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Treatment-Seeking Behaviors and Malaria Prevalence Among Under-5 Children in Niger

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Walden University
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Abstract

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BS, Frostburg State University, 2016

MS, Florida International University, 2007

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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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Abstract

Malaria is a deadly vector-borne disease that mainly affects children in Africa, especially in Niger. Although public health efforts in malaria prevention have been successful in many parts of the world, malaria remains a significant public burden in sub-Saharan Africa, especially among children. Despite the numerous studies conducted on individual factors influencing the prevalence of malaria in sub-Saharan Africa and Niger, there is little knowledge about the collective influence of treatment-seeking behaviors and malaria prevalence among under-5 children in Niger. This study was a quantitative study with a cross-sectional design guided by the social-ecological model (*SEM*) that used secondary data from the Demographic and Health Survey (DHS), which surveyed 10,750 individuals to understand how types of antimalarials, source of antimalarials, and bed net usage collectively influenced malaria prevalence among under-5 children in Niger. The analyses revealed that there was no association between types of antimalarials and malaria prevalence (p =.252 and p =.300]). However, the analyses showed a significant association between the source of antimalarials and malaria prevalence (p <0.001), and between bed net usage and malaria prevalence (p <0.001). The significance of this study for social change is that it may provide a better understanding of the social support needed by children in Niger to institute health behavior changes that will help decrease malaria prevalence. In addition, findings from this study may foster positive social change through the development of culturally appropriate and age-specific multifaceted interventions to meet the specific needs of children in Niger using the *SEM*.

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Dedication

This doctoral study is dedicated to all the children who are victims of the deadly and preventable malaria around the world, especially those from my beloved country, Niger. I also dedicate this dissertation to my daughter Ranya, who has been my biggest inspiration and has motivated me to be the greatest version of myself so I can pave a bright future for her and my descendants to come. To my hero, my late father Yaye Habi, thank you so much for showing me the right path, for providing me with the best education I can possibly have, and for guiding me and supporting me until your death (01/01/1955 to 12/06/2016). You will forever be in my heart, and I know that you will continue to look after me from the other end of life. Finally, I thank the Almighty God who has given me the strength and courage to persevere despite life's obstacles in my path.

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Section 1: Foundation of the Study and Literature Review

Introduction

Malaria is one of the deadliest vector-borne diseases that mainly affects children and pregnant women in Africa. Although preventable and curable, malaria is one of the most severe public health problems worldwide and is the leading cause of death in many developing countries such as Niger (Centers for Disease Control and Infections [CDC], 2019). There were an estimated 229 million malaria cases, with 409,000 deaths worldwide in 2019, among which under-5 children accounted for 67% (274,000) of those deaths (World Health Organization [WHO], 2021). The African region is the most impacted, with 94% of all malaria cases and deaths and six countries accounting for half of all malaria deaths worldwide. These six countries are Nigeria (23%), the Democratic Republic of the Congo (11%), Tanzania (5%), Burkina Faso (4%), and Niger (4%; WHO, 2021). In Niger, malaria accounted for 8 million cases and 17,022 deaths in 2019 alone (Severe Malaria Observatory [SMO], 2019).

Despite ongoing efforts from international organizations, governments, nonprofit organizations, and private entities to prevent this disease, malaria continues to be a burden in the public health arena, especially in sub-Saharan Africa. Malaria is prevalent in Africa because of poor weather conditions, poor sanitary conditions, poverty, and PQAs (CDC, 2019; Walker et al., 2018). Moreover, children and pregnant women are most vulnerable (CDC, 2019). Therefore, there is a need to examine why malaria continues to be endemic in Niger despite ongoing efforts in malaria prevention and management, especially in children.

This study aimed to determine how treatment-seeking behaviors such as types of antimalarials, source of antimalarials, and bed net usage collectively affect malaria prevalence among under-5 children in Niger. The social implications of this study were to understand how effective the current malaria prevention strategies are in Niger and to effectively improve or correct any inefficiency while utilizing the *SEM*. The first section of this paper will include the background, problem statement, the purpose of the study, research questions and hypotheses, theoretical and conceptual framework, the nature of the study, literature search strategy, theoretical framework, literature review related to key variables and concepts, definitions, assumptions, scope and delimitations, limitations, significance, summary, and conclusion.

Background

Malaria is a disease caused in humans by five different Plasmodium parasites (mainly Plasmodium falciparum and Plasmodium vivax) carried by infected female anopheles' mosquitoes (Philips et al., 2017). Malaria is an acute febrile illness that usually manifests as fever, headache, and chills about 2 weeks after an infected mosquito bite (WHO, 2021). The mild cases can be difficult to diagnose; however, if not treated within 24 hours, the cases of P. falciparum malaria can progress to severe illness and often death (WHO, 2021).

Malaria prevalence in children has been a topic of discussion worldwide as malaria impacts children's lives in developing countries such as Niger. For example, in 2020 alone, there were an estimated 241 million cases of malaria globally, causing an estimated 627,000 deaths of which the sub-Saharan Africa accounted for 96% with 80%

being children under the age of 5 (Nature Index, 2022). Malaria prevention in Niger continues to have funding from different agencies such as the Global Fund, President Malaria Initiative (PMI)/United States Agency for International Development, WHO, Government, World Bank, and United Nations International Children's Emergency Fund (SMO, 2017). The National Malaria Control Program ensures severe malaria case management, proper diagnosis, and treatment for each malaria case in Niger, seasonal malaria chemoprevention strategies, malaria in pregnancy, and community case management to ensure access to care for under-5 children living away from a health facility (SMO, 2017). Additionally, the U.S. PMI, led by the U.S. Agency for International Development and implemented together with the CDC, has partnered with Niger since 2018 to deliver cost-effective, lifesaving malaria interventions to support Niger to end malaria by investing almost $72 million in the program (PMI Niger, 2021).

Moreover, several research studies demonstrate current malaria treatments and prevention efforts. However, despite the multitude of efforts to end malaria endemic in sub-Saharan Africa and Niger, malaria continues to be a public health concern in Niger. Malaria is endemic throughout Niger and accounts for 28% of all illnesses and 50% of all recorded deaths in the country (SMO, 2019). Moreover, between 2015 and 2019, children under 5 years of age accounted for 54% of the malaria burden and 48% of malaria-related deaths in Niger (SMO, 2020). Therefore, this study aimed to examine factors related to increased malaria prevalence in under-5 children in Niger despite all the efforts and resources and find sustainable solutions to help manage malaria in under-5 children in Niger using the *SEM*.

Problem Statement

Malaria is a treatable and curable disease that continually plagues sub-Saharan Africa. Globally, there are an estimated 1.7 billion malaria cases and 10.6 million malaria deaths between 2000 and 2020. The WHO African region accounts for 82% of cases and 95% of deaths, followed by the WHO South-East Asia Region (cases 10% and deaths 2%; WHO, 2021). In 2020, an estimated 241 million cases of malaria and 627,000 malaria-related deaths worldwide were reported, which is an increase from 227 million cases and 558, 000 deaths in 2019 (WHO, 2021). The African region accounts for 95% of all malaria cases and 96% of malaria deaths, with under-5 children accounting for 80% of all malaria-related deaths (WHO, 2021).

The specific research problem for this study is that it is unclear whether there is an association between types of antimalarials, source of antimalarials, bed net usage, and malaria prevalence among under-5 children in Niger. The implementation of an integrated community case management system could help reduce the all-cause child mortality in Niger by providing timely treatment for common childhood illnesses such as malaria at the community level by community health workers among children ages 2–59 months (Prosnitz et al., 2019). Likewise, mass azithromycin distributions have reduced preschool children's mortality (Arzika et al., 2019; Oldenburg et al., 2019). However, although researchers have investigated this issue, there is little or no literature on the influence of treatment-seeking behaviors such as types of antimalarials, source of antimalarials, and mosquito net usage on malaria prevalence among under-5 children in Niger. Among these behaviors are types of antimalarials, sources of antimalarials

(preference in traditional venues in obtaining medicines such as on the street rather than in licensed pharmacies (Yeboah et al., 2020) despite the wide availability of western antimalarial drugs), and mosquito net usage. Moreover, there is a lack of reliable data to guide national malaria control programs (Ibrahim et al., 2019). Therefore, this study offers up-to-date empirical data on the link between treatment-seeking behaviors and malaria prevalence among children in Niger.

Purpose Statement

This quantitative study explored whether antimalarial types, source of antimalarials, and bed net use influenced malaria prevalence among under-5 children in Niger after controlling for the mother's education and the type of place of residence. The study followed an exploratory approach to identify the association between types of antimalarials available, source of antimalarials, bed net usage, and malaria prevalence in children in Niger. This study focused on three predictor variables: types of antimalarials, source of antimalarials, and bed net usage. The first predictor variable described people's intention to use antimalarials and if using pharmaceutical versus traditional remedy antimalarials when sick. The second predictor variable described the source of antimalarials, such as street versus pharmacy antimalarials. The third predictor variable described people's behaviors in response to malaria treatment and prevention, such as having bed net but not using it or using it not for the intended purpose. The dependent variable (DV) depicted the malaria prevalence in children in Niger measured by a hemoglobin level of less than 8g/dl. The confounder variables included education, which is the highest education level of mothers, and type of place of residence, such as urban or

rural. Bronfenbrenner's *SEM* constructs were used in the study to provide a framework for preventing malaria or reducing its prevalence in children in Niger.

Research Questions and Hypotheses

Research Question 1 (RQ 1): Is there a relationship between types of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine given for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

$H_0$1: there is no relationship between the type of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

H_a1: there is a relationship between the type of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

RQ 2: Is there a relationship between source of antimalarials (first source for current method) and malaria prevalence (anemia level) among children in Niger, controlling for antimalarials locations or venues.

$H_0$2: there is no relationship between the first source of antimalarials (first source for current method) and malaria prevalence (anemia level) among children in Niger, controlling for antimalarials locations or venues.

H_a2: there is a relationship between the first source of antimalarials (first source for current method) and malaria prevalence (anemia level) among children in Niger, controlling for antimalarials locations or venues.

RQ 3: Is there a relationship between bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

$H_0 3$: There is no relationship between bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

$H_a 3$: There is a relationship between bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

Theoretical Framework

The model that grounds this study includes Bronfenbrenner's (1994) *SEM*. The logical connections between the framework and the nature of this study include the *SEM* description of how five internal and external environmental factors or constructs influence an individual's health behaviors. These constructs are individual, interpersonal, organizational, community, and public policy. The first factor identifies biological and personal history that affects an individual's health behavior, such as poverty, knowledge

deficit or education, and ability to acquire bed net in this case (Glanz et al., 2015). The second factor examines close relationships that may affect individuals' behavior, such as the mothers' way of handling malaria when their children are sick. The third factor explores the settings, such as schools, workplaces, and neighborhoods, in which social relationships occur and seeks to identify these settings' characteristics that affect health behaviors. The fourth factor looks at the broad societal factors such as the health, economy, education, and policies that affect public health behaviors. More prominent societal factors include the help to maintain economic growth or reduce social inequalities between groups in society. Prevention strategies at this level include promoting social norms that encourage positive health behaviors and efforts to strengthen household financial security, education, employment opportunities, and other policies that affect health's structural determinants.

Moreover, changing an individual's environment will subsequently change their health behavior (Hayden, 2019). The *SEM* seeks to understand further the dynamic interrelations among various personal and environmental factors. The model considers the complex interplay between an individual and their environment. It puts the importance of a multi-level approach to public health issues.

Nature of the Study

The specific research design to address the research questions in this quantitative study includes a cross-sectional design using secondary data from the DHS. The data used in the study are from the 2012 Niger dataset from the DHS program. Variables from this data were used to determine whether there is an association between treatment-

seeking behaviors such as types of antimalarials (combination with artemisinin taken for fever/cough, traditional medicine taken for fever/cough), source of antimalarials (first source for current method), bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria prevalence (anemia level) among under-5 children in Niger while confounding for education (mother's highest level of education) and type of place of residence (rural versus urban). For the planned research design, I sent a written request to the primary data owner, the DHS, and I received an email in return granting me access to use the data. The 2012 DHS survey contains all the variables needed to conduct the study, including the variables listed in Table 1 below.

Table 1

Alignment Among Variables, Research Questions, and the SEM

SEM Level	Variable	Research Questions
Intrapersonal Interpersonal Community Public policy	Education Type of place of residence	RQ1; RQ 2: RQ 3
Interpersonal Community	Combination with artemisinin given for fever/cough traditional medicine taken for fever/cough	RQ1
Intrapersonal Interpersonal	First source for current method	RQ2
Intrapersonal Interpersonal Community Public policy	Have mosquito bed net for sleeping	RQ 3
Intrapersonal Interpersonal	Children under 5 slept under mosquito net last night	RQ 3
Intrapersonal Interpersonal Community Public policy	Anemia level	RQ1; RQ 2: RQ 3

The data analysis for all three research questions was ordinal logistic regression (OLR). An OLR predicts an ordinal DV (Afran & Sherwani, 2017). Moreover, regression models are flexible, and the researcher can include multiple predictor variables that they wish to associate with the DV in the same regression model (Laureate Education, 2020). The ordinal level DV selected for all three research questions is the malaria prevalence measured by "Anemia level" or hemoglobin level. According to the DHS, a hemoglobin level of less than 8.0g/dl is an indirect indication of malaria. Because the DV is ordinal in this dataset, an OLR analysis is a perfect choice.

Literature Search Strategy

For the literature search, I used a combination of Google Scholar, government websites such as the CDC, health organizations such as the WHO, and the Walden University Library. The keywords and databases searched in the Walden library included *malaria and Niger*, and *malaria and prevention and control and Niger*. I also used the following databases: MEDLINE, CINAHL Plus, PubMed, Directory of Open Access Journals, Science Direct, Supplemental Index, and Gale Academic One File Select. The literature reviewed included peer-reviewed articles, government, and reputable organizations' sites such as the CDC and WHO, all from 2016 to 2021.

Theoretical Framework

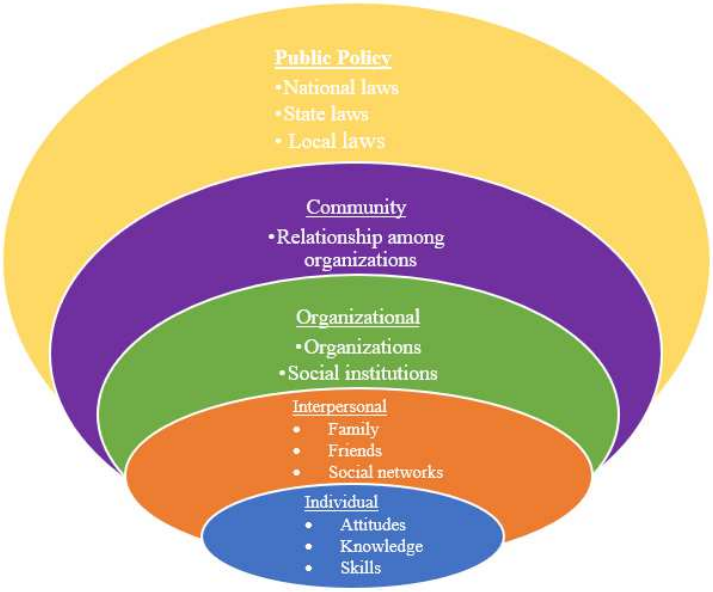
Health practitioners and psychologists use behavioral theories to determine why people act as they do. Children's interactions with their physical environment, such as family, school, and the local community, can influence their contracting of malaria. Therefore, developing a multi-factorial model to reduce malaria prevalence in under-5

children in Niger using the *SEM* is ideal because it targets interventions at all levels, which may be more effective and significantly reduce the prevalence of malaria. The *SEM* explains internal and external factors influence on health behaviors and how changing environment changes health behavior. The *SEM* was first developed in the 1870s by two German researchers Schwabe and Bartholomal, who attempted to study how children's neighborhoods affect their development. It was later put into practice by a developmental psychologist named Urie Bronfenbrenner in the mid-1970s (Hayden, 2019). Bronfenbrenner developed the *SEM* on the proposition that human development occurs through complex back-and-forth interactions between things in their environment regularly over time. These back-and-forth interactions affect the personal characteristics of the child and his or her environment (Hayden, 2019).

According to the *SEM*, five factors influence health-related behaviors and conditions: intrapersonal, interpersonal, institutional, community, and public policy (Glanz et al., 2015). Hayden (2019) added that the *SEM* also views the environment as a critical component of behaviors into a set of concentric systems or levels with each environment level inside the other, like nesting dolls (Hayden, 2019; see Figure 1). The *SEM* is a complex process that fosters structural change by conveying the health and social relevance of policy and environmental change initiatives, building partnerships to support them, and promoting more equitable distributions of the resources necessary for people to meet their daily needs, control their lives, and freely participate in the public sphere (Golden et al., 2015). In other words, the *SEM* deals with an issue at the root cause, which has more remarkable long-term positive change.

Figure 1

SEM



SEM is widely used among researchers in similar studies. For example, with the use of the *SEM*, Awuah et al. (2018) determined factors associated with treatment-seeking for malaria in poor urban communities in three communities: James Town, Ussher Town, and Agbogbloshie in Accra, Ghana. The authors found that of the 707 retained sample, 31% of the respondents sought orthodox treatment, 8% sought traditional/herbal treatment, and 61% self-medicated as the first response to malaria, mainly because of current health insurance status, perceived relative economic standing, level of social support, and locality of residence. The constructs of the *SEM* align with the current study's research questions because they seek to improve children's conditions at all levels to ensure a reduction of malaria prevalence by targeting the individual, interpersonal, organization, community, and the public policy.

Literature Review Related to Key Variables and Concepts

Malaria is a disease caused by infected mosquito bites (Moukam-Kakmeni et al., 2018; Philips et al., 2017). The CDC (2019) and the WHO (2021) have declared malaria a public health emergency. Studies showed that globally, nearly 229 million cases of malaria with 409,000 deaths were reported in 2019, among which under-5 children accounted for 67% (274,000) of those deaths, while 8 million cases with 17,022 deaths were reported in Niger in 2019 (SMO, 2019; WHO, 2021). Several studies have shown malaria prevalence among children despite the many ongoing treatments and prevention efforts. The researchers have identified treatment-seeking behavior that may have impacted malaria prevalence in under-5 children in Niger. In this research, some peer-reviewed articles were used to assess the effect of treatment-seeking behaviors (types of antimalarials, source of antimalarials, and bed net usage) on malaria prevalence in under-5 children in Niger despite efforts listed in this paper.

Several research studies have discussed the types of antimalarials and their effect on malaria prevalence. Studies have shown that insecticide-treated nets (ITNs), indoor residual spraying (IRS), and artemisinin-based combination therapy (ACT) have been effective in fighting malaria. For example, through an experimental design, Ye and Duah (2019) used rigorous statistical analyses to assess the effect of malaria treatments in reducing under-5 mortality and treatments used in sub-Saharan Africa under the PMI from 2005 to 2014. The treatments reviewed in the article were ITNs, IRS, and ACT. Country-level secondary data and controlled for several country-level characteristics were used to determine the impact of PMI on treatment types and under-5 mortality

reduction. At the end of the study, the under-5 mortality rate was reduced by 12 per 1,000 live births with a 95% confidence interval.

A survey conducted from 2000 to 2015 to perform a trend analysis for malaria intervention coverage and prevalence of under-5 morbidities in Mali (West Africa). There were 2.2 million recorded malaria cases in 2012 in Mali and 1,900 deaths. The assumption was that malaria significantly contributed to under-5 mortality. Therefore, control interventions were increased to fight the prevalence. ITNs were distributed to pregnant women and children under-5 years old in addition to ACT treatment and insecticide use. At the end of the survey, malaria prevalence decreased by 35.8% in 2015, and severe anemia decreased by 26.3% in 2012 and maintained a declining curve (Kaventao et al., 2018).

Moreover, Grandesso et al. (2018) assessed the efficacy of three combinations of antimalarials drugs using a WHO standard protocol found the combinations artesunate-amodiaquine (AS–AQ Winthrop), dihydroartemisinin-piperaquine (DHA–PPQ, Eurartesim® and artemether-lumefantrine (AM–LM, Coartem) to be effective antimalarials. For example, the drugs were administered to 212 children aged 6–59 months living in Maradi (Niger-West Africa) and suffering from uncomplicated malaria. The researchers used the Kaplan Meier 42-day PCR and a standardized parasite clearance estimator. All three treatments met WHO criteria and were considered good recommendations for treating uncomplicated malaria cases. However, their efficacy in emergencies must continue to be monitored (Grandesso et al., 2018; see also YayeHabi, 2020).

Despite the accessibility and affordability of antimalarials in Niger, many children continue to die from malaria. One possible explanation to explore is the source of antimalarials. A higher percentage of both communities' resort to orthodox medicines such as prayers, herbs, and orthodox medicine when infected with malaria instead of seeking help from health professionals (Chijioke-Nwauche & Sam-Ozini, 2017). Similarly, a study on mothers' understanding of childhood malaria and practices in rural communities of Ise-Orun in Nigeria showed that 87.5% of mothers whose children had malaria fever within the 3 months before the study visits used home treatment and local herbal remedies combined with orthodox medicine in malaria treatments for 91.5% of the children (Orimadequn & Ilesanmi, 2015). The participants reported that the main reasons for not seeking medical treatment at existing formal health facilities were "high cost," "challenges of access to facilities," and "mothers' preference for herbal remedies."

Another study showed that despite the wide availability of Western medications to fight malaria, most patients in Ghana prefer treatment with locally produced herbal remedies (Yeboah et al., 2020). This was due to the availability of traditional venues for obtaining medicines "on the street" rather than in licensed pharmacies, trust in local and "green" products, extensive advertisement of such local products, and an inherent distrust of imported and synthetic or orthodox medicines. However, street medicines may be questionable and may be of poor quality. For example, Walker et al. (2018) conducted a qualitative study to determine the quality of antimalarial drugs in pandemic regions. They also sought to lobby for regulatory involvement and found that despite easy access to antimalarials in Africa, malaria continues to take countless lives because of the

prevalence of poor-quality antimalarials (PQAs) in these regions. PQAs were being deliberately falsified to maximize profits in these regions. In 2013 alone, 4–92% of antimalarials tested were of poor quality in Southeast Asia and Africa, causing 122,350 deaths in children under 5. Consequently, there is an increased risk of developing drug-resistant strains of malaria. However, several efforts are being made to control the quality of antimalarials in these regions. Researchers are urging the WHO and other stakeholders to take part in reducing PQAs and improving antimalarials quality standards by developing a standardized international law of quality standards of antimalarials. (Walker et al., 2018; YayeHabi, 2020).

Another treatment-seeking behavior is bed net usage. ITNs effectively prevented malaria (Ye and Duah, 2019; Kaventao et al., 2018). However, studies have found that ITNs were not being used for their intended purposes. For example, a rapid global assessment of mosquito net fishing observations from expert witnesses living or working in malarial zones find that mosquito net fishing was widely used in fishery mainly due to poverty (Short et al.,2018). Likewise, a systematic survey of 51 homesteads in villages bordering Mida Creek for three weeks in June 2013 added that nearly half of homesteads interviewed used mosquito nets as fishing gear to target juvenile fish and prawns for subsistence and sale at a Kenyan coastal site among Giriama fishers (Bush et al., 2017). Moreover, there is a combination of ways to obtain nets. For example, 84% of the homesteads received nets through mass distributions, 27% through a private sale, and 16% through targeted maternal health distributions (Bush et. 2017). Finally, mosquito net

fishing was widely used as drag nets by men in ten villages in Palma District, Cabo Delgado Province, in the north of Mozambique (Jones & Unsworth, 2020).

Definitions

The operational definition for the variables in the study includes education, type of place of residence, have mosquito bed net for sleeping, children under 5 slept under mosquito net last night, combination with artemisinin taken for fever/cough, first source for current method, and anemia level.

Anemia level: In the study dataset, the anemia level is measured by hemoglobin level, and a hemoglobin level of less than 8.0g/dl is an indirect malaria indicator (DHS, 2021). Hemoglobin is a protein in red blood cells that carries oxygen throughout the body (myoclonic, 2021). A low hemoglobin count generally means a level of fewer than 13.5 grams of hemoglobin per deciliter of blood for men and less than 12 grams per deciliter for women (Myoclinic, 2021).

Children under 5 slept under a mosquito net last night: This refers to the number of children aged five or below who slept under a mosquito bed net the night before the survey from the household questionnaire.

Combination with artemisinin taken for fever/cough: This refers to children who receive combination with artemisinin medications for fever or cough.

First source for current method: This refers to the different sources of venues mothers use to acquire antimalarials for their children (DHS, 2021).

Have mosquito bed net for sleeping: As its name indicated, this refers to households in which children have mosquito bed net to sleep in from the household questionnaire (DHS, 2021).

Highest education level: In the study, this refers to the mother's highest educational level grouped into no education, primary, secondary, or higher. The highest level of education or educational attainment refers to the level of schooling an individual is attending or has completed (US Census Bureau [USCB], 2021).

Traditional medicine taken for fever/cough: Refers to children given traditional medicine when malaria is suspected.

Type of place of residence: this refers to whether the child lives in an urban or rural area. The Census Bureau's defines urban as densely developed territory, and encompasses residential, commercial, and other non-residential urban land uses. Likewise, "Rural" encompasses all population, housing, and territory not included within an urban area. (USCB, 2021).

Assumptions

This study assumed that using the DHS facilitated access to accurate malaria data and that participants have given consent prior to participating in the survey. Additionally, field editors and surveyors received the same training and used the same collection and data evaluation mode during collection. Moreover, data were handled ethically, and participants were not coerced to participate in the survey. Finally, respondents responded honestly to the questionnaire and collection and responses were free from bias.

Scope and Delimitations

The scope of the study focuses on children 5 years and under living in Niger in both urban and rural areas because this population is most vulnerable to malaria and has the highest malaria prevalence and mortality rate, 62% and 74%, respectively, in Niger (SMO, 2019). The study result helped clarify factors related to this population's high prevalence and mortality. Moreover, addressing this endemic is the right thing to do as it is part of human rights to have a safe and equitable environment. Finally, children are the future, so we must protect them to protect humanity.

The study's focus on under-5 children excluded anyone above 5 because this population is most vulnerable and cannot make decisions for themselves. Malaria is prevalent in almost all age groups in this world. Conducting a study to cover all age groups will be time-consuming, expensive, and unrealistic. However, by focusing on this age group, the study can indirectly impact a whole household and, therefore, the entire population. Since children cannot act for themselves, mothers are involved. Furthermore, if mothers get something out of this study, it will transfer to the whole household because they are great changing agents.

The study has generalizability potential because the results can be used to create *SEM*-based interventions among children in other malaria-prone countries. Moreover, the recruitment and data collection methods can be generalized to similar studies focusing on malaria prevalence in under-5 children. However, the study cannot be generalized to other age groups in malaria prevention cases

Limitations

Some of the limitations of this study include access to data. For example, the DHS performs a demographic and health survey every five years. However, the 2017 survey collected in Niger was deemed unreliable and not published. Therefore, the most recent data on Niger is from 2012, unlike the neighborhood countries with updated survey data (DHS, 2021), which is a significant limitation for this study. Another potential barrier is that the survey was self-reported, resulting in biased results. For example, the data may suffer from recall bias because some participants may not differentiate malaria symptoms from similar symptoms such as fever, which can be a sign of many other diagnoses. Finally, the study's cross-sectional nature only examined associations between variables, which may limit the ability to infer causality. To fully understand health-seeking behaviors in Niger, future studies should assess the history of treatment-seeking behaviors for many other diseases, using qualitative studies that can provide in-depth information on health and treatment-seeking choices in study communities.

Significance

This study is significant because, to the best of my knowledge, research on the influence of poverty, malnutrition, and treatments effectiveness on malaria prevalence is limited. The significance of this study is that it may provide a better understanding of the social support needed by children in Niger to institute health behavior changes that will help decrease malaria prevalence. This study may contribute to public health by providing evidence on the factors contributing to the cause of high malaria prevalence among children in Niger. Findings from this study may foster the development of

culturally appropriate and age-specific multifaceted interventions to meet the specific needs of children in Niger. Through increased knowledge about the risk factors associated with malaria prevalence among children in Niger, strategies could be identified to reduce the risk of malaria mortality and morbidity in this target population. Interventions may be developed to address treatment-seeking behaviors and PQAs among children in Niger. For example, children and their families will be educated on appropriate treatment-seeking behavior by reinforcing the benefits of pharmacy-based antimalarial drugs, benefits of proper use of bed nets, and antimalarials will be monitored closely to ensure no counterfeit is being distributed in the population. This study's social change implications for health educators and providers may include collaborating with families, friends, community organizations, institutions, and the government to develop malaria prevention interventions that prioritize children in Niger. The intervention could consist of supporting children's social networks to improve their health behaviors and inadvertently decrease malaria prevalence. Health policy planners may also utilize the study findings to conduct health promotion campaigns targeting children and their social networks, which may improve malaria-related health outcomes.

Summary and Conclusions

Malaria is a global health issue and is endemic in several countries. As mentioned above, there were an estimated 229 million malaria cases with 409,000 deaths worldwide in 2019, among which under-5 children accounted for 67% of those deaths. The study focused on Niger because it is one of the only six countries that accounted for half of all malaria deaths worldwide. For example, in Niger, of the 8 million malaria cases reported

in 2019, 17,022 people have died from it despite many efforts, which is a significant number (Severe Malaria Observatory, 2019). Most of the efforts have provided adequate antimalarials and treatments to the affected people. However, there is no or less focus on managing these provided antimalarials and treatment-seeking behaviors of most study populations. Bringing awareness and reducing malaria prevalence in under-5 children through the *SEM* is crucial for the public health field. Likewise, identifying the right stakeholders and engaging them throughout the process is a must. However, childhood malaria prevention programs are not without challenges like many others. Working with children and minorities is a great challenge as they represent a vulnerable population. Public health officials must continue to find effective ways to improve our communities' health, especially vulnerable ones like children.

Section 2: Research Design and Data Collection

Introduction

Malaria has been a widespread public health concern in sub-Saharan Africa, especially in under-5 children. Although preventable and curable, malaria prevalence and related deaths continue to increase in Niger. Therefore, public health professionals need to examine factors related to the increase in malaria prevalence and mortality in under-5 children in Niger. The study used an exploratory approach to identify the association between types of antimalarials available, source of antimalarials, mosquito net usage, and malaria prevalence (hemoglobin level) in under-5 children in Niger. This section of the paper includes the research design and rationale, the methodology, the threats to validity, and a summary.

Research Design and Rationale

This study is a quantitative, cross-sectional study in which secondary data from the 2012 DHS survey on Niger was used. A cross-sectional design is used to examine the relationship between exposure and disease prevalence in a defined population at a single point in time (Aschengrau & Seage, 2020). This study's design was appropriate to examine the relationship between treatment-seeking behaviors and malaria prevalence in under-5 children in Niger. The DHS dataset also followed a cross-sectional approach. A cross-sectional design is also appropriate for this study because it is cheaper and easier to conduct since it does not follow participants over time, unlike other observational studies (Wang & Cheng, 2020). Moreover, a cross-sectional study helps establish preliminary evidence in planning a future advanced study (Wang & Cheng, 2020). However, a

limitation of this design is that self-reported surveys like the DHS survey can be susceptible to recall bias, and the insights generated from the study are not causal inferences (see Frankfort-Nachmias & Leon-Guerrero, 2020; Wang & Cheng, 2020).

Methodology

In a quantitative study like this, the levels of measurements for both the dependent and independent variables are essential in determining the appropriate statistical analysis, and all variables must be captured in the dataset. I used the 2012 DHS dataset on Niger because that is the latest available dataset. DHS are nationally representative household surveys conducted every 5 years on population, health, and nutrition, using a large sample size (usually between 5,000 and 30,000 households) that provide data for a wide range of monitoring and impact evaluation indicators (DHS, 2021). This survey was conducted from February to June 2012 by the National Institute of Statistics of the Department of Finance in collaboration with the Technical Services of the Department of Public Health and the National Laboratory of Resource for STDs/HIV/TB in Niger (DHS, 2021).

Population

The DHS usually surveys women of reproductive age (15–49) and men aged 15–49, 15–54, or 15–59. The 2012 DHS survey population consists of 10,750 households with 64,011 members. The target population for this study is under-5 children. In the households interviewed, 12,558 were children under 5 years old, both genders included. Additionally, 11,554 live in rural areas and 17,56 in urban areas.

Sampling Procedures Used by Original Creators of the Data Set

DHS owns the data in its entirety. To ensure comparability, consistency, and best quality in survey results, the DHS uses nine fundamental sampling principles:

- Use of an existing sampling frame
- Complete coverage of the target population
- Probability sampling
- Using a suitable sample size
- Using the most straightforward design possible
- Conducting a household listing and pre-selection of households
- Providing good sample documentation
- Maintaining confidentiality of individual information
- Implementing the sample exactly as designed

In terms of using an existing sampling frame, the DHS surveys used a pre-existing sampling frame that is officially recognized, such as the countries' most recent population census. The DHS uses the census frames because they are the best available sampling frame regarding coverage, cartographic materials, and organization. Moreover, the DHS evaluates the quality and the accessibility of the frame during the development of the survey design. A detailed study of the sampling frame is necessary before drawing the sample. In terms of coverage, the DHS covers 100% of the target population in the country, which is all women aged 15–49 and children under 5 years of age living in residential households. Most surveys also include all men aged 15–59.

Additionally, the DHS used probability sampling using a random sampling method to generate unbiased estimation and to be able to evaluate the sampling errors (Statistics how to, 2019). The DHS survey had an adequate sample size of 11,160 women and 12,558 under-5 children. A sample size greater than 50 is both normally distributed and randomized (Frankfort-Nachmias & Leon-Guerrero, 2020). Likewise, the DHS used a two-stage household-based sample design, which is relatively easy to implement and easy to maintain quality. The DHS survey results include children with deceased mothers, non-interviewed mothers (information came from the household survey), and three children aged 6–59 months whose mothers' education level was missing. However, the survey results exclude children whose mothers were not listed in the households.

Another fundamental sampling principle is that the DHS recommends that households be pre-selected in the central office before fieldwork rather than by teams in the field to avoid bias from selection pressures. The interviewers are asked to interview only the pre-selected households, and no changes or replacements are allowed in the field to prevent bias. To perform pre-selection of households, a complete list of all residential households in each selected sample cluster is necessary. This list is usually obtained from a household listing operation conducted before the primary survey.

For documentation, the DHS also requires sample documentation that includes a sample design document and a list of primary sampling units. The sample design document must explain the methodology, the sampling procedure, the sample size, the sample allocation, the survey domains, and the stratification, with an appendix to the DHS final report describing the sample design. The sample list should include all

identification information for all the selected sample points and their probability of selection. Moreover, because confidentiality is a significant concern in DHS, anonymous surveys do not allow any potential identification of any single household or individual in the data file. Finally, the DHS requires that the sampling staff implement the sampling activities precisely to avoid severe bias and misleading results (DHS, 2021).

In all households, women aged 15–49 are eligible to participate, and in many surveys, men aged 15–54 (59) from a sub-sample are also eligible to participate. Additionally, there are several standardized modules for countries interested in those topics (DHS, 2021). DHS surveys collect primary data using four types of model questionnaires: Household questionnaire, women's questionnaire, men's questionnaire, and biomarker questionnaire. A household questionnaire gives information on the household's dwelling unit characteristics with usual residents and visitors. It is also used to identify eligible household members for an individual interview. Eligible respondents are then interviewed using an Individual Woman's or Man's questionnaire. Finally, the biomarker questionnaire gives biomarker data on children, women, and men. Interviews are conducted only if the respondent provides voluntary informed consent (DHS, 2021).

DHS data are open to the public for educational purposes, research usage, and decision-making purposes for policymakers. However, registration and request demand are required on the DHS website to gain access to the data. After registering on the DHS website, I was granted access to the dataset for some West African countries (Benin, Burkina Faso, Chad, Cote D'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Nigeria,

Senegal, Sierra Leone, and Togo) where malaria is prevalent. The data published under the public domain contains no identifiable information in the analysis (DHS, 2021).

The selected 2012 dataset is reputable because DHS developed it with the collaboration of the Niger government and several stakeholders. Before publishing the data, several stakeholders reviewed the 2012 DHS questionnaire for quality and relevance and approved only when deemed reliable (DHS, 2021). As mentioned earlier, DHS data undergo several quality checks to ensure accountability and reliability, which makes it reputable. I used the 2012 Niger DHS dataset because it is the most recent for the chosen target population, as the 2017 dataset was annulled for quality concerns.

The DHS uses power analysis to determine the probability sample size. For example, since simple random sampling is not feasible for a DHS, the DHS used a design effect to inflate the sample size for a complex survey with clustering such as the DHS. Design effect is a measure of the efficiency of cluster sampling characterized by a value of 1.0, indicating that the sample design is as efficient as a simple random sample, and a value greater than 1.0 indicates the increase in the sampling error due to the use of a more complex and less statistically efficient design. The formula for calculating the final sample size in terms of the number of households while taking non-response into account is given by: $n_{hi} = Deft^2 \times P \times (1-P)/\alpha^2 \times RR \times d$ where n is the sample size in households; Deft is the design effect (a default value of 1.5 is used for design effect if not specified); P is the estimated proportion; α is the desired relative standard error; Ri is the individual response rate; Rh is the household gross response rate, and d is the number of eligible individuals per household. The household gross response rate is the number of

households interviewed over the number selected. DHS reports typically report the net household response rate, which is the number of households interviewed over the number of valid households found in the field (i.e., excluding vacant and destroyed dwellings.) (DHS, 2021).

Instrumentation and Operationalization of Constructs

The DHS survey is appropriate for this study because it comprises general data collection options with local touch on specific monitoring and evaluation needs of host countries such as Niger. The DHS Program has developed a blueprint of procedures, methodologies, and manuals to guide the survey process across countries to ensure reliability. Four specific stages are required to ensure that the data properly reflect the situations they intend to describe and comparable data across countries. These stages can take up to 2.5 years, and the surveys are led by a local implementing agency, with technical assistance from The DHS Program.

The initial stage of the survey or survey design and preparation consists of designing the sample and questionnaires, which takes about 6 months. The second stage of the survey process focuses on training field staff and conducting the actual fieldwork, about 4 to 6 months. The third stage consists of data editing, tabulation, and report writing, which begins during the second Stage and may continue for up to a year. The final stage consists of disseminating the data and reports, data use and analysis, and can take up to 6 to 7 months. Research results are disseminated through participatory seminars, audience-centered materials, web-based tools, and other technologies that translate data into information accessible to various audiences to facilitate their use in

program design and evaluation. An analysis is done in-house by a research and analysis team through rigorous, timely, and innovative mixed-methods research on topics related to global public health, demography, and social epidemiology (DHS, 2021).

Moreover, the DHS Program maintains strict standards for protecting the privacy of respondents and household members in all DHS surveys. All procedures, protocols, and questionnaires for standard DHS surveys are reviewed and approved by the International Community Foundation's Institutional Review Board (IRB) and an IRB in the host country prior, which ensures survey compliance with the U.S. Department of Health and Human Services regulations for the protection of human subjects (45 CFR 46). In contrast, the host country's IRB ensures that the survey complies with the laws and norms of the nation. Survey compliance must include informed and voluntary participation, privacy, and confidentiality during data collection and processing, and biomarker referral, treatment, and counseling (DHS, 2021).

Finally, for capacity strengthening, the DHS Program strives to enhance the capacities of DHS partners and increase country accountability and ownership of survey data, as well as the processes for data collection, analysis, dissemination, and use by focusing on results, ensuring country ownership, utilizing best practices in learning, and by committing to evaluation (DHS, 2021).

Operationalization of Variables

The operational definition for the variables in the study includes education, type of place of residence, have mosquito bed net for sleeping, children under 5 slept under

mosquito net last night, combination with artemisinin taken for fever/cough, first source for current method, and anemia level.

Anemia level: In the study dataset, the anemia level is measured by hemoglobin level, and a hemoglobin level of less than 8.0g/dl is an indirect malaria indicator (DHS, 2021). Hemoglobin is a protein in red blood cells that carries oxygen throughout the body (myoclonic, 2021). A low hemoglobin count generally means a level of fewer than 13.5 grams of hemoglobin per deciliter of blood for men and less than 12 grams per deciliter for women (Myoclinic, 2021).

Children under 5 slept under a mosquito net last night: This refers to the number of children aged five or below who slept under a mosquito bed net the night before the survey from the household questionnaire.

Combination with artemisinin taken for fever/cough: This refers to children who receive combination with artemisinin medications for fever or cough.

First source for current method: This refers to the different sources of venues mothers use to acquire antimalarials for their children (DHS, 2021).

Have mosquito bed net for sleeping: As its name indicated, this refers to households in which children have mosquito bed net to sleep in from the household questionnaire (DHS, 2021).

Highest education level: In the study, this refers to the mother's highest educational level grouped into no education, primary, secondary, or higher. The highest level of education or educational attainment refers to the level of schooling an individual is attending or has completed (USCB, 2021).

Traditional medicine taken for fever/cough: Refers to children given traditional medicine when malaria is suspected.

Type of place of residence: this refers to whether the child lives in an urban or rural area. The Census Bureau's defines urban as densely developed territory, and encompasses residential, commercial, and other non-residential urban land uses. Likewise, "Rural" encompasses all population, housing, and territory not included within an urban area. (USCB, 2021).

For this study, the three predictor variables are types of antimalarials, source of antimalarials, and mosquito bed net usage for sleeping. The first predictor variable (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) describes people's intention to use or not use the recommended antimalarials (combination artemisinin) and if using pharmaceutical versus traditional remedy antimalarials when sick grouped under "Yes" or "No." The second predictor variable describes the source for current method, such as health centers versus non health centers antimalarials, grouped under "Pharmacy, central maternity of reference, central hospitaller regional maternity, HD maternity, integrated health centre, health cabin, mobile clinic, other public sector, hospital, private clinic, road kiosk, other private sector, shop, religious institution, friends, parents, moving pharmacy, on the ground, community relay, and other." This variable is recoded into "health centers" and "non health centers" for analysis. The Third predictor variable describes people's behaviors in response to malaria treatment and prevention, such as having bed net but not using them or using them not for the intended purpose, grouped under "Yes" or "No." The DV depicts the

malaria prevalence in children in Niger which is categorized by anemia level and grouped into “Severe,” “Moderate,” “Mild,” and “Not anemic.” This variable has been reversed coded to “Not anemic”, “Mild”, “Moderate”, and “Severe” for analysis. Anemia level is measured by hemoglobin level, with a level less than 8g/dl indicating anemia. The confounder variables include education, including the highest education level of mothers, grouped under “No Education,” “Primary,” “Secondary,” or “Higher”; and type of place of residence, grouped under “Urban” or “Rural.”

The variables stated in the RQ were collected and presented in the 2012 Niger DHS survey. All the predictor and confounding variables are nominal level variables except highest educational level, which is ordinal. The DV is also an ordinal level variable (see Table 2).

Table 2

Study Variables and Level of Measurements

Study Variables	Level of Measurement	Survey Questions	Response Options
Have ed net for sleeping	Nominal	V459	0= "No" 1= "Yes"
Children under 5 slept under mosquito bed net last night	Nominal	V460	0= "No" 1= "All Children" 2= "Some Children" 3= "No Net in Household"
First source for current method	Nominal	V3A07	10= "Public Sector" 11= "Pharmacy" 12= "Central maternity of reference" 13= "CHR maternity" 14= "HD maternity" 15= "Integrated health center" 16= "Health cabin" 17= "Mobile clinic" 18= "Other public sector" 20= "PRIVATE SECTOR" 21= "Hospital, private clinic" 22= "Pharmacy" 23= "Doctor" 24= "Mobile clinic" 25= "ANBEF center" 26= "Road kiosk" 28= "Other private Sector" 30= "OTHER SOURCE" 31= "Shop" 32= "Religious institution" 33= "Friends, parents" 34= "Moving pharmacy, on the ground" 35= "Community relay" 96= "Other" 98= "Don't' know"
Combination with artemisinin taken for fever/cough	Nominal	ML13E	0= "No" 1= "Yes"
traditional medicine taken for fever/cough	Nominal	S538L	0= "No" 1= "Yes"
Highest educational level	Ordinal	V106	0= "No Education" 1= "Primary" 2= "Secondary" 3= "Higher"
Type of place of residence	Nominal	V025	1= "Urban" 2= "Rural"
Anemia level	Ordinal	V457	1= "Not anemic" 2= "Mild" 3= "Moderate" 4= "Severe"

The research questions for this study come from household characteristics, women's background characteristics, children's health, and a biometric questionnaire on anemia. The Household characteristics focused on mosquito nets in areas with a high prevalence of malaria. The woman's background characteristics focused on the mothers' education, consisting of the highest educational level. Children's health focused on recent fever and cough occurrences for young children and treatment of childhood diseases such as malaria. Finally, the biomarker questionnaire on anemia focused on hemoglobin level in the blood, measured using a finger stick capillary blood sample. The hemoglobin test was adjusted using the CDC formula (CDC, 1998) and was measured in grams per deciliter (g/dl). The hemoglobin level was used to determine whether the respondent is anemic, which consists of a hemoglobin level of less than 8g/dl. Anemia level is then categorized as severe, moderate, mild, or not anemic based on the hemoglobin level. Results were shared with the adult respondent, the minor respondent and parent/guardian of the minor respondent, and the parent/guardian of the child. A blood sample is only collected if voluntary informed consent is provided (DHS, 2021).

Data Analysis Plan

SPSS version 27 software was used to perform the statistical analysis for this project. First, a descriptive analysis was performed to determine the target group's count, frequency, and percentage of distribution. A descriptive study is designed to describe the distribution of one or more variables without any causal or other hypotheses (Aggarwal & Ranganathan, 2019). Count, frequency, and percentage were used to determine anemia

level (severe, moderate, mild, and not anemic), antimalarial taken for fever/cough (yes and no), traditional medicine taken for fever/cough (yes and no), first source for current method (Pharmacy, central maternity of reference, central hospitaller regional maternity, HD maternity, integrated health centre, health cabin, mobile clinic, other public sector, hospital, private clinic, road kiosk, other private sector, shop, religious institution, friends, parents, moving pharmacy, on the ground, community relay, and other), have mosquito bed net for sleeping (yes and no), children under 5 slept under bed net last night (no, all children, some children, no net in the household), mothers' highest education level (no education, primary, secondary, and higher), and type of place of residence (urban and rural). All independent variables in the study are nominal level variables and the DV is ordinal level variable.

A frequency distribution table and pie-charts were generated because they are appropriate based on the level of measurements in this study, which determine the type of descriptive analysis suitable to use to describe the variables. Pie charts are ideal for categorical variables. Moreover, pie charts show the differences among frequencies or percentages for nominal or ordinal categories (Franforth-Nachmias & Leon-Guerrero, 2020).

For the inferential statistics, since the DV is ordinal, an OLR was used on the first and third research questions because it is appropriate based on the measurements of the variables in these RQs. OLR models predict ordinal dependent variables (Arfan & Sherwani, 2017). An OLR is a statistical analysis method that can be used to model the relationship between an ordinal dependent or response variable and one or more

independent explanatory variables can either be continuous or categorical (Cornell Statistical Consulting Unit, 2020). In this case, the predictor variables were types of antimalarials, source of antimalarials, and bed net usage. The DV was "anemia level," categorized into severe, moderate, mild, and not anemic.

OLR assumes that the DV should be an ordinal level variable and the independent variables should be continuous, ordinal, or categorical. OLR also assumes no multicollinearity (Laerd Statistics, 2018). A central assumption of OLR is the assumption of proportional odds model, which assumes that the effect of each predictor remains the same for each category of the response variable (Arfan & Sherwani, 2017). Chi-square was used on the second RQ.

Chi-square is generally used to compare the differences between the observed and the expected. Chi-square also tests for relationship between variables (Gerstman, 2015). Also, in this study, the independent variable (IV; first source for current method) is nominal, and the DV (anemia level) is ordinal, which is great for chi-square. Chi-square was used to determine the difference between participants who received treatments at different venues to determine the prevalence of malaria infection in that group.

For the statistical power calculation, a confidence level of 95% and 5% alpha level (type I error) was used to test the statistical significance between the independent variables (types of antimalarials, source of antimalarials, and bed net usage) and DV (anemia level) in all research questions. To minimize errors and biases, I accounted for mothers' education and type of place of residence as confounders for all three research

questions. To test the effect size, I tested for the Goodness-of-fit using the deviance and Pearson chi-square tests.

The null hypothesis is a statement of "no difference" (There is no significant difference in the prevalence of malaria-induced anemia between different degrees of treatment-seeking behaviors such as types of antimalarials, source of antimalarials, and bed net usage among under-five children in Niger; Gerstman, 2015)). The alternative hypothesis contradicts the null hypothesis (there is a positive association between anemia level and treatment-seeking behaviors in under-five children in Niger). I also tested the Likelihood Ratio chi-square test to test the model, which is an alternative goodness-of-fit test (Starkweather & Moske, 2011). Finally, I interpreted the results using *p* values and odds ratio.

Research Questions and Hypotheses

RQ 1: Is there a relationship between types of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine given for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

$H_0$1: there is no relationship between the type of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

H_a1: there is a relationship between the type of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for

fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

RQ 2: Is there a relationship between source of antimalarials (first source for current method) and malaria prevalence (anemia level) among children in Niger, controlling for antimalarials locations or venues.

$H_0$2: there is no relationship between the first source of antimalarials (first source for current method) and malaria prevalence (anemia level) among children in Niger, controlling for antimalarials locations or venues.

H_a2: there is a relationship between the first source of antimalarials (first source for current method) and malaria prevalence (anemia level) among children in Niger, controlling for antimalarials locations or venues.

RQ 3: Is there a relationship between bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

$H_0$3: There is no relationship between bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

H_a3: There is a relationship between bed net usage (have mosquito bed net for sleeping, children under 5 slept under mosquito bed net last night), and malaria

prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

Threats to Validity

Validity measures the accuracy of a quantitative study, which is exploratory research that seeks to generate knowledge and understanding (Burkholder, Cox & Crawford, 2016). Additionally, validity refers to how a researcher's inferred conclusions from data reflect actuality (Heppner et al., 2008 in McKibben & Silvia, 2016). The threats to validity limit the scope of the research and reduce its applicability (Cruzes & Othmane, 2017).

There are two types of validity in quantitative research: internal and external validity. Internal validity measures the strength of the study results and helps eliminate other systematic errors or biases within the study. On the other hand, external validity occurs when the findings of a study can be applied to a larger group or population (Torre & Picho, 2016). The present study describes potential internal and external validities relevant to this study and potential recommendations to address those threats to validities.

Threats to Internal Validity

Threats to internal validity include selection, defined as the procedures for selecting the study participants, which results in systematic differences across conditions (Shadish et al., 2002). Selection bias can be avoided using the same criteria for selecting cases and controls, obtaining high participation rates, using various methods to trace study subjects successfully, and taking diagnostic and referral practices into account when designing a study (Aschengrau & Seage, 2020). Another threat to internal validity

is the self-reporting nature of the DHS survey, which can lead to recall bias. Recall bias can be prevented or minimized by designing a structured questionnaire such as a self-administered questionnaire or audio computer-assisted self-administered questionnaire. Finally, another way to avoid recall b is to forgo questionnaires entirely and rely on biological measurements and pre-existing records for the necessary study data.

Threats to External Validity

The use of big data such as the DHS survey in this study strengthens the study's validity and provides more representation of the population being studied. Big data can proactively identify, monitor, and improve a range of medical, environmental, and social factors relevant to communities' health (Gamache et al., 2018). Although the 2012 DHS survey on Niger used randomized sampling selection in this study, the cross-sectional design method limits the current study to correlation (DHS, 2021). Likewise, cross-sectional studies could not make a causal inference (Wang & Cheng, 2020).

Another threat to external validity, in this case, would be social desirability responding, which tends to present oneself in an overly optimistic way (McKibben & Silvia, 2016). For example, according to the current recommendations, mothers may not respond accurately to whether they have treated their children for malaria. For example, a mother may respond by giving their child pharmaceutical antimalarials instead of home remedies or nothing, even if that was the case. An excellent way to prevent social desirability responding is to incorporate the Marlowe–Crowne Social Desirability Scale in the survey, a viable measure of social desirability for use with nonclinical populations. This scale measures whether people admit typical human faults and failings such as "I

like to gossip at times" or endorse unrealistically optimistic qualities such as "No matter whom I am talking to, I am always a good listener" (McKibben & Silvia, 2016).

Ethical Procedures

Ethics is typically associated with morality and both deal with matters of right and wrong. A potential ethical issue in quantitative research is protection from harm, especially in experimental studies where the research manipulates or does something to the subject which may cause harm to the subject. The research must not harm subjects; ideally, subjects should benefit from it (Babbie, 2017).

Any project is not without ethical concerns. A potential ethical and legal concern regarding working with these obese children would be to get informed consent from their parents to participate in this program. We cannot and must not work with any children without parental consent. The ethical issue would be leaving out children who desperately need the program because of parents' unwillingness to participate. Having someone snooping around anyone's child is a sensitive matter, and we must proceed with caution by asking parents first before approaching their children.

In clinical trials and other study designs such as cohort, cross-sectional, informed consent is crucial. Obtaining informed consent should be voluntary, and there should be full disclosure about what subjects may or may not undergo in the study. If the researchers are not careful in handling their subjects' privacy, there would be a potential number of subjects dropping out of the study. Likewise, legal actions may be brought against the researcher (s). Additionally, the potential misuse of data defies the study's validity and significance.

Moreover, potential study biases may arise and weaken the study's validity. Finally, mishandling the subjects' privacy and data security may also negatively affect them. Often, social research calls for an intrusion into people's lives, and researchers must protect these participants at all costs (Babbie, 2017).

To minimize or eliminate ethical procedures, DHS obtained IRB approval prior to conducting the survey, and all participants have given consent, approved by IRB, before participating in the survey (DHS, 2021). Moreover, all survey interviewers were trained on how to survey with specific attention to cultural competency (DHS, 2021).

Summary

The cross-sectional design selected for the project aligns with the design used by DHS to collect the original data. The cross-sectional design is also suitable because of its cost-effective nature, and it allows researchers to gather information to facilitate decision making, such as effective interventions in fighting malaria in under-five children in Niger and other malaria-prone regions. The methodology also aligns with the variables included in the model because it aligns with the variables' levels of measurements. The statistical analysis approaches were discussed in Section 2 and the implementation and interpretation of the results are discussed in Section 3.

Section 3: Presentation of the Results and Findings Section

Introduction

In this quantitative study, the association between types and sources of antimalarial and malaria prevalence among under-5 children in Niger was examined after controlling for the mother's education and the type of place of residence. The association was also examined between bed net use and malaria prevalence among under-5 children in Niger after controlling for the mother's education and the type of place of residence. The study used a data source collected by the DHS in Niger in 2012. A descriptive analysis was performed using SPSS to describe how the study variables were distributed. Likewise, an inferential analysis was conducted to determine if there is an association between the independent and dependent variables in each of the three research questions. This section of the paper will include accessing the data set for secondary analysis, the results, and a summary.

Accessing the Data Set for Secondary Analysis

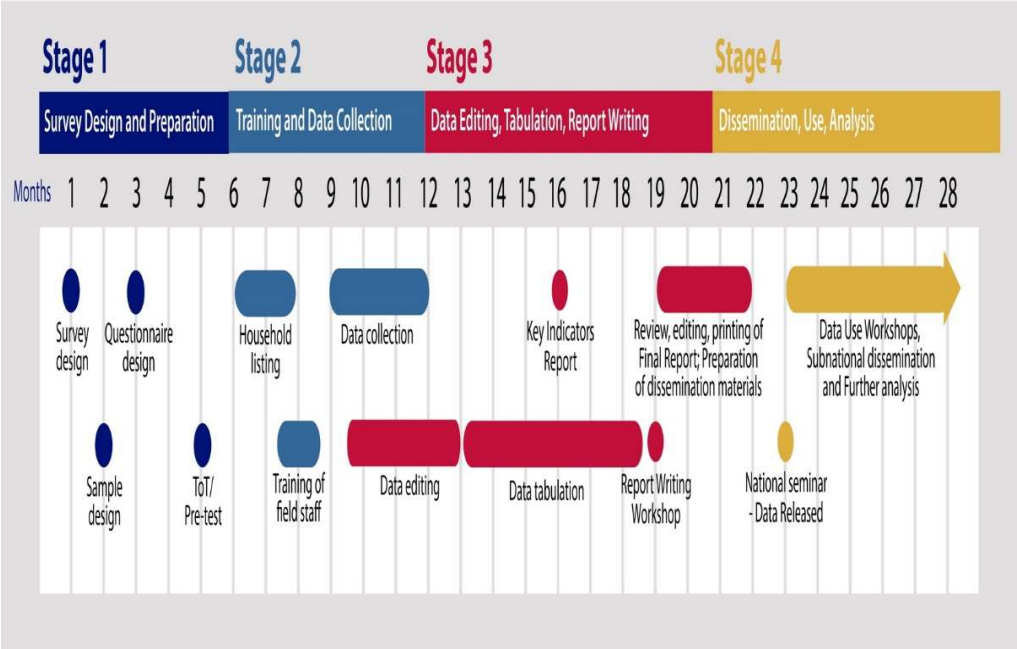
The DHS are nationally representative household surveys that provide data for monitoring and impact evaluation indicators in population, health, and nutrition for public health usage (DHS, 2021). The DHS uses large sample sizes (usually between 5,000 and 30,000 households) and is typically conducted about every 5 years to allow comparisons. The data used in this study were collected from February 2012 to June 2012 from a sample size of 10,750 households in Niger with 64,011 members. The response rate was 98%. Finally, there were no discrepancies in using the data set from the plan presented in Section 2.

2012 DHS Survey Timeline

The DHS Survey process had four stages spread in up to 2.5 years. Figure 2 shows the standard timeline for the 2012 DHS survey. The 2012 DHS survey population consists of 10,750 households with 64,011 members—11,160 women aged 15–49, and 3,928 men aged 15–59. The target population for this study is under-5 children, which consisted of 12,558, both genders included. Most of the data are collected via questionnaires except for anemia and malaria status, which were clinically diagnosed.

Figure 2

2012 DHS Survey Timeline



Results

This section of the study deals with examining and analysis of the collected data. The data collected from the survey are only raw data that do not convey any significant

trends or the behavior of the individuals until the data is firmly analyzed. Data analysis refers to the process of converting the raw data into meaningful information, using the mathematical, statistical, or computational algorithms for better comprehension (Ahrens et al., 2011). The dependent variables were malaria prevalence (anemia level). The independent variables were types of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) and bed net usage (have mosquito bed for sleeping and children under-5 slept under mosquito bed net last night).

Two factors used in the ordinal logistics regression model were education and type of place of residence. OLR is a statistical analysis approach for modelling the connection between one or more explanatory factors and an ordinal response variable (Abreu, 2008). An ordinal variable is a categorical variable in which the category levels are clearly ordered (Christensen, 2015). In general, OLR is preferred (Osborne, 2015). Unlike multiple logistic regression which generates numerous sets of regression coefficients and tests, OLR only generates a single set of regression coefficients to estimate correlations between independent and dependent variables. As a result, OLR will produce a sparser representation of the data when the DV is ordered than multiple logistic regression. These pseudo-R-square values are used in ordinary least squares regression as rough equivalents to the R-square value. However, in general, there is not much information in the literature about how to utilize or interpret them (Hahs-Vaugn, 2013).

The chi-square test was also used to explain the second research question. This test aims to determine whether a disparity between observed and predicted data is due to chance or a link between the variables used for this study (Satorra, 2010). The Pearson's chi-square test, also known as the chi-square goodness-of-fit test or the chi-square test for independence, is a frequent application of the chi-square test (Bolboacă, 2011). When examining cross-tabulations of collected data, the chi-square test tells researchers whether there is a statistically significant difference between how portion or classes answered a given question because cross-tabulations expose the frequency and percentage of responses to questions by various segments or classifications of participants (Pontius, 2006; YayeHabi, 2020).

Characteristics of the Study Sample

Descriptive analysis helps describe, demonstrate, or summarize the collected data constructively so that the trends and patterns can be easily observed and analyzed (Shrestha, 2018). Descriptive analysis has some important measures, including mean, median, mode, range, normality test, standard deviation, skewness, and kurtosis. Mean, median, and mode measure the central tendency of the variable to typify the whole data set (Park, 2008). Since all variables in this study are categorical, frequency distribution was the perfect choice to represent data in informative and summary form. The number of measurements that fall within each interval is shown in the frequency table. Frequency tables can be used to analyze categorical data and check for data entry issues (Duquia, 2014).

Table 3 indicates that 78% of sample participants have mosquito bed net for sleeping. Out of 44,183 participants, 9,726 children do not have mosquito bed net for sleeping. Besides, there were 19,146 children under 5 who did not sleep under a mosquito bed net last night, and a significant number of children (7,749) do not have a net in the household. Regarding taking medicine for fever/cough, 2,334 participants do not take any traditional medicine. Most of the participants are missing in this variable. Missing data may decrease a study's statistical validity and produce inaccurate results due to misleading estimations. There are different participants in this study, and they fall under different educational levels. 85.9% of sample children do not have any education, whereas only 0.4% of children have a secondary higher education. The difference in educational levels can be caused by the type of residence. Out of 44,183 sample children, more than 75% of participants are living in rural areas. Most participants (2,067) do not prefer the combination with artemisinin taken for fever/cough. There are 18 sources for the current method whereas Integrated health centre (2,976) is their first choice and Community relay (18) is their least favourite source.

Table 3

Characteristics of the Study Sample

Variables	Categories	Frequency	Percent
Have a mosquito bed net for sleeping	No	9726	22.0
	Yes	34457	78.0
	Total	44183	100.0
Children under 5 slept under mosquito bed net last night	No	19146	43.3
	All children	8675	19.6
	Some children	2054	4.6
	No net in household	7749	17.5
	Total	37624	85.2
Missing	System	6559	14.8
Total		44183	100.0
Traditional medicine taken for fever/cough	No	2334	5.3
	Yes	17	0.0
	Total	2351	5.3
Missing	9	44	0.1
	System	41788	94.6
	Total	41832	94.7
Total		44183	100.0
Highest educational level	No education	37956	85.9
	Primary	4160	9.4
	Secondary	1821	4.1
	Higher	177	0.4
	Total	44114	99.8
Missing	9	69	0.2
Total		44183	100.0
Type of place of residence	Urban	9866	22.3
	Rural	34317	77.7
	Total	44183	100.0
Combination with artemisinin taken for fever/cough	No	2067	4.7
	Yes	284	0.6
	Total	2351	5.3
Missing	9	44	0.1
	System	41788	94.6
	Total	41832	94.7
Total		44183	100.0

(table continues)

Variables	Categories	Frequency	Percent
First source for current method	Pharmacy	92	0.2
	Central maternity of reference	81	0.2
	CHR maternity	132	0.3
	HD maternity	188	0.4
	Integrated health centre	2976	6.7
	Health cabin	388	0.9
	Mobile clinic	14	0.0
	Other public sector	87	0.2
	Hospital, private clinic	104	0.2
	Pharmacy	87	0.2
	Road kiosk	13	0.0
	Other private sector	41	0.1
	Shop	43	0.1
	Religious institution	28	0.1
	Friends, parents	833	1.9
	Moving pharmacy, on the ground	126	0.3
	Community relay	18	0.0
	Other	547	1.2
	Total	5798	13.1
Missing	99	180	0.4
	System	38205	86.5
	Total	38385	86.9
Total		44183	100.0
Source_recode	Health center	3958	9.0
	Non health center	1840	4.2
	Total	5798	13.1
Missing	99	180	0.4
	System	38205	86.5
	Total	38385	86.9
Total		44183	100.0
Anemia level	Severe	10931	24.7
	Moderate	6733	15.2
	Mild	2416	5.5
	Not anemic	159	0.4
	Total	20239	45.8
Missing	9	1232	2.8
	System	22712	51.4
	Total	23944	54.2
Total		44183	100.0

RQ 1

RQ 1: Is there a relationship between types of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough), and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

The independent variables were types of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough), and the DV was malaria prevalence (anemia level) which is an ordinal scale. The Deviance and Pearson chi-square tests, which are important for detecting if a model fits the data well, are included in Table 4. Non-significant test results indicate that the model is well-suited to the data (Archer, 2006). The Pearson chi-square test [2(39) =44.472, p =.252] and the deviance test [2(39) =43.114, p =.300] were both non-significant in this study. These findings point to a solid model fit.

Each IV in the model has its regression coefficients and significance tests. The regression coefficients are directly translated as the anticipated change in log chances of being in a higher (rather than lower) group/category on the DV per unit increase on the IV (controlling for the other independent variables). In this table, the threshold estimates are provided as intercepts. These estimates can be read as the "log chances of being in a certain group or below when scores on the other variable(s) are zero," (Courvoisier, 2011). The IVs (combination artemisinin taken for fever/cough- ML13E and traditional medicine taken for fever/cough- S538L) and factor variables (education- V025 and type

of place of residence- V106) do not have any significant impact on the DV (anemia level- V457). Therefore, the null hypothesis that there is no relationship between the type of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence cannot be rejected. See table 4 and 5 below.

Table 4

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	44.472	39	.252
Deviance	43.114	39	.300

Link function: Logit.

Table 5

Parameter Estimates

							95% CI	
		Estimate	SE	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[V457 = 1]	.044	.488	.008	1	.928	-.912	1.000
	[V457 = 2]	1.856	.492	14.214	1	.000	.891	2.821
	[V457 = 3]	5.279	.659	64.108	1	.000	3.986	6.571
Location	ML13E	.022	.187	.013	1	.908	-.346	.389
	S538L	.248	.634	.153	1	.696	-.995	1.490
	[V025=1]	-.014	.147	.009	1	.925	-.302	.275
	[V025=2]	0[a]	.	.	0	.	.	.
	[V106=0]	-.091	.485	.036	1	.851	-1.041	.858
	[V106=1]	-.194	.496	.154	1	.695	-1.166	.777
	[V106=2]	-.261	.512	.259	1	.611	-1.265	.743
	[V106=3]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

RQ 2

RQ 2: Is there a relationship between the first source for current method and the anemia level?

Cross tabulation is a statistical tool that is used to analyze categorical data. Besides, it separates the categorical data or variables into different categories that are mutually exclusive from one another (Yin, 2013). All data has been accounted for and is properly separated by anemia level and the first source for the current method recoded into source_recode. It can be seen right away that it appears that most of the children's first source for the current method of the health center are influenced by severe (0.2%), moderate (4.1%) and mild (22.6%) anemia levels. Besides, some children's first sources for the current method are non-health centers that are influenced by severe (0.2%), moderate (3.5%), and mild (10.9%) anemia levels. See Table 6 below.

Table 6

Anemia Level Crosstabulation

			Anemia level				
			Severe	Moderate	Mild	Not anemic	Total
Source	Health Center	Count	5	113	615	1141	1874
		Expected Count	7.6	143.0	627.9	1095.5	1874.0
		% of Total	0.2%	4.1%	22.6%	41.9%	68.8%
	Non Health Center	Count	6	95	298	452	851
		Expected Count	3.4	65.0	285.1	497.5	851.0
		% of Total	0.2%	3.5%	10.9%	16.6%	31.2%
Total		Count	11	208	913	1593	2725
		Expected Count	11.0	208.0	913.0	1593.0	2725.0
		% of Total	0.4%	7.6%	33.5%	58.5%	100.0%

The chi-square Test of Independence determines whether there is a relation between categorical variables (Howell, 2011). A chi-square test for goodness of fit with α= .05 was used to assess the relationship between the first source for the current method, recoded into "source_recode" and anemia level. The chi-square test was statistically significant, χ^2 (1, N=2725) = 29.882, p <.001. Therefore, the null hypothesis that there is no relationship between the first source for the current method and anemia level was rejected. It can be concluded that there is a significant relationship between the first source for the current method and anemia level in the population. See table 7 below.

Table 7

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	29.882[a]	3	.000
Likelihood Ratio	28.492	3	.000
Linear-by-Linear Association	26.030	1	.000
N of Valid Cases	2725		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.44.

RQ 3

RQ 3: Is there an association between bed net usage (have mosquito bed for sleeping and children under-5 slept under a mosquito bed net last night) and malaria prevalence (anemia level) among children in Niger, controlling for education and type of place of residence?

The chi-square goodness of fit test is a statistical technique that is used to examine whether a variable is likely to originate from a certain distribution. It's frequently used to see if a sample of data is representative of the entire population (Balakrishnan, 2013). We may reject the null hypothesis since the *p* value is less than or equal to the significance threshold (0.05), implying that the data may not follow a proportional distribution. In this analysis, we see that both the Pearson chi-square test [χ^2 (75) =262.059, p <.001] and the deviance test [χ^2 (75) =289.132, p <.001] were both significant. See table 8 below.

Table 8

Goodness of Fit

	Chi-Square	df	Sig.
Pearson	262.059	75	.000
Deviance	289.132	75	.000

Link function: Logit.

The independent (have mosquito bed for sleeping- V459 & children under-5 slept under a mosquito bed net last night- V460) and factor variables (education- V025) and (type of place residence- V106) have a significant impact on the DV (anemia level- V457). Having a mosquito bed net for sleeping was a significant positive predictor of anemia level. For every one-unit increase on this variable, there is a predicted increase of .161in the log odds of children being in a higher level of DV. Children under-5 sleeping under a mosquito bed net last night was also a significant positive predictor of anemia level. For every one-unit increase on this variable, there is a predicted increase of .166 in the log odds of children being in a higher level of the DV.

Besides, for every one-unit increase in a rural area, there is a predicted decrease (-.259) in anemia level. In level of education, for every one-unit increase in a zero and secondary education for mothers, there is a predicted decrease (-.022 & -.273)) in anemia level in children. Therefore, the null hypothesis has been rejected. Therefore, it can be concluded that there is a statistically significant association between bed net usage (have mosquito bed for sleeping and children under-5 slept under a mosquito bed net last night) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence. See table 9 below.

Table 9

Parameter Estimates

							95% CI	
		Estimate	SE	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[V457 = 1]	.388	.302	1.653	1	.199	-.204	.980
	[V457 = 2]	2.140	.303	50.002	1	.000	1.547	2.733
	[V457 = 3]	5.062	.314	260.471	1	.000	4.447	5.676
Location	V459	.161	.076	4.456	1	.035	.011	.310
	V460	.166	.026	39.520	1	.000	.114	.218
	[V025=1]	-.259	.039	43.557	1	.000	-.336	-.182
	[V025=2]	0[a]	.	.	0	.	.	.
	[V106=0]	-.022	.289	.006	1	.938	-.589	.545
	[V106=1]	.122	.292	.176	1	.675	-.449	.694
	[V106=2]	-.273	.301	.823	1	.364	-.862	.316
	[V106=3]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

Summary

The data have been analyzed using SPSS 27. The analyses provide standard formulas that have been applied for calculating means, standard deviations, percentages, *p* values, and *F* values. Descriptive analysis has been conducted to represent the

characteristics of the sample. OLR and chi-square test have been used to explain the three research questions. It has been found that bed net usage and the first source for the current method have a statistically significant relationship with malaria prevalence (anemia level).

The data of a statistical test examines only as good as the data it explores. The statistical analysis produced by researchers that collect data using incorrect or biased techniques will be deceptive. The difference between the sample and actual populations is referred to as "sampling error." The statistical methods do not study the nature of the phenomenon, which cannot be expressed in quantitative terms. When even phenomena happen, that is due to many causes, but all these causes cannot be described in terms of data. When a test shows that a difference is not statistically significant, it could be significant in practical life. It can be concluded that the above results have fulfilled the aim of this research. The implementation and interpretation of the results were discussed in this part 3, and the study's applicability to professional practice and implementations for social change were discussed in Section 4.

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

Introduction

In this quantitative study I examined the association between treatment-seeking behaviors and malaria prevalence among under-5 children in Niger. The analyses focused on types of antimalarials, source of antimalarials, bed net usage, and malaria prevalence among under-5 children in Niger after controlling for the mother's education and the type of place of residence. The study used a data source collected by the DHS in Niger in 2012, publicly available upon request. The study population comprises 12,558 children under-5 years old, scattered in 10,750 households with 64,011 members. In this study, the *SEM* framework was used to explain how different multiple and interchangeable levels interact with one another to influence malaria prevalence among these under-5 children in Niger. Among those levels are the children, their parents, family, friends, schools, community, and the government.

Additionally, parents' educational levels and types of place of residence were included as covariates to malaria prevalence. The analyses revealed that there was no association between types of antimalarials and malaria prevalence. However, the analyses showed a significant association between the source of antimalarials, bed net usage, and malaria prevalence. Finally, a descriptive analysis was performed using SPSS version 27 to describe how the study variables were distributed and to determine if there is an association between the independent and dependent variables in each of the three research questions. The basis of the analyses was to either accept or reject the null hypothesis in each research question. This section of the paper will include an

interpretation of the findings, study limitations, recommendations, implications for professional practice, social change, and conclusion.

Interpretation of the Findings

The findings from this study were mostly consistent with other studies on the association between treatment-seeking behaviors and malaria prevalence among under-5 children.

RQ 1

RQ 1: Is there a relationship between types of antimalarials for fever/cough (combination artemisinin taken for fever/cough, traditional medicine taken for fever/cough) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence? For this research question, both the Pearson chi-square test [$2(39) = 44.472$, $p = .252$] and the deviance test [$2(39) = 43.114$, $p = .300$] revealed no significant association between types of antimalarials and malaria prevalence controlling for education and types of place of residence. Therefore, the null hypothesis was accepted. However, in past studies, combination artemisinin-based therapies were shown to be the first line of therapy for uncomplicated malaria cases in almost all countries where malaria is endemic (Dini et al., 2018). For example, combination therapies were found to effectively treat uncomplicated malaria cases in 212 children aged 6–59 months from the region of Maradi in Niger (Grandesso et al., 2018). Additionally, combination artemisinin therapies such as artemether-lumefantrine as first-line antimalarial therapies in Mali were 99.0% (95% CI; 98.3%, 99.8%; Maiga et al., 2021). Moreover, a meta-analysis conducted in Sudan in 2018 showed that ACT remains

highly efficacious in Sudan, with an overall malaria treatment success rate of 98.0% (Maiga et al., 2021). The findings of the current study may not support these previous studies because of the current ongoing emergence of drug-resistant parasites to artemether (Dini et., 2018). Consequently, the West African Network for Clinical Trials of Antimalarial Drugs consortium is currently running a trial of the novel ganaplacide/lumefantrine drug combination in Burkina Faso, Gabon, Mali and Niger to replace the combination drug artemether/lumefantrine (Nature Index, 2022).

RQ 2

RQ 2: Is there a relationship between the first source for the current method and the anemia level? The results from this RQ showed that most of the children's first sources for the current method is the health center, which is influenced by severe (0.2%), moderate (4.1%) and mild (22.6%) anemia levels. Moreover, some children's first sources for the current method are non-health centers that are influenced by severe (0.2%), moderate (3.5%), and mild (10.9%) anemia levels. The chi-square test for goodness of fit with $\alpha = .05$ was statistically significant, $\chi^2 (1, N=2725) = 29.882$, $p < .001$. Therefore, the null hypothesis was rejected, and it can be concluded that there is a significant relationship between the first source for the current method and the anemia level in the population.

In past studies, it was determined that most communities resort to unorthodox medicines for malaria (Chijioke-Nwauche & Sam-Ozini, 2017) because of the high cost of medicines and challenges of access to facilities (Orimadequn & Ilesanmi, 2015). Some mothers in Ghana prefer treatment with locally produced herbal remedies because of trust

in local and "green" products and an inherent distrust of imported and synthetic or orthodox medicines (Yeboah et al., 2020). These findings were supported in the current study, as most children acquire their antimalarials from friends and families. However, the integrated health centers seem to be more popular as venues for antamalrials in the study perhaps because of reporting issues. Most mothers who resort to unorthodox medicines may not feel comfortable reporting it.

RQ 3

RQ 3: Is there an association between bed net usage (have mosquito bed for sleeping and children under-5 slept under a mosquito bed net last night) and malaria prevalence (anemia level) among children in Niger, controlling for education and type of place of residence? In this analysis, both the Pearson chi-square test [χ^2 (75) = 262.059, p < .001] and the deviance test [χ^2 (75) = 289.132, p < .001] were significant, implying that children under-5 sleeping under a mosquito bed net last night was a significant positive predictor of anemia level. Additionally, both mothers' education and types of place of residence were significant predictors of malaria prevalence. For example, for every one-unit increase in a rural area, there is a predicted decrease (-.259) in anemia level, and for every one-unit increase in a zero and secondary education for mothers, there is a predicted decrease (-.022 & -.273) in anemia level. Therefore, the null hypothesis was rejected, and it can be concluded that there is a statistically significant association between bed net usage (have mosquito bed for sleeping and children under-5 slept under a mosquito bed net last night) and malaria prevalence (anemia level) among children in Niger controlling for education and type of place of residence.

In past studies, mosquito nets have also been shown to help prevent malaria. Ye and Duah (2019) confirmed the effectiveness of ITNs by adding that ITNs in combination with IRS and ACT, collectively under-5 mortality rate 12 per 1,000 live births with a 95% confidence interval. Kaventao et al. (2018) also conducted a survey from 2000 to 2015 to perform trend analysis for malaria intervention coverage and prevalence of under-5 morbidities in Mali (West Africa), in which ITNs were distributed to pregnant women and children under-5 years old along with ACT treatment and insecticide use. At the end of the survey, it was determined that malaria prevalence decreased by 35.8% in 2015, and severe anemia decreased by 26.3% in 2012 and continues to decline.

The *SEM* Framework

The *SEM* is a framework used to explain how intrinsic and extrinsic factors influence behavior or, in this case, a health condition such as malaria. This study used four *SEM* constructs to explain the association between treatment-seeking behaviors and malaria prevalence among under-5 children in children. The following sections discuss how each of the four constructs relates to the research questions.

Individual/Intrapersonal

R1 (Variables: Education; Have mosquito bed net for sleeping). The intrapersonal level investigates the biological and personal history factors that increase one's chance of becoming a malaria victim. Therefore, this level will investigate the factors such as child age, place of residence, ability to acquire bed net, and how these factors can contribute to the spread of malaria in Niger.

Specific approaches and prevention strategies include ensuring individual education on proper malaria prevention strategies for those old enough to understand and providing free bed net to all households containing under-5 children to prevent malaria.

Interpersonal

R1, R2, R3 (Variables: Mother's education, Children under-5 slept under a mosquito net last night; Combination artemisinin taken for fever/cough; traditional medicine taken for fever/cough; the First source for current method). This level investigates a child's close relationships that can influence behavior and contribute to the spread of disease. Relationships are vital determinants for the success of malaria control programs in Niger. Specific approaches and prevention strategies include educating mothers on the proper way to treat and prevent malaria in their children by educating them on the benefits of using medical pharmacy instead of street pharmacy to acquire good quality antimalarials and the importance of seeking medical help. Moreover, heads of households should be educated on using ITNs for the intended purpose only.

Community

R1, R3 (Variables: Education, type of place of residence, have mosquito bed net for sleeping, and First source of child's antimalarials). Prevention strategies at this level may be creating safe places to live, work, and play. For example, malaria control programs include reducing human and mosquito contact through environmental cleanliness, IRS, ITNs, ensuring a safe place to live, and making bed net available and easily accessible in the community.

Public Policy

R1, R3 (Variables: Education and first source of child's antimalarials). Prevention strategies at this level include efforts to eliminate malaria and to promote social norms that will help fight against the spread of malaria in Niger. These include adopting the WHO elimination programs, educating the public about malaria and the preventative measures, coming up with health policies that will help stop the spread of malaria in Niger, increasing public awareness of the benefits of modern medicine and an improvement and control of the quality of herbal remedies to raise the standard for the treatment of malaria in Niger.

Limitations of the study

As mentioned before, some of this study's limitations include data access. For example, the DHS performs a demographic and health survey every 5 years. However, the 2017 survey collected in Niger was deemed unreliable and not published. Therefore, the most recent data on Niger is from 2012, unlike the neighborhood countries with updated survey data (DHS, 2021), which is a significant limitation for this study. Additionally, this 2012 DHS secondary data on Niger was collected specifically for this study, making the study design completely dependent on the variables already included in the 2012 DHS data. Therefore, I cannot account for other confounders, such as the quality of antimalarials in Niger known to influence malaria prevalence.

Another potential barrier is that the survey was self-reported, resulting in biased results. For example, the data may suffer from recall bias because some participants may not differentiate malaria symptoms from similar symptoms such as fever, which can be a

sign of many other diagnoses. Moreover, there were many missing data in the dataset, which may affect this study's internal validity. The study's cross-sectional nature also only examined associations between variables, which may limit the ability to infer causality. Additionally, the inability to investigate the temporal relation or association between outcomes and risk factors represent a major limitation of a cross-sectional design (Weng & Cheng, 2020). Finally, the findings of this study are only restricted to under-5 children in Niger and thus cannot be generalized outside this population and location.

Recommendations

Studies have shown that ITNs, IRS, and ACT were proven to prevent malaria infection among under-five children. Therefore, these treatments should be available and accessible to the general population to prevent malaria. Additionally, climate change has a big impact on malaria prevalence, and as such, the government of Niger, in collaboration with community leaders and members, should eliminate stagnant waters as they present significant vectors of malaria-caused mosquitoes. The government should also make the new malaria vaccine available in the country and sensibilize the general population on its benefits.

The world is celebrating a milestone as the first-ever malaria vaccine, the RTS, S, was introduced in 2019 (Mugala, 2022). It is currently being administered to children in Ghana, Kenya, and Malawi as a pilot program where more than 800,000 children received at least their first dose. It is believed to help reduce malaria cases in children, including cases of severe, life-threatening illnesses (Mugala, 2021). Likewise, the government of Niger needs to adopt a malaria elimination mindset by allocating

resources to elimination programs. The World Health Assembly adopted the Global Technical Strategy for malaria 2016–2030 in 2015 to maintain the vision of a world free of malaria that was first established in 1955 by the WHO's Global Malarial Eradication Program (Lindblade et al., 2021).

The Global Technical Strategy calls for malaria eradication through individual country efforts to eliminate malaria within their borders by adopting an interactive analysis process and implementing intervention packages appropriately tailored to the subnational context (Lindblade et al., 2021). Finally, to fully understand health-seeking behaviors in Niger, future studies should assess the history of treatment-seeking behaviors for many other diseases, using qualitative studies that can provide in-depth information on health and treatment-seeking choices in study communities.

Implications for Professional Practice and Social Change

Although malaria has been an ongoing public health issue in Africa, it has been eradicated in other parts of the world, especially in North America, Europe, Australia, and some parts of Asia. Nevertheless, despite ongoing efforts, the African continent continues to succumb to the disease, accounting for 92% of malaria cases and deaths worldwide (Mbacham et al., 2019). Literature has shown that long-lasting ITNs), rapid diagnostic tests, and ACTs have proven to be effective malaria prevention tools. Moreover, the WHO Global Malarial Eradication Program of 1955, which relied heavily on vector control such as IRS and systematic detection and treatment of cases, was successful in eradicating malaria in 37 of the 143 countries where it was endemic in 1950 (Shretta et al., 2017). However, the withdrawal of funds from malaria elimination

programs to focus on control programs led to a global resurgence of the disease during the 1970s and 1980s and a complete reversal of progress in some countries, such as Sri Lanka and Pakistan (Shretta et al., 2017). Therefore, a professional practice should not only return to elimination focus instead of control focus but must also maintain vigilance and sustain investments during elimination efforts.

This study revealed a strong association between the source of antimalarials, bed net usage, and malaria prevalence. Therefore, specific health measures to reduce or eliminate malaria should focus on standardizing the quality of antimalarials across different venues and the availability and accessibility of mosquito bed net to households with under-five children. The Niger government should ensure children under-5 years old have quality antimalarials and bed net by subsidizing the cost of malaria treatments and providing the public with free, good quality antimalarials and bed nets.

Moreover, communities should multiply efforts to eliminate stagnant waters and maintain cleanliness to eliminate malaria vectors. A clean environment helps fight many diseases and improve society's health overall. Findings from this study will help implement tailored interventions to fight malaria among the vulnerable under-5 children in Niger but could also help neighboring countries by adopting the same recommendations. This study's findings will be shared with the Ministry of Health of Niger. These efforts are likely to bring about social change.

Conclusion

Malaria continues to be a public health concern in Niger and is endemic in most regions, costing countless lives among under-five children yearly in Niger despite

multitudes of efforts. Several research studies have proven that quality ACTs and bed nets contribute largely to malaria prevention and control. This study did not find an association between ACTs and malaria prevalence measured by anemia level. This discrepancy may be due to the emerging drug-resistant parasites to the drug artemether, the principal antimalarial drug agent (Dini et al., 2018). However, the study did find an association between the source of antimalarials, bed net usage, and malaria prevalence. Studies have shown that most people resort to unorthodox malaria treatments because of cost and access issues. Additionally, although bed nets were proven effective in preventing malaria, studies have shown that they may not be used for the intended purpose, such as their use as fishnets in fishery.

It is not known why malaria continues to be endemic in Niger despite the evidence-based treatments and control modalities available. A strong recommendation is to subsidize the costs of ACTs and ITNs to allow the vulnerable population free and easy access to these evidence-based malaria treatment tools. The government should also maintain strict control on the quality of ACTs by standardizing the quality requirements across different venues. Moreover, the government should adopt a malaria elimination mindset as the WHO's Global Technical Strategy initiatives recommended. The best recommendation for the Niger government is to develop the economy. Providing free bed nets is just a temporary solution in the interim because development does not happen overnight. A sustainable development is the simple most reassurance to fight diseases like malaria. To fully understand health-seeking behaviors in Niger, future studies should assess the history of treatment-seeking behaviors for many other diseases, using

qualitative studies that can provide in-depth information on health and treatment-seeking choices in study communities. Finally, malaria elimination efforts should be generalized to extend to Africa. There is no reason for one part of the world to be malaria-free while it is endemic in another part. In the wake of globalization, a public health concern in one country is an issue for another as it is only a matter of time until it crosses over. The current covid-19 pandemic and the past Ebola pandemic are great examples of how diseases can cross borders easily at an alarming rate. Therefore, governments and private sectors must remain vigilant and multiply financial efforts on malaria elimination worldwide.

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Appendix: Permission to Use Data

Dear Aissa Yaye Habi:
This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Public health doctoral":

Benin, Burkina Faso, Chad, Cote d'Ivoire, Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Nigeria (Ondo State), Senegal, Sierra Leone, Togo

To access the datasets, please login at: [redacted]. The username is the registered email 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 to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional 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 or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration 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 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. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: [redacted]

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: [redacted].

Sincerely,
Bridgette Wellington
Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program