2021

Risk Factors Associated with Childhood Vaccination Coverage in Afghanistan

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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2021

Abstract

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MPH, University of Liverpool, 2014

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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May 2021

Abstract

Globally, vaccination is among the most successful and cost-effective public health practices in the prevention of infectious diseases. The purpose of this study was to examine the child, parental, and geographical risk factors that influence childhood vaccination coverage in Afghanistan. The health belief model and socio-ecological model was used in this study as the theoretical framework to examine the effects of these risk factors on vaccination coverage among children in Afghanistan. Univariate, bivariate, and multivariate tests were conducted within the secondary data analysis of the 2015 Afghanistan national Demographic and Health Survey dataset. Of the 32,420 children aged 0 to 5 years, for all vaccines (BCG, DPT, measles, and polio), only 14.2% had complete vaccination, 65% had partial, and 20.8% had no vaccination. Vaccination coverage was significantly related to the region, age of child, and wealth index of parents ($p < 0.001$). Similarly, birth order and ethnicity of child; and age, educational level, and occupation of parents were also significantly related to vaccination coverage ($p < 0.001$). The child's gender was not significantly related to vaccination coverage ($p < 0.597$). Region, age of child, and wealth index of parents were significantly associated with complete vaccination coverage for all vaccines examined at 95% confidence interval in multivariate analysis. Positive social change implications of this study include the evidence found on the identification of the specific risk factors that could be barriers to complete vaccination coverage and other relevant information for stakeholders to achieve sustainable success in complete vaccination coverage in Afghanistan.

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Dedication

To Almighty God, our most beloved Creator, the most beneficent and most merciful; H. H. The Aga Khan IV, my spiritual guide, mentor, and role model; my beloved wife, Sultana Mawani; my beloved maternal and paternal late grandparents; my cherished late father, Mr. Noorali Bhimji Hassam Alibhai Gada Mawani; my beloved mother, Mrs. Kulsum Noorali Mawani; my beloved siblings, Nigar-Sultana and her husband Siraz, Nashrullah and his wife Bilkis, Naznin and her late husband Shiraz, Nashir, Tazeem, and Nizar and his wife Rafika; all my esteemed nieces, nephews, grandnieces, and grandnephew; all aunts and uncles, all extended family members and friends; and our entire beloved global humanity. May God bless you all!

Acknowledgements

I am most grateful to our Lord and Creator, Almighty God, for His beneficence and mercy that allowed me to succeed in the Doctor of Public Health Program through which I was able to learn more about His creation and that the new knowledge gained will be used to achieve positive social impact for the benefit of the global humanity.

I am also very grateful to my beloved wife and all my family members and friends for their steadfast support, enormous sacrifice, constant encouragement, good wishes, and sincere prayers that deeply inspired me to learn more rigorously with a true heart, and simultaneously apply the new knowledge gained to serve my family, my community, my country, and globally.

Finally, my sincere gratitude extends profoundly to my Chair, Dr. Jeanne Connors, the committee, Dr. Claire Robb, the University Research Reviewer, Dr. Chester Jones, the Walden University Librarian, Ms. Julie James, the Form and Style Reviewer, Dr. Rose Gold, Ms. Jennifer Krou, from the Academic Skills Center, and all the Walden University Instructors and staff with whose leadership and guidance my DrPH journey was not only successful, but greatly fulfilling. You are an awesome team! I will always remain grateful for your commitment to academic excellence, guidance, dedication, and mentorship. May God bless you all!

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Section 1: Foundation of the Study and Literature Review

Introduction

Globally, approximately 35 million deaths were prevented between 2000 and 2018 because of vaccination (World Health Organization; WHO, 2019). Furthermore, vaccination may prevent at least 122 million deaths due to infectious diseases among children born between 2000 and 2030 (WHO, 2019). According to United Nations International Children's Emergency Fund (UNICEF; 2019), vaccination is a justified public health practice worldwide in the prevention of many serious infectious childhood diseases.

The WHO established the Extended Program of Immunization (EPI) in 1974 to investigate the vaccination procedures in different regions of world (Shen, Fields, & McQuestion, 2014; WHO, 2015). This program reported the vaccination rates and procedures required to prevent the outbreaks of vaccine preventable diseases (VPDs), especially among young children and infants. Successful vaccination coverage can protect children against serious infectious disease like diphtheria, tetanus, whooping cough, measles, polio, and tuberculosis (Chan, 2014a). The reports of EPI emphasized the weaknesses of health systems towards the vaccination of children of low- and middle-income countries. In 1991, EPI targets of vaccination coverage were to reach the 80% of world vaccination rates, but the coverage is well below that in low-income countries such as Afghanistan (Chan, 2014b; Farzad et al., 2017).

UNICEF reported that the mortality of non-vaccination or failure of follow-up vaccination was estimated to be 29% of children aged 1-59 months, which is preventable and controllable if there were practical steps of vaccination coverages by local health institutes and new vaccination health plans were used (WHO, 2014). The process of routine vaccination coverage is usually delivered in low-income countries through health fixed sites like hospitals and clinics, or it can be proceeded by health professionals in campaigns within 5-15 km from the nearest health facility. The target of reaching out to the people for vaccination purposes was to achieve at least 50% of population (Partapuri, Steinglass, & Sequeira, 2012). Research scholars reported that the importance of strategies used in interventional program for campaigns of vaccination coverages to obtain integrations of health plans as prophylaxis against the health problematic consequences like the increment of morbidity and mortality rates (Wallace, Dietz, & Cairns, 2009). All vaccination programs in most United Nations (UN) countries have supported their surveillance systems to eradicate the infections and minimize the burdens of complications (Castillo-Solórzano et al., 2011).

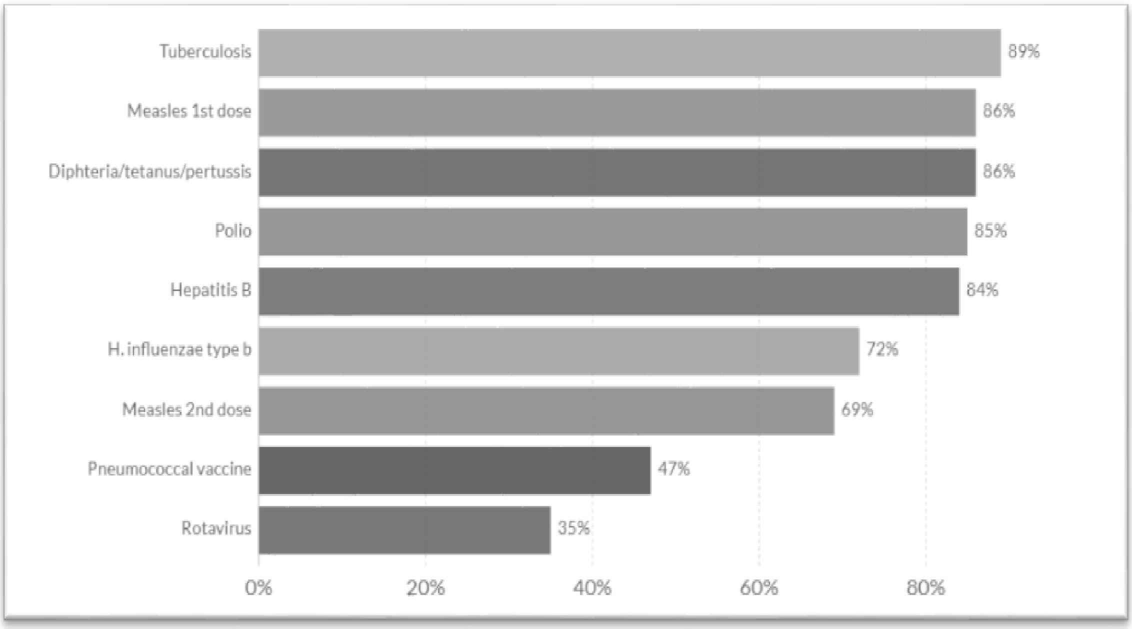
Every year, vaccination is estimated to save 3 million lives of children under the age of 5 years worldwide (Harrison et al., 2020; UNICEF, 2019). Plotkin et al. (2018) noted the use of vaccination as a cost-effective and safe public health practice to prevent global morbidity and mortality related to infectious diseases. Currently, some global vaccination coverages may exceed 80%, but the problem is that there remains insufficient vaccination coverage in many developing countries such as Afghanistan (WHO, 2019). Sufficient vaccination coverage means that the country has fulfilled all the requirements of the full vaccination protocol set by the Expanded Program on Immunization (EPI) to provide universal coverage of childhood vaccination (Harrison et al., 2020).

Problem Statement

According to the United Nations (UN; 2019), progress has slowed or even stagnated in providing sufficient vaccination coverage in many developing countries. In 2018, about 19.4 million children globally who were under the age of 1 year did not get vaccinated (WHO, 2019). In terms of the public health practice gap, the Global Alliance of Vaccines and Immunization (GAVI, 2020) highlighted the risk of global morbidity and mortality in developing countries' failure to provide sufficient vaccination coverage. For example, Afghanistan had the highest infant mortality rate (IMR) of approximately 111 deaths per 1000 live births among all the countries compared worldwide (Central Intelligence Agency, CIA; 2018). Even though IMR in Afghanistan may be affected by other factors such as access to health services, sanitation, economy, and infectious diseases, any improvement in vaccination coverage could help mitigate the IMR (CIA, 2018; GAVI, 2020). Global vaccination coverage variation is depicted in Figure 1 to illustrate the problem of insufficient vaccination coverage variation.

Figure 1

Global Vaccination Coverage Variation Among One-year-old Children in 2018



Note. From "*Vaccination*," by S. Vanderslott, B. Dadonaite and M. Roser, 2020, https://ourworldindata.org/vaccination Copyright permission: https://creativecommons.org/licenses/by/4.0/

Notable highlights are the relatively lower vaccination coverages for haemophilus influenzae type B at 72%, measles 2nd dose at 69%, pneumococcal vaccine at 47%, and rotavirus at only 35%, which is the most common cause of severe infant diarrheal disease (Vanderslott et al., 2020). In terms of justification for this study, these infectious diseases may pose future global health threats if they remain unresolved (Bloom & Cadarette, 2019). Globally, the variation of vaccination coverage is not only limited to specific vaccines, but it also varies by different regions (WHO, 2019). For example, Afghanistan was found among the lowest vaccination coverages in the Asia region (WHO, 2019).

Based on this information, Afghanistan was selected for this study to examine one of the most vulnerable countries globally in the context of an ethnically, religiously, and culturally diverse population complicated by perpetual war, poverty, and challenging geography (Pitt & Koufopoulos, 2012, p. 337).

In terms of the gap in the vaccination research literature, there are no current studies that are specifically focused on the risk factors and childhood vaccination coverage for each vaccine in the context of Afghanistan. The results of this study can provide useful information to public health policymakers to modulate and appropriately target vaccination intervention programs and improve successful vaccination coverage in Afghanistan. For example, if the vaccination coverage is lower for a specific vaccine in a particular region with identified risk factors, then appropriate provisions for health education, promotion, and motivation among others could be supplemented within the new vaccination program to address them more effectively and efficiently for that region.

Purpose of the Study

The purpose of this study was to examine the risk factors that influence vaccination coverage in Afghanistan and to provide evidence about these influences preventing the achievement of universal coverage. Understanding vaccination interventions for universal coverage is essential, but also knowing the associated influences such as risk factors is crucial (Smith et al., 2017). The need for this study was based on highlighting these associated influences that may help or hinder universal coverage. The dependent variable in this study was the vaccination coverage (full, partial, or none) for each vaccine available in the secondary data set - the bacillus calmette-guérin (BCG), diphtheria-pertussis-tetanus (DPT), measles, and polio vaccines. The independent variables in this study include the risk factors such as the age, gender, and ethnicity of the child; age, education level, and wealth of the parents; and the regions for each vaccine available in the secondary data set for Afghanistan.

Research Questions and Hypotheses

RQ1 – Quantitative: What is the effect of the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) on vaccination coverage (full, partial, and none) for Afghanistan children?

$H_0$1 – There is no significant effect of the risk factors on vaccination coverage for Afghanistan children.

$H_1$1 – There is significant effect of the risk factors on vaccination coverage for Afghanistan children.

RQ2 – Quantitative: What is the effect of interaction between the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) for each vaccine (BCG, DPT, measles, and polio) on vaccination coverage (full, partial, and none) for Afghanistan children?

$H_0$2 – There is no significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children.

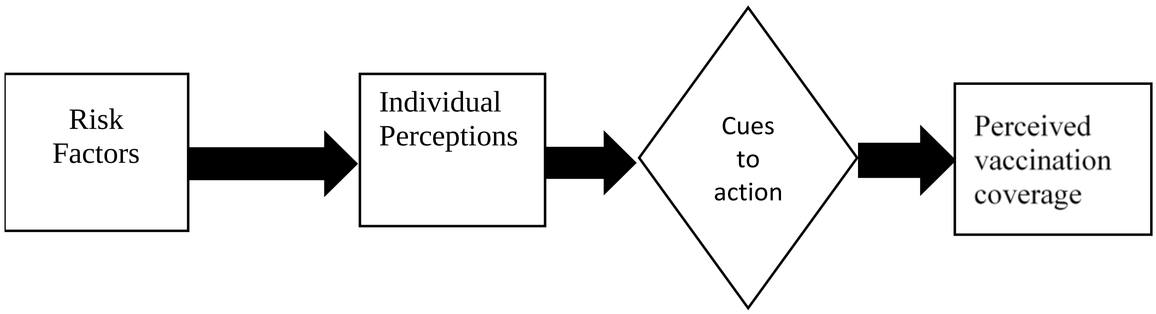
$H_1$2 – There is significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children.

Theoretical Foundation for the Study

The theoretical framework of this study will be the health belief model (HBM) and the socio-ecological model (SEM). The HBM is used to explain how an individual adopts a specific health action such as successful vaccination coverage that ultimately leads to a healthy behavioral change (Smith et al., 2011). In early 1950s, the HBM was developed by social psychologists in the U.S. Public Health Service to explain why people failed to participate in public health programs to detect and prevent diseases (Hochbaum, Rosenstock, & Kegels, 1952). The HBM was used to address the responses from participants, which may be represented within the psychological stimulus-response theory and the cognitive-behavioral theory (Glanz et al., 2015; Rosenstock, 1974). For example, the participant may respond to the vaccination in which both the stimulus (vaccination) and the response (health belief) may be reflected in the HBM represented in the psychological stimulus-response theory. The reason or cognition to vaccinate or not, which is represented in the cognitive-behavioral theory, may be attributed to the "cues to action" response to the vaccination that is also reflected in the HBM. The HBM is illustrated below and was adapted to vaccination coverage from Glanz, Rimer, and Viswanath (2015).

Figure 2

The Health Belief Model Adapted to Vaccination Coverage



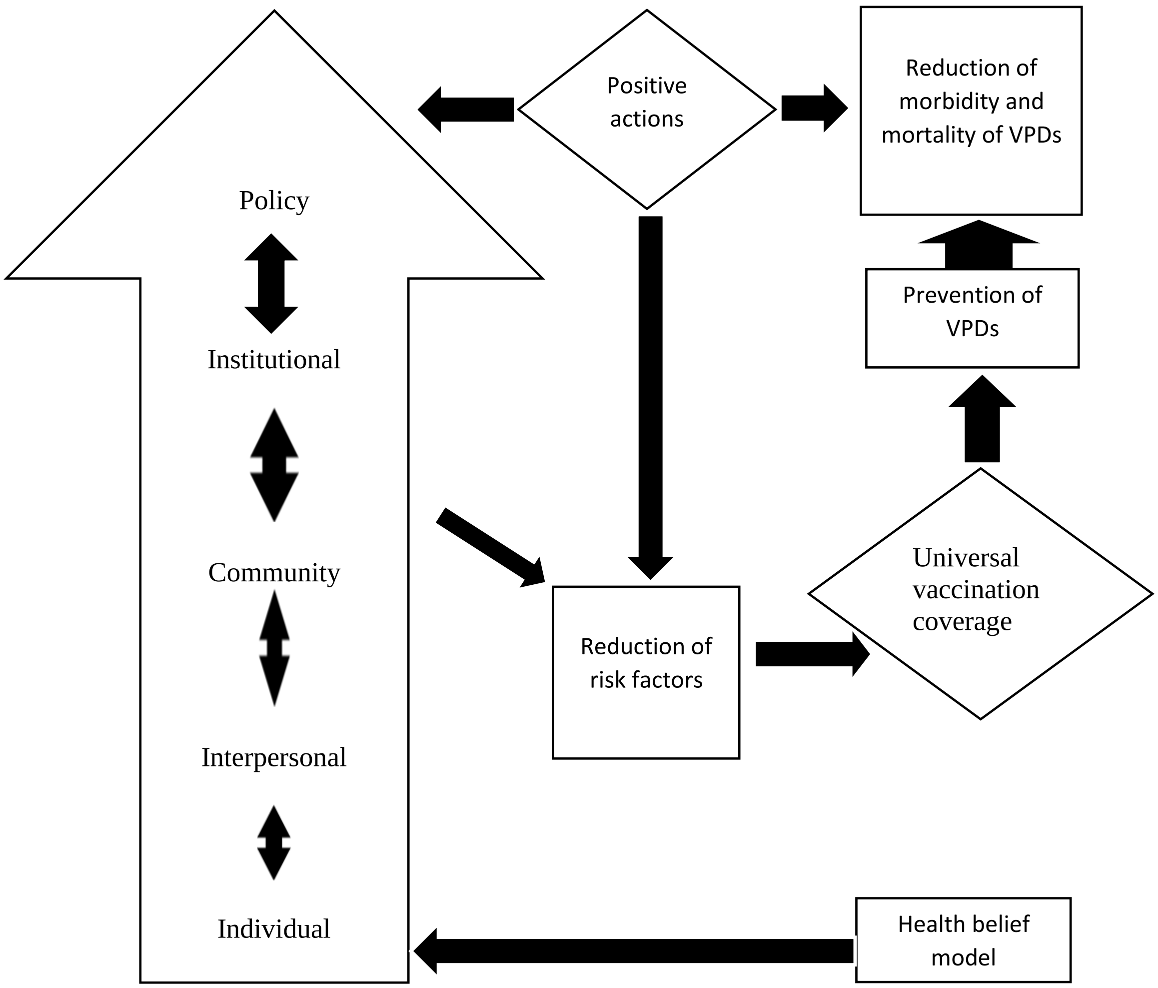
Note. Adapted from "Health behavior and health education: Theory, research, and practice (5th ed.)," by K. Glanz, B. K. Rimer, and Viswanath, 2015, (p. 79). John Wiley & Sons.

The aim of using the HBM depicted in Figure 2 in this study was to understand the risk factors such as age, gender, ethnicity, religious beliefs, marital status, educational level, socio-economic status, and health literacy among others that underlie the individual perceptions on how people view VPDs. Individual perceptions about the susceptibility and seriousness of VPDs and benefits, barriers, and self-efficacy related to vaccination provide cues to action on whether vaccination coverage will be successful. Perceived barriers such as inaccessibility to vaccination health centers were found to be the most powerful predictor of preventative health behavior like vaccination coverage and perceived severity was the least predictor (Glanz et al., 2015; Janz & Becker, 1984). However, perceived severity was a better predictor than perceived benefits. Smith et al. (2011) evaluated the association between parents' beliefs about vaccines and their decision to delay or refuse vaccination and vaccination coverage. The data from 11,206 participants were analyzed for children between age 24 to 35 months. The researchers found lower vaccination coverage for all 10 vaccines among the participants who did not believe that vaccines were beneficial (perceived benefits), who believed that vaccines were not safe (perceived severity), and who believed that their child will not get the VPD (perceived susceptibility).

In addition to the HBM, the SEM was used to address the relevant risk factors that may affect public health practice related to the vaccination intervention programs at the intrapersonal, interpersonal, institutional, community, and public health policy levels, where behaviors may be shaped and shape the social environment (Kolff et al., 2018; McLeroy et al., 1988). The SEM provides a viable framework for vaccination program managers to focus on specific positive actions at the five foundational levels (CDC, 2015). Figure 3 is adapted from Kumar et al. (2012) and depicts a SEM that is applicable to vaccination coverage. The SEM provides the opportunity to highlight the knowledge of challenges at each of the SEM levels (Figure 3) in a pedagogical manner that may offer guidance to facilitate specific improvements in the practice of vaccination coverage within the context of Afghanistan.

Figure 3

The Socio-Ecological Model Applied to Vaccination Coverage



Note. Adapted from "*The social ecological model as a framework for determinants of 2009 H1N1 influenza vaccine uptake in the united states*. Health Education & Behavior, *39*(2), 229-243," by S. Kumar et al., 2012, (p. 230). Copyright permission: https://s100.copyright.com/AppDispatchServlet#formTop

The SEM provided a foundation of inquiry into individual and social risk factors related to vaccination coverage that need to be addressed simultaneously across the five SEM levels to achieve positive impact of universal vaccination coverage (CDC, 2015).

Nature of the Study

The nature of this study was a retrospective cross-sectional quantitative study. In this study, the existing secondary data from the Demographic and Health Surveys (DHS) program was used (United States Agency for International Development [USAID], 2020). The research design was consistent with a scientific inquiry (Creswell & Creswell, 2018). The study purpose was designed to specifically answer the research questions by examining the vaccination risk factors that influence vaccination coverage in Afghanistan. Halloran et al. (2010) posited the use of systematic frameworks to demonstrate associations between vaccination-related dependent and independent factors using research study designs to estimate the relationships. The application of quantitative analysis helped determine the association between the type of vaccine and vaccination coverage and the effect of interaction between risk factors and each vaccine on vaccination coverage in Afghanistan.

A secondary data source from the DHS Program was used in this study. The DHS Program is funded by USAID, contributions from participating countries, and other donors (USAID, 2020). The secondary data to be analyzed was already de-identified by the DHS program. The dependent variables were categorical: vaccination coverage (full, partial, or none). The independent variables were also categorical variables: Risk factors such as the age, gender, and ethnicity of the child; age, education level, and wealth of the parents; and the regions for each vaccine available in the secondary data set for Afghanistan. In the present study, I conducted appropriate secondary data analysis using SPSS version 25 to provide specific answers to each of the research questions.

Literature Search Strategy

An open-ended search for literature strategy with a focus on publications mostly ranging from years 2015 to 2020 was used for this present study. Emphasis was placed on peer-reviewed journals. However, relevant national documents from the CDC, the UNICEF, and the WHO reports were also used to supplement the literature review. Additionally, some seminal research was used such as those related to the HBM and the SEM. Finally, a few relevant doctoral studies from Walden University were reviewed.

The following search engines were used for this study: Walden University Library, Pub Med, Science Direct, Research Gate, Google Scholar, and Dissertations and Theses at Walden University. The keywords searched were vaccination status, vaccination coverage, vaccination risk factors, health belief model, socio-ecological model, and Afghanistan.

Literature Review Related to the Main Concepts and Variables

Population and Geographical location

In 2020, the estimated total population of Afghanistan was 36,643,815 people with a median age of 19.5 years and 40.62% were between 0 to14 years with only 4.01% over the age of 55 years (CIA, 2020). Children under the age of five years, the target population of the present study, constituted approximately 20% of the total population in Afghanistan which is about 7.4 million children (Mugali et al., 2017). Only 26% of the total population lived in urban areas (CIA, 2020). The total fertility rate was 4.82 children with 36.7 births and 12.7 deaths per 1,000 population. In 2017, Afghanistan had a Gross Domestic Product (GDP) estimated at US $69.45 billion with 11.8% spent on health expenditures. Afghanistan had the Infant Mortality Rate (IMR) of 110.60 deaths per 1,000 live births, the highest worldwide with the life expectancy at birth at 64.49 years among the lowest in the region (CIA, 2018; World Bank, 2019).

From a geographical perspective, Afghanistan has a challenging rugged and mountainous terrain and is a landlocked country in South Asia (CIA, 2020). Afghanistan is surrounded by six countries: China, Iran, Tajikistan, Uzbekistan, Turkmenistan, and Pakistan as shown in Figure 4 (WHO, 2017). Other common natural challenges in Afghanistan include earthquakes, flooding, and droughts (CIA, 2020). Additionally, Afghanistan has a consistent history of perpetual political instability, conflicts, and wars, with 54.5% of the population living below the poverty line in 2017. Afghanistan consists of 34 provinces dominated by 99.7% Muslim population of which about 15% are Shias and the others are 0.3% (United Nations High Commissioner for Refugees; UNHCR; 2018). There are four main ethnic groups including Pashtun, Tajik, Hazara, Uzbek, among others. About 77% of the population speak the Dari language and 48% speak Pashto; the two official languages spoken there. In 2016, only 10.6% of the population used the internet (CIA, 2020).

Figure 4

Geographical Location of Afghanistan

Note. From "*EPI Review Mission in Afghanistan from 21 January to 12 February 2017,*" by WHO, 2017. http://www.emro.who.int/images/stories/afghanistan/afg_epi_review_report_final.pdf Copyright permission: https://www.who.int/about/who-we-are/publishing-policies/copyright

Relevance of Vaccination Coverage

Sufficient vaccination coverage as a public health practice is identified as an effective, efficient, and safe strategy to mitigate morbidity and mortality of infectious diseases worldwide (GAVI, 2020; WHO, 2019; Plotkin, 2018). Afghanistan is among the lowest vaccinated countries worldwide due to insufficient vaccination coverage (WHO, 2019). Vaccine preventable diseases (VPDs) continue to be a significant public health burden in Afghanistan (Wagner et al., 2017). That public health burden extends throughout the year as Wagner et al. (2017) found that the highest incidence of measles was in the spring, diarrhea and typhoid in the summer, and pneumonia in the winter while acute viral hepatitis and meningitis did not demonstrate any seasonality. In the context of childhood pneumonia, Zabihullah et al. (2017) concluded that the high death rate from pneumonia could be reduced by strengthening existing vaccination programs. In this vein, Afghanistan has the highest infant mortality rate (IMR) of approximately 110.60 deaths per 1000 live births in the world (CIA, 2018). Although all children deaths may not be attributed to VPDs, according to WHO (2019) and GAVI (2020), sufficient vaccination coverage will help mitigate the morbidity and mortality rates. In this context, Farzad et al. (2017) noted that it was necessary to consider risk factors of vaccination coverage to achieve full vaccination coverage.

The vaccination coverage practice is an essential health service due to its positive social impact in mitigating morbidity and mortality of VPDs worldwide (WHO, 2019; GAVI, 2020). Ekezie, Adaji, and Murray (2020) found gaps in health education in essential health services that could be applied to the public health practice of vaccination coverage. This finding is particularly relevant to the present study because it demonstrates the need to provide vaccination-related health education where it is needed. For example, if vaccination coverage may be low in identified regions, then incorporation of appropriate vaccination health education, promotion, and motivation may improve the vaccination uptake in those targeted regions (Frew & Lutz, 2017).

History of Vaccination Coverage in Afghanistan

In addition to geographical challenges, historical, and contextual background are important considerations in the vaccination coverage process in Afghanistan. In 1978, the Mass Immunization Program (MIP) was started through the Ministry of Public Health (MoPH) aimed at universal vaccination coverage throughout the country (Mugali et al. (2017). Political conflicts and wars disrupted the vaccination coverage in addition to other health care services for decades. In 2001, the MoPH had to build a viable health care system from the beginning. At that time, the IMR was 96 per 1000 live births (Mugali et al., 2017). In 2018, the IMR was 111 and had not improved at all (CIA, 2018). This statistic is particularly important because children under 5 years account for 20% of the population in Afghanistan (Mugali et al., 2017). According to GAVI (2020) and WHO (2019), universal vaccination coverage can reduce morbidity and mortality. In keeping with this information, 194 countries including Afghanistan committed to the Global Vaccination Action Plan (GVAP) created by the WHO to strengthen vaccination coverage at the national level (WHO, 2019). The GVAP resolution called for all countries to strengthen the governance and leadership of the national vaccination programs to optimize vaccination funding, surveillance, quality data collection, international cooperation, performance, and achieve positive social impact of universal coverage. In this vein, Farzad et al., (2017) found that only 38.8% of Afghanistan children were fully vaccinated which is far below the target of 90% coverage. Since then, concrete steps have been taken by the Afghanistan government to enhance the vaccination coverage program (GAVI, 2018). For example, a national measles vaccination program was created by the Government of Afghanistan in collaboration with GAVI, UNICEF, and WHO to protect about 14 million children aged 9 months to 10 years (UNICEF, 2018). However, Farzad et al. (2017) also noted that it was vital to consider other strategies that include identified risk factors. To achieve full vaccination coverage, the relevant risk factors to consider would include the regions, socio-economic status, and education level among others which the present study aims to investigate.

Challenges and Opportunities in Vaccination Coverage in Afghanistan

Several challenges noted by Mugali et al. (2017) that likely disrupted sufficient vaccination coverage in Afghanistan include weak governance, high dependence on foreign aid, armed dynamic conflicts, and natural disasters such as earthquakes, droughts, and floods with internal displacement of approximately 1.2 million people, and access issues to vaccination coverage health services such as transportation and affordability. Additionally, other researchers also noted the challenges with the collection of quality health and population data relevant to vaccination coverage (WHO, 2018). For example, in 2010, there was a discrepancy between the administrative data that presented high rates of vaccination and Multiple Indicator Cluster Survey (MICS) that found only 16% of full vaccination coverage. In 2017, the Central Statistics Organization (CSO) in Afghanistan with the support of UNICEF conducted a population census including the full vaccination coverage which was found to be only 51% (Mugali et al., 2017). It should be noted that Farzad et al. (2017) had found only 38.8% of Afghanistan children were fully vaccinated. The challenge of a wide variation of vaccination coverage data is a reality that remains unresolved in Afghanistan (WHO, 2018). In this vein, Harrison et al. (2020) found the need to invest in health information systems and standardized quality data in the expanded program on immunization (EPI) of developing countries.

Finally, issues remain with certain population segments that remain unconvinced about the importance of sufficient vaccination due to misinformation, mistrust, and their cultural beliefs (Mugali et al., 2017). In seeking reasons for partial vaccination in all provinces of Afghanistan, Mugali et al. (2017) found 11% of the population surveyed had the fear of side effects of vaccines, and another 16% were non-believers of vaccination. This finding may create opportunities in the increasing the uptake of sufficient vaccination coverage in Afghanistan. For example, determining where a vaccine coverage is less prevalent may provide policymakers decisive information to target appropriate vaccine health education specific to the vaccine and the regions identified more effectively and efficiently.

Operational Definitions and Abbreviations

Definitions

Vaccination and Immunization: According to the Centers for disease Control and Prevention; CDC (2018), vaccination and immunization terms may be used inter-changeably. Vaccination refers to the act of introducing a vaccine into a person to protect against a specific infectious disease (Immunize BC, 2020). Immunization refers to the process by which the person gets immunized against an infectious disease through vaccination. In the present study, I will use the terms vaccination and immunization inter-changeably.

Sufficient vaccination coverage: Sufficient vaccination coverage means that the country has fulfilled all the requirements of the full vaccination protocol set by the Expanded Program on Immunization (EPI) to provide universal coverage of childhood vaccination (Harrison et al., 2020). Currently, BCG, DPT, HBV, Hib, OPV, IPV, Measles, PCV, and TT vaccines are provided by EPI in Afghanistan from about 1767 vaccination service delivery fixed centers (WHO, 2017). In 2017, the goal of the Afghanistan's comprehensive Multi-Year Plan (cMYP) 2015 to 2019 was to decrease the VPDs' morbidity and mortality through universal vaccination coverage.

EPI - Expanded Program on Immunization: The EPI developed by WHO was initiated in 1978 in Afghanistan to help achieve universal vaccination coverage for VPDs. The EPI was used to target 6 VPDs using disease-specific vaccines: diphtheria, pertussis, tetanus; measles; tuberculosis; and poliomyelitis (UNICEF, 2014). Later, the HBV, Hib, PCV, and rotavirus vaccines were added. The objective of the cMYP 2015-2019 in Afghanistan was to achieve atleast 90% vaccination coverage, but Mugali et al. (2017) found only 51% vaccination coverage while Farzad et al. (2017) found only 38.8%. In this vein, it should be noted that vaccination hesitancy that contribute to vaccination insufficiency was named as a global threat by WHO (2019c).

Vaccination risk factors: Researchers in this literature review have identified vaccination risk factors that include factors such as education level, income level, ethnic minority, rural areas, marital status, and regions among others (Anokye et al., 2018). In the present study, similar variables will be examined in the DHS secondary data set to find out their relationships with each vaccine and vaccination coverage in Afghanistan.

Abbreviations

Table 1

List of Abbreviations

Abbreviation	Definition
ANDS	Afghan National Development Strategy
BCG	Bacillus Calmette-Guérin
BPHS	Basic Package of Health Services
CDC	Centers for Disease Control and Prevention
CIA	Central Intelligence Agency
cMYP	Comprehensive Multi-Year Plan
CSO	Central Statistics Organization (Afghanistan)
DHS	Demographic Health Surveys
DPT	Diphtheria-Pertussis-Tetanus vaccine
EPI	Expanded Programme on Immunization
GAVI	Global Alliance of Vaccines and Immunization
GDP	Gross Domestic product
GoA	Government of Afghanistan
GVAP	Global Vaccine Action Plan
HBM	Health Belief Model
IBM	International Business Machines
IIS	Immunization Information Systems
IMF	International Monetary Fund
IMR	Infant Mortality Rate
MICS	Multiple Indicator Cluster Survey
MIP	Mass Immunization Program
MoPH	Ministry of Public Health in Afghanistan
NGOs	Non-Government Organizations
NIP	National Immunization Programme
OPV	Oral Polio Vaccine
PCV	Pneumococcal Conjugate Vaccine
SEM	Socio-Ecological Model
SPSS 25	Statistical Package for Social Sciences version 25
TIPs	Tailoring Immunization Programmes
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations International Children’s Emergency Fund
VPDs	Vaccine Preventable Diseases
WHO	World Health Organization

Vaccination Schedules in Afghanistan

The Government of Afghanistan (GoA) prioritized universal vaccination coverage in "Afghanistan's Compact 2006" document which provided a basis for the Afghan National Development Strategy or ANDS (WHO, 2017a). EPI then became an important part of the Basic Package of Health Services or BPHS. The MoPH of the GoA created a national structure known as the National EPI in collaboration with WHO and UNICEF to manage and implement vaccination services across all 34 provinces of Afghanistan with many contracted out to NGOs (WHO, 2017a). The Table 2 below summarized the current schedule of vaccination in Afghanistan:

Table 2

Current Vaccination Schedule Approved by EPI for Afghanistan

Vaccine	Birth	6 weeks	10 weeks	14 weeks	9 months	18 months
BCG	+					
HepB	+					
OPV	+	+	+	+	+	
IPV				+		
DTwP-HepB-Hib		+	+	+		
PCV		+	+	+		
MCV1					+	
MCV2						+

Note. From "*EPI Review Mission in Afghanistan from 21 January to 12 February 2017,*" by WHO, 2017a.

http://www.emro.who.int/images/stories/afghanistan/afg_epi_review_report_final.pdf

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Vaccination Coverage Inequities

The goal of the Global Vaccine Action Plan or GVAP 2011 to 2020 was to achieve universal vaccination coverage (WHO, 2016). Researchers found considerable vaccination coverage inequities in the 86 low- and middle-income countries across different global regions in socio-economic status, urban/rural residence, and the gender of the child. A comparable study conducted by Guzman-Holsta et al. (2020) in the Latin American region found low socio-economic status, low education level, and age contributed to the inequity of universal vaccination coverage. In Afghanistan, Akseer et al. (2016) found similar findings where socio-economic and regional inequities threatened universal coverage of health care services. The researchers of the WHO (2016) study recommended exploring additional cross-sectoral strategies where there were the worst inequities vaccination coverage within the country regions. In pursuit of resolving the vaccination coverage inequities through evidence-based research, WHO (2019b) researchers considered two models: The Increasing Vaccination Model and the Caregiver Journey Framework to provide a clearer path to universal vaccination coverage. In support of this strategy, the Tailoring Immunization Programmes (TIP) was developed by WHO/Europe researchers which recommended evidence-based information to identify populations that were most vulnerable to VPDs within a country (WHO, 2020; WHO, 2019d). This present study aspired to contribute to this evidence-based information to identify populations that are least vaccinated in the context of risk factors in Afghanistan.

Studies on Risk Factors associated with Vaccination Coverage

This section involves literature reviews for several studies conducted about the vaccination coverages of different vaccines in various low-income countries. The researchers of these studies also investigated the vaccination coverage and risk factors for the successful vaccination. The studies mentioned in this literature review used similar variables from the DHS datasets which is the same secondary data source I will be using for the present study.

A study was conducted by Acharya et al. (2019) in Nepal for all patients with diseases of tuberculosis; bacille Calmette-Guerin (BCG), diphtheria, pertussis, tetanus (DPT), polio, and measles between years 2001 to 2016. This study was implemented for children aged 12 to 23 months. The study evaluated the vaccination coverage in terms of full, partial, and non-vaccination. Results of this study showed the full vaccination coverage increased with years from 65.6% in 2001 to 87% in 2011. Regions of the country and maternal education significantly influenced the vaccination coverages. The authors recommended have specific vaccination programs for infants of uneducated mothers in Nepal (Acharya, Paudel, & Dharel, 2019).

A similar study was conducted by Rossi (2015) in Zimbabwe for 1,031 children aged 12-23 years months between years 2010 to 2011. This study involved vaccines of BCG, measles, three doses of polio, and DTP/pentavalent. The full vaccination coverage in this study was 65.8%. Presence of parents with children showed higher level of full vaccination. Mothers' education and good level behavior associated with vaccination rates of their children. Some interventional program for pregnancy and enhancing educational level was recommended by authors of this study to improve the vaccination coverages (Rossi, 2015).

A study conducted by Minh An et al. (2016) about the vaccination coverages of children in Vietnam investigated the complete vaccination between years 2000-2011. The vaccine and doses involved in this study were one dose of BCG, 3 doses of HBV, 3 doses of DPT, 3 doses of polio and one dose of MCV. In general, all children aged younger than five years were within low range of vaccination coverages. MCV for measles first dose showed higher coverages with 65.3%, 66.7% and 73.6% for years 2000, 2006, and 2011 respectively, while hepatitis B first dose was lowest with 172.5%, 19.3% and 45.5% respectively. Children of mothers with; lower household wealth levels, rural areas, ethnic minority, and low levels of education showed lower incidences of complete vaccination status. Regions play a significant predictor for complete vaccination in Vietnam (Minh An et al., 2016).

Nozaki et al., (2019) investigated the factors influencing basic vaccination coverage in Myanmar: secondary analysis of 2015 Myanmar demographic and health survey data. The researchers found that only 50% of the children received full vaccination coverage. The insufficient vaccination was associated with low economic status, younger maternal age, fewer antenatal care visits, and no maternal tetanus vaccination.

Another study was conducted by Tohme et al. (2017) for children in Haiti between years 2010-2016. The immunization program was influenced by series of earthquakes. The vaccines involved in this study were polio, measles, and rubella. with vaccination coverage exceeded the 90%. The vaccination coverages for tetanus were 70% for the two doses of the vaccine. This study also found that these vaccines could save lives of 5,227 children annually. Moreover, the regions and counties of Haiti found differences in vaccination coverages for these infectious diseases. Furthermore, fluctuations in coverages of vaccines depended on years for all vaccines, but it was better compared with the first years. Authors recommended full commitments of all stakeholders including families, health workers, and political levels, to the health vaccination plans recommended by international and local organizations (Tohme et al., 2017).

A study, although not peer-reviewed, was conducted in Afghanistan by Aalemi et al. (2019) for 5,708 children aged 12 to 23 months in 2015. The authors investigated the vaccination coverages for BCG, pentavalent polio, and measles. Main findings of this study revealed positive association between vaccination status with delivery in health facility, mothers aged 30 to 39, fathers' and mothers' education level, and high index of family wealth (rich). Regions played an important role in the vaccination status as well, where children who were residents in central regions got higher complete vaccination coverages than other children of other regions, while children in south regions got lowest coverages. Authors of this study recommended considering the regions as significant predictor for vaccination coverages in Afghanistan (Aalemi et al., 2019).

Another study was conducted by Oleribe et al. (2017) in Nigeria for 27,571 children aged 0 to 59 months for the year 2013. The assessment of vaccination coverage was depended on full vaccination, partial and no vaccination. The rate of full vaccination of this study was 22.1%, while children who did not get any vaccine was 29%. Outcomes of this study also revealed predictors of vaccination coverage with parents' socio-demographic characteristics, region, and marital status. Children characteristic also associated to vaccination coverages with significant to birth order, delivery place, and presence of vaccination card. Religion, education, regions, wealth index, marital status, and occupation were significant predictors of vaccination coverages. Authors of this study encouraged for implementation the interventional and educational programs in Nigeria to enhance the vaccination coverages (Oleribe et al., 2017).

A study was conducted by Lessler et al. (2011) for children at three countries Ghana, Madagascar, and Sierra Leone. This study involved only the measles vaccines administered to children of these countries. The incidence of vaccination coverages was 93%, 77% and 69% in Ghana, Madagascar, and Sierra Leone, respectively. Activity of inefficient vaccination programs showed lowest in Ghana, while higher in Sierra Leone and Madagascar. Authors of this study recommended evaluation and improvements in vaccination programs in these countries to provide the best health services and to achieve the targets of vaccination intervention (Lessler et al., 2011).

Utazi et al. (2019) conducted a similar quantitative study for five African countries Nigeria, Cambodia, Mozambique, Ethiopia, and Democratic Republic of Congo. This study covered the three doses of diphtheria-tetanus-pertussis (DPT) and one dose measles vaccines. Outcomes of this study showed that country-regions and distance play an important role in the vaccination coverages. Some predictors were reported in this study based on each country like; poverty for Nigeria; travel time and regions for Nigeria, Mozambique, and Cambodia; population density for Cambodia and Ethiopia; distance to urban areas for Ethiopia and DRC; and others. Authors concluded there are differences among regions and countries in vaccination coverages for DPT and measles. Therefore, they recommended establishing more strategies for vaccination coverages to minimize the incidence of infections (Utazi et al., 2019). In summary, most studies found the regions and various socio-demographic risk factors such as education level, wealth index among others to be significant predictors of vaccination coverage.

Assumptions

The assumptions of this study include the following: The participants told the truth when they participated in the primary research from which this secondary data study will be conducted; the data entry was conducted ethically, efficiently, and effectively with minimal errors; the missing data was assessed to ensure the study was not biased by them; and the vaccination coverage documentation was complete and accurate.

Scope and Delimitations

This study was based on the Afghanistan 2015 DHS dataset to investigate the risk factors associated with childhood vaccination coverage in Afghanistan (USAID, 2020). There were no primary data collection or any contact with the participants involved in the dataset. There was a time lag between when the secondary data was collected and the time when this secondary data analyses took place.

This study was delimited to a quantitative cross-sectional study, i.e., there were no control groups for comparison or any interventions for temporal analysis. The study was based on secondary data analyses with no primary data collection. Therefore, only the variables available in the dataset were analyzed. The study was also delimited to the variables present in the dataset when selected for this study. Finally, the study was delimited to the information collected by the data collectors and the time of the data collection.

Significance and the Potential for Positive Social Change

In the context of Afghanistan, there are no specific recorded inferential statistics related to risk factors as barriers for childhood vaccination coverage in the World Health Organization, other similar organizations such as UNICEF among others, and peer-reviewed studies. However, studies in other developing countries in the Asia region such as Nepal used similar risk factors successfully to examine their influence on vaccination coverage (WHO, 2017b). The results of the studies conducted in Nepal have increased vaccination coverage by providing pedagogical information to public health policymakers in addressing the identified risk factors (WHO, 2017b). The present study provides related inferential statistics to determine the relationship between risk factors associated with childhood vaccination coverage in Afghanistan. It is essential to understand these relationships for achieving sufficient vaccination coverage. The results of the present study, like similar other studies, can contribute to positive social change by providing valuable information to policymakers for improving vaccination coverage in Afghanistan and other developing countries.

Summary and Conclusion

This section described the public health practice of childhood vaccination coverage and related benefits in Afghanistan. The insufficient vaccination coverage has resulted in poor health outcomes and preventable deaths from VPDs in Afghanistan. The purpose of the study, nature of the study, the research questions and hypotheses, assumptions, limitations, delimitations, and detailed literature review were presented. The section was concluded with a brief description of the significance and the potential for positive social change impact of the study. The next section was focused on the methodology used for this scientific inquiry. In this section, the population studied, the dataset used, the data management process, and ethical issues were described.

Section 2: Research Design and Data Collection

Introduction

In this section, the research design and rationale, the research methodology, the study area, and the population examined in Afghanistan are described. Additionally, the secondary data management process, the authorization to access and use the DHS secondary data, the DHS program description, and ethical procedures are described. This is followed by a presentation of the research design conceptual framework of the present study. Next, the research data variables, the sampling procedure, the sample size calculations, effect size, and alpha level are explained. Subsequently, the inclusion and exclusion criteria and operationalization of constructs are described. Finally, the research questions, hypotheses, data analysis plan, the statistical tests, the handling of the data post-analysis, and the summary are presented.

Research Design and Rationale

A retrospective cross-sectional quantitative approach of an existing secondary dataset was used (Creswell & Creswell, 2018). There were unprecedented challenges in primary data collection in Afghanistan due to the political, socio-economic, historical, geographical, war and terrorism related factors (CIA, 2020). Given these extremely difficult conditions, the only currently available and most recent secondary dataset for Afghanistan was the 2015 dataset (DHS, 2019). Therefore, the 2015 Afghanistan dataset was used for the present study.

The type of research design that was used in this present study was efficient in time and cost including avoiding duplication of research, which were the key advantages of using a secondary dataset (Weston et al., 2019). Additionally, a research design based on secondary data analyses allowed for a large dataset analyses which could not be possible if the dataset were collected individually. Furthermore, it minimized ethical issues compared to primary data collection and ensured participants' confidentiality (Yiannakoulias, 2011). The study design was appropriate to determine the predictors and differences in vaccination coverages for each vaccine available in the Afghanistan 2015 DHS dataset. The present study depended on the determination of significance of outcomes which was required in this research study design. However, there were some manipulations and modification of data variables done, according to the suggestions reported by other vaccination studies and had to be consistent for appropriate data analyses.

Research Methodology

In this sub-section, the methodology used in the study was described. The study area and population examined was defined first. Next, the secondary data management process, the sampling techniques, and ethical issues were explained. Then, the research questions and the hypotheses were stated. Finally, the statistical tests and the analyses that were used are explained.

Study Area and Population

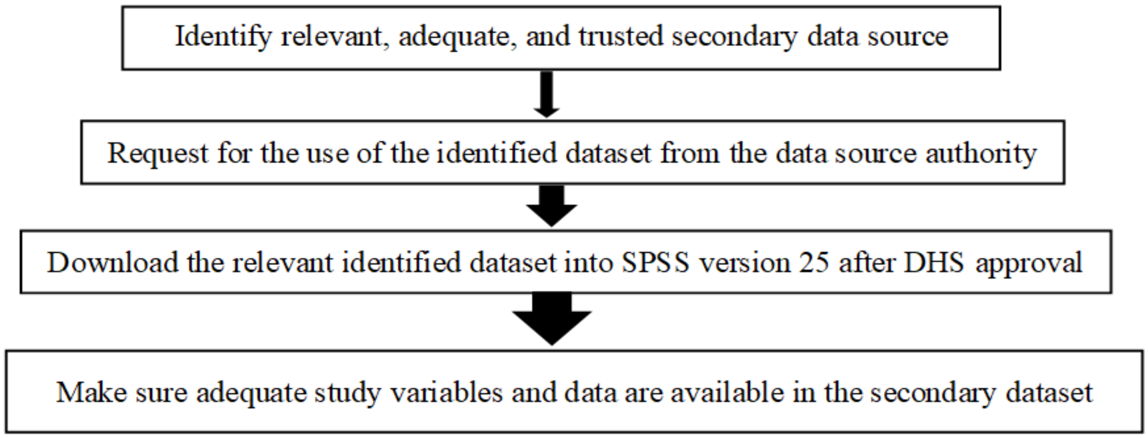
The study area was in Afghanistan which has 34 regions with a population of 36,643,815 and a median age of 19.5 years with approximately 40.2% between age 0 to 14 years (CIA, 2020). The target of the present study was children under 5 years old, which constituted about 20% of the total population of Afghanistan or 7.4 million children (Mugali et al., 2017). The dataset was dedicated for collection and investigation of the vaccination coverage and risk factors in Afghanistan. The number of regions involved that was used as geographic factors were 34 regions in Afghanistan. These regions were distributed in two main types of regions: rural (74%) and urban (26%) areas (CIA, 2020).

Secondary Data Collection Tools and Management

This research used the Afghanistan DHS 2015 data set to achieve its goals. The DHS data sets were commonly used by researchers to investigate their main outcomes, especially those related to geographic distribution, health, and nutrition for over 90 countries. The DHS program is among the areas of health research that involved child health, education, and other public health topics (USAID, 2020). The main purpose of USAID is to expand international healthcare services. There are two types of surveys used by DHS are: standard DHS surveys (large sample sizes between 5 and 30 thousand participants, which are conducted every 5 years) and interim DHS surveys (related to specific objectives like measuring the mortality rates or measuring the perception towards general health information.) These surveys involved small sample size with short used questionnaires. The following framework was used to manage the data process:

Figure 5

The Four Steps for Management of the Data Process



The DHS Program, Data Collection, and Ethical Procedures

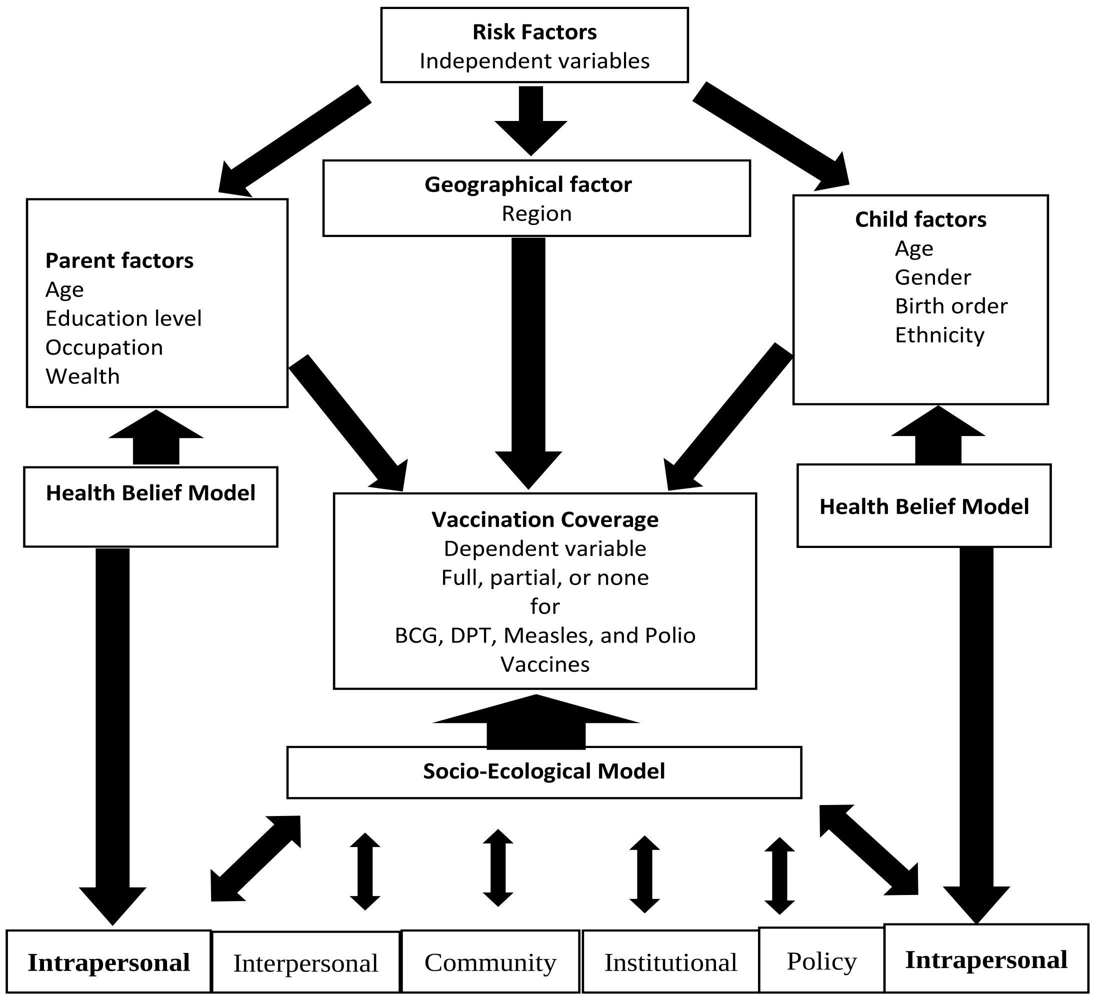
The primary DHS datasets were collected in the DHS program under the USAID organization for vaccination and other healthcare services of Afghanistan using approvals for data collection and partnerships with health institutes of Afghanistan (USAID, 2020). Authorization of interviews with families and participants in this institute was approved after de-identification according to academic procedures and evaluations of panels. The DHS program has partnered with many universities such as John Hopkins University and other governmental institutions. Therefore, the secondary database provided by the DHS Program as a trusted and valid source of a secondary dataset was used in the present study (DHS, 2019). Moreover, many peer-reviewed studies have been conducted and published using the secondary datasets from the DHS Program. Finally, the DHS Program has institutional authority to provide the datasets to researchers and clinicians for many applicants if they see the importance and benefits of using the information, i.e., there is eligibility criteria for authorization of DHS data access and use, which made the DHS program recognized internationally as one of the standard research organizations in the world. In the present study, all DHS data was treated as confidential and no effort was made to identify any individual or household interviewed in the DHS survey. Once the data analyses and the study were completed, the dataset from the system was deleted.

Conceptual Framework

The conceptual framework of this present study in terms of dependent and independent variables is depicted in Figure 6. Vaccination coverage was categorized as the dependent or outcome variable. Independent variables involved parents' factors (such as age, education level, occupation, and wealth), child's factors (age, gender, birth order, and ethnicity), and geographical factor (region). All the variables were collected by the DHS primary researchers for Afghanistan in 2015. The HBM was used to understand the risk factors at the individual level such as age and ethnicity of the child among others (Glanz et al., 2015; Janz & Becker, 1984). On the other hand, the SEM was used to address the relevant risk factors such as the region among others that may affect the public health practice of vaccination coverage (Kolff et al., 2018; McLeroy et al., 1988).

Figure 6

The Conceptual Framework of the Present Study



Note. Adapted from "*The social ecological model as a framework for determinants of 2009 H1N1 influenza vaccine uptake in the united states*. Health Education & Behavior, *39*(2), 229-243," by S. Kumar et al., 2012, (p. 230).

Data Variables and Description

The dependent variable used for this study was the vaccination coverage (full, partial, and none) which was evaluated for each specific vaccine (BCG, DPT, measles, and polio) in Afghanistan. Independent variables included: age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions.

The data set consists of three classes of variables: parents, children, and geographical variables. The age of each respondent was coded as the actual age, which were categorized later into groups. Gender of each respondent was coded as male and female. Education levels of each respondent was coded into no education, primary school, secondary school, and higher education. Wealth index was categorized into poorest, poorer, middle, richer, and richest. Child age was also coded in these data sets and ranged from younger than 1 year to 5 years. Variables of region and ethnicity were subjective to their county, i.e., there was no comparison conducted among cities and races of Afghanistan, but these regions and ethnicity were evaluated as predictors. For each vaccine coverage, the terms were coded as “Yes, No, or Do not know”.

Measurements of Variables

Since there were different doses of each vaccine in the data set of the present study, to determine a unified value of vaccination coverage, the data were classified into either full vaccination, partial vaccination, or no vaccination for each vaccine. This meant that each respondent was evaluated in terms of vaccination coverage based on number of vaccine doses received. For example, let us assume the number of polio doses are four for each child. “Full vaccination” then refers to those who got the four doses. Partial vaccination refers to the status of children who got vaccine doses, but the doses were incomplete. Non-vaccination status refers to children who failed to get any dose of vaccines. Several studies highlighted about the evaluation of vaccination coverage in this manner (Girmay & Dadi, 2019; Lessler et al., 2011).

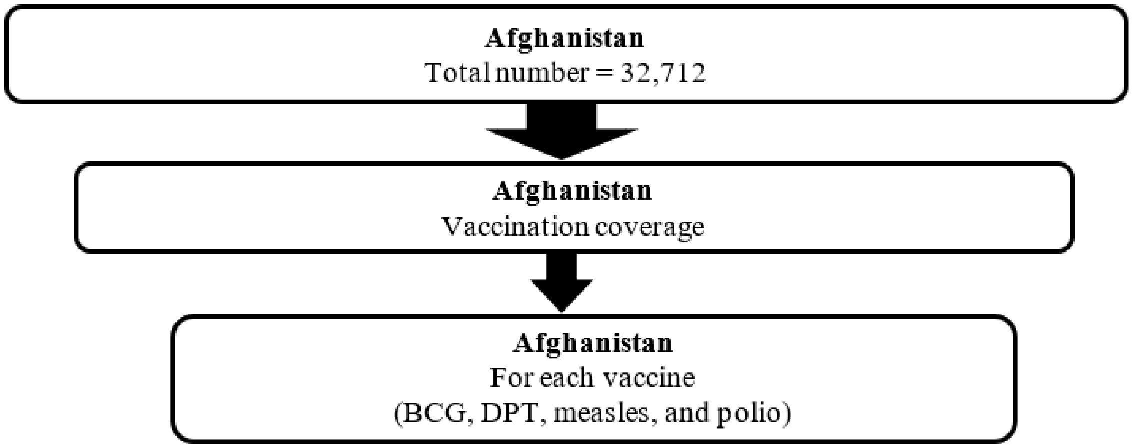
Sampling Procedure and Sample Size

Sampling Procedure

A stratified multi-stage cluster sampling technique was selected in this study with different stages of research. First stage started with arrangements of data sets and counting the total number of participants, where number of participants enrolled in Afghanistan was 32,712. This was within acceptable ranges of participants found in the DHS datasets. Second stage involved filtration for number of participants, who voluntarily agreed in the participation DHS survey. All participants involved in this study were related to vaccination coverage. Third stage involved separating the use of samples for each vaccine separately, as shown in Figure 7.

Figure 7

The Three Steps of Sampling Procedure of the Present Study



Sample Size, Effect Size, and Alpha level

G*Power statistical software was used to count the appropriate sample size of the present study. As academic research, several errors were noticed while calculating the sample size of the study such as the Type II error (Ledolter & Kardon, 2020). Therefore, power analysis was used in the present study to overcome this problem. Main parameters considered in power analysis were sample size, effect size, and alpha level. Alpha level chosen for present study was 0.05 to overcome Type I error, while 95 was the power level for Type II error. A medium effect size was preferred with value equals to 0.15 because it is a recommended standard of the G*Power statistical software and to get the optimal sample size for estimated number of predictors equals to 20. Therefore, the smallest acceptable number of samples of the present study were more than 222 participants from the G*Power statistical software. Adding 10% of sample for those to be excluded later before starting the analysis (because of eligibility criteria) and during analysis (because of missing information). The final number was 245 participants for Afghanistan.

Inclusion and Exclusion Criteria

The participants who enrolled in DHS surveys and voluntarily gave the information about their children’s vaccination coverages were considered as the eligible for the present study. Those who failed to give all details about the vaccination information were excluded from this study based on procedural steps like missing information and/or violations of assumptions in statistical analysis.

Operationalization of Constructs

The next step was the arrangement and modification of datasets variables to be consistent with the design of study and research needs. Some variables included several groups like wealth index which involved in the original SPSS file as poorest, poorer, middle, richer, and richest. This variable maybe modified into poor, middle, and rich only, and similar modifications were made for the other variables. The main purpose for modifications of these variables were attributed to first, achieve consistency among variables and secondly, to reduce the differences in sample sizes.

Vaccination coverages of vaccines were considered the main outcomes of present study. This study involved four main vaccines; BCG, DPT, measles, and polio where number of doses administered at different time periods were one, three, three and two, respectively. Children who completed all the vaccination doses in time were categorized within the full vaccination coverage, while those missed any dose of any vaccine as partial vaccination coverage. Parents of children who replied with “do not know” referred in present study to children who remained unvaccinated. Also, in the present study, the predictors, and differences in vaccination coverage for each vaccine were determined. Finally, the results of vaccination coverage for each vaccine were evaluated for the relationship between parents' acceptance to one or more vaccines with risk factors (Oleribe, 2017).

Vaccination coverage statistically can be set up as numerical variables. For example, completed vaccination for all vaccines were coded as 2 for full vaccination, 1 for partial vaccination and 0 for those who remained unvaccinated. Age was categorized into age groups for parents, while the age of children acted as numerical because they contained five age groups only. Education level of the parent also were recategorized into groups to be consistent for analysis. Ethnicities and regions remained the same because there were no comparisons in these variables. They were measured only as influencing risk factors of the outcomes.

Research Questions and Hypotheses

The research hypotheses, independent variables, dependent variables, and inferential statistical analysis are illustrated in Tables 3 and 4 below. Two hypotheses were involved in present study to achieve the purpose of this study. The risk factors were the independent variables. Vaccination coverage was the dependent variable. Multiple logistic regression was the test used to determine the significance and approve/reject the null hypotheses to answer two specific research questions:

RQ1 - Quantitative: What is the effect of the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) on vaccination coverage (full, partial, and none) for Afghanistan children?

RQ2 – Quantitative: What is the effect of interaction between the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) for each vaccine (BCG, DPT, Measles, and Polio) on vaccination coverage (full, partial, and none) for Afghanistan children?

Table 3

Hypothesis 1, Independent/Dependent Variables, and Statistical Tests

Hypothesis 1	Independent variables	Outcomes variables	Inferential statistical analysis
There is no significant effect of the risk factors on vaccination coverage for Afghanistan children.	1) Vaccine • BCG • DPT • Measles • Polio 2) Risk factors • Age, gender, birth order, and ethnicity of the child. • Age, education level, occupation, and wealth of parents. • Region.	Vaccination coverage • Full • Partial • None	Multinomial logistic regression

Table 4

Hypothesis 2, Independent/Dependent Variables, and Statistical Tests

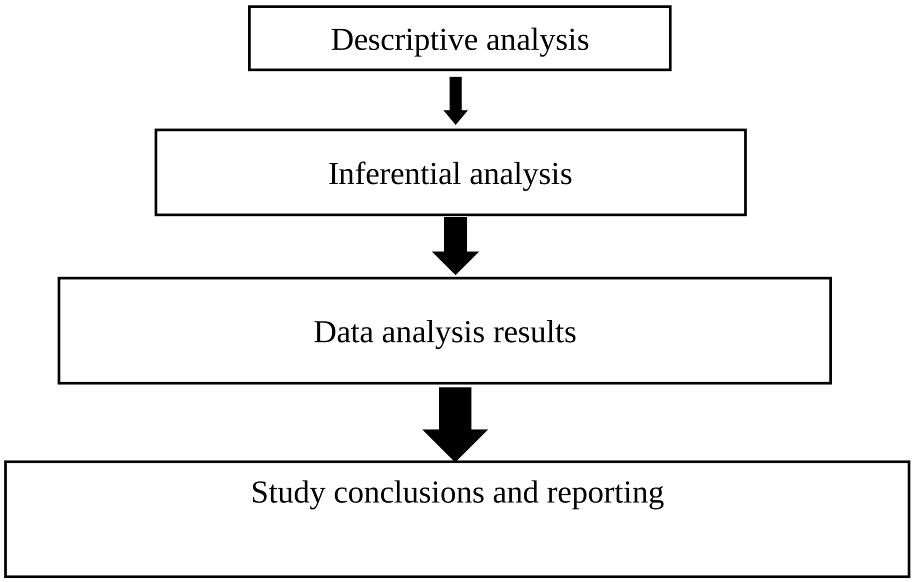
Hypothesis 2	Independent variables	Outcomes variables	Inferential statistical analysis
There is no significant effect of interaction between the risk factors and each vaccine on vaccination coverage for Afghanistan children.	1) Vaccine • BCG • DPT • Measles • Polio 2) Risk factors • Age, gender, birth order, and ethnicity of the child. • Age, education level, occupation, and wealth of parents. • Region.	Vaccination coverage • Full • Partial • None	Multinomial logistic regression

Data Analysis Plan

The data plan involved the description and inferential analyses. This was followed by data analysis results. Finally, the study conclusions and reporting were completed. The four steps of the data analysis plan were summarized in Figure 8.

Figure 8

The Four Steps of Data Analysis Plan



Statistical Tests and Analysis

SPSS version 25 was used to perform the statistical analysis of the Afghanistan 2015 DHS datasets (International Business Machines; IBM, 2017). The most appropriate statistical tests were used after checking for the test assumptions (Laerdal Statistics, 2018). All results with *p* values less than 0.05 are considered as significant. Statistical tests used in present study was the Chi-square test and multinomial logistic regression. Multinomial logistic regression was the appropriate statistical test used to determine the predictors of study outcomes, which found out the factors that most significantly influenced the dependent variables. The measurement and comparison among the significant predictors were based on the odds ratio (OR), which count the values of all variables in each subgroup (Szumilas, 2010). For example, the impact of regions, education level, ages... etc., on the vaccination coverage for each vaccine in Afghanistan.

Threats to Validity

There were a few threats to internal validity even though the dataset used in the present study had been validated several times. Construct and content validity threats may be present. There was a limited presence of inherent bias, missing information, unaccounted errors, limited absence of some relevant variables, and limited number of variables for analyses, all due to the dataset being a secondary dataset. To mitigate these threats, the dataset was re-validated by using the SPSS preloaded rules. The data passed the validation checks. Additionally, the data was collected in 2015, so there may be changes in the current situation in Afghanistan that may not be accounted for in the present study. Furthermore, security concerns may have prevented access to certain areas such as North Eastern regions in Afghanistan where clusters in highly dangerous areas were not covered which may have resulted in non-random missing data.

Ethical Procedures

The present study used the analyses of key variables from the DHS secondary dataset from Afghanistan indirectly involving human subjects. IRB approval was obtained from the DHS primary data collector (Appendix A) followed by the Walden University IRB approval with the approval number of 10-19-20-0537899 (Appendix B) before proceeding to the data retrieval, data analyses, and statistical report development.

Summary

Section 2 of this research inquiry elaborated on the research design, a cross-sectional quantitative approach, and rationale of the study. The methodology, the study area and population examined, secondary data set management process, sampling and sampling procedure, and operationalization of constructs were described. The independent and dependent variables, their measurements, and the data analysis plan were described. Additionally, the DHS Program procedures and ethical considerations were also discussed.

Section 3 presented the results and findings of the present study. The time frame for data collection, participant recruitment, and response rates of participants were described. Any discrepancies in the use of the Afghanistan 2015 secondary dataset were reported. Additionally, descriptive characteristics of the sample, representativeness of the sample of the population studied, and inferential analysis using multinomial logistic regression were reported.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this study was to examine the risk factors that influence vaccination coverage in Afghanistan and to provide evidence about these influences preventing the achievement of universal coverage. Based on the results and findings, evidence will be provided about the risk factors that hinder the achievement of sufficient vaccination coverage in Afghanistan. The study participants were from all 34 regions of Afghanistan that were surveyed in the Afghanistan 2015 DHS dataset. The IBM SPSS version 25 was used to analyze the dataset to answer the research questions by testing the associated hypotheses:

RQ1 – Quantitative: What is the effect of the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) on vaccination coverage (full, partial, and none) for Afghanistan children?

$H_0$1 – There is no significant effect of the risk factors on vaccination coverage for Afghanistan children.

$H_1$1 – There is significant effect of the risk factors on vaccination coverage for Afghanistan children.

RQ2 – Quantitative: What is the effect of interaction between the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) for each vaccine (BCG, DPT, measles, and polio) on vaccination coverage (full, partial, and none) for Afghanistan children?

$H_0 2$ – There is no significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children.

$H_1 2$ – There is significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children.

Simple descriptive univariate, bivariate, and multivariate analyses were conducted. Inferential analyses and conclusions were also completed and reported in this section. This was followed by a conclusion with a summary of the findings from the secondary data analyses.

Data Collection of the Secondary Dataset

The CSO and the MoPH implemented the 2015 Afghanistan Demographic and Health Survey (2015 AfDHS) from June 15, 2015 to February 23, 2016 (USAID, 2020). The 2015 AfDHS was designed to collect data for surveillance of the population health situation in Afghanistan. The objective of the 2015 AfDHS was to provide reliable estimates of relevant health parameters that included child health factors such as vaccination coverage. All the 34 regions of Afghanistan were involved in the survey conducted by the primary researchers.

A nationally representative sample of participants aged 15 to 49 years included 29,461 ever-married women in all selected households and 10,760 ever-married men in half of all selected households were interviewed. The response rates were 97% for the women and 91% for the men. The sample design provided data estimates for national, regional, urban, and rural areas.

Univariate Analysis

Descriptive Characteristics of the Sample Population

A sample population of 32,712 responded to the 2015 AfDHS survey within the age range of 15 to 49 years who had children within the age of 0 to 5 years. The participants were born between 1966 and 2000 with an average age of 28.7 ± 6.54 years and a median age of 28 years as depicted in Table 5. A summary and illustration of the age groups of the participants who participated in the AfDHS study is provided in Figure 9. Participants between the ages of 25 and 29 years were the most frequent at 31.38%, and participants between the ages of 45 and 49 were the least frequent at 2.35%.

Table 5

Average Age of Participants of the 2015 AfDHS Study

N	32,712
Mean	28.70
Median	28.00
Std. Deviation	6.540

Figure 9

Age Groups of Participants of the 2015 AfDHS Study

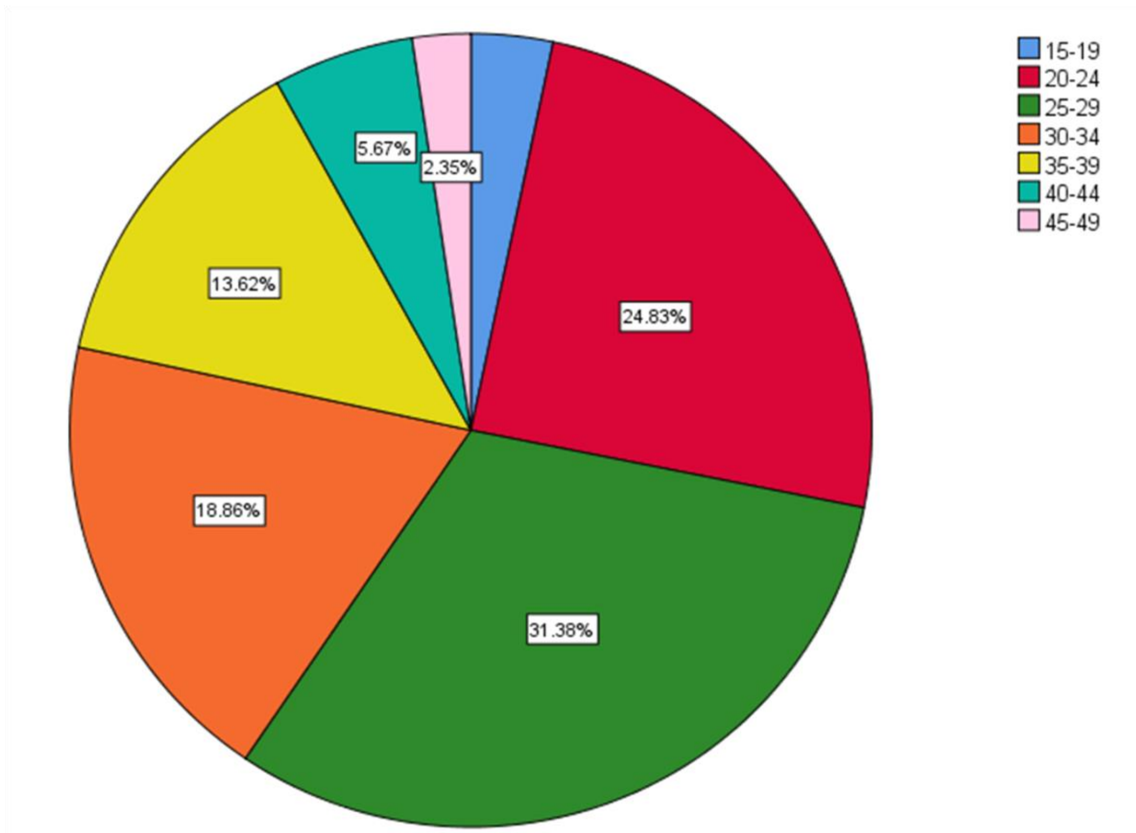


Table 6

Regional Distribution of Participants in the 2015 AfDHS Study

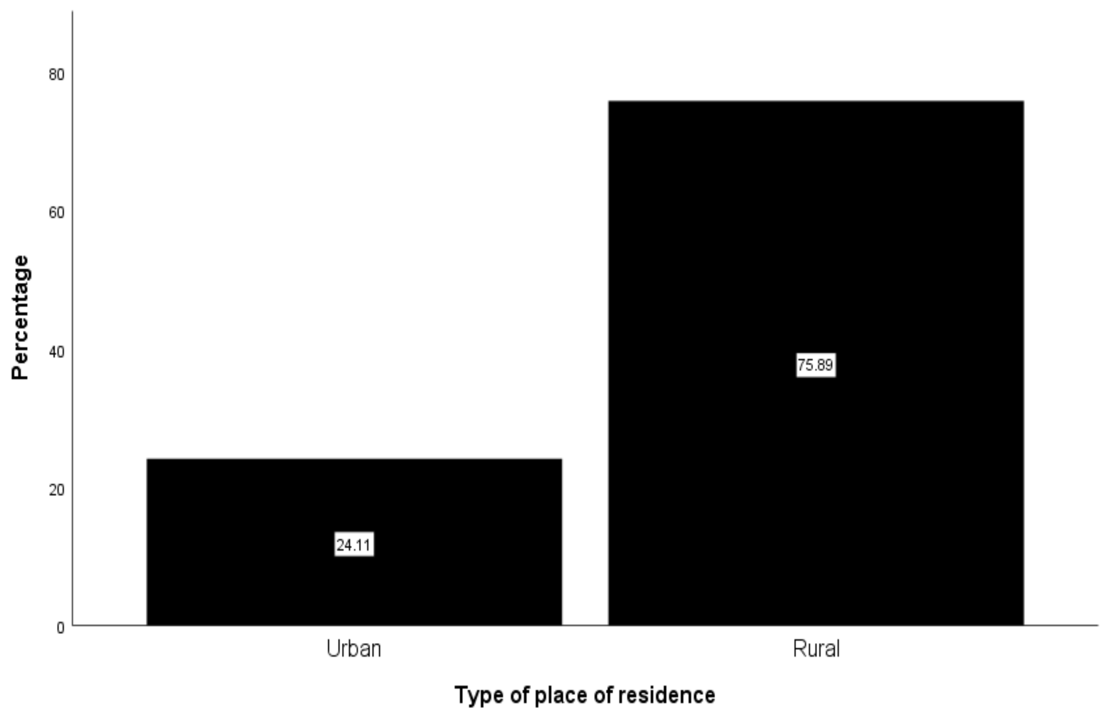
Region	Frequency	Percent
Kabul	769	2.4
Kapisa	954	2.9
Parwan	868	2.7
Wardak	756	2.3
Logar	846	2.6
Nangarhar	1361	4.2
Laghman	1101	3.4
Panjsher	480	1.5
Baghlan	701	2.1
Bamyan	721	2.2
Ghazni	727	2.2
Paktika	1219	3.7
Paktya	1319	4.0
Khost	1614	4.9
Kunarha	943	2.9
Nimroz	692	2.1
Badakhshan	801	2.4
Takhar	931	2.8
Kunduz	866	2.6
Samangan	748	2.3
Balkh	979	3.0
Sar-E-Pul	818	2.5
Ghor	1105	3.4
Daykundi	642	2.0
Urozgan	1417	4.3
Zabul	215	.7
Kandahar	1189	3.6
Jawzjan	873	2.7
Faryab	818	2.5
Helmand	834	2.5
Badghis	1027	3.1
Herat	906	2.8
Farah	1230	3.8
Nooristan	2242	6.9
Total	32712	100.0

The regional distribution of the participants is provided in Table 6. The data shows a relatively even distribution of origin of the participants for the most part with the highest coming from the region of Nooristan at 6.9% and the lowest from Zabul at only 0.7%.

The participants were mostly from the rural areas of Afghanistan at 76.3%. The participants from the urban areas only constituted 23.7% as depicted in Figure 10. This sample population distribution is accurately representative of the whole population of Afghanistan which was 76% rural and 24% urban (CIA, 2020).

Figure 10

Rural Versus Urban Distribution of Participants in the 2015 AfDHS Study



Most of the participants (86%) had no formal education, and only 14% had some form of formal education, as illustrated in Table 7. In contrast, the husband/partner's education level of participants in the 2015 AfDHS study was a lot higher in comparison as seen in Table 8. For example, secondary education was 21.8% compared to 5.9% in the wife's education level.

Table 7

Highest Education Level of Participants in 2015 AfDHS Study

Highest education	Frequency	Percent
No education	28137	86.0
Primary	2207	6.7
Secondary	1929	5.9
Higher	439	1.3
Total	32712	100.0

Table 8

Husband/Partner's Education Level of Participants in 2015 AfDHS Study

	Education level	Frequency	Percent
Valid	No education	18529	56.6
	Primary	4417	13.5
	Secondary	7138	21.8
	Higher	2177	6.7
	Don't know	355	1.1
	Total	32616	99.7
Missing		96	.3
Total		32712	100.0

Figure 11

Employment Status of Participants in 2015 AfDHS Study

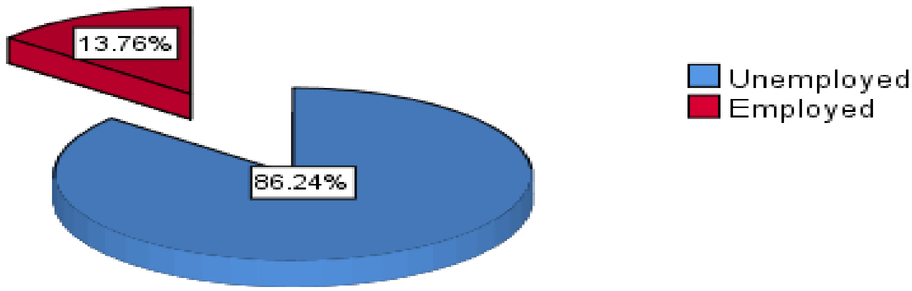


Table 9

Employment Status of the Husband/Partner of the Participants

Employment status		Frequency	Percent
Valid	Employed	32592	99.6
Missing	System	120	.4
Total		32712	100.0

The employment status of participants in the 2015 AfDHS study is depicted in Figure 11. Only 13.76% of the participants were employed. The remaining 86.20% were unemployed, and 0.1% was the missing data. In contrast, the employment status of the husband/partner of the participants was 99.6% as depicted in Table 9. This indicates that the husband/partner may be the main source of income in the family.

Figure 12

Wealth Index of the Participants in the 2015 AfDHS Study

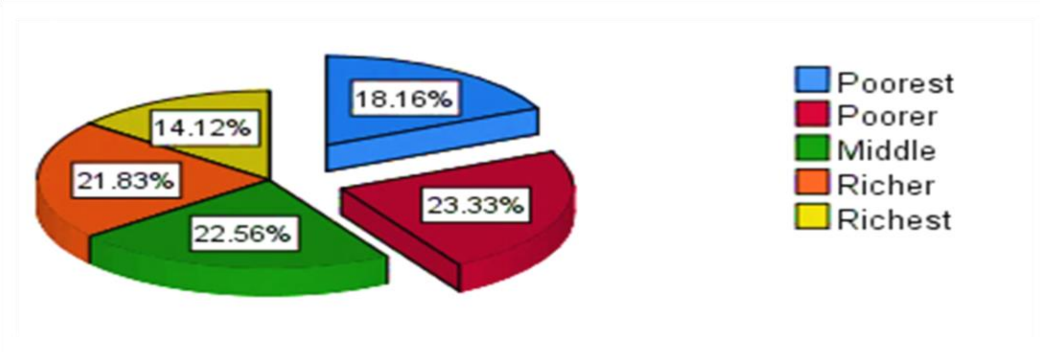


Figure 12 illustrates the wealth index of the participants in the 2015 AfDHS study. The data shows that 41.49% of the participants were poor whereas 35.95% were rich and 22.56% were in the middle class.

In summary, 19,464 participants out of 32,712 were below the age of 30 years. Participants originated from all regions of Afghanistan (mostly between 2 to 4% in each region) except for Zabul which only had 0.7% (lowest) and Nooristan had 6.9% (highest). Like the whole Afghanistan population, the sample population was approximately 76% from the rural areas and 24% from the urban areas of Afghanistan. 86% of participants had no formal education and 43.4% husband/partners had some form of formal education. Although 86.2% of participants were unemployed, 99.6% of their husband/partners were employed indicating that the men were the source of family income. 41.49% of participants were in poverty while the rest were in middle class and the rich category.

Child Descriptive Analysis

The mean age of the 29,414 children was 2.04 ± 1.395 years. The median and the mode was 2 years as illustrated in Table 10.

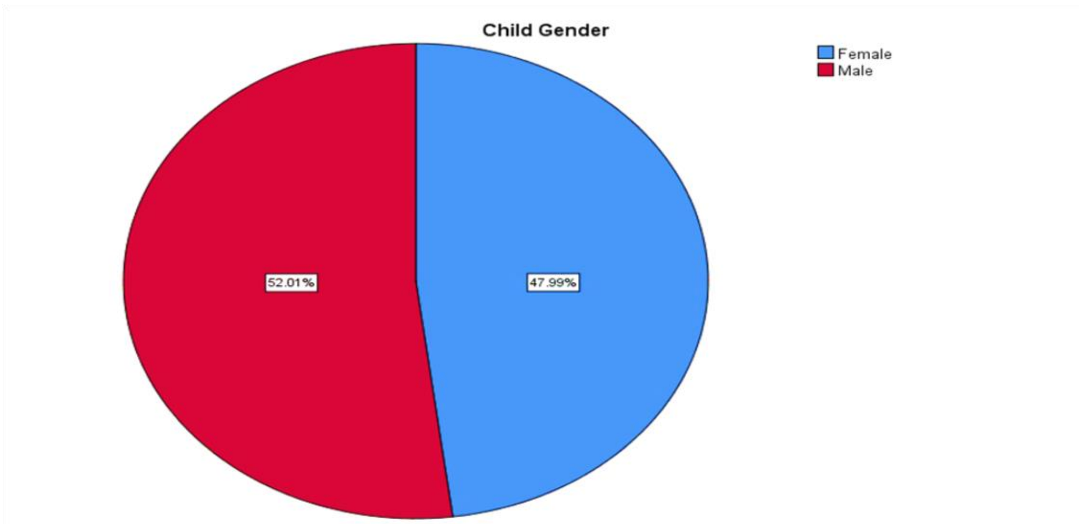
Table 10

Current Age of Child in Years

Statistic	Age
Mean	2.04
Median	2.00
Mode	2
Std. Deviation	1.395
Valid	31063
Missing	1649

Figure 13

Gender Distribution of Children between 0 and 5 years of age



As illustrated in Figure 13, 51.01% of children were male and 47.99% were female.

Figure 14

Coverage Percentage of all Vaccines – BCG, DPT, measles, and polio

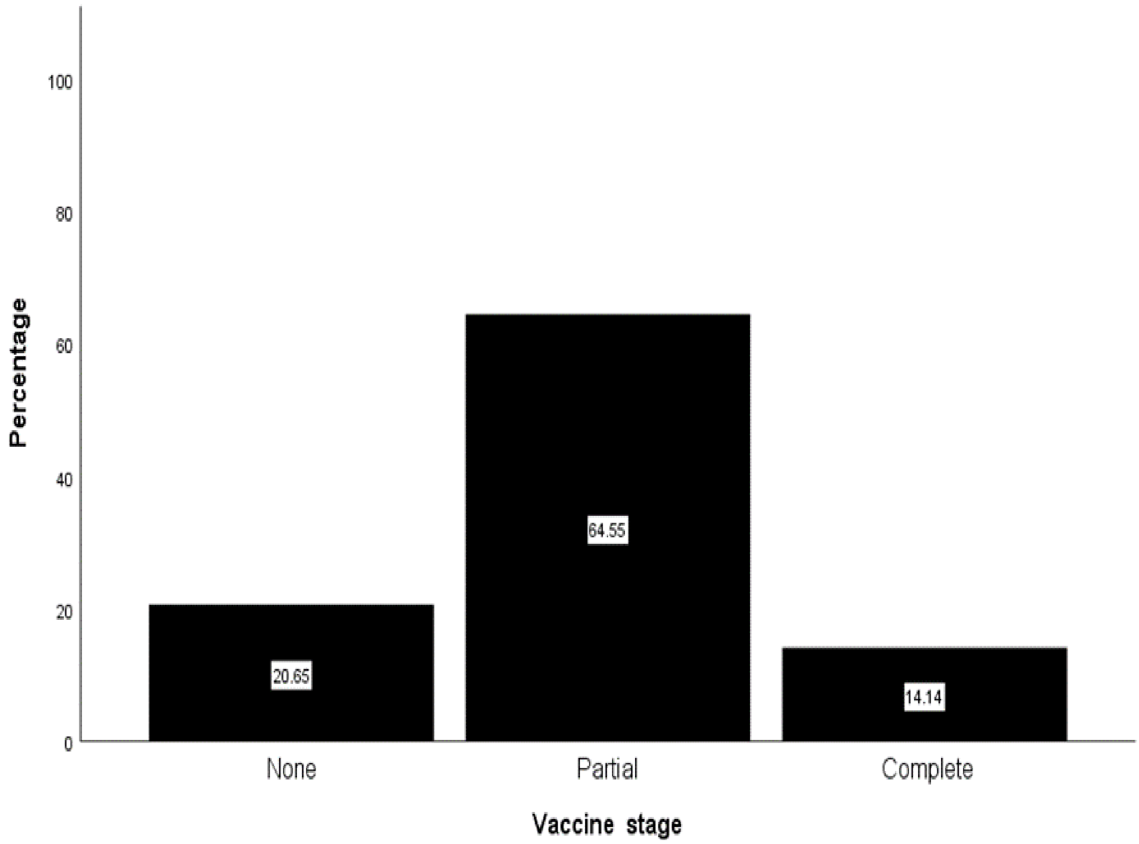


Figure 14 shows that only 14.14% of the children received complete vaccination, 64.55% received partial vaccination coverage, and 20.65% received no vaccination for all four vaccines examined in Afghanistan.

Figure 15

Coverage Percentage of the BCG Vaccine

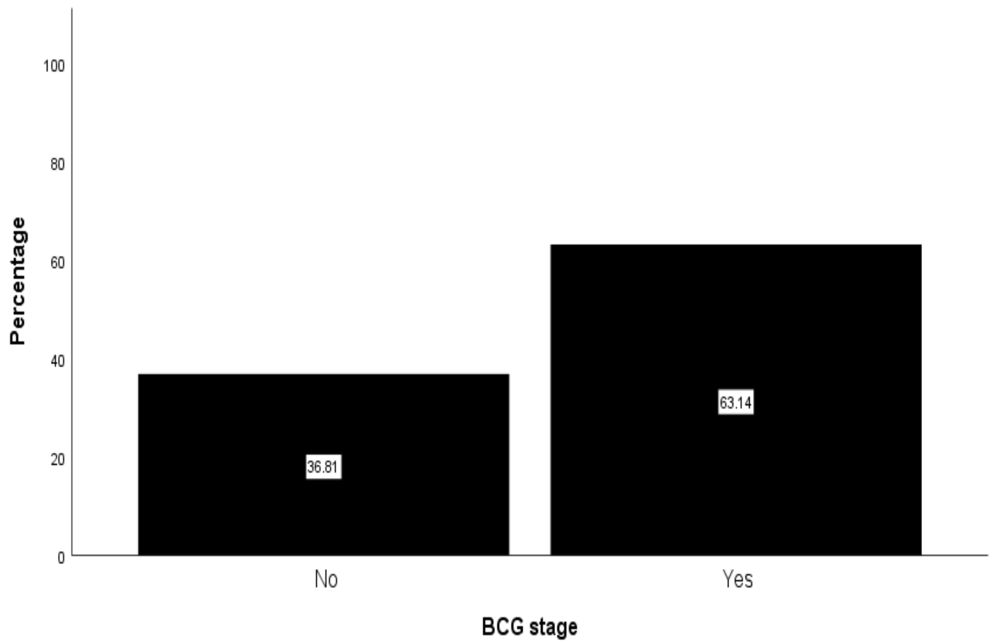


Figure 15 shows that 63.14% of the children received BCG vaccine and 36.61% received no BCG vaccination. The BCG vaccine has only one dose, so there is no partial vaccination.

Figure 16

Coverage Percentage of the DPT Vaccine

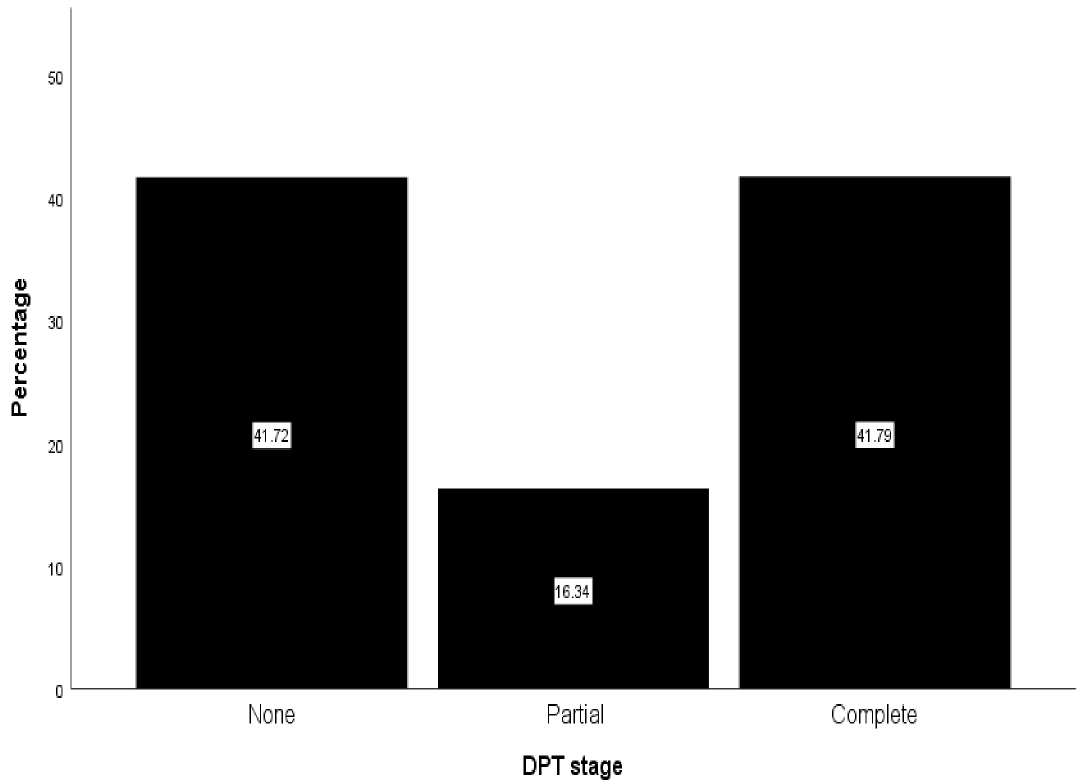


Figure 16 shows that 41.79% of the children received complete DPT vaccination, 16.34 received partial DPT vaccination, and 41.72 received no DPT vaccination.

Figure 17

Coverage Percentage of the Measles Vaccine

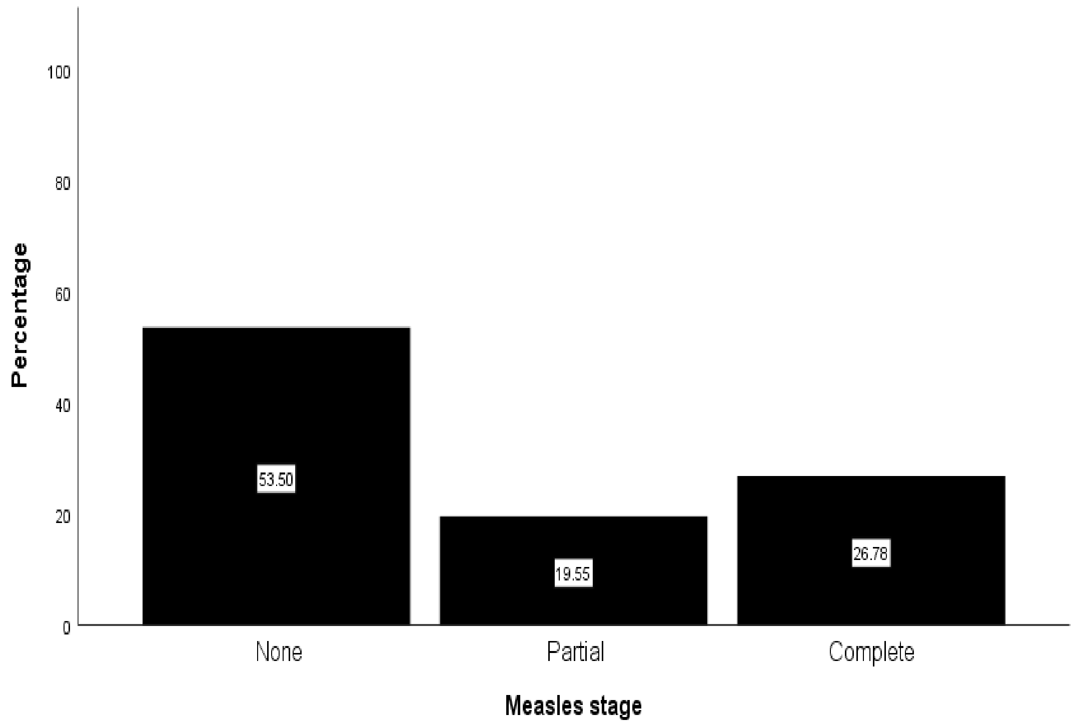
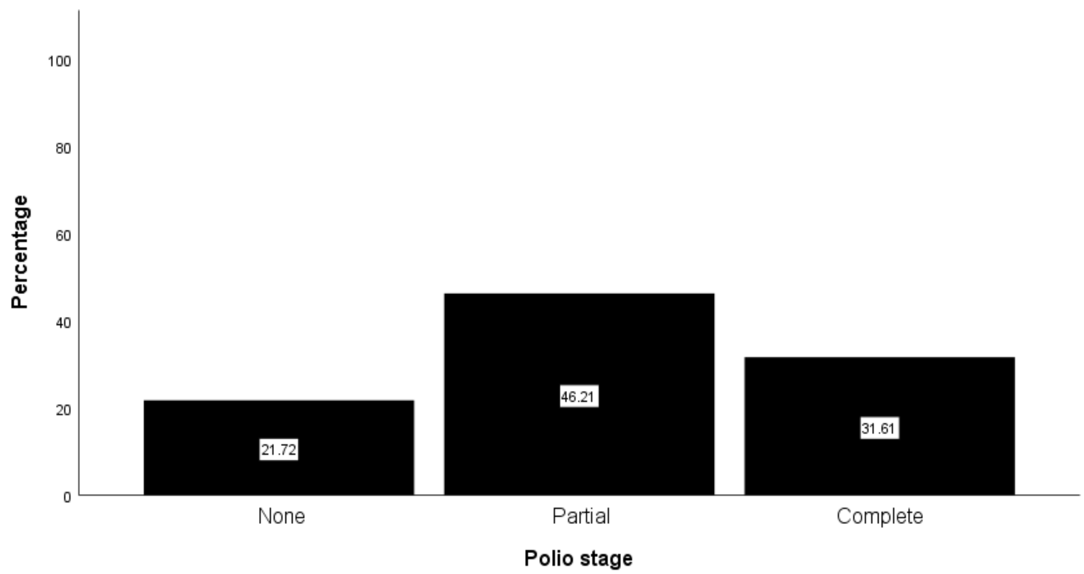


Figure 17 shows that 26.78% of the children received complete measles vaccination, 19.55% received partial measles vaccination, and 53.50% received no measles vaccination.

Figure 18 shows that 31.61% of the children received complete polio vaccination, 46.21% received partial polio vaccination, and 21.72% received no polio vaccination.

Figure 18

Coverage Percentage of the Polio Vaccine



Bivariate Analysis

Bivariate analysis was considered as a filtering stage for all the risk factors in the present study (child, parental, and geographical) involved in the final analysis of vaccination coverage (none, partial, and complete). Therefore, the risk factors with significant results were considered as proposed predictors of vaccination coverage for all four vaccines combined and then for each of the four vaccines separately to explicitly answer the research questions. The variables were tested separately with the vaccination coverage status using simple logistic regression to determine the relationship between each variable and the vaccination coverage status. The likelihood ratio tests were used for each variable to determine the statistical significance and the associated Chi-square value. All significant variables were involved in the multinomial logistic regression to determine which variables showed the highest influence than others on vaccination coverage.

Bivariate Analysis for All Vaccines

A summary of the bivariate analysis for all the risk factors (child, parental, and geographical factors) of the present study and vaccination coverage status (none, partial, and complete) for all four (BCG, DPT, measles, and polio) vaccines is provided in Table 11. All variables showed significant results with vaccination status except for the sex of the child. Therefore, all significant variables were involved in the multinomial logistic regression to determine which variables showed the highest influence on vaccination coverage status of all four vaccines. Region, ethnicity, and age of child showed the highest Chi-square values.

Table 11

Bivariate Analysis for Risk Factors and Vaccination Status for All Vaccines

	Model Fitting Criteria	Likelihood Ratio Tests		
Risk Factors	-2 Log Likelihood of Reduced Model	X^2	*df*	*p*
Region	7617.393	7192.810	66	<0.001
Education level of respondent	534.182	473.163	6	<0.001
Ethnicity	3413.862	3291.967	16	<0.001
Wealth index	537.342	451.839	8	<0.001
Respondent occupation	1295.378	1237.596	6	<0.001
Sex of child	39.052	1.031	2	.597
Respondent age	635.521	44.166	2	<0.001
Age of child	2495.089	1317.231	2	<0.001

Bivariate Analysis for the BCG Vaccine

A summary of the bivariate analysis of all the risk factors of the present study and BCG vaccination coverage status is provided in Table 12. All variables showed significant results with the BCG vaccination status except for the sex of the child, husband's age, and birth order. Therefore, all significant variables were involved in the multinomial logistic regression to determine which variables showed the highest influence on the BCG vaccination coverage status. Region, ethnicity, and occupation showed the highest Chi-square values.

Table 12

Bivariate Analysis for Risk Factors and BCG Vaccination Coverage

Risk Factors	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests X^2	*df*	*p*
Region	8261.556	8030.822	33	<0.001
Education level of respondent	848.423	817.003	3	<0.001
Ethnicity	3926.370	3860.174	8	<0.001
Wealth index	754.941	709.666	4	<0.001
Respondent occupation	1290.867	1259.941	3	<0.001
Sex of child	21.938	1.879	1	.170
Respondent age	342.289	14.245	1	<0.001
Age of child	362.753	303.328	1	<0.001

Bivariate Analysis for the DPT Vaccines

A summary of the bivariate analysis of all the risk factors of the present study and DPT vaccination coverage status is provided in Table 13. All variables showed significant results with the DPT vaccination coverage status except for the sex of the child. Therefore, all significant variables were involved in the multinomial logistic regression. Region, ethnicity, and occupation showed the highest Chi-square values than others.

Table 13

Bivariate Analysis for Risk Factors and DPT Vaccination Coverage

Risk Factors	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests X^2	*df*	*p*
Region	9347.577	8900.378	66	<0.001
Education level of respondent	821.496	758.680	6	<0.001
Ethnicity	3662.231	3535.390	16	<0.001
Wealth index	679.311	591.635	8	<0.001
Respondent occupation	1051.905	993.075	6	<0.001
Sex of child	41.596	2.759	2	.252
Respondent age	639.555	58.559	2	<0.001
Age of child	1688.264	697.958	2	<0.001

Bivariate Analysis for the Measles Vaccines

A summary of the bivariate analysis of all the risk factors of the present study and the measles vaccination coverage status is provided in Table 14. All variables showed significant results with the vaccination status except the sex of the child, husband's age, and birth order. Therefore, all significant variables were involved in the multinomial logistic regression. Region, age of the child, and ethnicity showed the highest Chi-square values.

Table 14

Bivariate analysis for Risk Factors and Measles Vaccination Coverage

Risk Factors	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests X^2	*df*	*p*
Region	6661.034	6209.045	66	<0.001
Ethnicity	2555.187	2427.478	16	<0.001
Sex of household	36.738	4.431	2	.109
Wealth index	364.538	276.830	8	<0.001
Respondent occupation	690.472	632.033	6	<0.001
Sex of child	39.829	1.025	2	.599
Respondent age	781.454	203.566	2	<0.001
Age of child	7111.101	3395.708	2	<0.001

Bivariate Analysis for the Polio Vaccines

A summary of the bivariate analysis of all the risk factors of the present study and the polio vaccination coverage status is provided in Table 15. All variables showed significant results with the polio vaccination coverage except the sex of the child. Therefore, all significant variables will be involved in the multinomial logistic regression to determine which variables showed the highest influence than others. Region, ethnicity, and occupation showed the highest Chi-square values than others.

Table 15

Bivariate Analysis for Risk Factors and Polio Vaccination Coverage

Risk Factors	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests X^2	*df*	*p*
Region	9347.577	8900.378	66	<0.001
Education level of respondent	821.496	758.680	6	<0.001
Ethnicity	3662.231	3535.390	16	<0.001
Wealth index	679.311	591.635	8	<0.001
Respondent occupation	1051.905	993.075	6	<0.001
Sex of child	41.596	2.759	2	.252
Respondent age	639.555	58.559	2	<0.001
Age of child	1688.264	697.958	2	<0.001

Multivariate Analysis

Predictors of All Vaccines

Multinomial logistic regression is the appropriate statistical test used to determine the predictors of the vaccination coverage status for all four vaccines (BCG, DPT, measles, and polio). Four assumptions were tested to approve the results of all the multinomial logistic regression models for the predictors.

- Assumption 1: The dependent variable must be nominal. The vaccination coverage status is nominal. Therefore, this assumption was accepted.
- Assumption 2: The independent variables are nominal. ordinal, or continuous. All risk factor variables in the present study are either nominal (region, respondent education, ethnicity, wealth index, and respondent education) or continuous (respondent age, and child age). Therefore, this assumption was accepted.

- Assumption 3: Independence of observation. All participants of the dependent variables were different. Therefore, this assumption was accepted.
- Assumption 4: There were 206 participants considered as outliers for predicting the vaccination coverage status for all vaccines. The outliers were excluded in the model. Therefore, this assumption was accepted.

All risk factors are statistically significant to the vaccination coverage status for all vaccines, except for the gender of the gender. The region showed the highest association with the vaccination coverage status for all vaccines (χ^2 = 3920.540, *df* (66), $p < 0.001$). The age of child showed the second highest association with the vaccination coverage status for all vaccines (χ^2 = 1311.413, *df* (2), $p < 0.001$) followed by others. Predictors (region and age of child) of vaccination coverage status for all vaccines are summarized in Table 16. The region is considered a significant predictor for vaccination coverage status for all vaccines. The regions with the highest complete vaccination coverage status for all vaccines compared to Nooristan region (reference) were observed in the Badghis region (OR = 20.615), followed by Laghman (OR = 19.221), Wardak (OR = 12.088) , Bamyan (OR = 10.494), and Herat (OR = 9.44). For regions with the lowest complete vaccination coverage status for all vaccines, Zabul was (OR = 0.194), followed by Urozgan (OR = 0.794). and others. For the age of child, the complete vaccination coverage status for all vaccines increased (OR = 1.397).

The region is also considered a significant predictor for partial vaccination coverage for all vaccines in the present study. The regions with the highest partial vaccination coverage status for all vaccines in the present study, include the Badghis region (OR = 10.519), followed by Laghman (OR = 9.558), and Faryab (OR = 8.215). For regions with the lowest partial vaccination coverage for all vaccines, Khost had the lowest (OR = 0.255), followed by Kunarha (OR = 0.493), and Ghazni (OR = 0.496), and others. For the age of child, the partial vaccination coverage status for all vaccines decreased by (OR = 0.857) as illustrated in Table 16.

Table 16

Predictors of the Vaccination Coverage Status for All Vaccines

All Vaccines		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	.898	.221	16.555	1	<0.001			
	Age child	-.154	.013	149.944	1	<0.001	.857	.836	.879
	Laghman	2.257	.184	151.310	1	<0.001	9.558	6.670	13.695
	Ghazni	-.701	.114	37.920	1	<0.001	.496	.397	.620
	Khost	-1.367	.242	31.994	1	<0.001	.255	.159	.409
	Kunarha	-.706	.095	55.180	1	<0.001	.493	.409	.594
	Faryab	2.106	.210	100.181	1	<0.001	8.215	5.439	12.408
	Badghis	2.353	.183	166.205	1	<0.001	10.519	7.355	15.044
	Nooristan (Ref.)	0	.	.	0	<0.001	.	.	.
Complete	Intercept	2.104	.321	42.871	1	<0.001			
	Age child	.334	.018	355.794	1	<0.001	1.397	1.349	1.446
	Wardak	2.492	.208	143.104	1	<0.001	12.088	8.036	18.184
	Laghman	2.956	.201	216.449	1	<0.001	19.221	12.964	28.496
	Bamyan	2.351	.214	120.969	1	<0.001	10.494	6.902	15.953
	Urozgan	-1.582	.313	25.607	1	<0.001	.206	.111	.379
	Zabul	-1.642	.540	9.252	1	.002	.194	.067	.558
	Badghis	3.026	.207	212.915	1	<0.001	20.615	13.729	30.953
	Herat	2.245	.203	122.254	1	<0.001	9.440	6.341	14.054
	Nooristan (Ref.)	0	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Predictors of the BCG Vaccine

Multinomial logistic regression is the appropriate statistical test used to determine the predictors of vaccination coverage status for the BCG vaccine. There were no participants considered as outliers for predicting the vaccination coverage status for the BCG vaccine. This assumption was accepted.

The region showed the highest association with the vaccination coverage status for the BCG vaccine ($\chi2$ = 3755.400, *df* (66), p value < 0.001), followed by the age of child (χ^2 = 375.098, *df* (2), p value < 0.001), and others. There was no significant effect for the sex of the household.

The region is considered as a significant predictor of the vaccination coverage status for the BCG vaccine. The predictors of the BCG vaccination coverage status are illustrated in Table 17. The highest BCG vaccination coverages were observed in the Laghman region (OR = 16.651), followed by Bamyan (OR = 11.659), and others. For regions with the lowest complete BCG vaccination status compared to the Nooristan region (reference), Khost (OR = 0.011), followed by Zabul (OR = 0.445), and Urozgan (OR = 0.488). For age of child, the complete vaccination coverage status reduced with the elder child (OR = 0.820). There are no partial BCG vaccine doses (only one dose), so there is no data for partial BCG vaccine.

Table 17

Predictors of the Vaccination Coverage Status for BCG Vaccine

BCG Vaccine		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	UB
Yes	Intercept	-.107	.185	.337	1	0.001			
	Age of child	-.198	.010	368.371	1	<0.001	.820	.804	.837
	Laghman	2.812	.143	389.283	1	<0.001	16.651	12.592	22.017
	Bamyan	2.456	.155	250.058	1	<0.001	11.659	8.599	15.808
	Khost	-4.506	.604	55.598	1	<0.001	.011	.003	.036
	Urozgan	-.717	.083	74.292	1	<0.001	.488	.415	.575
	Zabul	-.810	.161	25.230	1	<0.001	.445	.324	.610

Note: The reference category is: Vaccination = None

Predictors of the DPT Vaccines

Multinomial regression is the appropriate statistical test used to determine the predictors of vaccination coverage status for the DPT vaccine. There were 46 participants who were considered as outliers for predicting the vaccination coverage status for the DPT vaccine. These outliers were excluded from the test. This assumption was accepted.

The region showed the highest association with the vaccination coverage status for the DPT vaccine (χ^2 = 4831.699, *df* (66), *p* value < 0.001), followed by the age of child (χ^2 = 654.159, *df* (2), *p* value < 0.001), and others. No significant effect was observed for the sex of the household.

The region is considered as a significant predictor of the complete vaccination coverage status of the DPT vaccine. Predictors of the DPT vaccination coverage status are summarized in Table 18. The regions with the highest complete DPT vaccination coverages observed were in the Bamyan region (OR = 10.776), and Wardak (OR =

10.670). For regions with the lowest complete DPT vaccination coverage status, Khost was less than the reference region Nooristan (OR = 0.05), followed by Urozgan (OR = 0.083). No significant effect was found for the age of child on the complete DPT vaccination coverage status.

The region is also considered a significant predictor for partial DPT vaccination coverage status. The highest partial DPT vaccination coverage status was observed in the Laghman region (OR = 9.735), followed by Wardak (OR = 7.350), Paktya (OR = 6.927), and Faryab (OR = 6.213). For regions with the lowest partial DPT vaccination coverage status less than Nooristan (reference) was Khost (OR = 0.009), followed by Urozgan (OR = 0.234), and others. For age of child, the rate of partial DPT vaccination coverage status decreases with elder child ages (OR = 0.730) as depicted in Table 18.

Table 18

Predictors of Vaccination Coverage Status for DPT Vaccine

DPT Vaccination stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	UB
Partial	Intercept	1.273	.267	22.742	1	<0.001			
	Age child	-.314	.014	508.493	1	<0.001	.730	.711	.751
	Wardak	1.995	.171	136.451	1	<0.001	7.350	5.259	10.271
	Laghman	2.276	.141	260.345	1	<0.001	9.735	7.384	12.834
	Paktya	1.935	.121	256.841	1	<0.001	6.927	5.467	8.777
	Khost	-4.738	.874	29.377	1	<0.001	.009	.002	.049
	Urozgan	-1.454	.165	77.392	1	<0.001	.234	.169	.323
	Faryab	1.827	.161	128.863	1	<0.001	6.213	4.533	8.517
	Nooristan (Ref.)	0[b]	.	.	0	<0.001	.	.	.
Complete	Intercept	1.183	.210	31.605	1	<0.001			
	Age child	-.005	.011	.241	1	.623	.995	.973	1.016
	Wardak	2.367	.135	306.337	1	<0.001	10.670	8.185	13.909
	Logar	.549	.105	27.487	1	<0.001	1.732	1.411	2.127
	Nangarhar	1.645	.095	300.465	1	<0.001	5.183	4.303	6.243
	Laghman	2.124	.115	339.915	1	<0.001	8.369	6.677	10.489
	Panjsher	1.208	.134	80.789	1	<0.001	3.348	2.572	4.357
	Baghlan	.685	.116	34.661	1	<0.001	1.984	1.579	2.492
	Bamyan	2.377	.146	266.263	1	<0.001	10.776	8.099	14.338
	Ghazni	.138	.108	1.634	1	.201	1.148	.929	1.419
	Paktika	.798	.088	81.849	1	<0.001	2.221	1.868	2.640
	Paktya	-1.482	.095	242.502	1	<0.001	4.402	3.653	5.305
	Khost	-5.215	.925	31.794	1	<0.001	.005	.001	.033
	Kunarha	-.388	.098	15.751	1	.000	.679	.560	.822
	Nimroz	1.417	.132	115.860	1	.000	4.126	3.188	5.341
	Badakhshan	1.984	.129	236.317	1	.000	7.272	5.647	9.365
	Urozgan	-2.489	.158	248.577	1	.000	.083	.061	.113
	Nooristan (Ref.)	0[b]	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Predictors of the Measles Vaccines

Multinomial logistic regression is the appropriate statistical test used to determine the predictors of the vaccination coverage status for the measles vaccine. There were no participants who were considered as outliers for predicting the vaccination coverage status for the measles vaccine. This assumption was accepted.

The age of child showed the highest association with the vaccination coverage status for the measles vaccines (χ^2 = 3833.960, *df* (2), *p* value < 0.001), followed by region (χ^2 = 3816.809, *df* (66), *p* value < 0.001).

The predictors of the measles vaccination coverage are summarized in Table 19. The region is considered as a significant predictor of the measles vaccine. The regions with the highest complete measles vaccination coverage status were in the Badghis region (OR = 7.034), followed by Bamyan (OR = 6.112). For regions with the lowest measles complete vaccination coverage status compared to Nooristan (reference) was Khost (OR = 0.012), followed by Urozgan (OR = 0.178). For age of child, the complete vaccination coverage status increased (OR = 2.061).

The region is also considered as a significant predictor for partial vaccination coverage status for the measles vaccine. The region with the highest partial vaccination coverage was observed in the Badghis region (OR = 16.913), followed by Wardak with (OR = 12.44). For regions with the lowest partial vaccination coverage status for the measles vaccine less than the Nooristan (reference) was Khost region (OR = 133), followed by Urozgan (OR = 0.37). For age of child, the partial vaccination coverage status increase with elder child ages (OR = 1.199) as depicted in Table 19.

Table 19

Predictors of Vaccination Coverage Status for the Measles Vaccine

Measles Vaccination stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	2.711	.144	354.964	1	<0.001			
	Age child	.182	.012	218.054	1	<0.001	1.199	1.171	1.229
	Wardak	2.521	.141	321.031	1	<0.001	12.440	9.442	16.390
	Khost	-2.020	.660	9.368	1	.002	.133	.036	.484
	Urozgan	-.994	.178	30.991	1	<0.001	.370	.261	.525
	Badghis	2.828	.141	404.716	1	<0.001	16.913	12.840	22.278
	Nooristan (Ref.)	0^b	.	.	0	.	.	.	.
Complete	Intercept	3.160	.125	639.576	1	<0.001			
	Age child	.723	.013	3155.198	1	<0.001	2.061	2.010	2.114
	Bamyan	1.810	.140	167.753	1	<0.001	6.112	4.648	8.038
	Khost	-4.384	.980	20.008	1	<0.001	.012	.002	.085
	Urozgan	-1.724	.144	142.821	1	<0.001	.178	.134	.237
	Badghis	1.951	.124	245.544	1	<0.001	7.034	5.511	8.978
	Nooristan (Ref.)	0^b	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Predictors of the Polio Vaccines

Multinomial logistic regression is the appropriate statistical test used to determine the predictors of vaccination coverage status for the polio vaccine. There were 143 participants who were considered as outliers and were excluded from the test. This assumption was accepted.

The region showed the highest association with the vaccination coverage status for the polio vaccines (χ^2 = 4946.778, df (66), p value < 0.001), followed by wealth index (χ^2 = 172.531, df (8), p value < 0.001), age of child (χ^2 = 132.372, df (2), p value < 0.01), and others. No significant effect was observed for the birth order.

The region is considered as a significant predictor for the vaccination coverage status of the polio vaccine. Predictors of the vaccination coverage status for the polio vaccines are summarized in Table 20. The highest complete vaccination coverage status for the polio vaccines were found in Laghman region (OR = 18.934), followed by Badghis with (OR = 15.087), and Wardak with (OR = 9.586). The lowest complete vaccination coverage status for polio vaccines compared to the Nooristan region (reference) was Khost by (OR = 0.218), followed by Urozgan with (OR = 0.322), and Kunarha with (OR = 0.383). For age of child, no significant effect was found on the complete vaccination coverage status of the polio vaccine.

The region is considered as a significant predictor for partial vaccination coverage status for polio vaccines. The region with the highest partial vaccination coverage status for polio vaccines was observed in the Badghis region with (OR = 9.768), followed by Paktya region with (OR = 8.156). The lowest partial vaccination coverage status for the polio vaccines compared to Nooristan (reference) was found Khost by (OR = 196), followed by Kunarha with (OR = 0.413), and Ghazni with (OR = 0.456). For age of child, the partial vaccination coverage status decreased with elder child ages by (OR = 0.891) as illustrated in Table 20.

Table 20

Predictors of the Vaccination Coverage Status for the Polio Vaccine

Vaccination stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	95% CI for OR *LB*	*UB*
Partial	Intercept	.620	.221	7.883	1	0.005			
	Age child	-.115	.013	84.366	1	<0.001	.891	.869	.913
	Ghazni	-.785	.122	41.528	1	<0.001	.456	.359	.579
	Paktya	2.099	.133	248.294	1	<0.001	8.156	6.282	10.590
	Khost	-1.627	.257	40.137	1	<0.001	.196	.119	.325
	Kunarha	-.884	.102	75.114	1	<0.001	.413	.338	.504
	Badghis	2.279	.183	154.531	1	<0.001	9.768	6.820	13.992
	Nooristan (Ref.)	0^b	.	.	0	.	.	.	.
Complete	Intercept	-.466	.260	3.207	1	.073			
	Wardak	2.260	.177	163.251	1	<0.001	9.586	6.777	13.558
	Laghman	2.941	.180	268.098	1	<0.001	18.934	13.316	26.924
	Khost	-1.522	.320	22.666	1	<0.001	.218	.117	.408
	Kunarha	-.959	.117	67.299	1	<0.001	.383	.305	.482
	Urozgan	-1.134	.184	37.797	1	<0.001	.322	.224	.462
	Badghis	2.714	.189	206.635	1	<0.001	15.087	10.421	21.842
	Nooristan (Ref.)	0^b	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Interaction Effects of Risk Factors for All Vaccines

The highest risk factors (regions, age of child, and wealth index) associated with the complete and partial vaccination coverage status were selected for multinomial logistic analysis to determine the interactions for all the vaccines examined.

Region and Age of Child for All Vaccines

The interaction of the regions and the age of child showed significant impact on the complete vaccination coverage status of all vaccines examined in the present study (BCG, DPT, measles, and polio). The interaction effect of region and age of child on the vaccination coverage status of all vaccines is depicted in Table 21. Badghis with increase in age of child showed the highest complete vaccination coverage status for all vaccines by (OR = 3.347), followed by Laghman with age of child by (OR = 3.284). Urozgan with age of child showed the lowest complete vaccination coverage status for all vaccines by (OR = 0.573), followed by Zabul with age of child with (OR = 0.621) than others.

Interactions of the regions and the age of child showed significant impact on the partial vaccination coverage status of all vaccines examined in the present study. Faryab with increase in age of child showed the highest partial vaccination coverage status by (OR = 2.147), followed by Balkh with increase in age of child by (OR = 1.868). Khost with age of child showed the lowest partial vaccination coverage status for all vaccines by (OR = 0.444), followed by Kunarha with age of child by (OR = 0.542) than others.

Table 21

Interaction of Region and Age of Child on Vaccination Status of All Vaccines

Vaccine stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	1.368	.026	2685.995	1	<0.001			
	Khost * age of child	-.812	.026	978.078	1	<0.001	.444	.422	.467
	Kunarha * age of child	-.612	.032	363.411	1	<0.001	.542	.509	.577
	Balkh * age of child	.625	.083	56.776	1	<0.001	1.868	1.588	2.198
	Faryab * age of child	.764	.108	50.486	1	<0.001	2.147	1.739	2.650
Complete	Intercept	1.112	.043	670.880	1	<0.001			
	Laghman * age of child	1.189	.078	231.596	1	<0.001	3.284	2.817	3.827
	Urozgan * age of child	-.557	.130	18.370	1	<0.001	.573	.444	.739
	Zabul * age of child	-.477	.239	3.974	1	.046	.621	.388	.992
	Badghis * age of child	1.208	.088	186.464	1	<0.001	3.347	2.814	3.981

Note: The reference category is: Vaccination = None.

Region and Wealth Index for All vaccines

Interaction of regions and the wealth index showed significant impact on the complete vaccination coverage status for all vaccines. The interaction effect of the region and wealth index on the vaccination coverage status is summarized in Table 22. Rich participants from the Wardak region showed the highest association with the complete vaccination coverage status by (OR = 67.148), followed by the participants from the middle wealth index category from the Wardak region by (OR = 62.489). Followed by the richest participants from the Sar-E-Pul region with (OR = 61.667), and the richest from Herat with (OR = 55.089). Urozgan with the middle wealth index showed the lowest complete vaccination coverage status by (OR = 0.096) than other regions, followed by the poorest from Kunarha region with (OR = 0.183) than others.

Interaction of regions and the wealth index showed significant impact on partial vaccination status coverage of all vaccines. Paktya and the poorest showed the highest partial vaccination coverage status of all vaccines by (OR = 38.933), followed by Faryab and rich with (OR = 0.083), followed by Khost and rich with (OR = 0.181) than others.

Table 22

Interaction of Region and Wealth Index on Vaccination of All Vaccines

Vaccine stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR*	
								LB	*UB*
Partial	Intercept	.188	.128	2.153	1	.142			
	Paktya * Poorest	3.662	1.019	12.921	1	<0.001	38.933	5.287	286.704
	Khost * Rich	-1.709	.182	88.066	1	<0.001	.181	.127	.259
	Faryab * Rich	3.416	.523	42.697	1	<0.001	30.442	10.927	84.810
	Nooristan * Richest	0^c	.	.	0	<0.001	.	.	.
Complete	Intercept	1.414	.215	43.403	1	<0.001			
	Kunarha * Poorest	-1.700	.754	5.085	1	.024	.183	.042	.801
	Wardak * Middle	4.135	.509	65.964	1	<0.001	62.489	23.038	169.499
	Urozgan * Middle	-2.348	.747	9.882	1	.002	.096	.022	.413
	Wardak * Rich	4.207	.632	44.269	1	<0.001	67.148	19.446	231.867
	Sar-E-Pul * Richest	4.122	1.055	15.268	1	<0.001	61.667	7.801	487.464
	Herat * Richest	4.009	.511	61.584	1	<0.001	55.089	20.241	149.935
	Nooristan * Richest	0^c	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Wealth Index and Age of Child for All vaccines

Interaction effect of wealth index and age of child on the vaccination coverage status of all vaccines is summarized in Table 23. Participants with the richest and rich families showed the highest complete vaccination coverage status by (OR = 1.730) and (OR = 1.457) respectively than other wealth index family groups. Those with poorest and poor families showed lowest partial vaccination of all vaccines by (OR = 0.834) and (OR = 0.835) respectively than others as shown in Table 23.

Table 23

Interaction of Wealth Index and Age of Child on Vaccination of All vaccines

Vaccine stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	1.427	.026	3018.919	1	<0.001			
	Poorest * age of child	-.181	.015	142.298	1	<0.001	.834	.810	.860
	Poor * age of child	-.181	.014	162.625	1	<0.001	.835	.812	.858
	Middle * age of child	-.141	.015	88.188	1	<0.001	.869	.844	.895
	Rich * age of child	-.134	.016	73.070	1	<0.001	.875	.848	.902
	Richest * age of child	-.018	.021	.727	1	.394	.983	.944	1.023
Complete	Intercept	1.111	.042	690.880	1	<0.001			
	Poorest * age of child	.183	.021	72.977	1	<0.001	1.201	1.152	1.253
	Poor * age of child	.197	.020	97.301	1	<0.001	1.218	1.171	1.267
	Middle * age of child	.284	.020	196.732	1	<0.001	1.328	1.276	1.382
	Rich * age of child	.376	.020	351.466	1	<0.001	1.457	1.401	1.515
	Richest * age of child	.548	.024	507.691	1	<0.001	1.730	1.649	1.815

Note: The reference category is: Vaccination = None.

Interaction Effects on BCG Vaccination Coverage

Region and Age of Child

Interaction of regions and the age of child showed significant impact on the complete vaccination coverage status of the BCG vaccine. Table 24 summarizes the interaction effect of region and age of child on the vaccination coverage status of the

BCG vaccine. Laghman region with the increase age of child showed the highest BCG vaccination coverage status by (OR = 1.855), followed by Faryab with age of child by (OR = 1.568), and Badakhshan and age of child with (OR = 1.524) than others. Khost and age of child had the lowest BCG vaccination coverage status with (OR = 0.049), followed by Urozgan and age of child with (OR = 0.505) than other regions.

Table 24

Interaction of Region and Age of Child on BCG Vaccination Status

								95% CI for OR	
BCGnew[a]		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*LB*	*UB*
Yes	Intercept	.909	.023	1618.652	1	<0.001			
	Laghman * age of child	.618	.056	123.796	1	<0.001	1.855	1.663	2.068
	Khost * age of child	-3.017	.150	405.398	1	<0.001	.049	.036	.066
	Badakhshan * age of child	.422	.053	62.134	1	<0.001	1.524	1.373	1.693
	Urozgan * age of child	-.683	.029	550.320	1	<0.001	.505	.477	.535
	Faryab * age of child	.450	.055	67.607	1	<0.001	1.568	1.409	1.745

Note: The reference category is: Vaccination = No.

Interaction Effects on the DPT Vaccination Coverage

Wealth Index and Age of Child

The interactions of wealth index and age of child factors for the DPT vaccines are summarized in Table 25. For complete DPT vaccination coverage status, participants with the richest and rich families showed the highest complete DPT vaccination coverage status by (OR = 1.230) and (OR = 1.07) respectively than other wealth index family groups. For partial DPT vaccination coverage status, poorest and poor families showed the lowest coverage by (OR = 0.754) and (OR = 0.697) respectively than other groups as depicted in Table 25.

Table 25

Interaction of Wealth Index and Age of Child on DPT vaccination status

DPT stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	UB
Partial	Intercept	-.409	.027	230.171	1	<0.001			
	Poorest * age of child	-.283	.019	216.597	1	<0.001	.754	.726	.783
	Poor * age of child	-.361	.019	371.585	1	<0.001	.697	.672	.723
	Middle * age of child	-.326	.019	283.635	1	<0.001	.722	.695	.750
	Rich * age of child	-.256	.019	177.495	1	<0.001	.774	.746	.804
	Richest * age of child	-.135	.023	34.994	1	<0.001	.874	.836	.914
Complete	Intercept	-.031	.023	1.832	1	.176			
	Poorest * age of child	-.052	.014	14.769	1	<0.001	.949	.924	.975
	Poor * age of child	-.077	.013	37.823	1	<0.001	.925	.903	.949
	Middle * age of child	.004	.013	.075	1	.784	1.004	.979	1.029
	Rich * age of child	.069	.013	27.880	1	<0.001	1.071	1.044	1.099
	Richest * age of child	.207	.016	167.499	1	<0.001	1.230	1.192	1.269

Note: The reference category is: Vaccination = None.

Region and Age of Child

Interaction of the regions and age of child factors showed significant impact on the complete DPT vaccination coverage status and are summarized in Table 26. The region of Wardak with the increase of age of child showed the highest complete DPT vaccination coverage status by (OR = 2.164), followed by Laghman region with age of child by (OR = 1.928). Khost and age of child had the lowest complete DPT vaccination coverage status with (OR = 0.017) than other regions, followed by Urozgan and age of child by (OR = 0.286).

The interaction of regions and age of child factors showed significant impact on the partial vaccination coverage status of the DPT vaccine. Laghman with increased age of child showed the highest partial vaccination coverage status by (OR = 1.492), followed by Wardak with age by (OR = 1.343). In contrast, Khost and age of child showed the lowest partial DPT vaccination coverage status by (OR = 0.088) lower than other regions, followed by Kunarha with age of child by (OR = 0.348).

Table 26

Interaction of Region and Age of Child on DPT Vaccination Status

DPT stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	-.338	.028	150.019	1	<0.001			
	Wardak * age of child	.295	.072	16.953	1	<0.001	1.343	1.167	1.546
	Laghman * age of child	.400	.052	59.495	1	<0.001	1.492	1.348	1.652
	Khost * age of child	-2.428	.182	177.183	1	<0.001	.088	.062	.126
	Urozgan * age of child	-1.245	.084	220.126	1	<0.001	.288	.244	.340
Complete	Intercept	.039	.024	2.659	1	.103			
	Wardak * age of child	.772	.060	164.238	1	<0.001	2.164	1.923	2.436
	Laghman * age of child	.656	.047	198.158	1	<0.001	1.928	1.760	2.112
	Khost * age of child	-4.092	.404	102.720	1	<0.001	.017	.008	.037
	Urozgan * age of child	-1.253	.071	310.269	1	<0.001	.286	.248	.328

Note: The reference category is: Vaccination = None.

Region and Wealth Index

The interaction of regions and the wealth index factors showed significant impact on the complete vaccination coverage status of the DPT vaccine as shown in Table 27. Middle wealth index participants from Wardak region showed the highest complete DPT vaccination coverage status with (OR = 28.243), followed by Bamyan with poor by (OR = 18.197) than others. Khost with middle and rich wealth index showed the lowest complete DPT vaccination coverage status by (OR = 0.003) and (OR = 0.004) respectively than other groups.

The interaction of regions and wealth index factors showed significant impact on the partial DPT vaccination coverage status. Paktya and poorest level showed the highest partial DPT vaccination coverage status by (OR = 19.186), followed by Wardak and middle wealth index with (OR = 17.442). Khost region with rich and poor wealth index showed the lowest partial DPT vaccination coverage status by (OR = 0.028) and (OR = 0.036) respectively than others as shown in Table 27.

Table 27

Interaction of Region and Wealth Index on DPT Vaccination Status

DPT stage								*95% CI for OR*	
		B	*SE*	*Wald*	*df*	*p*	*OR*	*LB*	*UB*
Partial	Intercept	1.730	.205	71.218	1	<0.001			
	Paktya * Poorest	2.954	.549	29.006	1	<0.001	19.186	6.548	56.218
	Khost * Poor	-3.321	.493	45.320	1	<0.001	.036	.014	.095
	Wardak * Middle	2.859	.403	50.338	1	<0.001	17.442	7.918	38.421
	Khost * Rich	3.578	.738	23.509	1	<0.001	Q	.007	.119
Complete	Intercept	-.574	.133	18.755	1	<0.001			
	Urozgan * Poorest	-3.757	1.015	13.693	1	<0.001	.023	.003	.171
	Bamyan * Poor	2.901	.393	54.388	1	<0.001	18.197	8.417	39.341
	Wardak * Middle	3.341	.338	97.744	1	<0.001	28.243	14.564	54.771
	Khost * Middle	-5.803	1.010	33.036	1	<0.001	.003	.000	.022
	Khost * Rich	-5.427	1.010	28.879	1	<0.001	.004	.001	.032
	Nooristan * Richest	0^{c}	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Interaction Effects on the Measles Vaccination Coverage

Region and Age of Child

The interaction of regions and the age of child factors showed significant impact on the complete vaccination coverage status of the measles vaccine summarized in Table

28. Helmand with increased age of child showed the highest coverage by (OR = 3.700), followed by Nimroz with age by (OR = 3.664). Paktya and age of child showed the lowest coverage with (OR = 0.259) than other regions.

The interaction of regions and age of child factors also showed significant impact on the partial vaccination coverage status of the measles vaccine. Helmand region with increase in the age of child showed the highest partial measles vaccination coverage status by (OR = 2.396), followed by Parwan with age of child by (OR = 2.176). Paktya and age of child showed the lowest partial measles vaccination coverage with (OR = 0.376), followed by Khost with the age of child with (OR = 0.699) than other regions depicted in Table 28.

Table 28

Interaction of Region and Age of Child on Measles Vaccination Status

Measles stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	1.210	.026	2180.057	1	<0.001			
	Parwan * age of child	.777	.056	196.156	1	<0.001	2.176	1.951	2.426
	Paktya * age of child	-.978	.076	164.271	1	<0.001	.376	.324	.437
	Khost * age of child	-.358	.053	45.767	1	<0.001	.699	.630	.775
	Helmand * age of child	.874	.052	278.226	1	<0.001	2.396	2.162	2.655
Complete	Intercept	2.117	.032	4325.961	1	<0.001			
	Intercept	.866	.038	512.991	1	<0.001	2.378	2.206	2.563
	Parwan * age of child	1.236	.054	522.098	1	<0.001	3.441	3.095	3.825
	Paktya * age of child	1.353	.179	56.978	1	<0.001	.259	.182	.367
	Nimroz * age of child	1.299	.054	574.912	1	<0.001	3.664	3.295	4.075
	Helmand * age of child	1.308	.052	634.550	1	<0.001	3.700	3.342	4.096

Note: The reference category is: Vaccination = None.

Interaction Effects on the Polio Vaccination Coverage

Wealth Index and Age of Child

The interaction of wealth index and age of child factors showed significant impact on the complete polio vaccination coverage status as depicted in Table 29. The richest and rich families with increase age of child showed the highest complete polio vaccination by (OR = 1.233) and (OR = 1.058) respectively than other wealth index family groups. In contrast, the poorest and the poor with age of child showed the lowest coverage by (OR = 0.861) and (OR = 0.900) respectively lower than others. Those with poor families with age of child showed the lowest partial polio vaccination coverage by (OR = 0.893) than other wealth index family groups as depicted in Table 29.

Table 29

Interaction of Wealth Index and Age of Child on Polio Vaccination Status

Vaccine stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*95% CI for OR* *LB*	*UB*
Partial	Intercept	.946	.027	1272.795	1	<0.001			
	Poorest * age of child	-.100	.015	41.801	1	<0.001	.905	.878	.933
	Poor * age of child	.-114	.014	61.449	1	<0.001	.893	.868	.918
	Middle * age of child	-.089	.015	33.904	1	<0.001	.915	.888	.943
	Rich * age of child	-.112	.016	48.301	1	<0.001	.894	.866	.923
	Richest * age of child	-.014	.021	.457	1	.499	.986	.946	1.027
Complete	Intercept	.409	.029	200.572	1	<0.001			
	Poorest * age of child	-.150	.018	71.985	1	<0.001	.861	.832	.891
	Poor * age of child	-.105	.016	42.838	1	<0.001	.900	.873	.929
	Middle * age of child	-.032	.016	3.890	1	.049	.968	.938	1.000
	Rich * age of child	.057	.016	11.984	1	<0.001	1.058	1.025	1.093
	Richest * age of child	.210	.021	102.427	1	<0.001	1.233	1.184	1.285

Note: The reference category is: Vaccination = None.

Region and Age of Child

The interaction of regions and the age of child showed significant impact on the complete vaccination coverage status of the polio vaccine as depicted in Table 30. Laghman region with increase in the age of child showed the highest complete vaccination status for the polio vaccine by (OR = 2.508), followed by Badghis with age of child by (OR = 2.170) than others. Khost with age of child showed the lowest complete vaccination coverage status by (OR = 0.233) than others.

The interaction of regions and age of child factors also showed significant impact on the partial vaccination coverage status of the polio vaccine. Badghis region with increase age of child showed the highest partial polio vaccination coverage by (OR = 1.918), followed by Balkh with age of child by (OR = 1.869) than others. Khost with age of child showed the lowest partial vaccination of the polio vaccine by (OR = 0.510), followed by Kunarha with age of child with (OR = 0.524).

Table 30

Interaction of Region and Age of Child on Polio Vaccination Status

								95% CI for OR	
Polio stage[a]		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*LB*	*UB*
Partial	Intercept	.902	.027	1115.423	1	<0.001			
	Khost * age of child	-.673	.026	666.581	1	<0.001	.510	.485	.537
	Kunarha * age of child	-.647	.037	302.828	1	<0.001	.524	.487	.563
	Balkh * age of child	.626	.076	67.732	1	<0.001	1.869	1.611	2.170
	Badghis * age of child	.651	.081	64.229	1	<0.001	1.918	1.635	2.249
Complete	Intercept	.394	.030	178.518	1	<0.001			
	Laghman * age of child	.920	.073	158.600	1	<0.001	2.508	2.174	2.894
	Khost * age of child	-1.458	.077	361.590	1	<0.001	.233	.200	.270
	Badghis * age of child	.775	.082	89.822	1	<0.001	2.170	1.849	2.547

Note: The reference category is: Vaccination = None.

Region and Wealth Index

The interaction of regions and wealth index showed significant impact on the complete vaccination coverage status of the polio vaccine as illustrated in Table 31. Rich participants from the Wardak region showed the highest association to the complete vaccination coverage with (OR = 75.254), followed by the richest in Sar-E-Pul region by (OR = 65.847) than others. In contrast, Khost with rich wealth index showed the lowest by (OR = 0.034) than other groups., followed by Khost with the middle wealth index wit (OR = 0.047) than others.

The interaction between the regions and the wealth index also showed significant impact on the partial vaccination status of the polio vaccine. Paktya and the poorest showed the highest partial polio vaccination coverage status by (OR = 44.184), followed by Urozgan and richest with (OR = 43.107) than others. Kandahar and the poorest showed the lowest partial vaccination status by (OR = 0.108) than others.

Table 31

Interaction of Region and Wealth Index on Polio Vaccination Status

								95% CI for OR	
Polio stage		*B*	*SE*	*Wald*	*df*	*p*	*OR*	*LB*	*UB*
Partial	Intercept	-.075	.137	.299	1	.585			
	Paktya * Poorest	3.788	1.021	13.759	1	<0.001	44.184	5.969	327.058
	Kandahar * Poorest	-2.228	1.058	4.436	1	.035	.108	.014	.857
	Urozgan * Richest	3.764	1.022	13.572	1	<0.001	43.107	5.820	319.267
	Nooristan * Richest	0[c]	.	.	0	<0.001	.	.	.
Complete	Intercept	-.632	.161	15.387	1	<0.001			
	Khost * Middle	-3.050	.345	78.073	1	<0.001	.047	.024	.093
	Wardak * Rich	4.321	.606	50.785	1	<0.001	75.254	22.931	246.963
	Khost * Rich	-3.387	.442	58.657	1	<0.001	.034	.014	.080
	Sar-E-Pul * Richest	4.187	1.027	16.627	1	<0.001	65.847	8.799	492.766
	Nooristan * Richest	0[c]	.	.	0	.	.	.	.

Note: The reference category is: Vaccination = None.

Summary

From the results reported in this section, the three categories of independent factors (child, parental, and geographical factors) significantly influenced the vaccination coverage status ($p < 0.001$). For all vaccination coverage (BCG, DPT, measles, and polio), both complete and partial showed highest for participants from the Badghis region, while lowest in the Khost region. For BCG vaccination coverage, the highest vaccination coverage was also in Badghis and lowest in Khost. For the DPT vaccination coverage, the highest was in Bamyan (complete) and Badghis (partial), while it was lowest in Khost. For measles vaccination coverage, the highest complete and partial were in Badghis and lowest in Khost. For polio vaccination coverage, the highest was in Laghman (complete) and Badghis (partial), while it was lowest in Khost (complete and partial).

For the interaction effects on all vaccination coverage (BCG, DPT, measles, and polio), elder children from rich families showed the highest complete vaccination coverage, while elder aged children of poor families showed the highest partial vaccination coverage. The Badghis region with age of child showed the highest complete vaccination for all four vaccines, while Urozgan region with age of child showed the lowest. Faryab with age of child showed the highest partial vaccination coverage for all vaccines, while Khost was the lowest. The middle wealth index and rich from Wardak region also showed the highest in complete vaccination coverage for all vaccines, while the lowest was found in participants from the middle wealth index in Urozgan, followed by Kunarha and poorest wealth.

For only the BCG vaccine, the Laghman region with age of child showed the highest BCG vaccination coverage, while the Khost region was the lowest. For only the DPT vaccines, the Wardak and Laghman regions with age of child showed the highest DPT vaccination for complete and partial coverage respectively, while Khost with age of child showed the lowest. For only the measles vaccines, the Helmand region with age of child showed the highest complete and partial measles vaccination coverage, and lowest in Paktya (complete) and Khost (partial). For only the polio vaccines, Laghman (complete) and Badghis (partial) with age of child showed the highest polio vaccination, while Khost showed the lowest. Also, for the polio vaccination, Wardak with rich wealth index showed the highest polio vaccination (complete) and Paktya from poor wealth index showed the highest partial polio vaccination. The rich from Khost and poor from Kandahar showed the lowest polio vaccination.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Afghanistan remains among one of the lowest vaccinated countries worldwide. This is evidenced by the persistence of measle outbreaks and polio transmission (Mugali et al., 2017). The purpose of the present study was to examine the risk factors (child, parental, and geographical) associated with childhood vaccination coverage (none, partial, and complete) in Afghanistan. The study was designed to provide evidence about these influences that prevent achievement of universal vaccination coverage. Secondary data analyses were conducted using the 2015 AfDHS data set. Specifically, univariate, bivariate, and multivariate analyses were performed using the IBM SPSS version 25 to answer the research questions by testing the associated hypotheses.

Summary of Results and Hypotheses

A concise summary of the results from the analyses conducted is provided in Tables 32 and 33. Decisions regarding the hypotheses and the outcomes of the analyses are summarized in the tables to explicitly answer the two research questions.

RQ1 – Quantitative: What is the effect of the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) on vaccination coverage (full, partial, and none) for Afghanistan children?

$H_0 1$ – There is no significant effect of the risk factors on vaccination coverage for Afghanistan children.

$H_1 1$ – There is significant effect of the risk factors on vaccination coverage for Afghanistan children.

Table 32

Summary of Results of Analysis for Research Question 1

Hypothesis	Decision	Outcomes (highest association)	Other outcomes (highest and lowest interactions)
***H_0*1** There is no significant effect of the risk factors on vaccination coverage for Afghanistan children	Rejected	**1) All vaccination**: age of child and region significantly influenced the vaccination status (completed, partial and none)	**1) Complete**: Highest in Badghis and Laghman Lowest in Urozgan **2) Partial:** Highest in Badghis, and Laghman. Lowest in Khost and Kunarha
		2) BCG: Age of child and region significantly influenced the vaccination status (completed, none)	**1) Complete:** Highest in Laghman and Bamyan Lowest in Khost and Urozgan **2) Partial:** Only one dose (no partial)
		3) DPT: Age of child and region significantly influenced the vaccination	**1) Complete:** Highest in Bamyan and Wardak. Lowest in Khost and Urozgan **2) Partial:** Highest in Laghman and Wardak Lowest in Khost and Urozgan
		4) Polio: age of child, wealth index and region significantly influenced the vaccination status (completed, partial and none)	**1) Complete:** Highest in Badghis and Laghman Lowest in Khost, Urozgan, and Kunarha **2) Partial:** Highest in Badghis and Paktya. Lowest in Khost, Ghazni, and Kunarha
		5) Measles: age of child and region significantly influenced the vaccination status (completed, partial and none)	**1) Complete:** Highest in Badghis and Bamyan. Lowest in Khost and Urozgan, **2) Partial:** Highest in Badghis and Wardak. Lowest in Khost and Urozgan

RQ2 – Quantitative: What is the effect of interaction between the risk factors (age, gender, birth order, and ethnicity of the child; age, education level, occupation, and wealth of parents; and regions) for each vaccine (BCG, DPT, measles, and polio) on vaccination coverage (full, partial, and none) for Afghanistan children?

$H_0$2 – There is no significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children.

$H_1$2 – There is significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children.

Table 33

Summary of the Results of Analyses for Research Question 2

Hypothesis	Decision	Outcomes (highest association)	Other outcomes (highest and lowest interactions)
***H*₀2** There is no significant effect of interaction between the risk factors for each vaccine on vaccination coverage for Afghanistan children	Rejected	**1) All vaccination:** wealth index and age of child; region and age of child; region and wealth index	**Wealth index and age** **1) Complete:** Highest in elder children of richest and rich families. Lowest in poorest. **2) Partial:** Highest in elder age of richest. Lowest in elder children of the poorest and poor families. **Region and age of child** **1) Complete:** Highest in Badghis and age. Laghman and age. Lowest in Urozgan and age, Zabul and age. **2) Partial:** Highest in Faryab and age, elder age. Balkh and age. Lowest in Khost and age. Kunarha with age. **Region and wealth index** **1) Complete:** Highest in Rich,,middle from Wardak and Badghis. Sar-E-Pul and Richest, Herat richest . Lowest in Urozgan with middle, Kunarha and Poorest. **2) Partial:** Highest in Paktya and Poorest, Faryab and Rich. Lowest in Kandahar Poorest. Khost and Rich.
		2) BCG: Region and age of child	**Region and age of child** **1) Complete:** Laghman and age, Faryab with age, Badakhshan, and age. Lowest in Khost and age. **2) Partial:** Only one dose (no partial)
		3) Measles: Region and age of child	**Region and age of child** **1) Complete:** Helmand and age, Nimroz and age. Lowest in Paktya and age **2) Partial:** Helmand and age, Parwan and age. Lowest in Khost and age.
		4) Polio: Wealth index and age of child; Region and age of child; Region, and wealth index	**Wealth index and age** **1) Complete:** elder ages with richest and rich. Lowest in poor and poorest. **2) Partial:** elder children of poor families **Region and age of child** **1) Complete:** Laghman and age, Badghis and age. Lowest in Khost with age **2) Partial:** Badghis and age, Balkh, and age. Lowest in Khost with age, Kunarha with age **Region and wealth index** **1) Complete:** Rich and Wardak. Sar-E-Pul and Richest. Lowest in Khost with rich and middle **2) Partial:** Paktya and Poorest. Urozgan and Richest Lowest in Kandahar and Poorest
		5) DPT: Wealth index and age of child; region and age of child; region and wealth index	**Wealth Index and age** **1) Complete:** elder ages with richest and rich 2) Partial: elder age with poorest and poor **Region and age of child** 1) Complete: Wardak and age, Laghman and age. Lowest in Khost with age, Uruzgan and age 2) Partial: Laghman and age, Wardak and age. Lowest in Khost with age, Kunarha with age **Region and wealth index** 1) Complete: Middle and Wardak. Bamyan and poor. Lowest in Khost with rich and middle **2) Partial:** Paktya and Poorest. Wardak and middle. Lowest in Khost with rich and poor

Interpretations of Findings

Vaccination coverage status was measured based on the number of doses per total doses for all vaccines and for each vaccine separately. For example, the complete polio doses are four doses. Therefore, all children that received four doses of polio were grouped within the complete polio vaccination category, while any child that received at least one dose but not four was considered partial polio vaccination coverage status. This vaccination coverage status measurement approach was successfully used in several other peer-reviewed research studies (Russo et al., 2015; Oleribe et al., 2017; Ntenda et al., 2019; Sarker et al., 2019).

Issues Related to Insufficient Vaccination Coverage in Afghanistan

All Vaccines

The percentage of vaccination coverage status for all four vaccines (BCG, DPT, measles, and polio) in Afghanistan was 20.8%, 65%, and 14.2% for none, partial, and complete vaccination coverage status respectively (Table 16). This finding demonstrated that more than 85% of the Afghanistan children have vaccination coverage issues based on the present study result. Only 14.2% of Afghan children had complete vaccination coverage for all four vaccines examined. There is peer-reviewed research-based evidence attributing the failure of vaccination coverage in developing countries to risk factors such as individual, socio-economic, geographical, culture, religious beliefs, healthcare service, and government support system (Oku et al., 2017; Oleribe et al., 2017).

BCG Vaccine

The vaccination coverage status for the BCG vaccine was evaluated as either complete or none because it is only a single dose vaccine. The percentage of vaccination coverage for BCG vaccine was 63.2% (Table 17). This percentage showed the highest than other vaccines because BCG vaccine is given at birth in the hospital (Stensballe et al., 2017). However, 36.8% of Afghan children did not receive the BCG vaccine, and they may be born at home using mid-wifery services.

DPT Vaccines

The vaccination coverage status for the DPT vaccine alone showed 41.7%, 16.4%, and 41.9% for none, partial, and complete DPT vaccination respectively (Table 18). The percentage of children who did not get complete DPT vaccination was found to be 58.1% in Afghanistan, and these children are at a serious risk for mortality because they are more likely to be infected with diseases and complications associated with diphtheria, pertussis, and tuberculosis. Furthermore, not receiving the DPT vaccines may cause weakened immunity for these children creating potential risk for contracting other infectious diseases such as Covid-19 (Abbas et al., 2020). The main reasons for not getting the complete doses of vaccines may be related to family worries about symptoms of vaccine injections such as temporary pain and swelling, vaccine-related side-effects, and/or inappropriate belief that one dose would be adequate for a healthy child (Miller, 2016). Other reasons for poor compliance to the vaccination coverage plan may be due to psychological, social, financial, security, and vaccine accessibility and availability challenges (Mugali et al., 2017).

Measles Vaccines

The vaccination coverage status for the measles vaccines alone was 53.6%, 19.6%, and 26.8% for none, partial, and complete measles vaccination respectively (Table 19). Over half the children (53.6%) in Afghanistan did not receive the measles vaccination at all, and 26.8% received partial measles vaccination demonstrating weakness in the vaccination campaign system for the measles vaccines in Afghanistan. This finding is supported by Mugali et al. (2017), who found persistent measles outbreaks in Afghanistan. The most common reasons for vaccination coverage insufficiency were associated with family and health system factors (Ventola, 2016). These factors included: The lack of family awareness of vaccination, lack of knowledge about the importance of the complete vaccination coverage in children, inability to access vaccination, and insufficient health system follow-up on vaccination coverage status (Ventola, 2016).

Polio Vaccines

The vaccination coverage status for the polio vaccines alone was 21.8%, 46.4%, and 31.8% for none, partial, and complete polio vaccination respectively (Table 20). The percentage of the “none” category was the lowest compared to other vaccines, which may be attributed to the forms of the polio vaccines. There are two forms of the polio vaccine: oral and injectable dosage forms of delivery (Grassly, 2014). It is likely that families preferred the oral form rather than injections because of better tolerance and less adverse effects. However, the commitment to polio vaccination remains poor, demonstrated by the partial vaccination coverage of the polio vaccines at 46.4%. Additionally, the complete vaccination coverage of polio vaccines is only 31.8% that reiterates the assertion of low levels of family awareness, ability to access vaccination, and insufficient health system follow-up. This view is consistent with persistent polio transmission in Afghanistan found by Mugali et al. (2017) and WHO (2020).

Predictors of Vaccination Coverage Status

All factors involved in the present study significantly influenced the vaccination coverage status in Afghanistan except for the sex of the child ($p < 0.001$) as illustrated in Table 11. However, the predictors with the highest association to the vaccination coverage significantly were observed with region (geographical factor) and age of child (child factor) as seen in Table 11. Region plays a crucial role in vaccination coverage in Afghanistan. Another research study supports this finding in Afghanistan (Aalemi et al., 2019). The importance of the geographical region's role may be attributed to several issues such as security and safety concerns in certain regions and weak vaccination delivery systems in difficult to reach geographical areas.

Predictors of All Vaccines

Complete and partial vaccination coverage status of all vaccines (BCG, DPT, measles, and polio) were observed highest in the Badghis, Laghman, Wardak, Bamyan, and Herat regions (complete) when compare to other regions as summarized in Table 16. The lowest were observed in Zabul (complete) and Urozgan, Khost, Ghazni, and Kunarha (partial) as depicted in Table 16. Therefore, the regions with the lowest vaccination coverage status for all vaccines need more follow-up and intervention to improve vaccination coverage there and mitigate childhood mortality emanating from vaccination insufficiency in those regions. Table 16 also showed higher vaccination coverage status for elder ages indicating family commitment to the vaccination program may be higher in elder children than in the first years of the child's life.

Predictors of BCG Vaccine

Several predictors of complete vaccination coverage status for the BCG vaccine are reported in Table 17. Region and age of child again showed the highest impact on BCG vaccination coverage compared to other factors. The regions found most associated with the complete BCG vaccination coverage status were Laghman and Bamyan regions, which demonstrated compliance to the Afghanistan vaccination program. Khost, Zabul, and Urozgan regions showed the lowest BCG vaccination coverage, indicating the necessity for more attention to the BCG vaccination interventions in these areas. The age of a child is negatively associated to complete BCG vaccination coverage status because the BCG vaccine is administered in the first days of birth. Therefore, lower BCG vaccination coverage was observed in elder child ages.

Predictors of DPT Vaccine

The highest influence of predictors that showed for the vaccination coverage status for the DPT vaccine was the region and age of child depicted in Table 18. Highest DPT complete vaccination showed in Bamyan, Wardak, Badakhshan, and Laghman. Partial DPT vaccination showed in Laghman, Paktya, Wardak, and Faryab while Khost and Urozgan showed the lowest indicating the need for attention there. Age of child was most associated with partial vaccination, where elder ages showed lower vaccination indicating need to focus on elder children for DPT vaccine doses.

Predictors of Measles Vaccines

The age of child and the region were the highest predictors associated with the measles vaccination coverage status. Badghis, Bamyan, and Wardak regions showed the highest measles vaccination coverage status as depicted in Table 19. This indicates that the regions have better measles vaccination commitment and compliance to the measles vaccination intervention programs there. However, Khost and Urozgan regions showed the lowest measles vaccination coverage status indicating the necessity for improving the measles vaccination programs in these regions. The age of child also plays a significant role in influencing the measles vaccination coverage status, where the vaccination coverage increased with the age of the child. Therefore, the healthcare decision-makers may need to target on the first ages of the children in a measles intervention program.

Predictors of Polio Vaccines

Predictors of the polio vaccination coverage status showed the highest association with region, age of child, and the wealth index. Laghman, Badghis, Paktya, and Wardak regions showed the highest complete and partial vaccination coverage status than other regions as depicted in Table 20. Khost, Urozgan, Kunarha, and Ghazni regions showed the lowest polio vaccination coverage status than other regions. The persistent outbreaks of polio transmission in Afghanistan found by Mugali et al. (2017) is consistent with this finding. This indicates the necessity to improve polio vaccination interventions in the regions with the lowest polio vaccination coverages.

Interaction of Predictors and Vaccination Coverage Status

The interaction of predictors was examined to determine the risk factors that influenced the vaccination coverage status the most so that the outcome of the interactive predictors may guide vaccination intervention programs with more precision. In the present study, the highest influencing predictors were used to identify their impact to the vaccination coverage status in Afghanistan. The predictors that most influenced the vaccination coverage status were the region (geographical factor), age of child (child factor), and the wealth index (parental factor). I identified differences in the outcomes of the interactive predictors among all the vaccines examined in the present study.

Interactions of Predictors for All Vaccines

Region and Age of Child

Geographic region and age of child were considered as significant interaction to the vaccination coverage status for all vaccines. Families from the Badghis and Laghman with elder ages of children showed the highest commitments to complete vaccination coverage status for all vaccines as depicted in Table 21. Faryab region families with elder ages of children showed the highest partial vaccination coverage status for all vaccines which indicates insufficient vaccination follow-up in the Faryab region for all vaccines. This finding is attributed to the variance of vaccination coverage status among regions, but all regions were consistent in elder ages of the children contributed to better vaccination coverage status compliance for all vaccines. Urozgan, Zabul, Khost, and Kunarha regions showed the lowest vaccination coverage status for all vaccines with elder ages children. This finding indicates the necessity for health policy decision-makers to focus on elder children groups in these regions because they are more susceptible to the mortality and complications of infections from VPDs.

Region and Wealth Index

Wealth index and regions were also considered significant interaction to the vaccination coverage status for all vaccines. Wardak, Sar-E-Pul, and Herat showed the highest complete vaccination coverage status with high levels of wealth index than other regions as seen in Table 22. In contrast, Paktya, Kandahar, Khost, Urozgan, and Kunarha regions from poor wealth index showed the highest partial vaccination coverage status than other regions. This finding indicates vaccination coverage insufficiency in these regions which warrants improvement in vaccination intervention program for them.

Wealth Index and Age of Child

Wealth index and age of child were considered as significant interaction to the vaccination coverage status for all vaccines (BCG, DPT, measles, and polio). For all vaccines, rich wealth index families and elder ages of child families showed significant influence on the complete vaccination coverage as depicted in Table 23. This finding may be explained by the better financial capacity of rich families to get educated and be compliant with the vaccination programs especially with elder children. Conversely, children of poor wealth index families are less likely to have similar capacity for achieving complete vaccination coverage status unless provision is provided by the health system (UNICEF, 2020).

Interactions of Predictors for the BCG Vaccine

Region and Age of Child

Region and age of child showed significant impact on the BCG vaccination coverage status. Laghman, Faryab, and Badakhshan regions with elder ages of children showed the highest BCG vaccine (single dose is complete vaccination) as depicted in Table 24. Khost and Urozgan regions were the lowest with elder age of children. This finding indicates that BCG vaccination intervention programs in these regions are insufficient and will require improvement there.

Interactions of Predictors for the DPT Vaccines

Wealth Index and Age of Child

Wealth index and age of child showed significant impact on the DPT vaccination coverage status. Elder ages of children from wealth index rich families showed the highest complete DPT vaccination as depicted in Table 25. For partial DPT vaccination coverage status, elder ages of children from the wealth index poor families showed the lowest partial DPT vaccination. This finding indicates the need for paying particular attention to poor families for DPT vaccination programs.

Region and Age of Child

Wardak and Laghman regions with elder ages of children showed the highest complete DPT vaccination coverage status as shown in Table 26. Khost, Urozgan, and Kunarha regions with elder age children showed the lowest DPT vaccination coverage status. This indicates that DPT vaccination interventions in these low DPT vaccination regions remain insufficient and would necessitate improvement through targeted intervention.

Region and Wealth Index

Families with moderate wealth index from Wardak showed the highest DPT vaccination coverage as seen in Table 27. Paktya and Khost regions with poor wealth index showed the lowest DPT vaccination coverage status. This indicates that DPT vaccination intervention programs should target poor wealth index families in Paktya and Khost regions to improve the DPT vaccination coverage status.

Interactions of Predictors for the Measles Vaccines

Region and age of child

Helmand, Nimroz, and Parwan regions with elder age of children showed the best results for the complete measles vaccination coverage status than all other vaccines and regions as depicted in Table 28. Khost and Paktya regions with elder age children showed the lowest complete measles vaccination coverage than other regions. Helmand and Parwan with elder age children showed the highest partial measles vaccination coverage status than all others. Khost with elder age of children showed the lowest. These findings indicate the need for the measles vaccination intervention programs to target the Khost and Paktya regions for improving measles vaccination coverage and achieving complete measles vaccination coverage status.

Interactions of Predictors for the Polio Vaccines

Wealth Index and Age of Child

Richest and rich wealth index families with elder ages of children showed the highest complete polio vaccination coverage status as depicted in Table 29. In contrast, poor and poorest wealth index families with elder ages of child showed the lowest complete polio vaccination coverage status. This finding re-iterates targeting the poorest and poor wealth index families with elder ages of children for polio vaccination program to improve polio vaccination coverage status in Afghanistan. This approach is supported by UNICEF (2020).

Region and Age of Child

Laghman, Badghis, and Balkh regions with elder ages of children showed the highest polio vaccination coverage as depicted in Table 30. Khost and Kunarha regions with elder ages of children showed the lowest polio vaccination coverage status. This finding indicates the targeting of the Khost and Kunarha regions for polio vaccination programs to improve polio vaccination sufficiency in these regions.

Wealth Index and Region

Rich wealth index families in Wardak and Sar-E-Pul showed the highest complete polio vaccination coverage status than other regions as depicted in Table 31. Khost and Kandahar regions with poor wealth index families showed the lowest polio vaccination status. This finding indicates the need to target polio vaccination programs in poor wealth index families in Khost and Kandahar regions.

Analyses and Interpretation in the Context of Theoretical and Conceptual Frameworks

Consistent with the HBM, the perception of parents of Afghanistan children about the susceptibility and severity of VPDs and the benefits and barriers of vaccination coverage affects their commitment to initiate, sustain, and complete appropriate vaccination doses to achieve complete vaccination coverage. The present study found that the parents' level of education significantly affected the vaccination coverage status for all vaccines. This indicates that the parents' perception of severity and susceptibility of VPDs and the benefits and barriers to vaccination may also be low due to low education as education is also related to health literacy (Biasio, 2017). Effective use of the HBM could improve vaccination coverage through properly tailored vaccination health education programs to improve perceptions of the benefits of vaccination as a solution to the perceived susceptibility and severity of VPDs including overcoming the perceived barriers to vaccination. Such programs can provide cues to action for parents to take positive actions in complying with complete vaccination coverage for their children.

The complete vaccination coverage status for all vaccines (BCG, DPT, measles, and polio) was only 14.2% in Afghanistan which may be related to illiteracy (did not complete primary education). The present study found participants with no primary education at 86% and the husband/partner at 56%. This finding indicates the necessity to improve health literacy levels of parents in regions where the poorest vaccination levels were found to upgrade their education status through education programs and improving vaccination coverage through targeted knowledge (cues to action) of the susceptibility and severity of VPDs and the benefits and barriers of sufficient vaccination coverage.

Consistent with the SEM, individual (e.g., parent's education level, age of child), family (e.g., wealth index), community (e.g., geographical region), institutional (e.g., funding), and policy (e.g., legislation) are all necessary elements to create sufficient vaccination coverage in Afghanistan (CDC, 2015; McLeroy et al., 1988). The present study revealed regions, age of child, and the wealth index were significantly associated with vaccination coverage status for all vaccines (BCG, DPT, measles, and polio) in Afghanistan. Policy decision-makers can use evidence-based information to appropriately target vaccination programs in regions and population segments where the need is more than others, attain institutional funding and drive-up vaccination coverage using the HBM and SEM to achieve complete vaccination coverage for all vaccines in Afghanistan.

Limitations of the Study

The present study used secondary data analysis from 2015 AfDHS dataset that was previously validated and historically, the DHS data source is reliable, trustworthy, and valid in national demographic health surveys and other national indices. The study population sample size and power were adequate and fully representative of the Afghanistan population. Therefore, the findings of the present study are generalizable to the entire Afghanistan population. However, the findings cannot be generalized to other countries because the risk factors of vaccination coverage may vary due to the different socio-ecological, cultural contexts and other related relevant information.

Only four vaccines (BCG, DPT, measles, and polio) out of 17 vaccines were examined in this study. Some regions had smaller sample sizes possibly due to security concerns such as the Zabul region. The present study was conducted in 2020 from a 2015 data set which presents a five-year time lag in which situation in Afghanistan may be different now, so this must be considered before applying the findings of the present study in practice.

Recommendations

The present study used a quantitative approach using secondary data analysis to examine only four vaccines out of a possible 17 vaccines administered in Afghanistan. Therefore, the first recommendation would be to investigate the other vaccines in a similar manner to gain insight into all vaccines used in Afghanistan. This knowledge would provide specific information that could help target vaccines more specifically to the population segments that need them the most.

Secondly, it would be appropriate, although not necessarily feasible due to security concerns, to conduct primary qualitative research in Afghanistan to explore the root causes of vaccination coverage insufficiency by region using interviews. This knowledge would greatly assist policy decision-makers understand the perceptions of people in different regions about vaccination coverage that would provide opportunity to create a tailored path to vaccination sufficiency in Afghanistan.

Finally, I would recommend creating a multi-national public health task force to specifically focus on funding, monitoring, creating, and implementing evidence-based vaccination coverage programs for Afghanistan in all 34 regions because Afghanistan is among the lowest complete vaccination coverage countries worldwide with a plethora of complex socio-economic challenges complicated by history, geography, culture, poverty, war, terrorism, and politics.

Implications for Professional Practice and Social Change

The present study revealed that child, parental, and geographical factors significantly influence vaccination coverage in Afghanistan. The study also highlighted the highest predictors and interaction of predictors most influenced the complete and partial vaccination coverage for the BCG, DPT, measles, and polio separately and with all four vaccines.

Professional Practice

The present study demonstrated that secondary data analysis can be used to achieve valuable insight on data analyzed to inform policy decision-makers about vaccination coverage efficiently in time and cost. For example, in the findings of the present study, the region of Khost was identified as having the lowest complete vaccination coverage for all vaccines. This is critical information for the health policy decision-maker because it provides guidance to health professionals to target a vaccination program in the region of Khost based on evidence provided by the present study. Another finding of the present study was related to specific vaccines that showed lower vaccination coverage in poor areas. Again, this information would further specify the population segment to be targeted for the vaccination program using a specific vaccine based on evidence provided for that vaccine in the present study.

Positive Social Change

The present study provided evidence about the risk factors (child, parental, and geographical) that significantly influenced the vaccination coverage for BCG, DPT, measles, and polio, the highest predictors, and the interactions of the highest predictors. By targeting population segments appropriately for tailored vaccination programs using the evidence provided in this study, the benefit of achieving increased uptake of vaccination can be reached in Afghanistan. The role of the individual (parent), family, community, relevant institutions, and health policy decision-makers working collaboratively is critical in achieving positive social change of reaching complete vaccination coverage and thereby reducing VPDs and mitigating childhood mortality in Afghanistan. The findings in the present study can positively influence vaccination policy development, vaccination program creation, implementation, monitoring, and evaluation including health outcomes in Afghanistan. The present study could also impact policies of international organizations such as NGOs, World bank, IMF, relevant stakeholders, and governments who want to help Afghanistan improve its vaccination coverage plans.

Conclusion

The findings from the present study revealed that: there is association between geographical factors (regions); child factors (age of child); and parental factors (wealth index); and vaccination coverage (complete, partial, and none) of childhood vaccination in Afghanistan for all vaccines examined (BCG, DPT, measles, and polio). Vaccination coverage is one of the most important public health practices to mitigate risk of contracting VPDs especially now, in the time of a global Covid-19 pandemic.

Vaccination coverage is a justified cost-effective and efficient public health intervention to reduce childhood morbidity and mortality worldwide. Many nations have adopted complete vaccination coverage as a cornerstone of their public health policy and practice, thereby reducing morbidity and mortality of the childhood population and have successfully mitigated the incidence of VPDs.

Afghanistan remains one of the least vaccinated countries globally. One of four unvaccinated children worldwide are from Afghanistan. From the results of the present study, Afghanistan has only achieved 14.2% complete vaccination coverage of the BCG, DPT, measles, and polio vaccinations. It is, therefore, a moral imperative for the civil society, rich governments, World Bank, IMF, and other relevant stakeholders to motivate global public health policy leaders and decision-makers to allocate sufficient resources to assist countries like Afghanistan, being a low-income developing country, in achieving complete vaccination coverage in all 34 regions of Afghanistan. Persistent measles outbreaks and polio transmission continue unabated in Afghanistan which will likely worsen due to the Covid-19 pandemic. In this vein, on November 6, 2020, UNICEF and WHO has urgently called to emergency action to avert major measles and polio epidemics, as Covid-19 pandemic continues to disrupt vaccination coverage worldwide, especially in Afghanistan, and other vulnerable countries. Let Covid-19 pandemic and the re-emergence of measles outbreaks and polio transmission provide a strong impetus to drive precise and decisive actions on complete vaccination coverage beginning with the most vulnerable populations such as in Afghanistan, so that no-one is left behind.

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Appendix A: Authorization to Download the DHS Data

DHS Download Account Application

archive@dhsprogram.com <archive@dhsprogram.com>

To: Iqbal Mawani

Wed., Jul. 22, 2020, at 8:08 a.m.

**Please see the attached authorization letter. **

You are authorized to download Survey data from the Demographic and Health Surveys (DHS) Program. The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data you download, must not be passed on to others, but you may share the data with coresearchers registered on this project. All other interested users are required to register for a download account and access the data from their approved accounts. Users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

To begin downloading datasets, please login at: The DHS Program login page or the IPUMS DHS login page.

THE DHS PROGRAM

The files you will download are in zipped format and must be unzipped before analysis. After unzipping, please print the file with the Word document (found in the Individual and Male Recode Zips). This file contains useful information on country specific variables and differences in the Standard Recode definition. You will also need the Guide to DHS Statistics, the questionnaires used in the survey, and the DHS Recode Manual. The Recode Manual contains a general description of the recode data file, including the rationale for recoding; a description of coding standards and recode variables, and a listing of the standard dictionary, with basic information relating to each variable.

The types of datasets generated for each survey vary by survey design. However, there are seven common types of recode data files associated with the core questionnaires. The three questionnaires: the household, the woman's and the men's; from an analytical point of view, contain the analytical units of: household information, household member's information, women's information, children's information (of the interviewed women), and men's information. Further, the children's information exists in two groups – basic data for all children of a woman, and more in-depth information for children born in the last five years. Then, where possible, individual men and woman are matched into couples. Listing of files:

- Household file (HR)
- Household members, or persons file (PR)
- Women's file (IR)
- All Births file (BR)
- Children born in the 5 years prior to the interview, or kids file (KR)
- Men's file (MR)
- Couple's file (CR)

IPUMS DHS

If you use **IPUMS DHS**, you will have the option of choosing your record type (e.g., women, household members) when you begin selecting data. Variable names are links that provide extensive information, including variable descriptions, cautionary notes, and the survey text used to generate each variable. Variables in IPUMS are harmonized across samples, making this an excellent tool for comparative analysis. You will download a single integrated dataset with all the samples and variables that you select. IPUMS DHS is currently available for Standard DHS surveys from many, but not all, DHS participating countries. More samples are being added all the time.

DHS METHODOLOGICAL INFORMATION

For additional methodological information about DHS data and data quality, please see:

- DHS Methodological Report series
- External Database of Journal Articles based on DHS data

SOME USEFUL DHS LINKS

- Model questionnaires
- Model DHS Datasets
- STATcompiler
- Final Country Reports

- File Types and Names
- DHS Recode Manual
- Guide to DHS Statistics
- DHS User Forum
- DHS Video Tutorials
- Using DHS Data for Analysis
- Merging DHS Datasets

We now have repositories of code written in Stata and SPSS available on Github. Please reference these code repositories as a resource for code to match or calculate DHS indicators. The code repositories can be found at:

- https://github.com/DHSProgram/DHS-Indicators-Stata
- https://github.com/DHSProgram/DHS-Indicators-SPSS

For problems with your user account, please email archive@dhsprogram.com. For problems using the IPUMS DHS website, please email ipums@umn.edu. For data related questions, please register to participate in the DHS Program User Forum at: http://userforum.dhsprogram.com.

The Demographic and Health Surveys (DHS) Program
XXXXX

LOGIN INFORMATION:
Login Email: XXXXX
Password: (use password selected when you registered)

Name: Iqbal Mawani
Project: Risk Factors Associated with Childhood Vaccination Coverage in Afghanistan

Appendix B: Authorization Letter for DHS Data Use

Jul 22, 2020

Iqbal Mawani

Walden University

Canada

Phone: XXXXX

Email: XXXXX

Request Date: 07/21/2020

Dear Iqbal Mawani:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Risk FactorsAssociated with Childhood Vaccination Coverage in Afghanistan":

Afghanistan

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registeredemail address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities tobe identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to theregional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area(Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names orlocations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and notfor individual households, and the measured coordinates are randomly displaced within a large geographic area so that specificenumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use thedata for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort shouldbe made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at:https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registeredin your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electroniccopy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

XXXXX

The Demographic and Health Surveys (DHS) Program

Appendix C: Walden University IRB Approval

IRB Materials Approved - Iqbal Mawani

IRB <irb@mail.waldenu.edu>

Mon 10/19/2020 9:43 PM

To: Iqbal Mawani

Cc: XXXXX

Dear Mr. Mawani,

This email is to notify you that the Institutional Review Board (IRB) confirms that your study entitled, "Risk Factors Associated with Childhood Vaccination Coverage in Afghanistan," meets Walden University's ethical standards. Our records indicate that you will be analyzing data provided to you by The Demographic and Health Surveys (DHS) Program as collected under its oversight. Since this study will serve as a Walden doctoral capstone, the Walden IRB will oversee your capstone data analysis and results reporting. **The IRB approval number for this study is 10-19-20-0537899**, which expires when your student status ends.

This confirmation is contingent upon your adherence to the exact procedures described in the final version of the documents that have been submitted to IRB@mail.waldenu.edu as of this date. This includes maintaining your current status with the university and the oversight relationship is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, this is suspended.

If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB materials, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the Documents & FAQs section of the Walden web site: http://academicguides.waldenu.edu/researchcenter/orec

Doctoral researchers are required to fulfill all of the Student Handbook's Doctoral Student Responsibilities Regarding Research Data regarding raw data retention and dataset confidentiality, as well as logging of all recruitment, data collection, and data management steps. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.