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Exposure to Malaria Awareness Messages and Preventive Health Behaviors Among Informal Workers in Ghana

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Abstract

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by

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MPH, Texas A&M University, 2016

BS, Stephen F. Austin State University, 2013

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Malaria is a global health issue that is most prevalent in Sub-Saharan countries such as Ghana. In the past, various studies have examined the use of malaria messages and malaria prevalence; however, very few Ghanaian studies focus explicitly on using various types of malaria-related messaging modalities and the impact of these messaging systems on lessening malaria contraction among the informal sectors. The aim of this study was to analyze the relationship between exposure to malaria awareness messages, place of residence, and preventive health behaviors controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers. This study used descriptive and inferential quantitative statistics to describe the sample and predict the population with secondary data from the 2014 Ghana Demographic Health Survey through the lens of the health belief model to understand the causal relationship between the dependent and independent variables. A binomial logistic regression (N=7650) was used to analyze the data. The results revealed that there was no significant relationship between exposure to malaria messages and preventive health behavior after controlling for the covariates (sex, occupation, marital status, and educational level). However, there was a significant relationship between place of residence and preventive health behavior after controlling for covariates. The positive social change implication was that this study may improve public health and other health professionals' information communication and identify other strategies that strengthens understanding and importance of malaria message. It can likely bring about behavioral change and healthier practices regarding malaria prevention in Ghana's informal sector.

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Dedication

This dissertation is dedicated to all the informal workers especially in Ghana, who are most at risk for the greatest burdens of the malaria disease each day. I also dedicate this dissertation to my parents Mr. Augustus L. Larkai and Mrs. Regina K. Larkai, my entire family, and friends for their greatest support through this academic journey.

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Section 1: Foundation of the Study and Literature Review

Introduction

In Ghana, malaria is a critical public health concern and a leading cause of morbidity and mortality among the population. Globally, nearly 1.2 billion people were at high risk for contracting malaria in 2015 (Adu-Prah & Kofi Tetteh, 2015). In 2016, there was an estimated global increase to 216 million malaria cases and 445,000 malaria deaths. These numbers reflect an estimated increase of 5 million cases from the previous year (Bahk et al., 2018; World Health Organization, 2017). Sub-Saharan African countries, including Ghana, carry the world's highest burden of malaria cases and deaths. This burden is notable among children under the age of five years. Children under age five are the most vulnerable, accounting for an estimated 78% of malaria deaths. Historically, malaria transmission has been high among children and pregnant women; however, recent studies have shown an increased burden among informal workers in high-risk countries, including Ghana. An informal worker is an individual who migrates to the cities for work and has little to no formal education, skill, and abilities to obtain formal employment (Diallo et al.,2017). This increased burden among informal workers in malaria cases may depend on many factors, including the year, season, climate, geographic region, socioeconomic status, education level, and occupation (World Health Organization, 2016). The critical public health concern of increasing malaria infections in Ghana warrants investigation into the reactionary and tactile malaria interventions to determine their effectiveness and ineffectiveness.

Historically, Ghana is one of the few West African countries to implement a program to diminish malaria contraction among its population. Ghana is in the malaria control phase by the global malaria elimination program (World Health Organization, 2016). Malaria control is an effort to reduce malaria transmission to a level where it is no longer considered a public health issue (Center for Disease Control and Prevention, 2018). Therefore, to decrease the malaria burden in Ghana by 75 %, the National Malaria Control Program (NMCP) in Ghana developed a strategic plan. The goal of this plan was to enhance prevention efforts; improve access to timely and practical treatment; improve monitoring; evaluation; and operational research efforts to restore health systems at all levels, and create a sustainable partnership with department agencies, government sectors, programs within and outside of the health sector, NGOs, private and informal sectors (Ghana Statistical Service [GSS] et al., 2015). These partnerships paved the way to introduce methods and interventions to reduce the spread of malaria in Ghana.

Other interventions that dated back to the pre-independence era include monotherapies or medications that target the parasite in the human host, such as Chloroquine, amodiaquine-pyrimethamine, lapdrine, and primaquine. Chloroquine was one of the main medications used to treat malaria diagnoses until reports indicated widespread parasite resistance (Awine et al., 2017). Because of the parasite resistance in Chloroquine and the other medications, there was a recommendation for policy change in treatment and prevention efforts.

Thereby, government health officials worked with organizations like The Global Fund to Fight AIDS, Tuberculosis (TB), and Malaria; The US President's malaria

initiative (PMI); and the World Bank to find a new approach to decreasing malaria cases in Ghana. One of the programs that developed from the aid of these organizations is the distribution of approximately 2.4 million insecticides treated nets (ITNs) to Ghanaian households, which covered about 30% of the Ghanaian households owning an insecticide net (Owusu Adjah & Panayiotou, 2014). Although the number of ITN owners are much lower than the total households in Ghana, the Ministry of Health (MOH) and various Nongovernment Organizations (NGOs) aimed at promoting the usage of ITNs through communication strategies such as malaria-related messaging. These communication strategies included different malaria messaging modalities, including in-person, on paper such as billboards or pamphlets, and technologically through television, radio, and even text messaging. However, despite these efforts, there has been limited research on informal workers' exposure to different types of malaria messaging and the impact of these strategies on their behavior.

This study addressed the relationship between exposure to malaria awareness messages (electronic mode, print media, word of mouth), place of residence (rural or urban), and preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under a long-lasting insecticide net [LLTN]), controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers.

Problem Statement

Malaria is a global public health issue that impacts people of all age groups and ethnicities. Malaria remains the leading cause of morbidity and mortality in Sub-Saharan

Africa (SSA; N. Diallo et al., 2017; Snow, 2015). Howes et al. (2015) and Benelli et al. (2016) explained that malaria spreads by infection with protozoan parasites of the *Plasmodium* species. The *Plasmodium falciparum* is a parasite responsible for malaria-related illnesses usually transmitted through the bite of infected mosquitoes. *Plasmodium falciparum* has been associated with almost every malaria death and is the malaria species' most common and critical strain (Snow, 2015). In addition, nonspecific symptoms may present among individuals infected by malaria, including chills, rigors, and fever (Snow, 2015). Grabias et al. (2019) revealed that malaria was responsible for approximately 445,000 deaths in 2016, mainly among young children in SSA. In 2015, an estimated 212 million new malaria cases occurred worldwide, with about 905 in the African region malaria cases (World Health Organization, 2017). The World Health Organization (2016, 2017) has indicated that malaria is responsible for approximately 1,800 admissions a year in the Ghana health care system and 10 deaths for every 100,000 residents in Ghana.

Although pregnant women and children under the age of five are most at risk of contracting malaria, the informal sector has an even higher risk of disease transmission (Grabias et al., 2019). The informal sector comprises self-employed people, such as farmers, head porters (also known as kayayei in Ghana), truck drivers, and others. The informal sector makes up more than 80% of Ghana's working population, and these individuals lack general legal and social protection and work under precarious working conditions (Adzawla et al., 2015; Akazili et al., 2018). These working conditions adversely affect welfare and access to needed health services (Akazili et al., 2018). In a

study of exposure to occupational injuries and disease among the informal sector in Ghana, survey responses indicated that malaria accounted for 72% of the self-reported occupation disease. Adei et al. (2021) showed that the high malaria case rate among respondents was not surprising because their work environment is breeding mosquitoes. However, the researchers also found that informal workers could contract malaria outside their working environment (Adei et al., 2021). Therefore, although the working environment can contribute to malaria contraction among informal workers in Ghana, other factors such as place of residence can also influence transmissions.

Additionally, the high migration rate and rapid population growth in big cities and towns in SSA countries like Ghana have led to severe overcrowding and high unemployment rates (Diallo et al., 2017). Most of these migrants within Ghana work in the informal sector. According to the Urbanization Report from World Bank (2015), the urban population in Ghana has more than tripled with a rise from 4 million to approximately 14 million people over the last three decades. This overcrowding and high unemployment have people who lack accommodations to work casually on the street or sleep in open areas at night. These situations increase their risk of contracting malaria.

Other characteristics such as sociocultural context, economic activities, accessibility to health services, access to antimalarials, service availability and readiness, behavioral constraints, language barriers, and access to safe water and sanitation also put some migrants and informal workers at risk malaria infection. This is also due to the emergence of drug-resistant strains, activities for social mobilization, and ecology (Diallo et al., 2017; Wai et al., 2014). Therefore, it is imperative to consider all the factors

contributing to high transmission among informal workers, especially in an intervention's planning and implementation stage.

Message dissemination is an essential practice in public health because it can increase awareness among individuals and groups. In this research, I examined malaria message dissemination to address the increased risk of the disease in the informal workers' inconsistent place of residence in rural or urban areas. Chen et al. (2019) suggested that structural barriers like limited exposure to media and shortage of or lacking access to doctors' offices may account for malaria-related behavioral differences between urban and rural residents. The researchers studied a community called Godokpe, located in the Ho, the Volta region in Ghana, with 46.7% in urban localities and 53.3% in rural areas. Diema Konlan et al.'s (2019) results showed that some variations exist in knowledge levels and care-seeking for malaria treatment based on residence, which shows that individuals in rural areas are more likely to have insufficient knowledge and care-seeking for malaria.

Additionally, understanding how exposure to malaria messages varies among groups based on residence (urban versus rural) can help public health practitioners determine the most effective way to reach their target audience. For example, in a study conducted in eight SSA countries, Yaya et al. (2018) assessed the influence of mass media exposure delivered through posters, radio, and community health workers and its impact on adult women's malaria prevention behavior. The study results revealed a potential relationship between receiving malaria information through mass media (television, radio, billboard, etc.) and the increased use of ITN in SSA (Yaya et al., 2018).

Therefore, public health professionals must evaluate the effectiveness of message dissemination by considering the audience, source, and channel for prevention messages.

Economically, malaria contraction among the informal workforce in Ghana is a significant public health issue because of its ability to significantly lower productivity. Because informal workers make up over 90% of Ghana's workforce, contracting malaria may cause poor attendance and possibly reduce productivity leading to a shortage in goods and services within the city or community (Boateng et al., 2017; GSS et al., 2015). Statistics from the GSS (2015) indicate that approximately 45% of the economically productive population work in agriculture, and 41% provide services. Most of the informal sector in Ghana is self-employed (GSS et al., 2015). Given the significant effect of malaria contraction among informal workers on Ghana’s productivity, malaria awareness messaging campaigns have become even more essential. Research is needed in the various technology or mass media outlets such as radio, television, billboard to understand the influence the multiple modes of communication have on health behaviors to reduce malaria contraction among informal workers in Ghana.

In addition, researchers have found links between education or higher schooling levels and better health and health behaviors (Li & Powdthavee, 2015). Education can induce more practical use of health information by enhancing decision-making skills and promoting the allocative performance and an individual's capacity to obtain and process health information (Li and Powdthavee, 2015). Understanding how educational level and modes of receiving malaria messages can affect behavior performance can help identify methods to improve the informal workforce's health to avoid lowered productivity.

There are currently several gaps in the literature related to malaria contraction among the informal sector in Ghana. Most malaria-related studies conducted within the last 5 years in Ghana have focused on the high risk of contracting malaria solely among children under 5 years and pregnant women (GSS et al., 2015). Although children are considered most at risk, other populations such as the informal sector in Ghana are also at high risk due to their social circumstances (Diallo et al., 2017; Evans Otieku et al., 2017; Nyarko & Tahiru, 2018). Researchers have yet to conduct many studies concerning the informal sector and their susceptibility to malaria contraction. Based on research, no current studies have been conducted that target potential intervention to reduce malaria contraction, specifically among Ghana's informal sector. Additionally, few Ghana studies have been focused explicitly on using malaria-related messages through various communication systems and their impact on lessening malaria contraction among the informal sector (Mohammed et al., 2019; Yaya et al., 2018).

Because there is limited research among Ghana's informal sector, this research can bring awareness of how to best intervene, primarily through various communication modes, to reduce malaria contraction among Ghana's informal sector. Additionally, this study's results may help improve preventive health behaviors by assessing the impact of malaria-related messages through outlets such as computers, television, radio, magazines, newspapers, and others. Gaps exist in the literature, including issues of accuracy in the data collection methods among the informal worker population like the head porters (*kayayei*) in Ghana; thus, conducting a study on this topic can bring about awareness on

how to reduce the contraction of malaria and encourage preventive health behaviors among this population in Ghana.

Purpose of the Study

The study aim was to examine the relationship between exposure to malaria awareness messages (electronic mode, print media, word of mouth), place of residence (rural or urban), and preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under a LLTN), controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers. The independent variables are exposure to malaria messages and place of residence. The dependent variables are preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under a LLTN. The covariates are sex, occupation group (e.g., agriculture, sales, etc.), marital status, and educational level. Thus, a quantitative approach was used to analyze the relationship between independent and dependent variables. In addition, this study identified the gaps and limitations in current literature among the Ghanaian informal workforce because there is currently little to no literature that addresses the relationship between exposure to malaria awareness messages, place of residence, and preventive health behaviors.

This study also presented a unique opportunity to address a global public health issue and shed light on the under-studied problems related to malaria's level of influence among the working population in Ghana. Additionally, the results of this study may help identify an efficient way to increase malaria awareness while diminishing malaria contraction among the Ghanaian workforce based on their residence.

Research Question and Hypothesis

This research examined the relationship between exposure to malaria awareness messages (electronic mode, print media, word of mouth), place of residence (rural or urban), and preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under a LLTN), controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers. I also examined the relationship between the demographic characteristics: sex, education level, marital status, and occupation group. Lastly, logistic regression analysis was used to predict the likelihood of Ghanaian informal workers engaging in preventive health behavior by analyzing the odds ratio of respondents participating in preventive health behaviors through their yes and no response and demographic characteristics retrieved from the 2014 GHS survey. The research questions and hypotheses are as follows:

Research Question 1 (RQ1): What is the relationship between exposure to malaria awareness messages (electronic mode, print media, word of mouth), place of residence (rural or urban), and preventive health behaviors (spraying dwelling in 12 months, sleeping ITN, and sleeping under an LLTN) controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers?

$H_0$1: There is no relationship between exposure to malaria awareness messages and preventive health behaviors controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers.

H_a1: There is a relationship between exposure to malaria awareness messages and preventive health behaviors, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers

Research Question 2 (RQ2): What is the relationship between place of residence (rural or urban) and preventive health behaviors controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers?

$H_0 2$: There is no relationship between place of residence and preventive health behaviors, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers.

$H_a 2$: There is a relationship between place of residence and preventive health behaviors, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers.

Theoretical Foundation for the Study

The use of the framework is one of the essential guides researchers use in public health to develop programs and interventions to enhance health behaviors or health problems. In this study, the health belief model (HBM) is the framework that best aligns with the research topic. The HBM examines the relationship between exposure to malaria awareness messages, place of residence, and preventive health behavior—at the same time, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers. The HBM has been a guiding framework in health-related behaviors and intervention since the 1950s. The intention behind the development of the HBM was to elaborate on when and why people participate in behaviors and programs to

prevent and identify a disease (Ahadzadeh et al., 2015; Glanz et al., 2015; Hochbaum et al., 1952). According to Glanz et al. (2015), HBM has become one of the most extensively employed frameworks in research today, foretelling whether people will detect, prevent, or manage sickness and why. The initial four constructs were perceived susceptibility, severity, benefits, and barriers to engaging in a behavior. Rosenstock et al. (1988) added the last two additional constructs, and they cue to action and self-efficacy (Glanz et al., 2015). Overall, the HBM indicates that a person is likely to partake in health behavior based on the following six assumptions: (a) perceived susceptibility: if the individual is deemed at risk for a disease or condition; (b) perceived severity: the possible seriousness of the illness and its outcome; (c) perceived benefits: the course of action available could be a potential benefit in diminishing their susceptibility to or their severity of disease; (d) barriers in engaging in a behavior; evaluation of the benefits of taking action, (e) cue to action: when a person feels like their practical barriers outweigh the benefit and are not strong enough to prevent action, (f) self-efficacy: confidence in a person performing a behavior (Glanz et al., 2015).

The theoretical framework of HBM can be used in research studies through each of the constructs. For instance, the concept of perceived susceptibility helps a researcher address the attitude and beliefs of a person and their probability of acting against disease contraction. This study used HBM to examine the assumptions about modifying behaviors related to malaria contraction among Ghana's informal workers. The perceived severity construct determined whether informal workers in Ghana consider potential malaria contraction a severe concern. Additionally, the construct of perceived threat

helped me consider the workers' understanding of the likelihood of malaria contraction. For example, an informal worker with little to no knowledge about malaria may not consider mosquito bites a sufficient threat to their health because they may have had many been bitten several times by mosquitoes and had no serious health problems prior. Therefore, using the HBM indicates that these informal workers will not perceive malaria contraction as a threat. The perceived benefits in this study examined the use of mosquito nets, spraying of dwellings, and repellent to reduce malaria contraction based on the informal workers' survey responses. For example, in the 2014 GHS survey, the participants were asked if they ever slept under ITNs, LLTNs, or sprayed their dwelling. The participants who responded yes to any of the options were likely to see the benefits of taking action to prevent themselves from malaria contraction. Partaking in these actions can improve their ability to continue working with good health while weighing in on the possible hindrance to malaria prevention. According to Ahadzadeh et al. (2015), a person with a higher perceived health risk has a more prominent impulse to modify their health behavior related to that risk choosing and engaging in health behaviors to reduce their risk by gathering and utilizing preventive measures. These measures include accessing communication channels, such as television, radio, computers, the internet, pamphlets, newspapers, and community health workers to fulfill health-related information and communication needs (Ahadzadeh et al., 2015).

The last two concepts, HBM, are cues to action and self-efficacy. In this study, the cues to action addressed the informal workers' exposure to malaria awareness messages through various communication modes and the influence on whether

individuals have taken action to prevent disease contraction. The construct of self-efficacy allowed me to evaluate whether a person has confidence in their ability to prevent malaria contraction (Glanz et al., 2015).

For the concept of perceived susceptibility, I considered the attitude and beliefs of informal workers and their probability of taking action against disease contraction. I used HBM to examine workers' assumptions about modifying their behaviors related to the perception of contracting malaria. Similarly, I considered the severity by examining the relationship of informal workers who received a message about malaria prevention and then participated in preventive action through self-efficacy. This action addresses an individual's belief that spraying the dwelling and sleeping under a treated net may help prevent malaria. Therefore, taking action to avert malaria contraction is perceived as a threat to livelihood. For the concept of perceived benefits, I considered the beliefs and perspectives of the informal workers when it comes to spraying their dwelling or using a treated net. Finally, I also addressed the cues of action by showing how a person's residence may affect receiving malaria prevention messages through various modes of communication.

Using the HBM, I addressed the literature gap by identifying the most effective communication method in promoting preventive behavior change among Ghanaian informal workers based on where they reside. Thereby, the application of the HBM in this research may enable a more profound understanding of how specific complex determinants interact and drive the ultimate decision on the course of action to take

regarding malaria prevention. Thus, the model could help identify the perceived benefits and barriers among informal workers in Ghana and malaria contraction.

Nature of the Study

The nature of this study is a mix of a descriptive and inferential quantitative research study with a cross-sectional design to examine the relationship of the dependent variable, preventive health behavior, and the independent variables, exposure to malaria messaging, and the place of residence, respectively. The quantitative research approach examined the secondary data retrieved from the 2014 GDHS dataset. Additionally, the statistical method for the study was a logistic regression. Logistic regression determined malaria's probability of malaria prevention through exposure to malaria awareness messages while controlling for other variables informed by the HBM. The quantitative analysis aided in identifying the influence of the relationship between each variable. Malaria messaging and residence are the independent variable for the research question, while the dependent variable is preventive health behaviors. The study's covariates variables include sex, education, occupation grouped, and Ghana's informal workers' marital status. With these variables, I analyzed the relationship between the Yes/No responses to malaria awareness messages among the covariates to examine whether the variables are associated with delivering messages. The study's research question also assessed how the workers' place of residence affects exposure to malaria awareness messages.

Literature Search Strategy

The selected articles relate to understanding the relationship between exposure to malaria messages and preventive health behaviors related to malaria contraction among Ghana's informal workers. Therefore, I used MEDLINE, CINAHL, Google Scholar, PsycInfo, and ScienceDirect to identify articles supporting the research. I used the keywords and keyword combinations: *malaria* and *Ghana, informal/mobile population* and *malaria* and *Ghana, kayayei, head porters* and *Ghana, healthcare,* and *malaria* and *Ghana, preventive health behavior* and *malaria, informal workforce* and *malaria* and *Ghana, economy* and *malaria* and *Ghana,* and *level of education* and *malaria, socio-demographic* and *malaria,* and *geography* and *climate* and *malaria*. The search also utilized the "gold box search" on the Health Sciences under the Walden University Library research page to find relevant and specific information to the research topic. The additional phrases and terms used in the gold box included *Ghana* and *malaria* and *technology, cell phone* and *malaria, radio* and *malaria, television,* and *malaria*. After running the searches, I applied the following limits to narrow down the most relevant literature by choosing only to review peer-reviewed scholarly journals only, published between 2015 to 2020. To further gather relevant data, I used other websites such as World Health Organization (WHO) to get background information on malaria through the WHO Malaria page, World Malaria Report 2018, High-Risk Groups, and Ghana country profile.

The literature review search helped identify the gaps in existing research regarding malaria messaging and preventive health behaviors in Ghana among informal

workers. Although multiple authors have conducted reviews of the literature on this topic, my study demonstrates that there is still some underlying demand for future investigation to understand better those determinants that influence malaria messaging and health behaviors. Therefore, this review can provide background on the need for this study and the research topic to surveying and suggest improvements to reduce malaria contraction, especially among informal workers in Ghana.

Literature Review Related to Key Variables and/or Concepts

Geography, Climate, and Malaria in Ghana

Ghana is one of the Sub-Saharan African (SSA) countries with a principal determinant of morbidity and mortality due to malaria contraction, especially amongst children under 5 years old (Nyarko & Cobblah, 2014). Geographically, Ghana is in the western part of Africa, close to the world's center, with the Greenwich Meridian crossing. Ghana borders Burkina Faso, Cote d'Ivoire', Togo, and the south's coastline bordered by the Gulf of Guinea (Arab et al., 2014; Adu-Prah & Kofi Tetteh, 2015). Like various malaria-endemic countries in SSA, malaria contraction in Ghana is exceptionally complicated; it is impacted spatially and temporally (Arab et al., 2014; Adu-Prah & Tetteh, 2015). According to Awine et al. (2017), there is a relationship between malaria transmission to climate change, altitude, topography, land use/human settlement, and other environmental factors. These factors overwhelmingly impact the mosquito as the malaria vector, including the presence of the parasite and transmission patterns.

In all ten geographic regions of Ghana, studies indicate that malaria prevalence and risk differ extensively according to the area, season, and year. There are two distinct

seasons, which include dry and rainy (Adu-Prah & Tetteh, 2015). Malaria transmission is problematic and changes simultaneously along the various ecological zones in conjunction with the seasons. During the wet seasons between June and October in Ghana, the parasite is highly prevalent, especially in the northern savannah. (Nkrumah et al., 2014; Awine et al., 2017). The malaria parasite peaks twice a year in forest and coastal ecological regions (Awine et al., 2017; Nkrumah et al., 2014). Due to the geographic landscape, different climate conditions, and water bodies present, these places become desirable as procreating localities for the vectors (Awine et al., 2017). The two main vectors that drive malaria transmission in Ghana include Anopheles gambiae (sensu lato) and Anopheles funestus; they are significantly visible during the rainy season (Yankson & Gough, 2019). The southern region of Ghana, located near the coastal and forest ecological zones, usually has malaria transmission almost yearly. In contrast, the northern part of Ghana frequently endures seasonal transmission more prevalent during the wet season (Yankson et al., 2019). The increased visibility in these parasites can cause a surge of malaria transmission during the rainy season; therefore, it is imperative to address these factors to decrease seasonal malaria transmission.

Other factors that influence malaria transmission include space and time, as it presents notable changes and is essential in outlining and evaluating malaria interventions (Adu-Prah & Tetteh, 2015). Studies have also associated climate variables like temperature, rainfall, contingent humidity, and wind speed due to malaria distribution (Adu-Prah & Tetteh, 2015; Yankson et al., 2019). The climate variables explain the timely identification of locations requiring targeted interventions to optimize resource-

limited resource usage (Yankson et al., 2019). Therefore, to diminish malaria transmission in Ghana, public health practitioners and stakeholders must understand and recognize factors that influence malaria prevalence in these regions.

Informal/ Mobile Population and Malaria

Like many SSA countries, Ghana is enduring rapid population growth and urbanization with high migration rates into the cities and large towns, creating unemployment and overcrowding (Diallo et al., 2017). Most of the migrants in SSA, including Ghana, are known as the mobile or informal population. The informal community comprises nonresidents of cities who casually move around in the cities, performing unskilled jobs such as hawking or head porting, and sleeping in open spaces at night (Diallo et al.,2017). In Ghana's informal sector, individuals include hawkers, long-distance truck drivers, kayayei (head porters), and agriculture workers. Moreover, most migrants to the major cities in Ghana search for financial security (Nyarko & Tahiru, 2018). For example, the kaya business, or head portage, is most popular among girls and women among the informal population. "Kayayoo or Kayayei" is a term used to define a woman who carries a head load of goods on her head for a charge. The word comes from two languages commonly spoken in Ghana, Hausa and Ga. "Kaya" in Hausa translates as produce or goods. Simultaneously, the term "yoo" in Ga denotes women (Boateng et al., 2017). Most female informal workers who participate in the kaya business are between 10 and 35 years with limited or no prescribed education (Nyarko & Tahiru 2018). Agriculture is the leading occupation among men in the informal sector (GSS et al., 2015). Due to the lack of skilled abilities among the informal sector,

receiving formal employment can be difficult for these women or the informal population. Hence, most engage in unskilled jobs like Kaya and agriculture to have an opportunity to gain income.

Researchers have linked a high risk of malaria contraction among informal workers due to their sociocultural circumstances, economic activities, harsh living situations, and access to health services (Diallo et al., 2017). This is because the informal sector in Ghana lacks materials that protect against mosquitoes, such as long-lasting and insecticide-treated bed nets (Diallo et al., 2017). In addition, among the informal worker in Ghana, kayayei are known to have high numbers who reside and sleep in unsanitary areas that expose them to various health issues, including malaria. For example, Diallo et al. (2017) indicated that most head porters sleep in wooden tents or makeshift structures that they build and are shared with other head porters most of the time. However, further research reports that the head porter sleeps outside the tent structures and keeps belongings like clothes, money, and cooking pans inside (Nyarko and Tahiru, 2018). Either way, living in these conditions can be detrimental to a person's health; therefore, understanding the circumstances in which some informal workers live can assist with developing messages and methods to improve health behaviors.

Most of the informal workers in Ghana have little to no education. Sometimes, they may hear or receive messages but cannot comprehend or understand the message due to barriers in language. Because Ghana is a country with over 100 dialects, language becomes a barrier that can negatively impact a person's ability to access antimalarial practices projecting a rise in health issues. Nyarko and Tahiru (2018) reported that head

porters in Accra, Ghana, on malaria and health, in general, were unaware of health risks based on their living conditions. Respondents in the survey vocalized that although they recognize the possible health risk that may arise from overcrowding in one room, they are not familiar with symptoms that come with the various diseases (Nyarko &Tahiru. 2018). This information is an essential part of understanding factors contributing to malaria cases among informal workers. It addresses the lack of knowledge and literacy in health and the importance of education.

Healthcare and Informal Sector in Ghana

Health and access to healthcare play an integral role in malaria in Ghana. Several interventions have been implemented over the years to reduce the gap of access. As a result, the burden of malaria transmission in Ghana and the country has achieved some distinctive signs of progress in diminishing the prevalence of diseases connected with malaria and financial barriers (Alhassan et al., 2016). However, few barriers remain, such as limited health care access and ensuring healthcare cost-effectiveness. Like most Sub-Saharan African countries, Ghana's healthcare cost is a direct out-of-pocket expense payment system. Therefore, in hopes of improving the healthcare system, Ghana introduced the National Health Insurance Scheme (NHIS) in 2003 to expand access to quality healthcare services (Fenny et al., 2015; Nsiah-Boateng et al., 2017). The NHIS replaces a "cash-and-carry system" in Ghana that requires payment before services administration to patients. It also aimed to grant primary health care to all citizens, and about 95% of the NHIS coverage is for diseases, including malaria and cholera (Lattof et al., 2018). Although the scheme aims to reach all Ghanaians, studies indicate a link

between NHIS membership and urban Ghanaian residents with higher educational achievement and higher socio-economic levels than the less educated and rural residents (Akazili et al., 2014; Lattof, 2018). Therefore, it is imperative to understand that although the NHIS is available to all citizens, the accessibility and benefits are the same among Ghanaian residents based on variables like education, place of residents, and socio-economic status.

Conversely, people in the informal sector report various barriers that impact the utilization and enrollment in the NHIS; these factors include geographical access to facilities, the coverage and cost of the health insurance, and the provider (Simon et al., 2017). In addition to, lack of renewal by forgetting a card when migrating, losing insurance cards in fires, fleeing abusive partners, theft, or floods (Lattof et al., 2018). The NHIS also requires the informal sector, adults over the age of 18 and under 71 years, to pay an annual minimum premium of GH¢7.2 (US$4.8) because they do not contribute to the social security scheme. Therefore, although most informal workers can initially enroll in the plan, keeping up with enrollment and premium payment can cause them to lose their benefits altogether.

Overall, the NHIS coverage is not assuring because only 34% of the population had valid membership cards at the end of 2012, and the total range is below 40% of the people in Ghana (Dalaba et al., 2014; Fenny et al., 2015). Furthermore, the unsatisfactory renewal of the NHIS membership among informal workers, such as the head porters, reported that the wait time to renew membership is long, hence why they don’t renew membership. This is also because most of the drugs prescribed to the informal workers

are too expensive, and the NHIS does not fully cover costs after seeing a physician (Nsiah-Boateng et al., 2017). Therefore, due to the lack of insurance, access, and affordability in healthcare or visitation to the doctor's office, most informal workers seek care from drug stores that are likely to be unlicensed chemical shops or prescription drugs from drug peddlers are not authorized to provide prescriptions. At times, most informal workers self-prescribe their medication based on these unlicensed drug peddlers (Fenny et al., 2015; Nyarko & Tahiru. 2018). Therefore, in addressing access to health among informal workers in Ghana, it is imperative to understand the two main determinants of care-seeking behavior: insurance status and travel to a health facility. These factors significantly impact the informal workers and aspects that hinder access to healthcare.

Malaria Prevention Efforts

Over the years, Ghana successfully reduced malaria prevalence by 32%, from 237 cases per 1000 population to 161 per 1000 population at risk, between 2016 to 2019. However, there is still a gap in research on handling the prevention methods (Tizifa et al., 2018; WHO, 2019). In Ghana, malaria prevention efforts date back to the pre-independence era with interventions that concentrated on two areas: the host of the parasite or the vector and medication such as trimaquine, lapudrine, and chloroquine (Awine et al., 2017). These medicines were actively used to prevent malaria until other preventive methods were discovered, such as mosquito nets and residual sprays.

The insecticide-treated nets (ITNs) and indoor residual spraying (IRS) are two of Ghana's essential strategies for reducing malaria contraction. These two control methods serve as central vector control interventions for large-scale malaria prevention (Monroe et

al., 2015). The ITNs, which include long-lasting insecticide nets (LLINs), are among the efforts described as the most promising intervention to guard people by administering physical and insecticidal obstruction, decreasing possible mosquito contracts on humans (Nyavor et al., 2017; WHO, 2020). The ITNs have aided in reducing malaria occurrences by 48-50% and, if used universally, can prevent approximately 7% of global under-five mortality (Nyavor et al.,2017). The other vector strategy used to reduce malaria transmission is indoor residual spraying (IRS). The IRS involves diffusing the inside of housing constructions with an insecticide with prolonged residual activity, and this action usually occurs about once or twice per year. WHO (2020) reported a global decline from 5% to 3% from 2010 to 2017 using IRS across all WHO regions. Therefore, there is a likelihood that using these vector-targeted methods may help in reducing malaria contraction.

Preventive Health Behavior, Education and Malaria

As malaria continues as a public health issue in Ghana, it is imperative to understand individuals' and families' preventive health behaviors to protect themselves from daily mosquito bites. Preventive health behavior is any action initiated by a person who considers himself (or herself) healthy to prevent or recognize sickness in an asymptomatic state (Glanz et al., 2015). One of the factors that have been associated with preventive health behavior with regards to malaria is education. Polec et al., 2015 revealed that educational interventions observing ITNs use attested that education improves the number of adults and children using ITNs compared to adults with no education.

Another strategy that is still relative to the education strategy in reducing mindset malaria-related stigmas and increasing preventive health behavior is behavior change communication. Behavior communication change encourages families to use their ITNs, care for them regularly, and repair them (Tizifa et al., 2018). Although there are strategies to improve preventive health behavior for malaria, Nyavor et al. (2017) affirm that owning an ITN may not translate into usage as usage does not appear near universal. Most studies report usage rates in the range of 60-80%, although the World Malaria report documented 90% use (Nyavor et al., 2017). Thus, understanding the reason behavioral change does not translate into ITN usage can improve the use of ITNs and decrease malaria transmission.

Education and Informal Sector in Ghana

The formal education system in Ghana was first introduced in the eighteenth century by the missionaries. Although most people acknowledged the significance of formal education, it was not compulsory before Ghana's independence in 1957 (Ametepee & Anastasiou, 2015). In the 1960s, the Ghana Education system provided an opportunity for the parents or households who wanted formal education and introduced a free mandatory primary school education for each child in Ghana, quickly expanding to secondary and tertiary education. The education system comprises a primary school for six years, a junior secondary for three years, a senior secondary school for an additional three years, and tertiary education, consisting of four or more years (Ametepee & Anastasiou, 2015; Gyimah-Brempong & Asiedu, 2015). Children are usually not required to enroll in kindergarten before entering grade one. The reason for not requiring

enrollment is because private entities regularly own most of the kindergarten schools; therefore, parents enroll their children themselves (Gyimah-Brempong & Asiedu, 2015). As the country evolved, the system grew; this growth has developed into Ghana's private and public schools today. Free public-school education has dominated the rural areas while private schools are evenly balanced in the urban areas mainly located in the Southern parts of Ghana (Gyimah-Brempong & Asiedu, 2015).

In most Ghana, the primary and Junior Secondary Schools (JSS) are usually tuition-free. The parents are required to pay the cost of everything else, such as uniforms, books, transportation, etc. These required costs are sometimes too expensive for parents with low socioeconomic status; therefore, additional expenses discourage them from enrolling their children in school (Gyimah-Brempong & Asiedu 2015. Additionally, when the children complete their JSS education, tuition and room boarding expenses are required to obtain admission in Senior Secondary School (SSS) to expect these students to live on campus. Due to these additional boarding costs, most parents cannot meet the requirement, and therefore, children miss out on their SSS education (Alhassan et al., 2016).

The introduction of a formal education system in Ghana heavily focused on male education. Most households believed that girls should only become better wives to their educated counterparts, making educating girls a waste of family resources (Alhassan et al., 2016). Unfortunately, this notion still stands and continues through the current century, especially in the rural areas, including most places in the Northern regions of Ghana, and is reflected in the adult and migrant population's educational fulfillment in

Ghana (Alhassan et al., 2016). Due to the lack of education among females in the rural areas when they migrate to the Southern parts of Ghana, they work in unskilled areas within the informal sector in Ghana (Alhassan et al., 2016). In understanding the influence of schooling among informal workers, a survey conducted by the Ghana Federation of the Urban Poor of Kayayei revealed that over 90% of migrants did not take advantage of free education nor receive any formal education (Boateng, 2018). Some of the head porters surveyed indicated that they missed out on schooling in the attempt to escape poverty (Agyei et al., 2016; Boateng, 2018). Therefore, the decision to drop out of school provides them with little to no employable skills in the formal sector, making it challenging to obtain jobs when they come to the cities and end up in the Kayayoo business (Agyei et al., 2016). To enhance their circumstances, they are taken advantage of and used for cheap labor by employers (Boateng 2017). Due to the emphasis placed on male education in some households in Ghana, most women miss out on education. They are left to identify other ways to financially support themselves and their families by working in unskilled positions in informal sectors such as head portaging, hawking, or unskilled agricultural jobs.

Education in Ghana may be considered a privilege for some families due to low socioeconomic status (SES). Families with low SES are less likely to enroll their children to receive formal education because they sometimes rely on them to start working to meet the family needs (Boateng, 2018). Therefore, the children miss out on schooling, which may cause them to lack necessary survival skills in adulthood, such as basic knowledge of human rights and health care practices, including personal hygiene (Agyei et al., 2016;

Boateng, 2018). In understanding the role of education in health, health literacy, and health behaviors, Diallo et al. (2017) assessed the relationship of malaria contraction among individuals with no formal education compared with those with formal education. The results concluded that individuals with no formal education were more susceptible to malaria than those with no formal education. The individuals from the informal sector who received at least a primary level of education were more likely to have learned about malaria in school. They were also more likely to read and comprehend malaria messages on tracts, radio, or television than individuals with no formal education (Diallo et al., 2017). It is imperative to understand the role education plays in a person's life, as the skills they acquire can help improve different health behaviors and life in general.

Economy, Informal Sector and Malaria in Ghana

Ghana is a country that heavily relies on informal workers for productivity and economic growth. As of 2017, approximately 90% of the workforce in Ghana are informal workers (Boateng et al., 2017). The size of Ghana's informal sector employment was twice as much of the formal worker in the 1980s and increased almost six times in the 1990s (Basu et al., 2016). The increase of informal workers alone shows their essential role in supporting local economic development in Ghana. These roles include addressing the market transportation gaps, aiding in market exchange, contributing to taxes, and making local revenue to city administrations in Ghana's funding development initiatives (Agyei et al., 2016). Another vital role of the informal sector, specifically the female head porter, is paying the daily market toll, which costs GH¢ 0.50 ($0.16) to improve sanitation in the cities (Agyei et al., 2016). The influence and impact the

informal sectors have in Ghana's economy are massive; therefore, ensuring productivity means keeping them healthy to perform work to improve the economy.

The informal sector positively influences Ghana's economy, but it can also hinder its low productivity. Because informal workers play such a massive role in Ghana's economy, they must remain in good health to keep steady productivity. This means preventing themselves from illness and diseases to avoid missing a day to more from work. Unfortunately, Ghana is a country with many marginalized communities impacted by malaria prevalence. The burden of illness harms the nation's productivity, negatively affecting the economy due to restrictions on human advancement and the financial burden on the marketplace (Yao et al., 2018). For example, Yankson et al. (2019) found that any malaria infection in Ghana results in an average loss of five workdays, three days for the patient, and two days for the caretaker. Therefore, to prevent the absence of work due to illness and low productivity, it is essential to address the issues that put the informal workers at risk.

Furthermore, the transmission of malaria occurrences has immediate financial consequences for the household involved because of money or expense spent on medication, doctor visits, diagnosis, travel, and a restricted regime for the patient. Statistics show that malaria care costs are most prominent in the northern part of Ghana during its rainy season as 34% of household income goes to malaria care for lower-income versus higher-income households (Yao et al., 2018). The northern part of Ghana is most known for its farming; therefore, with a high prevalence of malaria contraction during the rainy seasons, it coincides with a farming period that impacts the economy

(Yao et al., 2018). Additionally, as a country whose national economy is dependent on agriculture and employs a significant percentage of the population at risk of malaria, the loss of productivity due to malaria contraction affects Ghana's economy tremendously. Therefore, there is a need to contribute to an understanding initiative that promotes malaria prevention health behaviors, thus filling this research gap to avoid low productivity among informal workers in Ghana.

Sociodemographic and Malaria

Socio-demographic factors are part of the determinants that are associated with malaria. The types of socio-demographic characteristics typically related to malaria transmission in Ghana comprise but are not limited to households. Household types are determined by the sort of development and over-crowdedness in a home. Other malaria-related socio-demographic factors include the nature of protection a person has against mosquito bites, education, awareness, and knowledge about malaria, income level, ethnic groups, unemployment, and family living standards (Assan et al., 2017). The socio-demographic variables that will be evaluated in this study include education, sex, occupation groups, and marital status. Socio-demographic characteristics also influence the impact and effectiveness of knowledge, acceptance, and usage level of intervention programs and disease progression.

Diallo et al. (2017) conducted a study concerning the prevalence of malaria. The factors that influence prevalence revealed that marital status, occupation, and educational level were significantly associated with Ghana's malaria contraction. Furthermore, within the same study conducted in Lagos, Nigeria, results showed more significant use of long-

lasting insecticide-treated bed nets (LLIN) among married couples because of their availability to children and pregnant women to protect against mosquito bites (Diallo et al., 2017). Thus, understanding the determinants and associated health behavior actions can significantly stride in creating prevention and intervention programs to diminish malaria among informal workers in Ghana.

Exposure to Messages and Malaria in Ghana

Today, television, radio, the internet, computers, and mobile phones have played a vital role in people's lives and health. Globally, various healthcare providers have shifted to the modern-day movement of electronic and mobile health systems, also known as e-health and m-health, to reach the vulnerable population assess to care (De La Torre-Díez et al., 2015). With a surge in usage, Bervell & Al-Samarraie, (2019) revealed that m-health is commonly used in increasing awareness and knowledge for treatment, prevention, and reminders towards adherence. To understand the effects of malaria messages through technology in Ghana, I conducted a literature review from countries like Ghana's population to understand the impact of malaria messages through various technology modes. The study showed an increase in malaria prevention measures through technology (Larocca et al., 2016; *Kaunda-Khangamwa et al., 2018)*. Therefore, there is a possibility that using a similar strategy in Ghana can increase preventive behavior against malaria.

The number of phone subscriptions in Ghana allows for short message service (SMS), offering a possibility for disease prevention and control efforts (Sarpong et al., 2015; Mohammed et al., 2019). SMS is a way to communicate messages through a

mobile device system, simultaneously exchanging messages from a mobile phone or a computer to one or many mobile phone devices (Mohammed et al., 2019). Such SMS messages effectively improve health service delivery in various diseases such as diabetes, smoking, weight, and improving behavioral change outcomes (Mohammed et al., 2019). Regarding reducing malaria prevalence, an additional study conducted among caregivers with children under the age of five suggests that the theory-driven voice SMS via mobile phones diminishes malaria prevalence (Mohammed et al., 2019). This is an important finding because it shows the SMS can be used as an effective tool in malaria health.

Another effective strategy that increases exposure to health programs and interventions in the past is through mass media campaigns like radio, television, outdoor media such as billboards, and print media such as newspapers and magazines (Wakefield et al., 2010). These mass media campaigns can increase the exposure of health-related messages across populations. However, although exposure to mass media increases people's awareness, Nwachukwu and Anorue (2019) explored the gap in adoption of behavior, specifically on the use of ITN among Southeast Nigeria residents. Although Nwachukwu and Anorue (2019) found an increase in exposure to preventive mass media messages on malaria, there is a minor effect on the use of ITN. Therefore, there is a need to identify how exposure to mass media campaigns can improve behavior change, hence why my study aims to understand the influence of mass media and how to impact behavior change positively.

Definitions

Education attainment: The highest level of education (GSS et al., 2015).

Exposure to malaria messages: The extent to which audience members have encouraged malaria messages (GSS et al., 2015).

Kayayei (Head Porters): A terminology used in defining a woman who carries head loads for a charge. The word comes from two dialects spoken in Ghana, which are Hausa and Ga. In Hausa, the name "kay" translates as merchandise or goods, while the term yoo" in Ga denotes women (Boateng et al., 2017).

Informal sector: Refers to an economic venture unregistered in the official national income account or the gross domestic goods (GSS et al., 2015).

Informal Workers: This refers to an individual migrating to the cities for work and with little to no formal education, skill, and abilities to obtain formal employment (Diallo et al.,2017).

Insecticide-treated bednet (ITN): This is a mosquito net that repels, disables, and kills mosquitoes coming into contact with insecticide on the netting material (Polec et al., 2015).

Malaria: Refers to a preventable and treatable infectious disease transmitted by mosquitoes that kills more than one million people each year, most of them in sub-Saharan Africa, where malaria is the leading cause of death for children under five (WHO, 2019).

Marital Status: Percentage of all respondents, currently married respondents, and sexually active unmarried respondents age 15-49 who know any contraceptive method, by the specific way (Ghana Demographic Survey, 2014).

Malaria messaging through technology: Malaria messages are sent through SMS, radio, and television programming.

National Health Insurance Scheme (NHIS): Insurance coverages aim to improve access to quality health care services and grant primary health care to all citizens (Fenny et al., 2015; Nsiah-Boateng et al., 2017).

Plasmodium falciparum: A parasite responsible for a malaria-related illness usually transmitted through the bite of infected mosquitoes (Snow, 2015). Plasmodium falciparum has been associated with almost every malaria death, as it is also known as the most common and most critical strain of the malaria species (Snow, 2015).

Preventive Health Behavior: Refers to any actions initiated by an individual who considers himself (or herself) healthy to prevent or detect sickness in an asymptomatic state (Glanz et al.,2015).

Technology: Television, computers, mobile phones, and radio as a mode of receiving messages (Mohammed et al., 2019).

Sociodemographic: The household population by age, sex, and education attainment

Occupational groups: Refers to a set of citizens described by common employment (GSS et al., 2015).

Assumptions

There are various assumptions in the GDHS dataset on malaria messaging modalities and their effect on informal workers' health behaviors and place of residence. First, I assumed that the assessed information was with no bias, and the instruments

utilized in the study offered an accurate measure of the variables to consider. The questions in the GDHS dataset were crafted to avoid bias in the measuring of each variable.

Second, I assumed that the respondents were honest in their answers regarding their use of ITN at night to reduce malaria contraction and their accessibility to malaria messages through various media outlets. Researchers may have been tempted to exaggerate the participants' responses to fit their studies hypothesis. However, since participants were assured confidentiality of their identities, I presume promoted accurate and truthful answers.

Thirdly, I assumed that the information gathered was based on the researchers' interest by applying clear criteria and interventions to obtain relevant knowledge for their study. The requirements for the was board yet narrowed to capture information about the population to use for the original dataset's intended purpose, which is to produce information about the current and consistent fertility, family planning, infant and child mortality, maternal and child health, and nutrition among Ghanaian citizens.

Finally, the fourth assumption is that the lack of malaria knowledge among the participants influenced actions taken to prevent illness and seek treatment. Because the focus population of the study is among the informal worker, and most of them received little to no education, I assumed they may know to be as knowledgeable about malaria and methods to prevent future illness.

Scope and Delimitations

Some of the limitations and challenges that may occur while conducting this study will include the availability of a database that addresses all the research topic components. Another barrier may be the insufficient literature on the topic; some of the covariate variables may not impact the relationship between the exposure to malaria awareness messages and the preventive health behavior among informal workers in Ghana. Finally, the current dataset is from 2014, as the DHS has yet to update the reports with new perspectives.

Significance, Summary, and Conclusions

This study's importance is to confer a thorough understanding of factors that influence Ghana's workforce-related malaria contractions as malaria is a significant public health issue in most Sub-Saharan African countries such as Ghana. In addition, this study contributes considerable knowledge to the existing literature regarding the exposure to malaria messages, its impact on preventive health behaviors, and how the place of residence may affect the dissemination of malaria messages through the various communication modes. This study's primary contribution was finding the best method in disseminating prevention messages to Ghana’s informal sector in rural and urban areas.

These factors include sociocultural context, economic activities, accessibility to health services, behavioral parameters, language barriers, and technology access. In addition, the environment plays a vital role in the day-to-day life of individuals and families. Hence, this analysis shed light on providing adequate information about the best

practices for the informal sectors at risk of contracting malaria. Understanding malaria contraction among workers can assist practitioners in developing intervention programs that address specific needs in the provision and dissemination of information about malaria prevention. In addition, obtaining the data from this study can encourage public health officials to employ the conclusions to guarantee that the interventions are receptive to the targeted population's needs.

The transmission of malaria continues as a public health issue among various populations in SSA countries. With the continuous rise of malaria contraction, this study will analyze the relationship between malaria messages through the different communication modes (technology, in person, and on paper) and malaria preventive health behavior among Ghana's informal workers in urban and rural areas. The informal sectors are among the high-risk malaria contraction groups due to increased migration into the cities and the overcrowding of their living situations (Diallo et al., 2017). Most of the informal sectors have little to no educational background and lack various skillsets for employments at the formal workplace. Consequently, they work in the informal sectors as head porters, hawkers, farmers, etc., with few benefits and many barriers. The benefits include the ability to enroll in the NHIS and receive access to health. Although insurance enrollment is considered beneficial, it also causes restrictions among the informal sector and their ability to maintain registration due to the cost of re-enrolling, accessibility to health facilities, and losing membership cards. In interpreting this study, the HBM was utilized to understand, measure, and identify the predictors responsible for malaria contraction and provide ways to increase knowledge and disseminate information among

the informal sector in Ghana at risk of malaria contraction. Because the informal sector in Ghana plays an essential role in the country's market as they make up 90% of the workforce, informal workers refrain from work due to illness or disease such as malaria lowers the economy's productivity (Boateng et al., 2017). Therefore, it is crucial to address and identify new programs or interventions to improve Ghana's informal workers' health and lifestyle. Other studies have revealed the impact these technologies can have on increasing knowledge and performance behavior among various populations in Ghana and Nigeria (Nwachukwu & Anorue, 2019; Yaya et al., 2018).

In conclusion, as it relates to malaria prevention among informal workers in Ghana, more research is needed to provide the necessary intervention to improve Ghana's health. Many gaps appear in the current studies analyzing the relationships between the exposure of malaria messages, educational attainment, accessibility to health, occupational groups, sex, and marital status among Ghana's informal sector. This first chapter presented the study's overall purpose, the problem statement, theoretical framework, the research question and hypothesis, the study's nature, and a comprehensive literature review with an assumption, limitation, and scope.

Section 2: Research Design and Data Collection

Introduction

As mentioned in Section 1, the study investigated the impact of exposure to malaria awareness messages, place of residents, and preventive health behaviors controlling for sex, occupation group, educational level, and marital status in Ghana among informal workers. In Section 2, I describe how conducted a quantitative study utilizing a secondary data analysis from the 2014 GDHS. The GDHS is a survey collected every 5 years by the Ghana Ministry of Health. It is a survey on fertility, family planning, infant and child mortality, maternal and child health, and nutrition (GSS et al., 2015). The dataset includes information such as the residence of the respondents (urban and rural), exposure to malaria messaging through in person, on paper, and technology, and preventive health behavioral actions (spraying dwelling in 12 months, sleeping under a ITN, and sleeping under a LLTN). This dataset was helpful determining the relationship between residence and exposure to malaria awareness messages and preventive health behavior among Ghana's informal workers. Additionally, since sex, occupation group, education attainment, and marital status play a significant role in informal workers' health and performance behavior change, these mediating factors helped evaluate the relationship between the independent and dependent variables. The rest of this section will discuss the research design and rationale, methodology, external and internal validity threats, and the overall summary of the section's findings.

Research Design and Rationale

This study employed a cross-sectional design through quantitative descriptive and inferential statistics. The descriptive statistics were used to describe the sample, and the inferential statistics determined the population within the 2014 GDHS, a dataset from Ghana Statistical Service. The survey explained the relationship between the dependent and independent variables. The place of residence and exposure to malaria messaging are the independent variables in this study, and the dependent variable is the preventative health behavior to malaria prevention. The covariate variables were measured using the sex, occupation groups, educational attainment, and marital status of the informal workers.

The hypothesis examined the relationship between place of residence, exposure to malaria messages through the various communication methods, and subsequent informal workers' preventive health behaviors in Ghana. I examined the relationships between the variables by drawing a representative sample of respondents from a 2014 GDHS population, measuring the variables, and testing the hypothesis using statistical analysis (Bloomfield & Fisher, 2019). The time and resource constraints associated with the quantitative research design included but were not limited to controlling where the study took place or the environment in which the respondents answered the survey (GSS et al., 2015). Another constraint was the study's time frame because most researchers often depend on a definite time to gather and interpret answers. Additionally, since the quantitative research method involves structured questionnaires with closed-ended questions, the respondents ultimately have limited solutions based on their choice (GSS

et al., 2015). Also, respondents are likely to answer differently if questions are too personal; therefore, their response and nonresponse may refute the data's validity.

The design chosen for this study is consistent with the research design needed to advance knowledge in public health research because it can identify the health behaviors citizens have concerning a particular issue and the demand for new or further services to address the problems. In addition to measuring data trends over time with statistical potentials, the choice design may also distinguish areas needing additional research and relationships between variables that require prospective study (Bloomfield et al., 2019).

Methodology

Population

The GHS 2014 dataset includes men and women between the ages of 15 and 59 years who reside in Ghana and are considered permanent residents of the selected households or visitors who live in the households the night before the survey. Overall, the representative survey included 9,396 women and 4,388 men from 11,835 households in Ghana. The study population for this study contained only individuals within the informal sector workforce, who report the following occupations: agricultural, sales, services, skilled and unskilled manual in the GDHS surveys. The population respondent's other characteristics included education, sex, marital status, and occupation group.

Sampling and Sampling Procedure

This research utilized the 2014 GDHS sampling measures with the updated sampling frame from the 2010 Ghana Population and Housing Census (PHC; GSS et al., 2015). The study sampling frame excludes institutional and nomadic populations in

barracks, hotels, and prisons. According to GSS et al. (2015), the GDHS used a two-stage sample procedure; the first sampling process included clusters consisting of enumeration areas (EAs). The study design allows estimated critical indicators at the national, urban, and rural areas and each of Ghana's100 administrates regions. Overall, there are 437 clusters, with 216 representing the urban areas and 211 representing rural areas.

The second stage of the sampling procedure included the systematic sampling of households, undertaken in all selected EAs from January- March 2014 (GSS et al.,2015). The survey households were randomly selected, totaling 30 households from each cluster to represent the total sample size of 12,831 (GSS et al., 2015). The study's inclusion criteria were participants who identified as women between the ages of 15 to 59 years old and individuals who identified as men between the ages of 15 to 59 years of age. Respondents were permanent residents of the selected household or visitors who had stayed in the household the night before the interview. The women participants who were eligible consented to get a blood pressure measurement and tested for anemia. In addition, the study collected information such as weight and height and blood samples for HIV testing with consent from eligible men and women. The data for this current study was then filtered down to informal occupation groups. Therefore, the population sample included (a) informal workers, including skilled labor, and (b) ages 15-59. Additionally, the samples were not self-weighting due to the possible equal sample size in each region; therefore, researchers added a weighting in the data file for a comparative outcome at a national level (GSS et al., 2015). It is possible that the weighting added on by GSS may impact the study’s analysis.

Data Accessibility and Permissions

To gain access to the 2014 GDHS, I sent a letter to the Demographic and Health Survey Program (DHS) in August of 2019. They replied to my request with a letter of approval and instruction on accessing the dataset through a website's database. I was then able to access the requested dataset that is relevant to the malaria statistics in Ghana. The DHS approved the request and provided access to download the SPSS version of the dataset. A copy of this approval is provided in Appendix.

Power of Analysis

This study used the power analysis to determine the sample size needed to find the desired effect. To conduct this analysis, I used the three sample size calculations: effect size, statistical power, and alpha level (Suresh & Chandrashekara, 2012). The effect size aims to measure the numerical strength of the relationship between the independent and dependent variables. In contrast, the power or 1- beta (1- β) measures the chance of rejecting the null hypothesis (McDonald, 2014). Finally, the alpha value is a measure of the significance level of the statistical test.

Additionally, in estimating the sample size required to detect an effect in this study, l used G*Power 3.1, a statistical power analyses tool. The G*Power calculator computed the statistical test through logistic regression. The test family used the z tests and a priori power of analysis to compute the required Alpha, power, and effect size. In determining the input parameters, I used the two-tailed Alpha and calculated the odds ratio using H1 and H0 probability estimates (Pr(Y=1|X+1) H1=0.5; Pr(Y=1|X+1) H0=0.3). The minimum sample size from the G*Power calculator 4945 (power= 0.80; alpha = 0.05,

odds ratio = 2.3) as shown in Table 1. I also used the R2 other X to check the association between the main predictor and other covariates. Since exposure to messages is one of the main predictor variables to predict if someone performs a preventive health behavior, it helps understand the association between the covariates (sex, educational level, occupation, and marital status) and exposure to messages. Lastly, because GDHS data indicated an uneven distribution among the population's males and females (Female: 4842, Male: 2808) for this study, I used .63 (X parm =.63) for the sample distributions instead of the standard 0.5.

Table 1

*Sample Size Calculation Using G*Power*

Input parameters	Tail(s)	Two
	Odds ratio	*2.3*
	Pr(Y=1|X+1) H0	0.3
	α err prob	0.05
	Power (1-β err prob)	0.80
	R^2 other X	*0.957*
	X distribution	Binomial
	X parm π	0.63
Output parameters	Critical z	1.9599640
	Total sample size	4945
	Actual power	0.8000368

Data Collection and Processing

The original purpose of the GDHS data was to produce the current and consistent fertility, family planning, infant and child mortality, maternal and child health, and

nutrition (GSS et al., 2015). The data processing and cleaning for this specific research will be guided by the research goals, which examine the relationship between the exposure to malaria messages and corresponding actionable preventive health behaviors among informal workers in Ghana. The secondary data was made available by the Ghana Health Service (GHS) in 8 different data file buckets of ~ 40,000 – 50,000 survey response data sorted in row entries and ~ 176 – 1500 variables arranged in columns representing the exact survey questions and information about each respondent (e.g., Education attainment, exposure to malaria messages through radio, television, etc.). The data files were all in the IBM SPSS file format. Row entries were the binary responses to questionnaires (e.g., Yes, No) and demographic information per respondent (e.g., occupation group, sex). Data cleaning and processing will use Microsoft Excel and exported to SPSS data frame for analysis.

Instrumentation and Operationalization of Constructs

I analyzed the primary data collected by the GHS through a quantitative method examining the nature of the relationship between preventive health behavior among informal workers in Ghana and their exposure to malaria messages, and analyzed the primary data collected by the GHS.

Operationalization of Variables

The following variables in Table 2 show the operational definition and how each variable is measured and calculated for the analysis. The variables evaluated included exposure to malaria messages, education level, sex, material status, preventative health behavior, and occupational group.

Table 2

Operational Definitions of Variables

Name	Type of Measurement	Definition	Variable
Sex (confounder)	Nominal		1=Male 2=Female
Marital Status (confounder)	Nominal	Marital Status	0=Married 1=Divorced 2=Widowed 3=Never in union 4=Living with partner 5=No longer living together/separated
Education Level (confounder)	Ordinal	Level of education completed	0= No Education 1=Primary 2=Secondary 3=Higher
Occupational Grouped (cofounder)	Nominal	Type of informal job	1=Agricultural self-employed 2=Sales 3=Services 4=Skilled manual 5=Unskilled manual
Residence (Independent)	Nominal	Place of residence	0-Rural 1-Urban
Preventive Action (dependent)	Nominal	Participated in a preventative health behavior	0=No 1= Yes
Exposure to Malaria Messages (independent)	Nominal	Exposure to Malaria Messages	0=No 1= Yes

Data Analysis Plan

The data analysis plan assisted in increasing understanding of the research questions and hypotheses. The study utilized logistic regression for the statistical data analysis. Logistic regression predicts the likelihood that a study falls into one of two categories of a dichotomous dependent variable based on one or more independent variables that can be either categorical or continuous (MacInnes, 2016). The research employed SPSS provided by Walden University to evaluate the variables and apply statistical tests to measure variables through a binary logistic regression. The logistic

regression in this study examined the relationship between exposure to malaria messaging through various modes, place of residence, and behavioral health actions among confounding variables: sex, educational attainment, marital status, occupational groups. It also determined the likelihood that interactions with individuals exposed to malaria messages versus those with no exposure to covariates and those who took behavioral health actions versus respondents who did not act. The study also predicts informal workers who resided in urban versus rural areas who participated in the preventive health actions versus those who did not.

Table 3

Study Variables

Variable Type	Variables	Characteristics	Types of Measurement
Dependent	Preventive Action (Preventive Health Behavior) (Dwelling sprayed in the 12 months, A person ever slept under a net, Person slept under LLIN (Yes/No)	No Yes	Binary
Independent	Place of Residence	Urban Rural	Binary
Independent	Exposure to Messages (electronic mode: television, radio, and computer; print media: billboards or pamphlets; word of Mouth: in person)	No Yes	Binary
Covariate	Current Marital Status	Divorced Living with a partner Widowed Never in union No longer living together/separated Married (reference category)	Nominal
Covariate	Sex	Female Male (reference category)	Nominal
Covariate	Occupation (grouped)	Agricultural employee Agriculture-self employed Sales Services Skilled manual unskilled manual (reference category)	Nominal
Covariate	Education Level	No education Primary Secondary Higher (reference category)	Nominal

Data Cleaning Procedures

As this is a secondary data source, 3 of the 8 data files have the necessary information to yield results relative to the research questions based on the research objectives. Additionally, the variables needed are not available in a single data file; instead, they are scattered amongst the three data files. The three data files I used are Household File (GHPR72FL), Male Only File (GHMR72FL), and Female Only File GHBR72FL. According to the information provided in the paper published by the GHS with details on logistics to generate the data, they first conducted a survey on household groups from selected enumeration areas from January – March 2014. Based on an age criterion (15 to 59), eligible males and females in a household were re-surveyed with different sets of questionnaires. The re-survey activity for the qualified male and female groups was previously sorted in other GDHS data files.

The GHPR72FL data file included responses from a household survey containing 43733-row entries and 176 variables sorted in columns and referred to as the household file from here onwards. Each household is differentiated by a Case ID in this file, and every respondent from the same household holds the same Case ID. Thus, the survey and questionnaire are tailored to address questions in households around the selected enumeration areas, as identified by GHS. More importantly, this data file included the responses regarding exposure to malaria messages through various communication means (13 in total) for each respondent, significant variables needed to address the research question. However, this file does not have other relevant variables such as occupation group, education level, sex, support, or control variables.

The GHMR72FL data file includes male respondents within the eligible age group from the GHPR72FL Household file (Eligible male respondents re-surveyed from GHPR72FL), a total of 4388 respondents sorted in rows and 655 variables. The GHMR72FL file will from here onwards be referred to as the male-only household file. Each respondent were differentiated by a new Case ID, a concatenation of their household Case IDs, and their private respondent line number (e.g., a Male respondent from a household with Case ID 112 and line number 1 will have a new Case ID: 112 1). The GHMR72FL file contained variables needed to support the research question, which was unavailable in the GHPR72FL household data bucket. The secondary variables in context are occupation groups, frequency of reading a newspaper, watching TV, reading magazines, and questions regarding actions taken to prevent mosquitoes. Notably, the occupation group is a filter variable to select data for only respondents with informal work.

The GHBR72FL file with 23118-row entries and 1158 variables Includes female respondents of eligible age groups from the household file bucket GHPR72FL. The GHBR72FL file will from here onwards be referred to as the female-only file. I differentiated the female respondents using new Case IDs, like in the male-only file. As common with secondary data, most of the variables stored in this file were irrelevant to the research objectives. However, variables like those in the all-male file are available in the data and needed. (e.g., occupation group). Furthermore, this file had duplicated entries; as such I will prune repetitions to only a single row entry per female respondent.

Because the variables needed to yield results for the research are scattered amongst the three files and data in the three files are practically from the same population sample, I extrapolated the survey responses from the three files and condense them into one file. I filtered the female and male files to only the following informal occupation groups: skilled and unskilled manual, agricultural laborers, sales, and services. I deleted irrelevant variables to the research topic from both files (e.g., Ever used contraception). To automate the extraction of survey responses for variables indicating exposure to malaria messages in the household file, I uniquely matched essentially the Case IDs and age of respondents in all three files. Again, this is possible because all three files share similar respondents, albeit with different survey types. I also used the VLOOKUP function in MS Excel to match critical identifiers in the household file and extract the corresponding data. For more illustration on the data cleaning process, a respondent in the household with Case ID 112 and age 24 would have a unique ID of 11224. If this respondent is eligible for an additional survey based on the age criterion, a record is available in the male or female data bucket. After stripping the line number from the male and female-only files' case ID and concatenating with age, the unique key identifier matched the household file (11224). Afterward, a VLOOKUP search will find the match and copy data from the Household file.

If two respondents with the age frame of the same household, I generated a similar key identifier. This action was mitigated by searching the spreadsheet for duplicate key identifiers and fixing the entries manually by deleting the duplicate entries. Furthermore, this automation method exposes possible errors made by the GHS in

recording the age; for example, if respondents available in the household group could not be found in the survey response, the VLOOKUP search will omit them.

Analysis Techniques

This study examined the two research questions by looking at the relationship between variables that can refute or validate the study hypothesis. As a result, the statistical method I used to analyze the data is binary logistic regression. The binomial logistic regression determined the relationship between exposure to malaria messaging through various modes of communication, place of residence, and behavioral health actions among the confounding variables: sex, educational level, marital status, occupational groups. The use of logistic regression determined whether the association between variables is scientifically significant and understand the effects of the predictors and how well the model fits or does not fit. In Block 1, I entered the control variables of sex, educational level, marital status, and occupational groups. Then, I calculated whether the control variables are significant predictors of my dependent variables. In Block 2, I added the predictor variable to determine if it adds any significant value to the model. The last indicator was used as the reference category. The following was used as the reference category for each variable: higher education, unskilled manual, widowed, and male. For example, under the education category, based on the order “higher education” is considered be the reference category used to compare the other categories such as primary education, secondary education, and no education.

The Rationale for Covariate Inclusion

The inclusion of sex, education, marital status, and occupational groups relates to differences in hearing about malaria messages that confound the relationship with taking preventive actions. These covariates had some effect on taking preventive health actions against malaria.

Threats to Validity

Identifying the internal and external validity are critical steps in research because they consider whether the study results are meaningful and trustworthy. The concept of external validity is the extent to which one can generalize or apply study findings to people, situations, settings, and measures. Whereas internal validity initiates trustworthiness of the cause and effect relationship in the study, the researchers' evidence proves that actions taken in the study cause an observed outcome (Patino & Ferreira, 2018; Meltzoff & Cooper, 2018). This research relies on analysis using secondary data to predict the relationship of the variables and does not seek to make causal inferences.

Threats to the external validity from the 2014 GDHS included a survey questionnaire where participants were asked how to dispose of a net. However, because the population for this study mainly consists of informal workers with little to no education, very few responses were contained in the dataset (GSS, 2015.). Therefore, to mitigate this threat, the survey responses identified a yes or no response to whether respondents slept under an LLN or ITN and spraying of the dwelling was used as inclusion criteria to filter the dataset in this study.

The overall threats to validity in this study are associated with the limitations compulsory in using secondary data. Multiple factors limit secondary data. First, the current research topic did not influence the purpose and collection method of the original data. As a result, the data may not be consistent and complete for the current research topic. Second, in some instances, the data format differed from the format suitable for this research analysis. This required additional data manipulation, leading to errors that can threaten the validity of the study outcomes.

Ethical Procedures

To gain access to the 2014 GDHS, I sent a letter to the Demographic and Health Survey Program (DHS) in August of 2019. The DHS sent a note through the website's database, which provided an available dataset relative to Ghana's malaria prevalence. Upon approval of the request, I gained access to download the SPSS version of the dataset. Additionally, I sent a request to the Walden IRB for approval and receive an approval number 09-10-21-0805962.

I stored all the data used for this analysis in a password-protected file and an encrypted flash drive located inside my residence. I will delete the data five years after completing my study, which aligns with Walden's IRB's requirements.

Summary

Section 2 briefly discussed the research design and its data processing and collection methods gathered initially by GDHS. This section also included the study's methodology, which had the population, sampling and sampling procedures,

instrumentation and operationalization of constructs, data analysis plan, and validity threats. The following section will disclose the outcomes of the research study relative to the two research questions.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this quantitative study was to analyze the relationship between exposure to malaria awareness messages, place of residence, and preventive health behaviors among Ghana's informal workers controlling for the covariates sex, occupation group, and marital status. A cross-sectional design was used for this study to analyze secondary data retrieved from the 2014 GDHS, part of the Demography and Health Survey Program by the United States Agency for International Development (USAID). The original GDHS dataset contained 9,396 women and 4,388 men from 11,835 households. For this study, only informal workers aged 15-59 years were included. Informal workers were then grouped by area of residence: urban versus rural. SPSS version 27.0 was used to analyze the study using the total sample size of 7650. The following research questions and hypotheses were addressed using logistic regression:

Research Question 1 (RQ1): What is the relationship between exposure to malaria awareness messages (electronic mode, print media, word of mouth), place of residence (rural or urban), and preventive health behaviors (spraying dwelling in 12 months, sleeping ITN, and sleeping under an LLTN) controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers?

$H_0$1: There is no relationship between exposure to malaria awareness messages and preventive health behaviors controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers.

H_a1: There is a relationship between exposure to malaria awareness messages and preventive health behaviors, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers

Research Question 2 (RQ2): What is the relationship between place of residence (rural or urban) and preventive health behaviors controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers?

$H_0 2$: There is no relationship between place of residence and preventive health behaviors, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers.

$H_a 2$: There is a relationship between place of residence and preventive health behaviors, controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers

Data Collection of Secondary Data Set

The study used descriptive and inferential statistics to evaluate the relationship between taking preventive health behavior and exposure to malaria awareness messages or place of residence among Ghanaian informal workers. The data used for this study was from the 2014 GDHS dataset, which was accessed through the DHS website. To gain access to the 2014 GDHS, I sent an online request to the Demographic and Health Survey Program (DHS) in August of 2019 and explained the use and purpose of requesting the dataset. DHS replied to my request with a letter of approval and instructions on accessing the dataset through the DHS website's database. A copy of this approval is provided in Appendix A.

The primary data collection for the 2014 GDHS used a two-stage sample design. The first stage included EAs, with 427 clusters: 216 in urban areas and 211 in rural areas across the 10 administrative regions in Ghana. The second stage involved systematic sampling of 30 households from each cluster. Households in barracks, hotels, and prisons were excluded. Overall, 12,831 households were selected for sampling for the primary dataset and 12,010 households were occupied. Of these occupied households, 11,835 participated, yielding a response rate of 99% (GSS, 2015). In addition, the GDHS report shows that 9,656 women were eligible for individual interviews in interviewed households, and 9,396 (97%) completed the interviews. Among the men, 4,609 were eligible for interviews; 4,388 conducted interviews, generating a response rate of 95%. A report of the GDHS primary data by GSS et al. (2015) stated that the men's response rate was lower, likely due to their more regular and more prolonged absences from the household.

Discrepancies in Data Set

The original GDHS data collected produces current and consistent information on fertility, family planning, infant and child mortality, maternal and child health, and nutrition (GSS et al., 2015); therefore, the information collected was not directly aimed to address the hypothesis for this study. In ensuring the research questions could be addressed by the dataset, the data were cleaned, and the population was narrowed to the informal sector, and variables that most aligned with this study were selected.

Descriptive Statistics

The primary 2014 GDHS survey includes 12,831 households, which in this study, only individuals within the informal workforce were included from the primary 2014 GDHS survey. As a result of these inclusion criteria, the sample size was $N = 7,650$. As shown in Table 4, the demographic distribution by sex is 63.3% female and 36.7% male. Among the sample population, 58.4% of the respondents resided in a rural area and 41.6% in an urban area. Additionally, 20.2% of the informal workers had no education, and 1.4% had higher education. About 59% of the respondents were married, and 42.6% of the respondents were self-employed agricultural workers.

Table Error! No text of specified style in document.**4**

Frequency Distribution for Participants Sex, Educational level, Marital status, Occupation

	Sex	Frequency	Percent
Sex	Female	4842	63.3
	Male (r)	2808	36.7
Education level	No education	1542	20.2
	Primary education	2351	30.7
	Secondary	3650	47.7
	Higher (r)	107	1.4
Marital status	Divorced	270	3.5
	Living with partner	1059	13.8
	Widowed	256	3.3
	Never in union	1217	15.9
	No longer living together/separated	324	4.2
	Married (r)	4524	59.1
Occupation	Agricultural employee	82	1.1
	Agricultural self-employed	3257	42.6
	Sales	2503	32.7
	Services	124	1.6
	Skilled manual	1276	16.7
	Unskilled manual (r)	408	5.3

Note. Reference Category (r).

Figure 1

Geographic Area of Participants

f

Figure 2 shows the distribution of participants who answered yes (94%) versus no (6%) to exposure to malaria messages. Additionally, Figure 3 displays participant responses by participating in preventative health behaviors: no (43.7%) and yes (56.3). All the characteristics mentioned representing the informal population for this study.

Figure 2

Frequency Distribution of Exposure to Malaria Awareness Messages

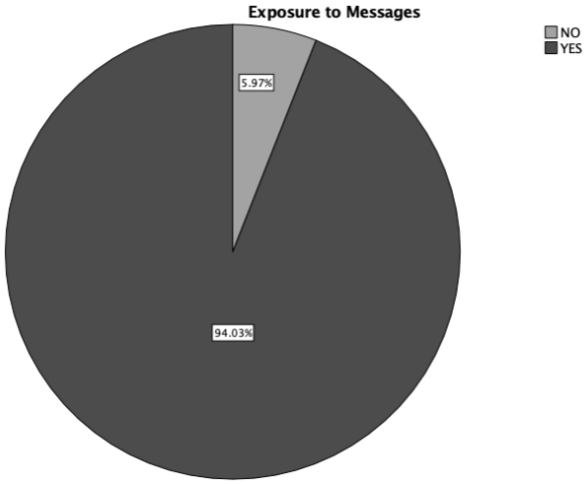
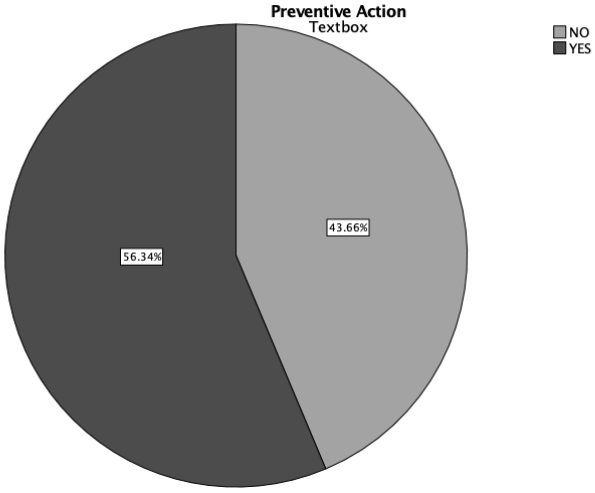


Figure 3

Frequency Distribution of Preventive Health Behavior (Action)



Data Analysis and Results

The statistical test used to address the two research questions for this study was binary logistic regression. Specifically, the study used binary logic regression to determine the likelihood of a Ghanaian informal worker engaging in preventive health behavior based on whether they had been exposed to malaria awareness messages (yes vs. no) and place of residence (urban vs. rural) using the odds ratio of respondents participating in preventive health behaviors based on a binary (yes or no) response and demographic characteristics retrieved from the 2014 GHS survey.

Using the sample size of N =7,650, logistic regression was also performed to determine the effect of sex, occupation, marital status, and educational level on the respondents' likelihood of taking preventive health actions. When included in the model labeled Block 1, all four covariates explained 13% (Negelkerke R2) of variance in preventive health behavior and correctly classified 65% of actions. Thus, the model was significant for determining preventive behavior based on $p < .05$.

Table 5

Block 1: Omnibus Test of Model Coefficient

	Chi-square	*df*	*Sig*
Step	781.153	14	.000
Block	781.153	14	.000
Model	781.153	14	.000

A regression summary shows that after adding the covariates (control model) from Block 1 to Block 2, the independent variable (exposure to malaria awareness messages), the control model is still significant. However, the addition of the independent variable did not add any contribution p = .989, OR= 1.001, $CL_{0.95}$ [.816, 1.1229], suggesting that exposure to malaria awareness messaging did not influence informal workers' use of preventative behaviors. Therefore, I accept the null hypothesis that there is no relationship between exposure to malaria awareness messages and preventive health behavior controlling for sex, occupation, marital status, and educational level. The likelihood of a male informal worker acting was OR=1.365; $CL_{0.95}$= [1,210, 1.541], i.e., males were 36% more likely to perform preventative behaviors. Additionally, compared to higher education, the informal workers with no education $p < .05$, OR=1.727; $CL_{0.95}$= [1.124, 2.655] were 30.7% more likely to take preventive action. Respondents with secondary education were also 47.7% more likely to take preventive action. This is further explained in Table 7, which presents the regression summary.

Table 6

Block 2: Omnibus Test of Model Coefficient

	Chi-square	*df*	Sig
Step	.000	1	.989
Block	.000	1	.989
Model	781.153	15	.000

Table 7

Logistic Regression: Exposure to Malaria Awareness Messages, Sex. Occupation, Marital Status, Education Level

	B	*SE*	*p*	Odds Ratio	95% lower	CL upper
Exposure to malaria awareness messages (1)	.001	.104	.989	1.001	.816	1.229
Occupation						
Agricultural- employee (1)	.961	.257	.000	2.615	1.580	4.328
Agricultural self-employed (2)	1.171	.114	.000	3.226	2.579	4.035
Sales (3)	.135	.20	.261	1.144	.905	1.447
Services (4)	-.005	.218	.980	.995	.649	1.525
Skilled manual (5)	.378	.122	.002	1.459	1.149	1.852
Unskilled manual (r)			.000			
Education Level						
No education (1)	.547	.219	.013	1.727	1.124	2.655
Primary (2)	.362	.220	.099	1.437	.934	2.209
Secondary (3)	.199	.219	.354	1.220	.802	1.855
Higher (r)			.000			
Sex						
Female (1)	.311	.062	.000	1.365	1.210	1.541
Male (r)			.000			
Marital Status						
Divorced (1)	.144	.182	.430	1.155	.808	1.650
Living with partner (2)	.293	.146	.046	1.340	1.006	1.785
Widowed (3)	.480	.135	.000	1.616	1.240	2.106
Never in union (4)	-.108	.149	.467	.897	.670	1.201
No longer living together/separated (5)	-.275	.177	.120	.760	.538	1.074
Married (r)			.000			
Constant	-.377	.283	.1.83	.686		

Note. Reference category (r).

A binary logistic regression analysis was conducted to examine if a person's place of residence controlling for sex, educational level, marital status, and occupation is a factor that predicts if a person will take preventive health action against malaria contraction. The outcome of interest was preventive health behavior. The independent variable was the place of residence, controlling for the covariates (sex, educational level, marital status, and occupation).

In Block 1, the covariates provided a significant, $p < .05$ contribution. The model explained 13% (Negelkerke R^2) of variance in preventive health behavior and correctly classified 65% of actions. After controlling for the control model in Block 2, the model is still significant, and the addition of the predictor (place of residence) did add a contribution. Table 10 presents the regression summary. The regression analysis reports show a significant relationship between place of residence and preventative health behavior. Therefore, I reject the null hypothesis that there is no relationship between place of residence and preventive health behavior controlling for sex, occupation, marital status, and educational level. A person living in a rural area is OR=.405, $CL_{0.95}$ =[.362, .453] more likely to respond "yes" to taking preventive health action compared to respondents in urban areas. The likelihood of an informal worker with no education who resides in a rural versus urban area is OR=2.085, $CL_{0.95}$ =1.366, 3.182] more likely to take preventive action against malaria.

Table 8

Block 1: Omnibus Test of Model Coefficient

	Chi-square	*df*	Sig
Step	781.153	14	.000
Block	781.153	14	.000
Model	781.153	14	.000

Table 9

Block 2: Omnibus Test of Model Coefficient

	Chi-square	*df*	Sig
Step	257.133	1	.000
Block	257.133	1	.000
Model	1038.286	15	.000

Table 10

Logistic Regression: Relationship Between Place of Residence, Sex, Occupation, Marital Status, Educational Level and Preventive Health

	B	*SE*	*p*	Odds Ratio	95% CL Lower	Upper
Place of residence	-.904	.057	.000	.405	.362	.452
Occupation						
Agricultural- employee (1)	.615	.262	.019	1.849	1.107	3.088
Agricultural self-employed (2)	.781	.119	.000	2.184	1,731	2.756
Sales (3)	.197	.122	.081	1.217	.958	1.547
Services (4)	-.064	.124	.775	1.066	.689	1.649
Skilled manual (5)	.376	.124	.002	1.457	1.142	1.859
Unskilled manual (r)			.000			
Education Level						
No education (1)	.735	.216	.001	2.085	1.366	3.182
Primary (2)	.561	.216	.009	1.753	1.250	2.676
Secondary (3)	.315	.211	.134	1.371	1.035	2.072
Higher (r)			.000			
Sex						
Female (1)	.272	.063	.000	1.313	1.160	1.484
Male (r)						
Marital Status						
Divorced (1)	.119	.186	.521	1.127	.783	1.621
Living with partner (2)	.251	.149	.105	1.273	.950	1.704
Widowed (3)	.497	.138	.000	1.644	1.256	2.153
Never in union (4)	-.128	.152	.401	.880	.654	1.185
No longer living together/separated (5)	-.296	.180	.100	.744	.523	1.059
Married (r)						
Constant	-1.003	.170	.000	.367		

Note. Reference category (r).

Summary

The results from the secondary data analysis from the 2014 Ghana Demographic Survey are presented in this section. The study used logistic regression as the statistical analysis to test the following hypothesis: (a) in RQ1, the overall model was significant; however, the predictor variable did not contribute any value to the model; Therefore, the null hypothesis that there is no relationship between malaria awareness messages and preventive health behavior, is accepted; and (b) in RQ2, there was a statistically significant association between place of residence, controlling for sex, occupation, marital status and educational level for Ghana's informal workers. Living in an urban area was associated with preventative behaviors. In a test to predict the likelihood of informal workers taking preventive action based on the four covariate variables (sex, occupation, marital status, and educational level), all the covariate variables had a statistically significant relationship to exposure to malaria awareness messages, place of residence and preventive health behavior. For example, females were OR=1.313 times more likely to have responded yes to taking preventative actions. Informal workers who had primary education were OR= 1.416 more likely to take preventive action compared to those with higher education.

In Section 4, the interpretation of the results from the analysis conducted in this chapter will be discussed, considering the research questions. The limitations of this study, recommendations for future research, and implications in terms of positive social change will also be addressed.

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

Overview

Malaria is a global public health issue that impacts people of all age groups and ethnicities. Malaria remains the leading cause of morbidity and mortality in SSA (N. Diallo et al., 2017; Snow, 2015). Howes et al. (2015) and Benelli et al. (2016) explained that malaria spreads by infection with protozoan parasites of the *Plasmodium* species. The *Plasmodium falciparum* is a parasite responsible for malaria-related illnesses usually transmitted through the bite of infected mosquitoes. *Plasmodium falciparum* has been associated with almost every malaria death and is the malaria species' most common and critical strain (Snow, 2015). In 2015, an estimated 212 million new malaria cases occurred worldwide, with about 905 million in the African region malaria cases, and in 2016 malaria was responsible for approximately 445,000 deaths, mainly among young children in SSA. (WHO, 2017; Grabias 2019). In addition, the WHO (2016, 2017) has indicated that malaria is responsible for approximately 1,800 admissions a year in the Ghana health care system and 10 deaths for every 100,000 residents in Ghana.

The purpose of this study was to examine the relationship between exposure to malaria awareness messages (electronic mode, print media, word of mouth), place of residence (rural or urban), and preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under an LLTN) controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers. This study used a cross-sectional design to analyze the secondary data retrieved

from the 2014 GDHS, part of the Demography and Health Survey Program by the USAID.

Ghana is a country in SSA with a principal determinant of morbidity and mortality due to malaria contraction, especially amongst children under 5 years old (Nyarko & Cobblah, 2014). Although malaria transmission has historically been high among children and pregnant women, recent studies have shown an increased burden among informal workers in high-risk countries, including Ghana (Diallo et al.,2017). The casual workforce plays an essential role in Ghana's market as they make up 90% of the workforce (Boateng et al., 2017). Additionally, most of the informal workers in Ghana have little to no education. Sometimes, they may hear or receive messages but cannot comprehend or understand the message due to barriers in language. Because Ghana is a country with over 100 dialects, language becomes a barrier that can negatively impact a person's ability to access antimalarial practices projecting a rise in health issues.

According to the 2014 GDHS, exposure to malaria messages through various media sources is more common in urban than in rural areas. For example, Greater Accra, which is in an urban area, had the highest percentage of respondents who were exposed to malaria messages through the TV (84%), newspaper/magazines (20%), or posters (39%) compared to the rural counterparts who received malaria messages from a health worker or a community volunteer. In addition, household ownership of ITNs was different based on place of residence.

Additionally, from the 2014 GDHS, at least 60 % of households in the urban areas own at least one ITN, compared with 78% of rural households. Since 2008, reports have shown an increase in net ownership from 45% to 70% and from 42% to 68%, respective of time. Overall, based on the survey response, 37% of the household population slept under a net the night before the survey; 36% slept under an ITN, nearly all (33%) are LLINs.

Since the 2014 survey, no current studies or surveys had focused on informal workers and their exposure to malaria awareness messages, place of residence, and preventive health behavior. Therefore, this study analyzed the relationship between exposure to malaria awareness messages and preventive health behavior and place of residence and preventive health behavior controlling for sex, occupation, marital status, and educational level.

Interpretation of Findings

A sample of 7560 respondents from the GDHS was analyzed using binary logistic regression to predict the two research questions. The findings of the results are as follows.

RQ1: What is the relationship between exposure to malaria messages and preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under an LLTN), controlling for sex, occupation group, marital status, and educational level? The results showed that overall covariant variables were significant predictors of taking preventive action; however, exposure to malaria was not a significant predictor of taking preventive action. This result is inconsistent with similar studies

conducted in the past. A similar analysis was also performed using the 2014 GDHS. The results showed that respondents who heard a message about using a bed net (taking preventive action) for malaria prevention were associated with increased net use (*OR*): 2.5, $CL_{0.95}$ [1.5–4.2] (Ricotta et al., 2019). In addition, studies conducted in Malawi and Nigeria show that parents of children who were exposed to malaria messages through various modes of communication took preventive action by sleeping under the LLN (Nkoka et al., 2021; Zalisk et al., 2019). The inconsistency in this study's results compared to the survey by Nkoka et al. (2021) and Zalisk et al. (2019) are that they used different sampling populations, which focused on children under the age of 5 years and their caregiver.

Meanwhile, the data retrieved from the 2014 GDHS for this study is focused on informal workers. Given that children are generally considered more vulnerable to malaria, caregivers were more likely to try to have children sleep under nets. Additionally, informal workers may not have access to the nets, whereas caregivers of children may have access through national and West African regional net distribution programs. Lastly, a reason for not seeing a difference between exposure to messages and preventive health behavior maybe because the majority of the informal workers had exposure to malaria messages and very few did not, making the comparison unequal.

The study also controls for variables to understand further if other predictors sensitive health action among informal workers. The results revealed that the sex of the informal workers was a good predictor of preventive health action. The likelihood of a male informal worker acting was *OR*=1.365; $CL_{0.95}$= [1,210, 1.541], i.e., males were

36% more likely to perform preventative behaviors. Additionally, compared to higher education, the informal workers with no education $p < .05$, OR=1.727; $CL_{0.95}$= [1.124, 2.655] were nearly 73% more likely to take preventive action. Additionally, results showed that informal workers who are married or living with a partner were significantly associated with taking preventive action. Lastly, among the type of occupation, individuals who worked in the agricultural fields (self-employed and employed) were OR=2.615; $CL_{0.95}$= [1.580, 4.328]; OR=3.226; $CL_{0.95}$= [2.579, 4.035] likely to prevent themselves from malaria contraction.

RQ2: What is the relationship between residence (rural or urban) and preventive health behaviors (spraying dwelling in 12 months, sleeping ITN, and sleeping under an LLTN) controlling for sex, occupation group, marital status, and educational level among Ghanaian informal workers. The null hypothesis stated there is no relationship between place of residence and preventive health behavior. Therefore, I reject the null hypothesis as there is significance in the relationship between place of residence and preventive health behavior. The results from this study align with another study conducted in Ghana using the 2014 GDHS and 2016 Malaria Indicator Survey (MIS). Their analysis shows that place of residence is a predictor of taking preventive health actions such as increased use in ILLN and LLN (Ricotta et al., 2019). This study also aligns with a study conducted by (Diallo et al., 2021) in Guinea among pregnant women and factors associated with taking preventive actions against malaria. The study results revealed that place of residence and socio-economic factors such as marital status and educational level were positively associated with malaria preventive measures.

Similar to the RQ1, further studies were conducted to understand whether the controlling variables contribute to the models. The results revealed that all the controlling variables were good predictors; for example, the likelihood of an informal male worker acting is *OR*=1.365; CL 95% [1,210, 1.541]. Additionally, the informal workers who had no education were *OR*= 2.085 more likely to take preventive action compared to respondent with higher education. In contrast, the informal worker's education was significant predictor of taking preventive measures against malaria. Additionally, respondents who were either married or living with a partner were significantly associated with taking preventive action. Lastly, among the type of occupation, individuals who worked in the agricultural fields (self-employed and employed) and skilled manual workers showed significance in preventing malaria contraction.

Findings in the Context of the Theoretical Framework HBM

In this study, the HBM was the framework used to explore the relationship between exposure to malaria messages and preventive health behaviors (spraying dwelling in 12 months, sleeping under an ITN, and sleeping under an LLTN), controlling for sex, occupation group, marital status, and educational level. In all, place of residence was a significant predictor for preventive action against malaria after controlling for sex, occupation, marital status, and educational level. Overall, six assumptions of the HBM indicates that a person is likely to partake in health behavior (a) perceived susceptibility: if the individual deems themself at risk for a disease or condition; (b) perceived severity: the possible seriousness of the illness and its outcome; (c) perceived benefits: the course of action available could be a potential benefit in diminishing their susceptibility to or

their severity of disease; (d) barriers in engaging in a behavior; evaluation of the benefits of taking action, (e) cue to action: when a person feels like their practical barriers outweigh the benefit and are not strong enough to prevent action, (f) self-efficacy: confidence in a person performing a behavior. (Glanz et al., 2015).

HBM is based on the belief that people are more likely to avoid illness if they believe their specific action will prevent disease. In my study, HBM explains the behavior of informal workers regarding their preventive health behavior to prevent malaria. This study is supported by most of the HBM postulations. For example, based on the majority taking preventive health action, informal workers had all the constructs of the model to perform this action. The place of residence and other controlling variables such as sex, occupation, marital status, and educational level significantly influenced informal workers' preventive health behavior against malaria.

Limitations of the Study

Threats to Validity

There were a few threats to the validity of this study. The overall threats to validity in this study are associated with the limitations compulsory in using secondary data. Multiple factors limit secondary data. First, the current research topic did not influence the purpose and data collection methods of the original GDHS. Second, the data for this study was filtered to only include individuals within the informal sector workforce, who report the following occupations: agricultural, sales, services, skilled and unskilled manual in the GDHS surveys, there I may have possibly missed some informal sector workers who did not fall into these categories. As a result, the secondary data

analysis I conducted may have threats to validity, leading to incorrect inferences as the primary data may have omitted important information about participants for confidentiality purposes. This then prevents the control of confounding factors that might be important in interpreting the results. This may have also caused some inconsistency when compared to previous studies because those studies had complete information to analyze the results, whereas this study did not.

Also, in this study, the only relationship between variables was evaluated and not causality; therefore, conclusions about causality cannot be made. Finally, the data for this study was initially collected as demographic data and not for the focus of this study. Therefore, due to the manipulation of the data, the results did not support the study's hypothesis. Lastly, my study estimation of the relationship between variables may not be an actual relationship because of other covariate variables that may have existed but not been captured in the primary research. Therefore, the internal validity of the results of this secondary data analysis may be affected.

Recommendations for Future Research

This study shows that there is no significant relationship between exposure to malaria awareness messages. Therefore, additional study is needed to address other predictors influencing preventative health behavior among informal workers in Ghana. A future study should collect primary data focusing on the informal sector workforce and factors such as their living conditions (housing, overcrowding, and construction of housing), social-culture barriers (beliefs and traditional impacts), economic barriers, and cost. Evidence implies mosquitoes are attracted to crowed houses due to high levels of

carbon dioxide and other chemicals, which may raise the risk of malaria (Bannister-Tyrrell et al., 2017; Coalson et al., 2021). Additionally, policymakers should consider reviewing current malaria programs and interventions, including informal workers, and not solely focusing on children under 5. This is important because, in Ghana, the informal population makes up about 80% of Ghana; therefore, the majority of the worker force is likely to have children. Increasing their behavior can improve their health and that of their families, including any children under the age of 5. Additionally, this research will assist in improving public health and other health professionals' communication of information that is likely to bring about behavioral change and healthier practices regarding malaria prevention in Ghana's informal sector.

Implications for Professional Practice and Social Change

Based on the results from this study, using exposure to malaria awareness messages alone as a predictor for preventive health actions may not be as effective. However, this shows the need for public health professionals to explore malaria cases, specifically among the informal workforce in Ghana, to better understand other factors that contribute to preventive health behaviors against malaria and address those. Additionally, since the study shows a significance between the place of residence and preventive health behavior, future research that focuses on and address these factors that influence actions will be necessary. This is especially true with variables such as income that may have been excluded from the study due to secondary data.

This study shows that another potential impact for positive social change is moving beyond the individual level to also engage multiple individuals and communities

simultaneously. Since family and peer networks play a huge role in decision-making, this study creates and shares dialogs on malaria prevention. Partners and family members of individuals who understand the importance of taking action can help through social support and peer influence to encourage an individual's malaria preventative actions and decrease the individual's malaria risk. Another implication to this study is the identification of gatekeepers and stakeholders within that community that will use their voice to educate further, promote and encourage individuals within the community to take action. Lastly, this study shows the importance of directing funds to aid the health needs of informal workers to avoid missing workdays due to malaria contraction by increasing awareness about malaria among the informal workforces. This action can be achieved by enforcing policies that ensure each neighborhood has access to community health workers who actively visit, educate, and distribute mosquito nets to families and other resources to assist families in malaria prevention.

Conclusion

Malaria has been a public health issue in Ghana for centuries. Although the country has strived to reduce malaria cases through various programs and interventions, it continues to be a public health issue. Despite the decrease in malaria contraction, very few Ghanaian studies focus explicitly on using multiple types of malaria-related messaging modalities and the impact of these messaging systems on lessening malaria contraction among the informal sector (Mohammed et al., 2019; Yaya et al., 2018). This study looked at the relationship between exposure to malaria messages, place of

residence, and preventive health behavior controlling for sex, occupation, marital status, and educational level.

The findings revealed that exposure to malaria messages was not a significant predictor of preventive health behavior. However, the controlling variables (sex, occupation, marital status, and educational level) and place of residence were revealed to be significant predictors of preventive health behavior. This suggests that in addition to increasing malaria awareness, efforts towards improving the living conditions of informal workers will also be essential.

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Appendix A: Authorization to Use Data

Aug 27, 2019

Nora Larkai
Walden University
United States

Dear Nora Larkai:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Prevalence of Malaria in Ghana":

Ghana

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name 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. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers 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: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

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

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