 (Table 4.2.2). AMICS showed that overall, 46% of women aged 15-49 years were married before the age 18 and rural girls and women are more likely to marry early than urban girls (19). According to the World Bank data, women age at the time of first marriage in Afghanistan is 21.5 years (54) which is an older age than the findings of this study. In Nangarhar province 85% of the mothers are un-educated (52) (as 81.4% in this study) and access to education is one of the important ways to raise human capitals including postponing the marriage age of male and female. As shown by AMICS, early marriage was strongly related to the level of education of the women. Young women without education are more than three times as likely to be married before the age of 18 as are their counterparts who have secondary education or higher (19).

Traditionally in Afghanistan, each female should get married after the menarche. Parents encourage their daughters to marry while they are still children since they hope that the marriage will benefit them both financially (such as through the payment of a bride price) and socially, while also relieving financial burdens on the family.

In this study the average number of parity was 4.1, and 14.2% of the mothers had 7 or more pregnancies, also the mean number of living children was 3.5 ± 1.6, and one fourth of the mothers (24.3%) had five or more children alive (Tables 4.2.3-4.2.4) The total fertility rate in Afghanistan is 5.1 (20) and the proportion of children under 15 years old is among the highest in the world and significantly higher than that of the neighboring countries (51). The high percentage of children in the population is a direct result of high fertility. Early marriage also influences the number of parity and living children; women who are married before the age of 18 tend to have more children than the others.

At the study time, just 4.8% of the mothers were working. Generally in Afghanistan, due to cultural barriers and security problems, majority of the educated women work as governmental employees in educational or health sector. According to the findings of this study, almost three fourth (73.8%) of the working mothers were teachers. In the year 2009 in Afghanistan, of the governmental employees 20% were female (55); it means that one fifth of the governmental staff were females, and this was higher than the 2007 figure of 17% (55). In Nangarhar Province, the percentage of female governmental employees was very smaller than the total (5%), which is much close percentage to this study's findings. In this study, more than half of the mothers stated their economic status not too bad ("average", 58.39%), and 26.87% as "poor". In Nangarhar Province agriculture is the major source of revenue for 55% of rural households; 28% of households derive some income from trade and services; livestock also accounts for income for 14% of rural households (52). These sources of revenue are not enough for earning money; economic status of the family is related to their working status.

Overall literacy rate was 31.9%; majority of the mothers (81.4%) and more than half of the fathers (54.8%) were illiterate (Table 4.2.7). MRRD mentioned the overall literacy rate in Nangarhar Province 29%, and of the men 59%, of the women 85% are illiterate (52); which is much close to the findings of this study. AMICS showed that in Afghanistan one in five women (22.2%) are literate and the women's literacy rate in

rural areas is more than three times lower than in urban areas (19). More than three decade conflict in Afghanistan affected all public service of the country including educational system.

5.3. Utilization of Maternal Health Services by Mothers

In this section, the number of antenatal and postnatal visits, place of delivery of the children in the study group, and TT vaccination of the mothers (basic five doses during childbearing age) were asked. In general, utilization of the health services by mothers was not good. Less than half (46.5%) and less than one fourth of the mothers (23.8%) respectively had antenatal and postnatal visit. Also 53.3% of the mothers had home deliveries and less than half of the mothers (46.0%) were completed the basic five doses of the tetanus toxoid vaccine (Tables 4.3.1-4.3.4). Coverage of antenatal care (by physician, nurse, or midwife) is low in Afghanistan, with 48% of women receiving antenatal care at least once during the pregnancy (19). Almost 33% of births in Afghanistan are delivered in a health facility, while the rest 67% occur at home. Women in rural areas are less than twice as likely to deliver in a health facility as their urban counterparts (19). In Pakistan 73% of the mothers had at least one antenatal visit, 61% had at least one postnatal visit and 48% of the deliveries were carried out in health facility by health personals (56). According to Turkish Demographic and Health survey (2008), in Turkey 92.0% of the mothers had at least one antenatal care visit, 84.5% had at least one postnatal care visit, and 91.3% of the deliveries were assisted by health personals (57). This is much higher than the utilization of maternal health care services in Afghanistan. All these mentioned components indicate the poor utilization of health service by mothers in Kama District-Afghanistan, and this may be due to poor educational status of the couples (especially women education), poor economy and some socio-cultural problem.

5.4. Knowledge of the Mothers on Vaccines and Vaccination

According to the finding of this study, mothers had not enough information about vaccines e.g. some of them (14.3%) were un-aware from the importance of vaccination,

nearly half of them could not indicate the correct age for childhood vaccination starting and ending time (42.7% and 65.8% respectively), only one fifth (20.9%) of the mothers could name three or more than three Vaccine Preventable Diseases (VPDs) and most of them identified poliomyelitis as the primary example of VPDs (Table 4.4.1). Knowledge about vaccination and childhood vaccine preventable diseases reflects an understanding of the immunization goals (58). Apart from poliomyelitis, which is understood by more than half of the mothers (59.4%), other preventable diseases remain largely ignored. Knowledge about the immunization program is proportionate to the effort the health system deploys for communication and promotion of awareness (59). Diseases that are addressed by specific awareness and campaign programs, such as is done for poliomyelitis, are better known because of their extensive coverage in the media.

According to the findings of this study, the most common source of information on vaccines and vaccination was health personal (74.4%) followed by mass media (41.2%). In a study from Libya (58), paramedical workers were the main source of information to the respondents followed by TV, posters and symposia while community leaders were found to be a lesser source. In a study form America (Massachusetts, Colorado, Missouri and Washington) (59) the most commonly used source of vaccine information was the child's healthcare provider followed by Vaccine Information Statements (printed materials from healthcare providers) and parents' friends; also tow fifth of the respondents, reported that they view the internet as a good or excellent source of vaccine information (59).

Opinion of mothers about the quality of immunization services in the residential area was also evaluated. Only half of the mothers (50.3%) satisfied with the services and nineteen mothers complained from services e.g. "*vaccinators come late and go back early, they are not working properly"*. More than one in fifth mothers (21.9%) had no idea about the quality of immunization services in the area (Table 4.4.3). A study form Egypt (60) stated that maternal satisfaction about vaccination is crucial to completeness of the schedule but it does not depend mainly on maternal knowledge about vaccination

but related some other factors such as staff attitude, waiting time and cost of the service, similar as in this study.

5.5. Coverage Level and Drop-out Rates

Achievement and maintenance of high vaccination coverage for vaccine-preventable diseases is an important part of programs to control, eliminate, or eradicate these diseases.

Tuberculosis is a re-emerging problem around the world and Afghanistan has still a high incidence (189/100,000) and prevalence (351/100,000) rates of tuberculosis (61). Neonatal BCG vaccine is safe and effective, with an overall protective value of 75% (62). Worldwide, different coverage rates have been obtained for this vaccine. BCG vaccine coverage was 90.8% (card plus history) in our study. This level of coverage is higher than the estimated global coverage (89%) for BCG (17), and higher than the national coverage (64.2%) estimated by AMICS in 2010-2011 (19). However, the card-only coverage rate is rather low as 59.2%. At the same age group (12-23 months) and from vaccination card plus mother's recall, BCG coverage in Pakistan (56) was 85.2%, in rural South Africa (63) was 89.3%, and in Bangladesh (64) was 97.8%. In Tajikistan (65), among children aged 18-29 months BCG coverage was 98.3%. In Turkey (57), BCG coverage among children aged 15-26 months was 95.9%.

DTP vaccine is recommended as multiple doses at 2^{nd}, 3^{rd} and 4^{th} months. The proportion of children receiving the first three doses of DTP is commonly used as measure of how well immunization programs are functioning (66). It is found that 90.0% of the children were received first dose of DTP (card plus history). Even though one dose of a vaccine will usually provide some degree of immunity, the full vaccine schedule is recommended to achieve long-lasting, full immunity. On the other hand, only 73.1% of the children were received three doses of DTP. In Afghanistan's EPI schedule DTP is given in combination with other recommended vaccines simultaneously, such as Hib and Hep B named as Penta vaccine. The low coverage of DTP3 also indicates the low coverage of Hib and Hep.B vaccines. The level of DTP

vaccination in the study site is quite low compared with the global average of 83% coverage (67). At the same age group (12-23 months) and from vaccination card plus mother's recall, in Pakistan (56), DTP1 coverage was 78.8% and DTP3 was 65.2%, in Bangladesh (64), DTP1 coverage 97.8% and DTP3 was 93.2%. Another study from rural areas of Bangladesh (68) showed DTP1 coverage as 87.5% and DTP3 coverage 70.7%. In Tajikistan (65), among children aged 18-29 months DTP1 coverage was 97.5% and DTP3 was 91.7%. In Turkey (57), among children aged 15-26 months, DTP1 coverage was 97.2% and DTP3 was 89.3%. In the Unites States of America (69), among children aged 19-35 months, DTP coverage (four doses or more) was estimated 85.9%. In Canada (70), among children aged 20-24 months DTP coverage (four doses or more) was 87.9%.

According to the findings of this study, 92.3% of the children had received the first dose of oral polio vaccine (card plus history). The coverage was 87.9% for the second dose and was 77.2% for the third dose, which is higher than Penta3. In Afghanistan's EPI program OPV vaccine is given simultaneously with Penta vaccine. Beside health centers and out-reach some children were vaccinated for OPV during the supplementary immunization activities (SIA), thus increase in the percentages of OPV coverage than Penta, may be due to special vaccination campaigns given for OPV. At the same age group (12-23 months) and from vaccination card plus mother's recall, in Pakistan (56), OPV1 coverage was 92.3% and OPV3 was 85.3.2%, in Bangladesh (64), OPV1 coverage 97.8% and OPV3 was 93.2%, while another study from rural areas of Bangladesh (68) showed OPV1 coverage 92.5% and OPV3 coverage 72.3%. In Tajikistan (65), among children aged 18-29 months OPV1 coverage was 97.4% and OPV3 was 92.3%. In Turkey (57), among children aged 15-26 months, OPV1 coverage was 96.8% and OPV3 was 88.3%. In the Unites States of America (69), among children aged 19-35 months, Polio vaccine coverage (three doses or more) was estimated 91.3%. In Canada (70), among children aged 20-24 months Polio vaccine coverage (three doses or more) was 96.2%.

As measles is a highly contagious disease, Cockman *et all* recommended that to achieve herd immunity and prevent outbreaks, at least 95% of children should receive first dose of the measles vaccine before age 2 years and a booster before age 5 years (71). In this study, coverage of the first dose measles vaccine was 70.9% (card plus history). At the same age group (12-23 months) and from vaccination card plus mother's recall, in Pakistan (56), measles vaccine coverage was 61.4%, in Bangladesh (64) it was 84.0%, in South African children (63) it was 77.3%. In Tajikistan (65), among children aged 18-29 months measles vaccine coverage was 95.2%. In Turkey (57), among children aged 15-26 months, measles vaccine coverage was 89.3%. In the Unites States of America (69), among children aged 19-35 months, measles vaccine coverage (one dose or more) was estimated 92.3%. In Canada (70), among children aged 20-24 months measles vaccine coverage (one dose or more) was 95.2%. In China (72) among children aged 12-23 months measles vaccine coverage was 95.4%.

When the vaccination status was grouped as "fully vaccinated", "partially vaccinated" and "non-vaccinated", it is found that, full vaccination coverage among children aged 12-23 months in Kama District was 69.7% (card plus history). This level of coverage is quite higher than the previous national full vaccination coverages either estimated by AHS (27%) in 2006 (20), or by AMICS (30%) in 2010-2011 (19). A study conducted in Kabul Province-Afghanistan, (73) showed proportion of fully vaccinated children to be 84.5% in the city center and 60.7% in the rural areas. Different levels of childhood full-vaccination coverage were obtained in different countries between 2010 and 2014. At the same age group (12-23 months) and from vaccination card plus mother's recall, in Pakistan (56), full-vaccination coverage was 53.8%, and in Bangladesh (64), was 82.5%, while in the rural areas of Bangladesh full vaccination coverage was 42% (74). In Tajikistan (65), among children aged 18-29 months full-vaccination coverage was 88.7%. In Turkey (57), among children aged 15-26 months, full-vaccination coverage was 80.5%, while another study from Turkey showed full-vaccination coverage among children 12-23 months 84% (75). In the Unites States of America (69), among children aged 19-35 months, full-vaccination coverage was

estimated 85%. In Canada (70), among children aged 20-24 months full-vaccination coverage was 88%. According to the results of 2009 National Survey in Haiti (76), 40.4% of children aged 12-23 months were received the eight recommended vaccines. A study from 27 Brazilian cities showed that 82.6% of children had received all recommended vaccines by 18 months of age (77).

First reason for rather high full vaccination coverage than the national figure in this study may be the developmental level of the study area; Kama District is one of the most developed districts of the country. In other districts this coverage could be absolutely lower. The second reason is may be the gradual improvement in the last few years; this might affected the immunization services delivery and utilization in the area. However; low coverage of full vaccination comparing with other countries, may be due to armed conflict and security problems that vaccinators cannot to go each area. A study (21) that analyzed reports of infant immunization from 331 districts across 7 regions of Afghanistan between 2000 and 2003 indicated a significant negative association between lack of security in the region and achievement of high coverage of vaccination. Also low coverage suggesting that full vaccination remains a challenge for developing countries. Worldwide, more progress is needed on achievement of full vaccination coverage endorsed by the WHO and UNICEF, to increase and sustain national vaccination coverage to at least 90% by 2015 (16).

According to this study, BCG-Measles drop-out rate was 22.0% (15.9% with card only) and Penta1 - Penta3 drop-out rate was 18.8% (12.6% with card only) which indicates poor performance of the immunization services in the research area (Table 4.5.4). Measles vaccine had the lowest coverage rate of 70.9% (49.8% with card only). The proportion of children received no vaccines at all was low (7.3%) and the coverage of BCG vaccination was high (90.8%), could indicate that the system of delivering vaccination at or close to birth works well. However, coverage of later vaccines such as measles vaccine given at 9 months was much lower, could indicate that challenges still exist in follow-up of children throughout the immunization schedule. Several other studies in developing countries have found a similar pattern with a drop-out in both

measles and Penta-3 vaccine coverage despite high BCG coverage, indicating that drop-out is a common challenge (78 and 79).

In this study, the main place of vaccination was health centers especially for measles vaccine (65.8%). Among the vaccinated children almost half of them were vaccinated at the health centers, and out-reach was ranked in second place. Immunization is a community-based health intervention and children must receive the service at the primary level of health services delivery system. Only for BCG vaccine, the second place of vaccination was hospital, that is may be due to the child delivery at hospital, since BCG vaccine is given soon after birth. Other studies from Turkey and Pakistan also showed that community health centers are the main place of vaccination (75, 80) as in this study.

5.6. Factors related to the vaccination status of the children

Vaccination cards are considered a quality measure in vaccination services and are extremely important to obtain reliable information about vaccination history.

Of the children participated in this study, only 59.4% had their vaccination cards. Of the total 882 children, 48.9% by vaccination card and 20.8% by mother's recall were fully vaccinated (Table 4.5.5). In another study from rural Kenya, vaccination cards were available for 86% of children and similarly to this study findings, for all vaccines coverage was higher for children with vaccine cards than for children without vaccine cards (81).

The relationship between vaccination status and the availability of vaccination record documents suggests three interpretations; 1) Recall bias: the eligible age group for the study included children who had already left the immunization program. Accurate recall by parents of events that took place almost a year before may, in some cases, be compromised. 2): Children of parents who lost immunization documents may not be accepted at vaccination sessions. In many rural areas health workers may not vaccinate children who do not have vaccination cards. 3): Maternal education, family

size, and economic conditions affect the ability of mother to keep immunization record in good conditions (Table 4.5.2).

According to this study, of the male children 72.7% and of the female children 66.3% were fully vaccinated and the difference was not statistically significant (Table 4.6.1). Also previous studies on child vaccination did not report significant differences by gender (11, 32, 82-84). When vaccination status considered in to two groups as "full-vaccinated" or "not", sex was found as associated with fully vaccinated status with male being more likely to be fully vaccinated than females (p=.037). There is a tradition of sex preference in Afghanistan and this finding may thus reflect this tradition of sex preference in providing proper care for male children including the decision to vaccinate a child. Similar to other studies (11, 32, 82-84), child age was not significantly associated with full vaccination status, though children at late ages e.g. at age interval 21-23 months were more fully vaccinated (74.2%) than others. These findings could indicate that children are more likely to receive vaccines by increasing time period and have opportunity to complete their vaccines.

In this study, it is found that family size was significantly associated with full vaccination status. By increasing number of family members, the number of fully-vaccinated children was decreased. This difference was observed tremendously between the families with less than 7 persons and with more than 15 persons (Table 4.6.1). A study from Pakistan (80) and a study from Burkina Faso (85) also showed the association between the family size and vaccination status of the children. The main reason for this situation could be, un-equally distributed responsibilities and competencies in the family. Most of the families in Afghanistan with large number of family members are extended families. As it is mentioned above in this type of families responsibilities and competencies are not equally distributed, and are limited within the family members. Hence, mothers cannot go out without the permission of the family ruler (mostly father-in law or mother-in law), and mothers in these families live with economical violence, they cannot get the money easily and spend it as they want. This may also lead to low rates of full-vaccination coverage.

Maternal age was not significantly associated with the children's vaccination status (Table 4.6.2). A study from Uganda (86) showed minor differences across age groups of mothers, the percentage of fully-vaccinated children increased with the increasing of mother's age: children whose mothers were in 45-49 years age group were more fully-vaccinated compared with children whose mothers were in the 15-19 years age group (86). In this study children of younger (≤19 years) and older mothers (≥35 years) were less likely to be fully vaccinated (50.0% and 58.2% respectively) than the others. Younger and older mothers might not give proper attention to their children as other mothers, since younger mothers maybe have less experience and older mothers are maybe too busy due to the greater number of children alive.

Number of parity was significantly associated with the children's vaccination status (Table 4.6.2). High number of pregnancies reflects the high number of live children. In this study by increasing the number of parity, decrease the number of fully-vaccinated children. This may be due to women with many under-five children face a higher burden of care and may not be able to take their children for vaccination services. Other studies from low and middle income countries have also found negative association between parity and fully-vaccinated status of the children (11, 82-83, 87).

The working status of the mothers was enormously associated with the vaccination status of the children (Table 4.6.2). Children of the working mothers were hundred percent fully vaccinated (it should be remembered that only 4.8% of the mothers were employed at the study time). Working status had a direct relation with the educational status of the mothers. Also children of the mothers who were rated their economic status as "good", were more likely to be fully vaccinated (86.9%) than children of mothers with average and poor economic status (71.8% and 55.7% respectively). Non-uptake of vaccination can be a consequence of either lack of acceptance or willingness but inability to access vaccination services, e.g. due to associated costs. Even in a system where vaccination is free, the indirect costs such as transport and opportunity costs may be a deterrent for some mothers to get their children vaccinated, despite general acceptance and robust provision of vaccination services (88).

Maternal education was one of the factors that were significantly associated with vaccination status (Table 4.6.3). In Kama District, the proportions of fully vaccinated children of mothers who had attained secondary and high school education or above were 95.6% and 100.0% respectively, which is higher than those who had lower educational level (88.0%) and those with no formal education (64.3%). Paternal education was also significantly associated with vaccination status; the proportions of fully-vaccinated children of fathers who had attained secondary and high school education or above were 77.2% and 93.3% respectively, which is higher than those who had lower educational level (67.1%) and those with no formal education (61.1%). This association is consistent with findings of several previous studies on parent's education (especially maternal education) and completion of vaccination series (78, 82, 84-85, 89-90). Education increases awareness on the role of vaccination services, and such awareness are important in influencing use of vaccination services.

In this study it is found that mother's health seeking behavior is significantly associated with vaccination status of the children (Table 4.6.4). The findings indicate that uptake of prenatal, natal, and post-natal care services and uptake of maternal TT vaccine increases the chances that mothers will access vaccination services. As observed in previous studies (32, 78, 82-85, 89, 91), use of antenatal care, delivery in health institution and use of postnatal care was significantly associated with completing childhood vaccination. In this study it is found that children of mothers with at least one antenatal visit were more fully vaccinated (82.0%) than children of mothers with no antenatal visit (59.1%); children delivered at health facilities were more fully vaccinated (82.0%) than children delivered at home (58.9%) and children of mothers with at least one postnatal visit were also more fully vaccinated (82.4%) than children of mothers with no postnatal visit (65.8%). TT vaccination of the mothers as indicated in other studies (32, 83-86) was associated with vaccination status of their children. Children of mothers who were completed the first basic five doses of TT vaccine were more fully vaccinated (87.7%) than children of mothers who had less than five doses (55.6%) or never received TT vaccine (23.5%).

The explanations related to these may be that the use of antenatal and postnatal care could encourage the use of subsequent maternal and child health services including vaccination; mothers who give birth at health facility could get more information on vaccination, and most of the time the first dose of vaccination is given just after birth. Receiving TT vaccination also give a chance for mothers to get more information on vaccines and could encourage them to take their children as well as themselves for vaccination.

Although majority of the mothers had an accurate idea about the objectives of vaccination (about 85.7% of the mothers know that vaccination is to prevent disease) however they had no detailed information on vaccines and vaccination e.g. information on VPDs and starting and ending age for childhood vaccination. Children of the mothers who participated in this study and had some information on vaccines e.g. knew the importance of vaccination, could name some VPDs, and could state the correct age for childhood vaccination, were significantly more fully vaccinated than the children of mothers who had no information (Table 4.6.5). Previous studies (92, 93) indicated that mothers who have enough information on vaccination and vaccines well take their children for complete vaccination series.

In this study, children of the mothers who rated immunization services in their residential area as "good" were more fully-vaccinated (83.6%) compared to the children whose mother rated as "bad" (15.8%). Parent satisfaction is very important for the utilization of vaccination services. A study from Guatemala (94) showed that positive opinion of the respondents about vaccination services made their children to be more fully vaccinated.

As a limitation of this study, distance between the households and health facilities was not asked. To estimate the relation of distance with vaccination status, all the sampled twelve clusters (villages) were divided in to two groups (as mentioned before in Findings; 4.6.5. Closeness to the Health Centers), villages within and without health centers, and then were assumed as close and far from the health centers. The

percentage of fully vaccinated children was significantly (p=.027) higher in the villages which were close to the health centers (76.6%), than the other villages (68.3%). Studies from Tanzania (95), Malawi (96), Nigeria (97), and Papua New Guinea (98), all indicated that travel time to health facilities was a barrier to the receipt of all infant vaccines. Studies from more densely populated areas such as Kenya found no association between the coverage of any infant vaccines and travel time to health facilities (81, 85, 99).

Factors which were predictors of fully vaccinated status of the children in Kama District identified as; male sex, small family size, maternal education, paternal education, mother's knowing importance of vaccination, receiving basic five doses of TT vaccine by mother, and good or not too bad opinion of the mother about immunization services in the area (Table 4.6.7). This finding is consistent with the study done in Central Ethiopia (32) that; presence of maternal education, delivery at health institution, presence of mother's knowledge on vaccines and vaccination, presence of antenatal care visits and receiving TT vaccination by mother are predictive factors of full-vaccination. Almost the same figure of predictive factors was presented in many studies in different parts of the world (26-31). In some studies (7, 26, 33, 100) additional to this study findings child age, maternal age number of living children, and income were also the predictive factors of fully-vaccinated status of the children.

5.7. Common Reasons for Non-vaccination

Information on coverage and reasons for non-vaccination is vital for the improvement of vaccination programs. The mothers mentioned the following reasons for their children's non-vaccination status: "family problems" (25.6%); "rumors on vaccines" (16.9%); "fear of side effects" (16.6%); "disease of the child resulting not bring for vaccination" (8.5%); "no faith on vaccination" (6.5%); "absence of vaccinator" (5.1%); "busyness of the mother" (3.8%); "disease of the child resulting not vaccination by the caregiver" (3.0%); "unaware of need for 2^{nd} or 3^{rd} doses" (2.5%); "farness the place of vaccination" (2.2%); "unawareness of need for vaccination" (0.2%) and

"specific reason was not given by mothers" (9.1%), (Annex 5, Table 1). When we classified the reasons for non-vaccination according to WHO Immunization Coverage Survey (as mentioned in methodology, part 3.7 Terms and Criteria), the main reason was "Obstacles" (48.2%); followed by "Lack of motivation" (23.4%); and "Lack of information" (19.3%), (Annex 5, Table 2). Some of the mothers (9.1%) did not mention a specific reason for not taking their children for vaccination. These reasons for non-vaccination were similar to the reasons recorded in other studies and seemed to be related with incorrect knowledge and educational status of the mothers. In Nigeria (101), completeness of vaccination was significantly correlated with mother's knowledge about vaccination. In Haiti (76), reasons for under-vaccination included "insufficient time to reach the vaccination location" (24.8%), "having a child who was ill" (13.8%), and "not knowing when, or forgetting, to have the child vaccinated" (12.8%). In a study from India (102) the major reasons for failure of vaccination were; "child being ill and hence not brought to the center for vaccination", "unaware of the need for vaccination", "place of vaccination being too far", "no faith in vaccination", "unaware of the need to return for 2nd and 3rd dose", "mother being too busy", "fear of side reactions", and "wrong ideas about vaccination".

6. CONCLUSION AND RECOMMENDATIONS

The main objective of the study was to assess the vaccination status of children (fully, partially, and non-vaccinated) aged 12-23 months, in Kama District and the factors associated with vaccination status.

Based on the findings of the study, the following conclusions are reached;

1. The result of this study has clearly indicated that mothers in Kama District have improved on taking their children for vaccination, compared to previous reports. Full vaccination coverage among children aged 12-23 months in Kama District is 69.7%. This level of coverage is good since it has exceeded the national coverage level of 30% as prescribed by Afghanistan Multiple Indicator Cluster Survey (AMICS) in 2010-2011.
2. However the challenges still exist are; partially vaccinated children are 23.0%, and they are children who has defaulted the routine immunization series. The drop-out rate between BCG and measles vaccine is 22.0% (15.9% with card only) and between Penta1 - Penta3 is 18.8% (12.6% with card only) which indicates poor performance of the immunization services in the district. The drop-out rate is highly unacceptable because it is above than 10 %. The second challenge is that almost one in fourteen children (7.3%) has received none of the recommended vaccines.
3. The main place of vaccination was health centers especially for measles vaccine (65.8%). Among the vaccinated children almost half of them were vaccinated at the health centers, and out-reach was ranked as second place of vaccination.
4. Common source of information on vaccines and vaccination was health personal (74.4%) followed by mass media (41.2%).
5. Characteristics of the mother e.g. education, number of parity and living children, working and economic status, partner (child's father) education; and family size are related factors with vaccination status of the children.
6. Utilization of maternal health services by mothers e.g. antenatal care visits, delivery at health facility, postnatal care visits, TT vaccination; and even mother's knowledge

on vaccines and vaccination are important factors to accomplish childhood immunization schedule.

7. Factors identified as the predictors of fully vaccinated status of the children in Kama District are; male sex, small family size, maternal education, paternal education, mother's knowing importance of vaccination, receiving basic five doses of TT vaccine by mother, and good or not too bad opinion of the mother about immunization services in the area.
8. The main reason for non-vaccination of the children is ″Obstacle″ (48.2%), followed by ″Lack of motivation″ (23.4%) and ″Lack of information″ (19.3%). Non-compliance to vaccination schedule was attributed to obstacle such as; family problems (including illness of mother, absence of mother during out-reach, restriction of mothers on going to outdoor), mother too busy, place of vaccination too far, child ill- not brought for vaccination, child ill- brought but not given vaccination and vaccinator absent.

RECOMMENDATIONS

In line with the conclusions drawn, the following recommendations are being made to improve EPI service utilization in Kama District.

1. More attention should be given to public education if high coverage levels are to be achieved and maintained. Health personnel should focus on vaccination during their health education activities.
2. Health personal should encourage mothers not to lose vaccination cards through the health education activities and even in child vaccination time.
3. Immunization staff should embark on routine education campaigns stressing the total number of times mothers need to visit the vaccinators to complete vaccination series of their children.
4. One frequently reason found for non-vaccination was "the child was ill". It is important to educate parents about accurate reasons for non-vaccination and stay on the use of mass media may help in such activities.

5. The number of immunization staff should be increased in order to strengthen the out-reach activities for easily access of the mothers to the immunization services.
6. District EPI Management Team (DEMT) should provide trainings and refreshment courses for immunization staff in regular time interval to improve the immunization program activities.
7. DEMT should solicit for funds to allow immunization staff to organize mop-up for mothers who have not gotten their children for full-vaccination.
8. Adequate motorbikes should be made available by the DEMT to enhance the movements of vaccinators who launch out-reach services and home visits exercise.
9. DEMT should provide incentive packages for immunization staff who work well, also allowances and accommodation should disburse in time to motivate staffs.
10. DEMT should work with community and religious leaders so to improve the uptake of vaccines.
11. Afghanistan MoPH should improve the Supplemental immunization activities and conduct vaccination campaign frequently. Strengthening the maternal health care services might increase the uptake of immunization services.
12. Education programs that can target poor and uneducated people should be put in place so that they are able to make informed decisions regarding vaccination of their children.
13. Public population should pay attention for education, especially women education. They should support their daughters/sisters and make opportunity for them to be educated.
14. Finally we emphasize the general need for increased research on childhood immunizations in Afghanistan. While this analysis is useful for determining vaccination coverage and factors associated with coverage, further qualitative research is needed to better understand why differences exist in different groups of the population and what barriers prevent full-vaccination of the children.

7. REFERENCES

1. Stern A M, and Markel H. The History of Vaccines and Immunization: Familiar Patterns, New Challenges. *Health Affairs*, 24, no.3 (2005): 611-621. doi: 10.1377/hlthaff.24.3.611.

2. Tarant M and Thomson N. Secrets to success: A qualitative study of perceptions of childhood immunization in highly immunized population. *Journal of Pediatrics and Child Health* 2008, 44: 541-547. doi: 10. 1111/j.1440-1754. 2008. 01334.x.

3. Hall JJ, Taylor R: Health for all beyond 2000: the demise of the Alma-Ata Declaration and primary health care in developing countries. *Med Journal* 2003, 178(1):17–20.

4. U. N. S. Division, "Official list of MDG indicators," 2008. Available from; **http://unstats.un.org/unsd/mdg/Host.aspx?Content=Indicators/OfficialList.htm.** [Accessed 07 April 2014].

5. Gaskin P S, Nielsen A L, Willie D, and Durant T C. Review Article Early Childhood Nutritional Status in CARICOM Countries: An Overview with respect to Five Nutrition Related Millennium Development Goals. *Journal of Environmental and Public Health*, Volume 2014, Article ID 580928.

6. Payne S, Townend J, Jasseh M, Lowe Jallow Y and Kampmann B. Achieving comprehensive childhood immunization: an analysis of obstacles and opportunities in The Gambia. *Health Policy Plan*. Mar 2014; 29(2): 193–203. doi: 10.1093/heapol/czt004.

7. Wiysonge CS, Uthman OA, Ndumbe PM, and Hussey GD. Individual and Contextual Factors Associated With Low Childhood Immunization Coverage in Sub-Saharan Africa : A Multilevel Analysis. *PLoS ONE* 2012, 7 (5): e37905. doi: 10.1371/journal.pone.0037905.

8. WHO. vaccine-preventable diseases: monitoring system–2010 global summary. Geneva, Switzerland: World Health Organization 2010. Available from;

whqlibdoc.who.int/hq/2010/WHO_IVB_2010_eng.pdf?ua=1. [Accessed 20 January 2014].

9. Rutherford ME, Dockerty JD, Jasseh M, et al. Preventive measures in infancy to reduce under-five mortality: a case-control study in the Gambia. *Tropical Medicine and International Health* 2009;14:149–55.

10. Wiysonge CS, Uthman O, Ndumbe PM, Hussey GD. A bibliometric analysis of childhood immunizations research productivity in Africa since the onset of the expanded program on immunizations in 1974. *BMC Med* 2013;14:66. doi: 10.1186/1741-7015-11-66.

11. Okwaraji YB, Mulholland K, Schellenberg JRMA, Andarge G, Admassu M and Edmond KM. The association between travel time to health facilities and childhood vaccine coverage in rural Ethiopia. A community based cross sectional study. *BMC Public Health* 2012; 12(476). doi: 10.1186/1471-2458-12-476.

12. Barros AJD, Ronsmans C, Axelson H. Equity in maternal, newborn, and child health interventions in Countdown to 2015: a retrospective review of survey data from 54 countries. *Lancet* 2012;379:1225–1233.

13. Machingaidze S, Wiysonge CS, Hussey GD. Strengthening the expanded programme of immunisations- looking beyond 2015. *PLoS Med* 2013; 14(3):e100405.

14. Hardon A, Blume S. Shifts in global immunisation goals (1984_2004): unfinished agendas and mixed results. *Social Science Med* 2005, 60: 345_56.

15. Burton A, Kowalski R, Gacic-Dobo M, Karimov R and David B: A Formal Representation of the WHO and UNICEF Estimates of National Immunization Coverage: A Computational Logic Approach. *PLoS One* 2012; 7(10): e47806. doi: 10.1371/journal.pone.0047806.

16. WHO, UNICEF. Global immunization vision and strategy 2006_2015. (2005) Report No.: WHO/IVB/05.05. Geneva: World Health Organization. Available from; **www.who.int/vaccines-documents/.** [Accessed 23 July 2014].

17. WHO. Global Vaccination Coverage; Weakly Epidemiological Record (WER), 1st November 2013, vol. 88, 44-45 (pp. 477–488). Available from: **http://www.who.int/wer/2013/wer8844_45.pdf** [Accessed 25 April 2014].

18. Ministry of Public Health-Afghanistan, General Directorate of Preventive Medicine and PHC, National EPI Directorate. *NATIONAL EPI POLICY 2005*. Available from: **http://moph.gov.af/en/documents?page=3** [Accessed Jan 2014]

19. Central Statistics Organisation (CSO) and UNICEF (2012). Afghanistan Multiple Indicator Cluster Survey 2010-2011: Final Report. Kabul: *Central Statistics Organisation (CSO) and UNICEF*. Available from **http://reliefweb.int/sites/reliefweb.int/files/resources/AMICS-Jun24-2012-FINAL.pdf** [Accessed 08 August 2014].

20. Ministry of Public Health-Afghanistan, Department of HMIS. Afghanistan health indicators, *Fact Sheet* 2012. Available from; **http://moph.gov.af/Content/Media/Documents/AfghHealthIndicatorsFactsheetwithnotes20121420131047091155 3325325. pdf.** [Accessed on 24 April 2014]

21. Mashal T, Nakamura K, Kizuki M, Seino K, and Takano T, Impact of conflict on infant immunization coverage in Afghanistan: a countrywide study 2000–2003. *International journal of Health Geographic* 2007, 6(1): 23. doi: 10.1 186/1476-072X-6-23.

22. Ministry of Public Health-Afghanistan. Health Economics and Financing Directorate. *Health Financing Policy* 2012-2020 Final. Available from **http://moph.gov.af/Content/Media/Documents/HealthFinancingPolicy2012-2020EnglishFinal17420131330131955332 5325.pdf** [Accessed 22 April 2014].

23. World Bank Projects: Afghanistan Health Sector Emergency Reconstruction and Development project. Available from **http://www.rbfhealth.org/content/Afghanistan.** [Accessed 12 December 2013].

24. Ministry of Public Health-Afghanistan, General Directorate of Planning and Policy, Department of Health Management Information System. *Third Quarter*

HMIS Report, January 2013. Avialale: **http://moph.gov.af/Content/Media/ Documents/ ThirdQ1391 HMISReport Jan 2013 173201313384511455332532 5.pdf** [Accessed on 19 May 2014].

25. O'Reilly KM, Durry E, Islam ul O, Quddus A, Abid N, Mir TP, Tangermann RH, Aylward RB and Grasslya NC. The effect of mass immunization campaigns and new oral poliovirus vaccines on the incidence of poliomyelitis in Pakistan and Afghanistan, 2001–11: a retrospective analysis. *Lancet* 2012; 380(9840): 491–498. doi: 10.1016/S0140-6736(12)60648-5.

26. Sia D, Fournier P, François JK, and Sondo Bk. Rates of coverage and determinates of Complete Vaccination Of Children in rural areas of Burkina Faso (1998-2003). *BMC Public Health* 2009, 9:416. doi: 10.1186/1471-2458-9-416.

27. Poorolajal J, Khazaei S, Kouschlou Z, Bathae SJ, and Zahiri A. Delayed vaccination and related predictors among infants. *Iranian J Public Health* 2012, 41(10): 65-71.

28. Babirye N J, Engebrestsen IM.S, Makumbi F, Fadnes L.T, Wamani H, Tylleskar T, and Nuwaha F. Timeliness of childhood Vaccinations in Kampala Uganda: A Community – Based Cross- sectional Study. *PLoS ONE* 2012, 7(4): e35432.

29. Ryman T K, Dietz V, and Cairns K L. Too little but not late: Results of literature review to improve routine immunization programs in developing countries. *BMC Health Service Research* 2008, 8: 134. doi:10.1186/1472-6963-8-134.

30. Rainey J J, Watkins M, Ryman T K, Sandhu P, Bo A, and Banerjee K. Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: findings from a systematic review of the published literatures, 1999-2009. *Vaccine* 2011, 29(46): 8215-8221.

31. Torun D S and Bakirci N. vaccination coverage and reasons for non-vaccination in a district of Istanbul. *BMC Public Health* 2006, 6(1): 125. doi: 10.1186/1471-2458-6-125.

32. Etana B and Deressa W. Factors associated with complete immunization coverage in children aged 12-23 months in Ambo Woreda, Central Ethiopia. *BMC Public Health* 2012, 12:566.

33. Maina LC, Karanja S, and Kombich J. Immunization coverage and its determinants among children aged 12-23 months in a peri-urban area of kenya. *Pan African Medical Journal* 2013, 14:3. doi:10.11604/pamj.2013.14.3.2181.

34. Clements CJ, Watkins M, de Quadros C, Biellik R, Hadler J, McFarland D, Steinglass R, Luman E, Hennessey K, Dietz V. Researching routine immunization-do we know what we don't know? *Vaccine* 2011;29:8477–8482. doi: 10.1016/j.vaccine.2011.08.048.

35. Illiyas – Shah – Ansar's. *Text Book of Public Health and Community Medicine*, Immunology and immunization, Chapter no 43, (2008): 643-653. ISBN: 969-8261-26-5.

36. Park. K. Park's *Textbook of Preventive and Social Medicine*, Infectious diseases epidemiology, Host factors, Immunity and immunizing agents, Chapter no 03, (2007-2008): 85-108. ISBN: 81-901282-8-0.

37. CDC (center for disease control and prevention). Department of Health and Human Services, Immunity Types. Available from **http://www.cdc.gov/vaccines/vac-gen/immunity-types.htm**. [Accessed 25 December 2013].

38. VACCINE FACT BOOK 2012: Basic Concept of Vaccination. Available from **http://www.phrmajp.org/archives/pdf/vaccinefactbook2012/en/1_Basic_Concept_of_Vaccination.pdf** [Accessed 25 December 2013].

39. IAC (Immunization Action Coalition), Vaccine Timeline. Historic Dates and Events Related to Vaccines and Immunization. Available from **http://www.immunize.org/timeline**/ [Accessed 10 July2014].

40. Henderson DA, "Edward Jenner's Vaccine," Public Health Reports 112, no. 2 (1997): 116–121; and Williams G, "WHO—The Days of the Mass Campaigns, "*World Health Forum 9, no. 1* (1988): 7–23.

41. NIH (National Institute of Health), NIAID (National Institute of Allergy and Infectious Diseases). Health and Research Topics, Vaccines. Available from **http://www.niaid.nih.gov** [Accessed 25 December 2013].

42. Handbook for vaccine and cold chain handlers. New Delhi: Ministry of Health and Family Welfare; 2010. Available from: **http://www.unicef.org/india/Cold_chain_ book_Final_(Corrected19-04-10).pdf** [Accessed 20 June 2014].

43. Omer S B, Salmon D A, Orenstein W A, and Neal Halsey N. Vaccine Refusal, Mandatory Immunization, and the Risks of Vaccine-Preventable Diseases. The *New England Journal of Med* 2009; 360:1981-8.9.

44. Kaddar M, Schmitt S, Makinen M, Milstien J. Global support for new vaccine implementation in middle-income countries. *Vaccine* 2013;31 Suppl 2:B81–96. http://dx.doi.org/10.1016/j.vaccine.2012.11.085 pmid: 23598496.

45. WHO. Immunization, Vaccines and Biological, immunization service delivery. Available from **http://www.who.int/immunizationdelivery/en**/ [Accessed 15 November 2013].

46. UNICEF, WHO. Expanding Immunization Coverage 2011. **http://www.unicef.org/immunization/indexcoverage.html** [Accessed 26 December 2013].

47. Murhekar MV, Dutta S, Kapoor AN, Bitragunta S, Dodum R, et al. Frequent exposure to suboptimal temperatures in vaccine cold-chain system in India: results of temperature monitoring in 10 states. Bull World Health Organ 2013; 91:906-913. doi: http://dx.doi.org/10.2471/BLT.13.119974.

48. Humphreys G. Vaccination: rattling the supply chain. *Bull World Health Organ* 2011; 89: 324-5 http://dx.doi.org/10.2471/BLT.11.030511 pmid: 21556298.

49. Sabot O, Yadav P, Zaffran M. Maximizing every dose and dollar: the imperative of efficiency in vaccine delivery. Seattle: *National Bureau of Asian Research* 2011. Available from: **http://www.nbr.org/downloads/pdfs/CHA/CHA_MazimizingEvery DoseandDollar** [Accessed 16 March 2014].

50. Lydon P, Zipursky S, Tevi-Benissan C, Djingarey MH, Gbedonou P, et al. Economic benefits of keeping vaccines at ambient temperature during mass vaccination: the case of meningitis A vaccine in Chad. *Bull World Health Organ* 2014; 92:86-92. doi: http://dx.doi.org/10.2471/BLT.13.123471.

51. Central statistics organization (CSO)-Afghanistan. *Statistical Year Book 2012-2013*, Area and Administrative Population. Available from; **http://cso.gov.af/Content/files/Area%20and%20Administrative%20and%20Population.pdf.** [Accessed 28 March 2014].

52. Ministry of Rural Rehabilitation and Development (MRRD)-Afghanistan, National Area Based Development Program, *Nangarhar Provincial Profile*. Available from **http://mrrd.gov.af/en/page/69/430.** [Accessed on 21 Jun 2014].

53. Singh B, Vashisht BM, Panda M and Khanna P. Study to find out the coverage evaluation and drop-out rates of different vaccines in urban area of Rohtak city in Haryana. *International Journal of Basic and Applied Medical Sciences* 2013; Vol.3(2),223-229.

54. World Bank; Afghanistan, age at first marriage, female. Updated on 05 May 2014. Avialable from; **http://api.worldbank.org/countries/AFG/indicators/SP.DYN.SMAM.** [Accessed 15 August 2014].

55. Women and Men in Afghanistan, the last hand book on Jun 2012. Available from **http://cso.gov.af/Content/files/Last%20HANDBOOK%20ON%20WOMEN%20AND%20MEN%20IN%20AFGHANISTAN_JUNE%202012%20)1.pdf.** [Accessed 10 August 2014].

56. Pakistan Demographic and Health Survey 2012-2013. National Institute of Population Studies, Islamabad, Pakistan 2013. Available from; **http://www.nips.org.pk/abstract_files/PDHS%20Final%20Report%20as%20of%20Jan%2022-2014.pdf.** [Accessed 18 August 2014].

57. Turkish Demographic and Health Survey (TDHS) 2008. Hacettepe University, institute of population studies, Oct 2009. Publishing no: NEF-HU.09.01; ISBN 978-975-491-274-6. Avialable from; **http://www.hips.hacettepe.edu.tr/tnsa2008/.** [Accessed 10 July 2014].

58. Bofarraj M. Knowledge, attitude and practices of mothers regarding immunization of infants and preschool children at Al-Beida City, Libya 2008. *Egypt J Pediatric Allergy Immunology* 2011; 9(1):29-34.

59. Jones AM, Omer SB, Bednarczyk RB, Halsey NA, Moulton LH, and Salmon DA. Parents' Source of Vaccine Information and Impact on Vaccine Attitudes, Beliefs, and Nonmedical Exemptions. *Adv Prev Med* 2012; 2012: 932741. doi: 10.1155/2012/932741.

60. Abdel-Rahman HA. Maternal satisfaction about childhood Immunization In primary health care center, Egypt. *Peer J Pre-Prints* 2013. Available from **https://peerj.com/preprints/171v1/**; doi: 10.7287/peerj.preprints.171v1.

61. Ministry of Public Health-Afghanistan. General Directorate of Preventive Medicine, Directorate of Communicable Diseases Control, National Tuberculosis Control Program, *Annual Report* 2012. **http://www.stoptbafghanistan.org/wp-content/uploads/2009/11/Annual_Report_2012_NTP.pdf.** [Accessed 11 July 2014].

62. Srinivasan R, Menon L, Stevens P, Campbell I, Alfaham M: Ethnic differences in selective neonatal BCG immunization: white British children miss out. *Thorax* 2006, 61(3):247–249.

63. Ndirangu J, Bärnighausen T, Tanser F, Tint K, Newell ML: Levels of childhood vaccination coverage and the impact of maternal HIV status on child vaccination

status in rural KwaZulu-Natal, South Africa. *Trop Med Int Health* 2009, 14(11):1383–1393.

64. Bangladesh Demographic and Health Survey 2011. National Institute of Population Research and Training, Dhaka, Bangladesh 2013. Available from; **http://dhsprogram.com/pubs/pdf/FR265/FR265.pdf.** [Accessed 19 Jun 2014].

65. Tajikistan Demographic and Health Survey-2012. Statistical Agency under the President of the Republic of Tajikistan 2013. Available from; **http://dhsprogram.com/pubs/pdf/FR279/FR279.pdf.** [Accessed 18 May 2014].

66. WHO, UNICEF and The World Bank. State of the World's Vaccines and Immunization. 3rd. Geneva: *World Health Organization* 2009. Available from **http://whqlibdoc.who.int/publications/2009/9789241563864_eng.pdf.** [Accessed on 17 July 2014].

67. WHO & UNICEF. Global Immunization Data. 2012. Available from **http://www.unicef.org/PDFs/Global_Immunization_Data.pdf.** [Accessed 9 January 2014].

68. Rahman M, Obaida-Nasrin S. Factors affecting acceptance of complete immunization coverage of children under five years in rural Bangladesh. *Salud Publica Mex* 2010;52:134-140.

69. Smith P J, Singleton J A. Vaccination Coverage Estimates for Selected Counties: Achievement of Healthy People 2010 Goals and Association with Indices of Access to Care, Economic Conditions, and Demographic Composition. *Public Health Reports* 2008; Volume 123, 155-172.

70. Public Health Agency of Canada. Vaccine Coverage in Canadian Children: Results from the 2011 Childhood National Immunization Coverage Survey. Available from; **http://www.phacaspc.gc.ca/im/nics-enva/vccc-cvec-eng.php.** [Accessed 9 August 2014].

71. Cockman P, Dawson L, Mathur R, Hull S: Improving MMR vaccination rates: herd immunity is a realistic goal. *BMJ* 2011, 343:d5703.

72. Geng XD: Analysis on children timely vaccination coverage and influencing factors of 5 kinds of expanded program for immunization (EPI) vaccine in Dinghai District of Zhoushan Municipal. *Zhongguo Yi Miao He Mian Yi* 2010, 16(2):169–172.

73. Hemat S, Takano T, Kizuki M, Mashal T. Health-care provision factors associated with child immunization coverage in a city centre and a rural area in Kabul, Afghanistan. *Vaccine* 2009;27(21):2823–2829. doi: 10.1016/j.vaccine.2009.02.097.

74. Uddin MJ, Koehlmoos TP, Saha NC, Khan IA, Shamsuzzaman Child immunization coverage in rural hard to reach areas of Bangladesh. *Vaccine* 2010;28:1221–5.

75. Ozcirpici B, Aydin N, Coskun F, Tuzun H and Ozgur S. Vaccination coverage of children aged 12-23 months in Gaziantep, Turkey: comparative results of two studies carried out by lot quality technique: what changed after family medicine? *BMC Public Health* 2014, 14:217.

76. Rainey JJ, Lacapère F, Danovaro-Holliday MC, Mung K, Magloire R, Kananda G, Cadet JR, Lee CE, Chamouillet H, Luman ET: Vaccination coverage in Haiti: results from the 2009 national survey. *Vaccine* 2012, 30(9):1746–1751.

77. Barata RB et al. Socioeconomic inequalities and vaccination coverage: results of an immunisation coverage survey in 27 Brazilian capitals, 2007-2008. *J Epidemiol Community Health* 2012; 66:934e941. doi:10.1136/jech-2011-200341.

78. Mutua MK, Kimani-Murage E, Ettarh RR: Childhood vaccination in informal urban settlements in Nairobi, Kenya: Who gets vaccinated? *BMC Public Health* 2011, 11:6.

79. Sharma R, Desai VK, Kavishvar A. Assessment of immunization status in the slums of Surat by 15 clusters multi indicators cluster survey technique. *Indian Journal of Community Med* 2009;34:152–5.

80. Usman H R et al. Randomized controlled trial to improve childhood immunization adherence in rural Pakistan: redesigned immunization card and maternal education. *Trop Med Int Health* 2011, volume 16(3);334–342. doi:10.1111/j.13653156.2010.02698.x.

81. Moisi JC, Kabuka J, Mitingi D, Levine OS, Scott JA: Spatial and sociodemographic predictors of time-to-immunization in a rural area in Kenya: is equity attainable? *Vaccine* 2010, 28(35):5725–5730.

82. Abuya BA, Onsomu EO, Kimani JK, Moore D. Influence of maternal education on child immunization and stunting in Kenya. *Maternal and child health journal* 2011;15(8):1389–99.

83. Fatiregun AA, Okoro AO. Maternal determinants of complete child immunization among children aged 12-23 months in a southern district of Nigeria. *Vaccine* 2012;30(4):730–6.

84. Sullivan MC, Tegegn A, Tessema F, Galea S, Hadley C. Minding the immunization gap: family characteristics associated with completion rates in rural Ethiopia. *J Community Health* 2010; 35(1):53–9.

85. Sanou A, Simboro S, Kouyate B, Dugas M, Graham J, and Bibeau G. Assessment of factors associated with complete immunization coverage in children aged 12-23 months: a cross-sectional study in Nouna district, Burkina Faso. *BMC Int Health Hum Rights* 2009; 9(Suppl 1): S10. doi: 10.1186/1472-698X-9-S1-S10.

86. Bbaale E. Factors Influencing Childhood Immunization in Uganda. *J HEALTH POPUL NUTR* 2013; 31(1):118-129. ISSN 1606-0997 | $ 5.00+0.20.

87. Wado YD, Afework MF, and Hindin MJ. Childhood vaccination in rural southwestern Ethiopia: the nexus with demographic factors and women's autonomy. *Pan African Medical Journal* 2014; 17(Suppl1):9. doi:10.11694/pamj.supp.2014.17.1.3135.

88. Canavati S, Plugge E, Suwanjatupporn S, Sombatrungiaroen S, Nosten F. Barriers to immunization among children of migrant workers from Myanmar living in Tak province, Thailand. *Bulletin of the World Health Organization* 2011;89:528–31.

89. Nankabirwa V, Tylleskär T, Tumwine J K, and Sommerfelt H. Maternal education is associated with vaccination status of infants less than 6 months in Eastern Uganda: a cohort study. *BMC Pedia* 2010; 10: 92. doi: 10.1186/1471-2431-10-92.

90. Rammohan A, Awofeso N, and Fernandez RC. Paternal education status significantly influences infants' measles vaccination uptake, independent of maternal education status. *BMC Public Health* 2012; 12: 336. doi: 10.1186/1471-2458-12-336.

91. Hu Y, Li Q, Chen E, Chen Y, and Qi X. Determinants of Childhood Immunization Uptake among Socio-Economically Disadvantaged Migrants in East China. *Int J Environ Res Public Health* 2013; 10(7): 2845–2856.

92. Kennedy A, Basket M and Sheedy K. Vaccine Attitudes, Concerns, and Information Sources Reported by Parents of Young Children: Results From the 2009 HealthStyles Survey. *Ame Aca of Pediatrics* 2011; 127; S92; DOI: 10.1542/peds.2010-1722N.

93. Luthy KE, Beckstrand RL, & Peterson NE. Parental Hesitation as a Factor in Delayed Childhood Immunization. *Journal of Pediatric Health Care* 2009. Vol 23(6); 388-393. doi:10.1016/j.pedhc.2008.09.006.

94. Barrera L, Trumbo SP, Alcántara PB, González MV and Holliday MCD. From the parents' perspective: a user-satisfaction survey of immunization services in Guatemala. *BMC Public Health* 2014, 14:231. doi:10.1186/1471-2458-14-231.

95. Armstrong JRM, Mrisho M, Manzi F, Shirima K, Mbuya C, Mushi AK, Ketende SC, Alonso PL, Mshinda H, Tanner M, Schellenberg D. Health and survival of young children in southern Tanzania. *BMC Public Health* 2008;8:194. doi: 10.1186/1471-2458-8-194.

96. Jahn A, Floyd S, Mwinuka V, Mwafilaso J, Mwagomba D, Mkisi RE, Katsulukuta A, Khunga A, Crampin AC, Branson K, McGrath N, Fine PEM. Ascertainment of childhood vaccination histories in northern Malawi. *Trop Med Int Health* 2008;13:129–138. doi: 10.1111/j.1365-3156.2007.01982.x.

97. Abdulraheem IS, Onajole AT, Jimoh AAG, Oladipo AR. Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *J Public Health* 2011;3:194–203.

98. Toikilik S, Tuges G, Lagani J, Wafiware E, Posanai E, Coghlan B, Morgan C, Sweeney R, Miller N, Abramov A, Stewart A, Clements CJ. Are hard-to-reach populations being reached with immunization services? Findings from the 2005 Papua New Guinea national immunization coverage survey. *Vaccine* 2010;28:4673–4679. doi: 10.1016/j.vaccine.2010.04.063.

99. Koumaré AK, Traore D, Haidara F, Sissoko F, Traoré I, Dramé S, Sangaré K, Diakité K, Coulibaly B, Togola B, Maïga A. Evaluation of immunization coverage within the Expanded Program on Immunization in Kita Circle, Mali: a cross-sectional survey. *BMC International Health and Human Rights* 2009; 9(Suppl 1): S13. doi: 10.1186/1472-698X-9-S1-S13.

100. Sheikh A et al. Reasons for non-vaccination in pediatric patients visiting tertiary care centers in polio-prone country. Archives of Public Health 2013, 71:19.

101. Odusanya OO, Alufohai EF, Meurice FP, Ahonkhai VI: Determinants of vaccination coverage in rural Nigeria. *BMC Public Health* 2008, 8:381.

102. Vohra R, Vohra A, Bhardwaj P, Srivastava JP, and Gupta P. Reasons for failure of immunization: A cross-sectional study among 12-23-month-old children of Lucknow, India. *Adv Biomed Res* 2013; 2: 71. doi: 10.4103/2277-9175.115809.

8. ANNEXIS

Annex 1: Questionnaire Form

Cluster Name: _____ Form No: _____
Area Name: _____ Date: / / 2014

ROUTINE VACCINATION COVERAGE AND RELATED FACTORS, AMONG CHILDREN AGED 12 – 23 MONTHS, IN ONE RURAL AREA OF NANGARHAR PROVINCE, AFGHANISTAN.

Dear Participant!
The aim of this study is to assess the vaccination status of children aged 12-23 months who live in the rural areas of Kama, and to identify factors which are related to the vaccination coverage. This study is important for improving immunization services in your district, and thereby for good and healthy future of your children. We do not want to learn your name. All information that you will be given to us will be kept secret and used just for this study purposes.
Thank you for attending and answering the questions completely and sincerely.

Dr. Mohammad Ibrahim Sherzai

Please mark (X), children aged 12-23 months

List of less than three years old children in the household

Name	Sex (male, female)	Age (months)	Eligible children (**X**)

Note: if there is more than one child aged 12-23 months in the household, for each child you should fulfill a separate form without the questions related to the mother/caregiver. But if the mothers/caregivers of children are also different in the same household then separate form should fulfilled for each child completely.

What is your relationship with ……? (Child name)

1. Mother
2. Other (specify) ……..

Attention: If the woman you are interviewing is not the child's own natural mother, then skip Part 1 and fulfill Part 2. But if she is the child's own mother then fulfill Part 1 and skip Part 2.

Part 1 (questions related to the child's mother)

Mother's socio demographic characteristics:

MS1. How old are you? …….. Years

MS2. When did you get married? …… Years ago

MS3. Is this your first marriage?

1. Yes (If the answer is "Yes", then go to **MS6**)
2. No

MS4. How old were you at your first marriage? ……. Years

MS5. How many times have you been married? ……. .Times

MS6. How many times did you get pregnant? ……... Times

MS7. How many children do you have alive? ……. Children

MS8. How many people are living in your household? ……. People

MS9. Do you do somewhere a work with money?

0. No
1. Yes

MS10. What is your job? ……..

MS11. How do you evaluate your economic status?

1. Good
2. Average
3. Poor

MS12. What is your level of education?

0. No education
1. Graduated from Primary school
2. Graduated from Secondary school
3. Graduated from high school
4. Graduated from university
5. Other (specify) …….

MS13. What is your Husband's level of education?

0. No education
1. Graduated from Primary school
2. Graduated from Secondary school
3. Graduated from high school
4. Graduated from university
5. Other (specify) …….

Utilization of health institution by mother:

MU1. How many times did you visit health center, when you were pregnant for…….?

0. No, I did not visit (If the answer is "No", then go to **MU3**)
1. Yes, I visited ……. Times

MU2. With who have had your examination?

1. Doctor
2. Nurse
3. Midwife

MU3. Where have you delivered ……..? (Child name)

1. At hospital/ health center
2. At home
3. At other place (specify) ……

MU4. At the delivery time, who have assisted you?

1. Health staff
2. TBA
3. No body
4. Other: (specify) ……..

MU5. How many times did you visit health center, after delivered ……..?

0. No, I did not visit (If the answer is "No", then go to **MU7**)
1. Yes, I visited …….. times

MU6. With who have had your examination?

1. Doctor
2. Nurse
3. Midwife

MU7. How many times did you receive TT vaccines?

0. No, I did not receive TT vaccines
1. Yes, I received …… times (If the answer is "Yes" then skip **MU8**)

MU8. Why have not you received TT vaccines? …….

Part 2 (If child does not has an own mother, then ask these questions from the child's caregiver)

CG1. Where is the child's own mother? …….

CG2. How old are you? …….. Years

CG3. Are you married?

0. No (If the answer is "NO" then go to **CG5**)
1. Yes

CG4. How many children do you have alive? …… Children

CG5. How many people are living in your household? ……. People

CG6. Do you do somewhere a work with money?

0. No
1. Yes

CG7. What is your job? ……..

CG8. How do you evaluate your economic status?

1. Good
2. Average
3. Poor

CG9. What is your level of education?

0. No education
1. Graduated from Primary school
2. Graduated from Secondary school
3. Graduated from high school
4. Graduated from university
5. Other (specify) …….

CG10. How many times have you received TT vaccines?

0. No I have not received TT vaccines
1. Yes I have received …… times (If the answer is "Yes", then skip **CG11**)

CG11. Why have not you received TT vaccines? …….

Part 3 (Knowledge of mother/caregiver about vaccination)

MC1. Have you heard the term vaccine?

0. No (If the answer is "No" then go to **part 4**)
1. Yes

MC2. According to you, is vaccination important?

0. No
1. Yes

MC3. What are the names of vaccines, you have known?

……

MC4. At which age should start a child vaccination? At …….. Month

MC5. At which age should finish a child vaccination? At …….. Months

MC6. From where have you gotten information about vaccines?

……

MC7. How do you evaluate the immunization services in this area?

1. It is good
2. It is not too bad
3. It is bad
4. No idea
5. Other (specify) ……

Attention: For every "0" code ask Question **V10.**

Part 4 (Vaccination history of the child)

V1.	Vaccination Card	Yes / No		**V10**. Why have not you vaccinated your child?
V2.	BCG	Date/+/0		
		Scar: Yes / No		
		source		
V3.	Penta1	Date/+/0		
		source		
V4.	Penta2	Date/+/0		
		source		
V5.	Penta3	Date/+/0		
		source		
V6.	OPV1	Date/+/0		
		Source		
V7.	OPV2	Date/+/0		
		Source		
V8.	OPV3	Date/+/0		
		Source		
V9.	Measles	Date/+/0		
		Source		

Key.
Date/+/0
Date = Copy date of immunization from card, if available
\+ = Mother reports immunization was given
0 = Immunization not given

Source
OUT (Outreach)
HOS (Hospital)
HC (Health center)
SIA (Supplementary immunization activity/activities)

Note: Penta is a combined vaccine of 5 vaccines (DTP-HepB-Hib)

The impression of interviewer about the interview

1. Fully trustable
2. Moderate
3. Not trustable

Name and Signature of the interviewer ……..

Annex 2. Ethical Permission of the Research Project

Islamic Republic of Afghanistan
Ministry of Higher Education
Nangarhar University
Medical Faculty

Meeting No: 01
Decision No: 08

Date: 26/ 03/ 2014

To: The Health Science Institute, Hacettepe University; Ankara
From: Research Committee of NMF (Nangarhar Medical Faculty)
Subject: Research Project Evaluation Report

Dears!

The thesis proposal of Mohammad Ibrahim Sherzai, under the supervision of Prof Dr. Bahar Guçiz DOĞAN, with a topic of "**ROUTINE VACCINATION COVERAGE AND RELATED FACTORS, AMONG CHILDREN AGED 12-23 MONTHS, IN ONE RURAL AREA OF NANGARHAR PROVINCE, AFGHANISTAN**" is studied in meeting No --01--. Its objectives, approach and methodology is evaluated, it was ethically appropriate and therefore approved by the Research Committee of NMF.

پوهنځی طب
FACULTY OF MEDICINE

Dr Khalid Yar
Dean of Nangarhar Medical Faculty

Annex 3. Calculation of the Drop-out Rates for Major Antigens

The percentage difference in coverage between major antigens is called drop-out or defaulter rate, and it was calculated as follows;

For card plus mother's verbal report:

Drop-out rate between BCG and measles vaccines was;

$$\frac{No.of\ children\ who\ received\ BCG - NO.of\ children\ who\ received\ Measles}{No.of\ children\ who\ received\ BCG}\ X\ 100$$

$$\frac{801 - 625}{801}\ X\ 100 = 21.97\% \cong 22\%$$

And between Penta1 and Penta3 vaccines was;

$$\frac{No.of\ children\ who\ received\ Penta1 - NO.of\ children\ who\ received\ Penta3}{No.of\ children\ who\ received\ Penta1}\ X\ 100$$

$$\frac{794 - 645}{794}\ X\ 100 = 18.8\%$$

For card only:

Drop-out rate between BCG and measles vaccines was;

$$\frac{522 - 439}{522}\ X\ 100 = 15.9\%$$

And between Penta1 and Penta3 was;

$$\frac{523 - 457}{523}\ X\ 100 = 12.6\%$$

Annex 4. Univariate logistic regression analysis for the association between independent variables and full-vaccination status of the children (Kama District-Afghanistan 2014)

Factor (n=882)		**OR (95% CI)**	**p-value**
Closeness to the Health Center (HC)	Far from HC*	1	
	Close to HC	1.52 (1.02-2.28)	0.041
Child Sex	Female*	1	
	Male	1.36 (1.02-1.81)	0.037
Family size	≤6*	1	
	7-9	2.78 (1.48-5.21)	0.001
	10-12	2.77 (1.64-4.66)	<0.001
	13-15	1.75 (1.06-2.88)	0.029
	≥16	1.70 (1.11-2.91)	0.045
Mothers age	≤19*	1	
	20-24	2.06 (0.64-6.62)	.226
	25-29	2.91 (0.92-9.23)	.070
	30-34	2.15 (0.67-6.92)	.194
	=>35	1.45 (0.43-4.94)	.554
First marriage age	≤17*	1	
	≥18	1.30 (0.97-1.75)	.075
No. of marriage	Twice*	1	
	Once	0.90 (0.80-1.01)	.078
No. of Pregnancy	≥7*	1	
	5-6	1.42 (0.90-2.23)	0.136
	3-4	1.89 (1.22-2.91)	0.004
	1-2	2.14 (1.34-3.41)	0.001
No. of Live Children	≥5*	1	
	4	0.83 (0.55-1.25)	0.378
	3	1.69 (1.10-2.59)	0.017
	2	1.43 (0.93-2.19)	0.105
	1	1.73 (0.99-3.01)	0.053
Economic Status	Poor *	1	
	Good	5.29 (2.99-9.36)	<.001
	Average	2.03 (1.47-2.80)	<.001
Maternal Education	Illiterate*		
	Primary school	4.06 (1.99-8.29)	<.001
	Secondary school or above	24.1 (5.89-98.37)	<.001

Annex 4. (Continue) Univariate logistic regression analysis for the association between independent variables and full-vaccination status of the children (Kama District-Afghanistan 2014)

Paternal Education	Illiterate*	1	
	Primary school	1.27 (0.86-1.87)	.0232
	Secondary school	2.11 (1.28-3.47)	.004
	High school or above	8.63 (4.43-16.83)	<.001
Ante Natal Visits	No visit*	1	
	At least one visit	3.14 (2.30-4.29)	<.001
Place of Delivery	Home*	1	
	Health facility	3.18 (2.33-4.35)	<.001
Post Natal visit	No visit*	1	
	At least one visit	2.43 (1.65-3.59)	<.001
Maternal TT	Non-vaccinated*	1	
	1-4 doses	4.06 (1.31-12.65)	.016
	Five doses	23.14 (7.26-73.75)	<.001
Vaccination card	Not-exist*	1	
	Exist	4.38 (3.23-5.95)	<.001
Importance of Vaccination	Mothers don't know*	1	
	Mothers know	9.43 (6.12-14.52)	<.001
Name of VPDs	Mothers don't know*	1	
	Mothers know ≥1	7.47 (4.06-13.73)	<.001
Vaccination starting age	Mothers don't know*	1	
	Mothers know	3.54 (2.62-4.78)	<.001
Vaccination ending age	Mothers don't know*	1	
	Mothers know	3.54 (2.48-5.07)	<.001
Vaccination services evaluation in the area	No-idea*	1	
	Good	8.17 (5.57-12.0)	<.001
	Not too bad	4.55 (3.01-6.89)	<.001
	Bad	0.30 (0.09-1.07)	.064

* Reference category

Annex 5. Reasons for Children's Non-vaccination Status

Table 1. Common reasons for non-vaccination of the children aged 12-23 months (Kama District-Afghanistan, 2014)

Vaccine	Reasons[1]											
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
BCG (n=81)	24 29.6	25 30.9	17 21.0	1 1.2	9 11.1	- -	- -	1 1.2	- -	- -	- -	4 4.9
Penta1 (n=88)	27 30.7	25 28.5	18 20.5	1 1.1	9 10.2	1 1.1	- -	1 1.1	1 1.1	- -	- -	5 5.7
Penta2 (n=126)	35 27.8	25 19.8	28 22.2	7 5.6	9 7.0	6 4.8	2 1.6	3 2.4	2 1.6	2 1.6	- -	7 5.6
Penta3 (n=216)	48 22.2	25 11.6	29 13.4	32 14.8	9 4.2	18 8.3	10 4.6	6 2.8	4 1.9	8 3.7	1 0.5	26 12.0
OPV1 (n= 68)	24 35.3	19 27.9	12 17.6	- -	9 13.2	1 1.5	- -	1 1.5	- -	- -	- -	2 3.0
OPV2 (n=106)	33 31.1	21 19.8	23 21.7	6 5.7	9 8.5	5 4.7	1 0.9	3 2.8	- -	2 1.9	- -	3 2.8
OPV3 (n=180)	47 26.1	21 11.7	25 13.9	28 15.6	9 5.0	15 8.3	7 3.9	5 2.8	- -	6 3.3	- -	17 9.4
Measles (n=237)	44 18.6	25 10.5	31 13.1	19 8.0	9 3.8	10 4.2	22 9.3	13 5.5	21 8.9	6 2.5	1 0.4	36 15.2
Total (%)*	**282 25.6**	**186 16.9**	**183 16.6**	**94 8.5**	**72 6.5**	**56 5.1**	**42 3.8**	**33 3.0**	**28 2.5**	**24 2.2**	**2 0.2**	**100 9.1**

[1] Key for Reasons: A: family problems, B: rumors, C: fear of side effects, D: child ill, not brought for vaccination, E: no faith on vaccination, F: vaccinator absent, G: mother too busy, H: child ill, brought but not given vaccination, I: un-ware of need for 2nd or 3rd doses, J: place of vaccination too far, K: un-ware of need for vaccination, L: un-known reason.

* Column percentages, all other are raw percentages.

Table 2. Common reasons (after grouping) for non-vaccination of the children aged 12-23 months (Kama District-Afghanistan, 2014)

Vaccine	Reasons									
	Obstacles		Lack of motivation		Lack of information		Un-known		Total	
	n	%	n	%	n	%	n	%	n	%
BCG	26	32.1	34	42.0	17	21.0	4	4.9	81	100.0
Penta1	30	34.1	34	38.6	19	21.6	5	5.7	88	100.0
Penta2	55	43.6	34	27.0	30	23.8	7	5.6	126	100.0
Penta3	122	56.5	34	15.7	34	15.8	26	12.0	216	100.0
OPV1	26	38.2	28	41.2	12	17.7	2	2.9	68	100.0
OPV2	50	47.2	30	28.3	23	21.7	3	2.8	106	100.0
OPV3	108	60.0	30	16.7	25	13.9	17	9.4	180	100.0
Measles	114	48.1	34	14.3	53	22.4	36	15.2	237	100.0
Total	**531**	**48.2**	**258**	**23.4**	**213**	**19.3**	**100**	**9.1**	**1102**	**100.0**