Current Status of Malaria among the Affected People of Bandarban Region

A project submitted

by

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Certification statement

This is to certify that the project titled “Current status of Malaria among the Affected People of Bandarban region” submitted for the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy from the Department of Pharmacy, BRAC University constitutes my own work under the supervision of **Ashis Kumar Podder**, Senior Lecturer, Department of Pharmacy, BRAC University that appropriate credit is given where I have used the language, ideas or writings of another.

Signed,

_____

Countersigned by the Supervisor

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Acknowledgment

Thanks to almighty whose blessing and love have given me strength to continue my studies and my academic career which includes this thesis.
This thesis project could not be possible without the support of some important people who helped to make this happen.
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Abstract

Malaria is still considered a public health problem of Bangladesh by the World Health Organization. Among 13 vulnerable districts of Bangladesh, 3 hill districts are highly affected by this disease. Malaria-infected people from Bandarban pouroshova, Thanchi bazar and their nearby areas (samples, n=144) were questioned at random to understand the present situation. Obtained data were analyzed by SPSS software. The study investigated the age group and gender who were infected by malaria, most used treatment type, infection causes, duration of illness, malaria knowledge, initiation of treatment after malaria infection etc. Delayed Seeking for treatment is the most common scenario among hill-tribes. 90.3% of infected people knew about the symptoms of malaria, 46.5% knew about the waterborne disease, 93.8% of infected people know that what the causes of malaria are. Most of the samples get information from NGO who are doing a remarkable job in this sector. They have a separate unit for malaria prevention in each of their regional offices. People of these regions know about Malaria and other related information. A reduction of more than 50% in malaria cases and 54% in related deaths since 2010. Though the infection reduction rate is satisfactory, the malaria cases in Bandarban are fluctuating and still need to be dealt with care.

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1. Introduction

1.1 History of malaria

Malaria illness has been recorded for over 4,000 years. From the Italian for "bad air," mal'aria has most likely impacted, all things examined, human populations and mankind's history. In early Chinese medical books, the symptoms of malaria disease were described. In 2700BC, several trademark symptoms were well detailed in the *Nei Ching* (The Canon of Medicine) later named malaria. The book was edited by Emperor Huang Ti. Malaria became extensively known in Greece and it was responsible for the declining of many of the town populations by 4th century BCE. By the age of Pericles, reference of malaria and decreasing population of rural area was recorded. A Sanskrit medical thesis, The Compendium of Susruta, sings of malarial disease and bite-symbol of certain insects were described. Various Roman writers credited malarial sicknesses to the marshes.

1.2 Discovery of malaria parasite

Charles Louis Alphonse Laveran, a French armed force specialist posted in Constantine, Algeria, was the first to discover parasites in the blood of a patient having malaria fever. This encountered on the sixth of November 1880. Laveran got Nobel Prize in 1907 for this discovery.

1.3 Differentiation of malaria species

Giovanni Batista Grassi and Raimondo Filetti are first who mentioned the names of parasites of malaria *Plasmodium vivax* and *P. malariae* which infect people in 1890. The both specialist were Italian. Laveran had believed that there was only a single animal categories, Oscillaria malariae. An American scientist named William H. Welch, discovered the subject and, he named the threatening tertian malaria parasite P. falciparum. There were several arguments against the application of this name; notwithstanding, the application was so broad in the writing that a change back to the name given by Laveran was never again thought conceivable. In 1922, John William Watson Stephens portrayed the fourth malaria illness parasite, *P. ovale. P. knowlesi* was first depicted by Robert Knowles and Biraj Mohan Das Gupta in 1931 out of a since quite a while ago followed macaque. Human disease occurred with *Plasmodium knowlesi* was last filled in 1965.

1.4 Malaria in Chinese history

Amid the 101-200 BCE, the Qinghao plant (Sweet wormwood) was depicted in the therapeutic treatise, 52 Remedies, found in the Mawangdui Tomb in China. In the United States, this plant is known as the yearly or sweet wormwood. This plant has the anti-fever properties and it was mentioned by Ge Hong of the East Yin Dynasty in 340 CE. The dynamic element of Qinghao, known as artemisinin, was secluded by Chinese researchers in 1971. Subordinates of this

concentrate, referred to on the whole as artemisinins, are today exceptionally strong and viable antimalarial drugs, particularly in blend with different solutions.

1.5 Malaria in Bangladesh

Bangladesh is the country which has 13 malaria endemic districts among 64 districts. Malaria is one of the dangerous diseases among the mosquito-related diseases. They are occurred by the bite of female Anopheles mosquito. The interesting part of this mosquito is that the Anopheles must be infected itself prior to infecting humans. Only the infected Anopheles mosquito can spread malaria. They carry the Plasmodium parasite and whenever they bite the person, they put plasmodium parasite into the bloodstream. World Health Organization has declared 'Malaria' as a public health problem in Bangladesh. There are 13 endemic districts in Bangladesh and among them, 3 hill districts are highly affected by malaria. The three hill districts Khagrachari, Bandarban, and Rangamati contribute 80-90% of the total case all over the country. Moreover among those 3 hill districts 'Bandarban' has the more endemic rate according to NGO health worker at Bandarban. At 2007, 'Khagrachari' was the highest prevalence rate according to the NCBI report which was carried out by BRAC and ICDDR, B. Among the parasite of Plasmodium, the rate of *Plasmodium falciparum* affected patient is dominantly comparing with the *Plasmodium vivax.* Government and NGO are both working together to remove malaria totally hand to hand. The vision of Government of Bangladesh is "Malaria free Bangladesh". On the other hand, the goal of the Government of Bangladesh is "Zero indigenous transmission and zero death, aiming malaria elimination in Bangladesh by 2020". Govt. of Bangladesh requested for funding for malaria program as $26.6 million to 'The Global Fund' (2016, 26th December). Govt. of Bangladesh is running the malaria program as the name of 'National Malaria Control Program (NMCP)'. Diagnosis and treatment of the malaria are available in the remote area. The government is working with NGO to reach the treatment, diagnosis and awareness program in a remote area of hill tracts. NGO has the more field worker and health personnel than the Govt. and they help Govt. officials to achieve the vision and goals which they announced.

Malaria is a blood-borne protozoan parasite passing on individual to individual by bite of female Anopheles mosquitoes. There are almost 500 million cases every year around the world and around 1 million deaths. The lion's share of deaths from malaria are among youngsters in sub-Saharan Africa, where more than 85% of total deaths happen by malaria. Travelers who travels endemic regions may become infected and carry the parasites along with symptoms like ill with high fever, shaking chills, headache and some other symptoms which take months to expose in the body, when plasmodium parasites had been incubating in liver cells are released into the systemic circulation, conquer red blood cells (RBCs) and making replica to produce succeeding generations of parasites. In the United States around 1500 cases are accounted for yearly, with all cases in returned voyagers. Four types of species are cause of malaria disease and they are *P. falciparum, P. vivax, P. ovale,* and *P. malariae*. A simian species, *P. knowlesi,* has been recognized as an irregular cause of some human infections acquired in regions of Southeast Asia. *Plasmodium falciparum*

and *Plasmodium vivax* are very common, but *Plasmodium falciparum* causes most severe disease condition to the patient and is the target of major prevention programs, especially in Africa. Infections by *Plasmodium falciparum* may result in death within a few days after the symptoms starts to show as fever, because of high levels of parasitemia, if not diagnosed properly and treated with recommended drugs. Drug resistance has been noticed to chloroquine, sulfadoxine-pyrimethamine, mefloquine (Jong, n.d.)

According to the WHO, there were 429,000 malaria deaths in 2015. A long time ago DDT was sprayed to eradicate malaria. It was the good choice at that time. USA based organization Centers for Disease Control and Prevention (CDC) have briefed about malaria elimination by DDT before it was banned. With the achievement of DDT, the approach of less lethal, more compelling engineered antimalarials, and the energetic and critical conviction that time and cash were of the embodiment, the World Health Organization (WHO) presented at the assembly of World Health occurred in 1955 an ambitious proposition for the elimination of malaria around the world. Annihilation endeavors started and concentrated on house spraying with unused chemical insecticides, antimalarial drug treatment, and investigation, and would be done in 4 steps: preparation, attack, consolidation, and maintenance. Successes included eradication in countries with calm atmospheres and occasional malaria transmission. A few nations, for example, India and Sri Lanka had sharp decreases in the number of cases, trailed by increments to significant levels after endeavors stopped. Different countries had negligible progress, (for example, Indonesia, Afghanistan, Haiti, and Nicaragua). A few countries were avoided totally from elimination campaign (the vast majority of sub-Saharan Africa). The rise of medication obstruction, across the board protection from accessible insecticides, wars and huge population movements, challenges in getting maintained subsidizing from benefactor nations, and absence of network cooperation made the long haul support of the exertion untenable. Finishing of the eradication campaign was in the long run abandoned. The objective of most current National Malaria Prevention and Control Programs and most malaria exercises directed in endemic nations is to decrease the quantity of malaria-related cases and deaths. To decrease malaria spread to a level where it is not anymore a usual medical fact is an objective of what is called malaria "control."

1.6 Malaria prevalence in Bangladesh

The cases of malaria in Bangladesh was negligible before 1971. Before 1971, there was frequent use of DDT due to malaria eradication program by the East Pakistan Govt. After the 1971 war, the DDT was banned from Bangladesh at 1985 and the cases of malaria had risen up (Ahmed, Islam, Haque, & Hossain, 2008). DDT was banned because it caused bad impact on human body. According to the Pesticide Action Network, DDT and the breakdown product DDE can cause breast and other cancers, delay in development of baby, infertility of male, damage of liver, problem in nervous system, miscarriages, low rate of birth etc.

1.7 Objectives of Government of Bangladesh on malaria

Government of Bangladesh has already announced the "National Malaria Strategic Plan (2015-2020)". It included vision, mission, goal and objectives. They are described briefly and there are 5 objectives to achieve the goals and vision. Here, the objectives are noted as follows,

- Objective 01: It indicates to achieve 100% coverage of population who are in 'at risk' with appropriate malaria preemptive interventions by 2018.
- Objective 02: It indicates to give 100% malaria patients early and effective diagnosis and treatment by 2018.
- Objective 03: It indicates to make malaria program management strong towards elimination by 2020.
- Objective 04: It indicates to make disease and vector surveillance strong and monitor and evaluation towards elimination of malaria.
- Objective 05: It indicates to intensify advocacy, communication and social mobilization (ACSM) for elimination of malaria.

1.8 Diagnosis of malaria

WHO states about the rapid diagnosis test (RDT). Rapid diagnostic tests (RDTs) aid the analysis of malaria showing the existence of parasites of malaria in blood. RDTs are a contrasting option to finding in view of microscopy, especially where great quality microscopy administrations can't be promptly given. Varieties happen between items, for example, targets and formats, however the standards of the tests are comparable. Malaria RDTs identify particular antigens created by malaria parasites in the infected people's blood. Antigen are proteins. Some RDTs can recognize just a single animal varieties (*Plasmodium falciparum*) while others identify various species (*P. vivax*, *P. malariae* and *P. ovale*). For the test, blood is usually acquired from a finger with pin line needle. This tests are immuno-chromatographic antigen-recognition tests, which depend on the catch of color marked immunoglobulin to create an obvious band of nitro-cellulose in the strip, regularly boxed in plastic packet, suggested to as cassettes. The color marked immunoglobulin first combines with parasite antigen, and the combination is caught on the strip by a band, framing an obvious line (T - test line) in the outcomes window. C-control line gives data on the solidarity of the immunoglobulin color conjugate, yet does not affirm the capacity to identify the antigen which is produced by malaria parasite.

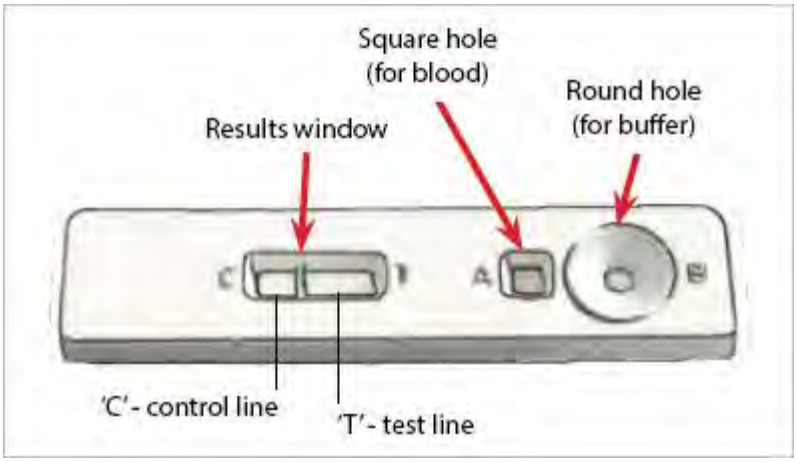
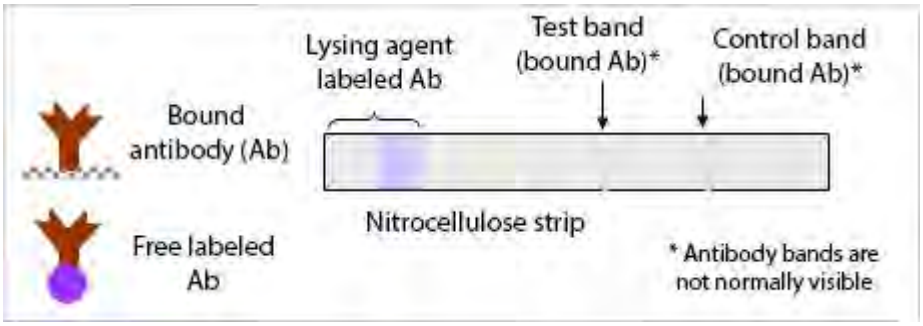


Figure 1.1: RDT cassette

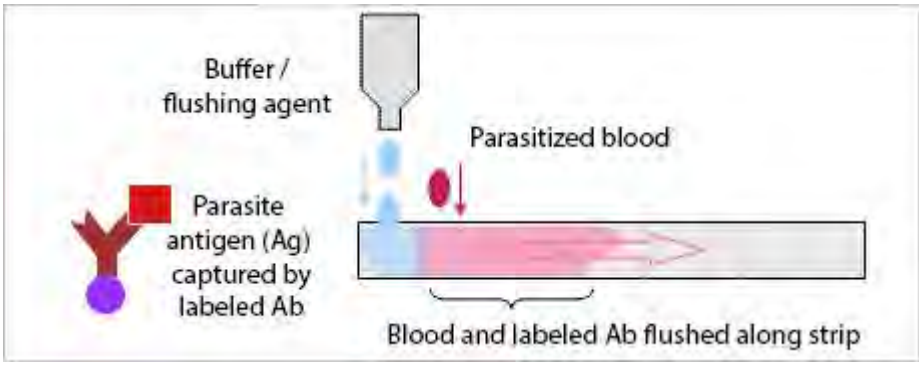
Strips are inside the cassette. They are made of nitrocellulose and filter paper. Commonly, place a drop of blood to the RDT through square hole (A; example well), and after that various drops of buffer for the most part through another opening (B; cradle well). It conveys the blood as well as the length of the RDT.

Format of Mode of action (M/A) of RDT:

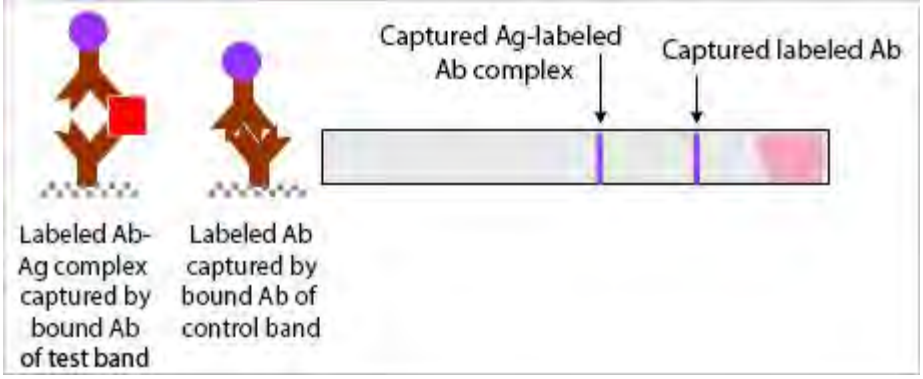
I. The initial move of this test system includes blending the blood of patients with a lysing agent in a test strip. It bursts the RBC, make the discharge of more parasite protein.



II. Dye named antibody, particular for target antigen, is available on the lower end of nitrocellulose strip. Buffer is used to move the parasitized blood and antibody thoughout the stipe. Considering the antibody response, the objective antigen bound to the test line and the other antigen bound to the control band.



III. Blood and support, which have been put on strip or in the well, are blended with named neutralizer and are shown the strip over the lines of bound counter acting agent.



IV. In the event that antigen is available, some marked antibody-antigen complex will be caught and collect on the test line. The rest amount of labeled antibody is caught and assemble on the control line. An obvious control line shows that named antibody has crossed the full length of the strip, past the test line, and that in any event some free antibody stays together to the dye and a portion of the catching properties of the Ab stay intact.

V. Fluctuation of the intensity of the test band will depend on the antigen, in any event at low parasite (antigen) concentration, as this will decide the measure of dye particles which will gather on hold. The control band power may diminish at higher parasite thickness, as a great part of the named antibody will have been caught with the test band before achieving the control.

1. 9 Treatment of malaria patient

National malaria control program (NMCP) has already published and distributed the leaflet of drug maintenance to the Governmental health complex and NGO personnel. The leaflet includes drug management for both *Plasmodium falciparum* and *Plasmodium vivax*. Generally, PV (*Plasmodium vivax*) malaria patients need to take 2 medicines. Chloroquine 3 days and primaquine 14 days both

must continue for the PV (*Plasmodium vivax*). It is important to be mentioned that, weight is an important parameter whenever PV malaria patient take the medicine.

Table 1.1: Depending on the weight the treatment with Chloroquine tablet chart for PV.

Days	Tablet	Weight (Kg)					
		6-9	10-19	20-29	30-39	40-49	50+
01	Choloroquine tablet (150mg)	1/2	1	1 ½	2	3	4
02	Choloquine tablet (150mg)	1/2	1	1 ½	2	3	4
03	Choloquine tablet (150 mg)	1/2	1	1 ½	2	2	2

Moreover, Primaquine need to take 14 days once in daily of 0.25 mg/Kg weight.

For *Plasmodium falciparum,* a malaria patient must take 2 types of drug and they are ACT (Artemisinin-based combination therapy) for 3 days and primaquine for 1 day. ACT drug must be taken twice daily for 3 days.

Table 1.2: Depending on the weight the treatment with ACT (Artemisinin-based combination therapy) chart for PF.

Weight (Kg)	Day 1		Day 2		Day 3		Total tablet quantity	Total dose quantity
	0 H. 1st dose	8 H. 2nd dose	24 H. 3rd dose	35 H. 4th dose	48 H. 5th dose	60 H. 6th dose		
5-<15	1	1	1	1	1	1	6	6
15-<25	2	2	2	2	2	2	12	6
25-<35	3	3	3	3	3	3	18	6
≥ 35	4	4	4	4	4	4	24	6

Primaquine tablet must be taken once for the whole treatment at the 1st day depending on the body weight for 0.25 mg/Kg.

To make malaria control successful, efficacious anti-malarial drug is needed. Malaria endemic countries like Bangladesh has a National Malaria Treatment Policy which has some fixed drugs as well as the treatment procedure depending on the geographical area and the treatment policy or chart are given above of the introduction. “Malaria parasites was developing resistance to the existing drug and new drugs was needed to be introduced” said by an organization name Malaria Consortium. They also added that, different combination is proposed to control the *plasmodium falciparum* and give expected cure rate and delay the progress of drug resistance.

ACT (Artemisinin-based combination therapy) are now welcomed as best treatment for the Pf malaria. They are found rapidly and reliably effective. Here, efficacy is depend on the artemisinin derivative. There are artesunate–mefloquine, artemether–lumefantrine, and dihydroartemisinin–piperaquine and their efficacy rate exceeds 95%. On the other hand, there are also some other effective combination for some other areas and they are artesunate–sulfadoxine–pyrimethamine and artesunate–amodiaquine. There was still uncertainty about the safety of the pregnant malaria patient. Moreover, the artemisinin derivatives are safe and well compatible with body except for occasional hypersensitivity reactions (Nosten, & White, 2007). Due to malaria, the deaths of pregnant and children can be avoidable because of availability of new generation antimalarial drugs. Monotherapies for antimalarial patient was very effective at the time of 1960, but clinicians were restricted to prescribe monotherapy due to drug resistance in the body. To give more effectiveness of drug, ACT was taken as policy (Whitty, Chandler, Ansah, Leslie, & Staedke, 2008)

1.10 Malaria prevention by using LLIN

Long lasting insecticide nets are distributed and used since WHO provided them to the govt. and local NGO form malaria prevention (Shannon et al., 2016). BRAC has chosen field Community Health Workers from their own particular network and included them to achieve poor people and individuals living in zones with constrained access to treatment administrations supplementing the administration's medicinal services framework. They give locally established care of malaria conclusion and treatment. They likewise give malaria related data particularly on transmission of malaria, bed net utilization, intestinal sickness side effects and accessible treatment administrations at network level. Diverse refinement gatherings are led with conclusion and religious pioneers, nearby government and common society agents to build mindfulness on intestinal sickness avoidance and administration. An ongoing overview demonstrated that net use rate among kids under five is 90% and among pregnant ladies is 85% in jungle fever endemic locale. The national disease particular report demonstrates a significant decrease in malaria cases from the standard year 2008 (84,690 cases) to 2013 (26,891 cases), a 68% diminishment of cases. Expanded utilize rate of LLIN/ITN alongside early looking for of locally situated intestinal sickness administration is the way to achievement in jungle fever control (Kabir et al., 2014). Long Lasting Insecticidal Net (LLIN) are given to the community every 3 years according to a health worker from BRAC. They exchange the old LLIN with the new LLIN. They also added that, Long Lasting Insecticidal Nets (LLIN) are delivered to them by WHO.

1.11 Mutation of malaria parasite in Bangladesh

Artemisinin resistance in Plasmodium falciparum has not been proven yet. The clinical understanding is a moderately moderate parasite clearance rate in patients getting artemisinin or artemisinin combination treatment (ACT). In low malaria transmission territories, parasite removal contemplates require screening of thousands of febrile people to enlist a couple of patients. Hence,

these examinations can be strategically and monetarily troublesome and badly arranged for patients. From biological point of view, in vitro contemplates have looked for a reasonable molecular marker to recognize artemisinin resistance in P. falciparum parasites. Transformation and changeable expression of a few qualities, for example, PfMDR and PfATPase6 have been proposed yet not proven. As of late, the K13 propeller gene PF3D7_1343700 (PF13_0238) has been connected to in vitro artemisinin resistance and in vivo moderate parasite remover rate and subsequently proposed as artemisinin resistance marker.

K13 propeller has been pictured to comprise of three areas 225 amino acid: I) Plasmodium-particular and well conserved N-terminal domain; ii) a BTB/POZ domain; and, iii) a six-cutting edge C-terminal propeller domain fixture of canonical kelch motifs. It containing proteins are developmental preserved crosswise over various kind and assembled into KLHL compose proteins. The human host have 42 of these KLHL-type proteins. KEAP1 protein, has most extreme similarity with Plasmodium K13 protein. KEAP1 protein from human is a negative controller of the inducible atomic erythroid 2-related factor 2 (Nrf2) - subordinate cytoprotective reaction, sequestering Nrf2 in the cytoplasm under resting state. The transcription factor Nrf2 ties to the cancer prevention antioxidant response element (ARE) available in promoters of genes engaged with stage II detoxification and oxidative pressure responses.Nrf2 shapes a heterodimer to actuate Maf transcription factor protein that ties to the ARE and activates transcription through the Maf recognition elemenet (MARE). KEAP1 is included Nrf-2 debasement by focusing on it for ubiquitination through the cullin 3 ligase combination. In this way, it is expected that the K13 propeller plays out a comparative capacity in the P. falciparum and transformation in the genes weaken anti-oxidant/cytoprotective capacity. However, no orthologue of Nrf2 has been distinguished in Plasmodium parasite genome.

Bangladesh is a malaria endemic nation with the border to India and Myanmar. Bangladesh has influenced extraordinary walks in malaria to control with a 65% decline in all out malaria cases. It also includes 91% lessening in malaria related mortality in between from 2008 to 2012. The quantity of national cases went between 26.891 and 63, 873 in the vicinity of 2009 and 2013 as indicated by the National Malaria Control Program. High scope and expanded utilization of insecticide treated nets, utilization of rapid diagnostic tests for case location at the network level, hostile to malarial medications with ACT, and the community field health workers and new solutions have contributed fundamentally to this accomplishment. Ministry of Health and Family Welfare (MoHFW) has presented artemether-lumefantrine (Coartem©) for the treatment of uncomplicated falciparum malaria since 2004 and the procedure has quickened with force from the Global Fund in 2007. ACT are considered as the last line of defense for the malaria occurred by P. falciparum. Since 2004, ACT remains very fruitful in Bangladesh. However the expansion of heritable artemisinin-safe malaria parasite in the Thai-Cambodia outskirt, and accordingly in the Thai-Myanmar border to southern Myanmar, is troubling for the Bangladesh-India-Myanmar tri-nation border area. Correct populace development in this border area isn't characterized on the grounds that immense unlawful developments are included. Rohinga community of Myanmar have

officially shaped a few evacuee camps in Bangladesh and still their number is expanding because of common war in Myanmar. Both transport of opposition by means of movement and all over again development of artemisinin obstruction are conceivable. Already, chloroquine and sulphadoxine/pyrimethamine-safe parasites developed in Thai-Cambodia boder, thusly spreading to sub-Saharan Africa over the Asia. Subsequently, observing of resistance of artemisinin in Bangladesh is an essential medical issue. The present investigation expected to distinguish the nearness or nonappearance of transformations in the K13 propeller quality of Bangladeshi P. falciparum clinical isolates in conjunction with structural examination to survey the functional implications of mutation display.

Malaria patients infected by Pf relating Upazila health complex (UHC) of seven endemic areas of Bangladesh were incorporated into this study. These regions include Khagrachari (Matiranga), Rangamati (Rajasthali), Cox's Bazar (Ramu and Ukhia), Bandarban (Lama), Mymensingh (Haluaghat), Netrokona (Durgapur and Kalmakanda), and Moulvibazar (Sreemangal and Kamalgonj). Informed consents were gotten from the patients or their legitimate guardians on account of kids and consent from youngsters matured 11– 17 years. A sum of 296 P. falciparum positive blood tests affirmed by field and lab microscopy in the middle of May 2009 and 2013 was gathered for this examination. Assent was likewise taken for later utilization of blood tests. The examination was affirmed by the Ethics Review Committee (ERC) of International Center for Diarrhoeal Disease Research, Bangladesh (icddr,b).

Table 1.3: Specific UHC and samples count and non-synonymous mutations.

Name of district	**UHC**	**Samples (N)**	**K13 Nested PCR and sequencing N (%)**	**Non-synonymous Mutation N (%)**
Bandarban	Lama UHC	14	149(100)	0(0.0)
Cox’s Bazar	Ramu and Ukhia UHC	74	69(93.2)	0(0.0)
Netrokona	Durgapur and Kalmakanda UHC	10	9(90)	0(0.0)
Mymensingh	Haluaghat UHC	2	2(100)	0(0.0)
Khagrachari	Matiranga UHC	154	144(93.5)	2*(1.29)
Rangamati	Rajasthali UHC	6	5(66.7)	0(0.0)

Name of district	UHC	Samples (N)	K13 Nested PCR and sequencing N (%)	Non-synonymous Mutation N (%)
Moulvibazar	Sreemangal and Kamalganj UHC	11	11(100)	0(0.0)
	Total	271	254(93.7)	2(0.78)

*The mutation A578S was identified in two unrelated individuals with genetically distinct isolates (Mohon et al., 2014).

According to the reports and data, the geographical figure is showed here including malaria endemic area, no-synonymous mutation, synonymous mutation and non-mutation.

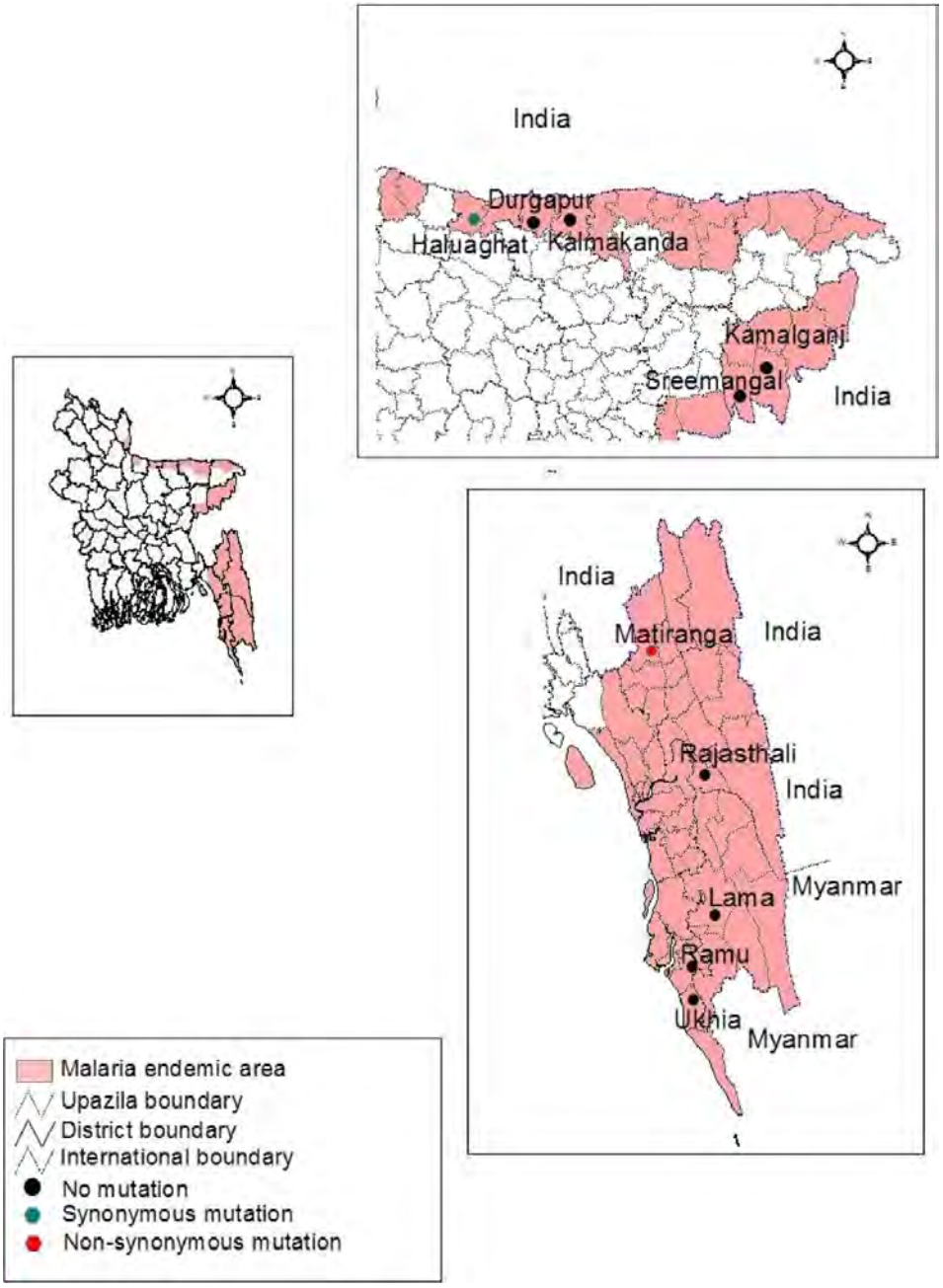


Figure 1.2: Geographical scenario of Plasmodium falciparum K13 gene mutations.

2. Methodology

2.1 Research objectives

The objectives of this research are to identify the present condition of malaria in the malaria endemic area specifically in Bandarban which is known as most endemic area among the 13 endemic area of Bangladesh. This study also analyzes the relationship between water and drainage system distance with the malaria possibilities.

2.2 Sample collection

For this study, sample were taken from the Badranban town, outside the local area of the Bandarban thana, thanchi local area, and local road side of Bandarban- Thanchi highway. A total of 144 *Plasmodium falcifarum* and *Plasmodium vivax* patients are counted for this study. The malaria patients are counted randomly from mentioned area. Their name were noted on confidential document as evidence of this study. The patients were agreed orally to give response to the questionnaire of this study and help to study the analysis on the malaria topic. Moreover, this survey is occurred during Mid-May of 2018. Among the samples, male and female are noticed, but other or third gender was not noticed.

2.3 Analysis

Samples have responded to the questions of questionnaire and the data are noted in Microsoft excel and SPSS. In the Microsoft excel, the confidential data of each sample have noted and other responses from the sample have also noted in both SPSS and excel for analysis. In SPSS, there is descriptive statistics and most of the study is done by frequencies sub-sectioned of analyze tool.

2.4 Research questions

Section 1A: Household information

1. Sample id?
2. Gender of sample?
3. Do you usually live here?
4. Do you usually live anywhere else?
5. What is your age?

Section 1B: Household Characteristics

1. How close is nearby water source?
2. Is there any nearby drainage system?
3. What is the main material of the floor?
4. What is the main material of the roof?

5. What is the main material of the exterior walls?
6. Do you use standard toilet facility?
7. How frequently is anti-mosquito chemical sprayed in your area?
8. Who sprayed anti-mosquito chemical past twelve months mostly?
9. Do you use mosquito nets?
10. Do you use mosquito coils?
11. Do you use electric mosquito bat?
12. Do you have any electronic devices such as smartphone, TV or computer at your home?

Section 2A: General knowledge and awareness of malaria

1. Do you know about malaria?
2. Do you know how one is affected by Malaria?
3. Do you know the name of the parasite which causes malaria?
4. Do you think that you can identify malaria at first glance?
5. Do you know about sanitary latrine?
6. Do you know the necessity of hand washing after using latrine?
7. Do you know about water-borne diseases?
8. Do you know how to purify water?
9. Do you know the symptoms of malaria?

Section 2B: Source of malaria related information

1. Source of information?

Section 3A: Specific information of malaria patient

1. Have you ever been encountered with malaria in last two years?
2. Have you suffered from malaria before 2015?
3. Have you suffered from malaria more than once in your lifetime?

Section 3B: Treatment of malaria

1. Which type of treatment did you seek for Malaria?
2. Where did you take the treatment?
3. Which anti-malarial drug did you take?

Section 3C: Duration of treatment

1. How long have you been ill?
2. When did your treatment start?

*This section gauges public opinion on the basis of statement evaluation questions.

3. Results

Section 1A: Household information

1. Sample id?

Samples of this study have specific id for future recognition. Every id has confidential data and this data are saved in Microsoft excel.

2. Gender of sample?

Among the samples, 79.2% are male and 20.8% are female and there is 0% of other. This percentage is telling us that, female have high possibility of being malaria infected than male.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	114	79.2	79.2	79.2
	Female	30	20.8	20.8	100.0
	Total	144	100.0	100.0	

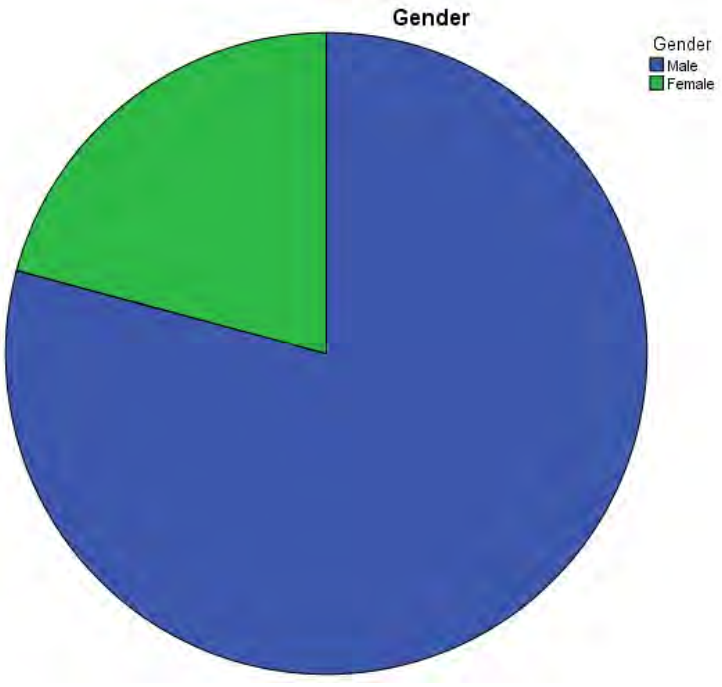


Figure 3.1: Samples response to gender related question

3. Do you live here?

88.9% of samples are local and 11.1% samples don't live there. According to the analysis, most of the samples live locally.

Live here

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	128	88.9	88.9	88.9
	No	16	11.1	11.1	100.0
	Total	144	100.0	100.0	

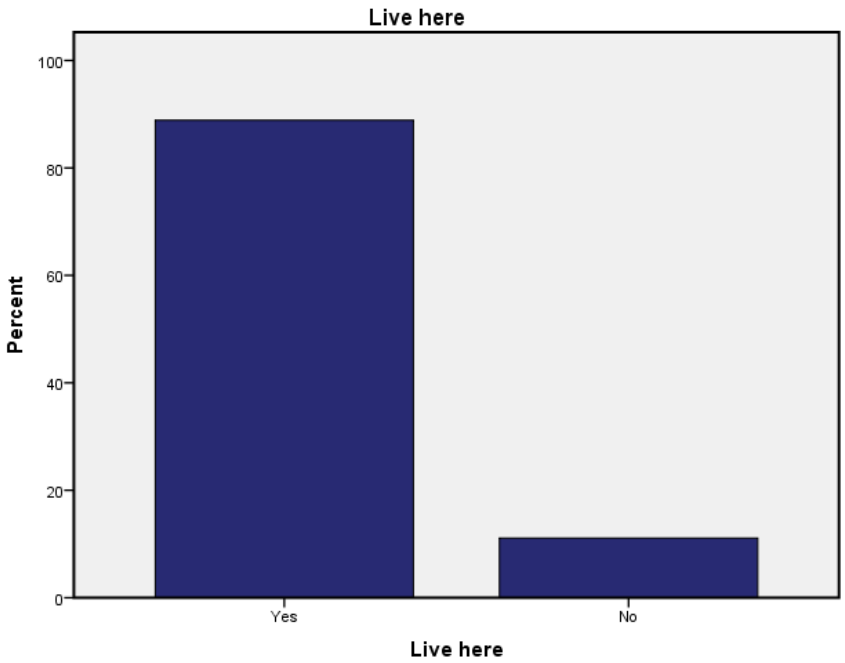


Figure 3.2: Response of the sample on residence.

4. What is your age?

In this question, 10.4% sample responses are under 18 years, 31.3% sample responses are 18-35 years and 58.3% sample responses are 36 years or older than that.

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 18	15	10.4	10.4	10.4
	18-35	45	31.3	31.3	41.7
	36 or older	84	58.3	58.3	100.0
	Total	144	100.0	100.0	

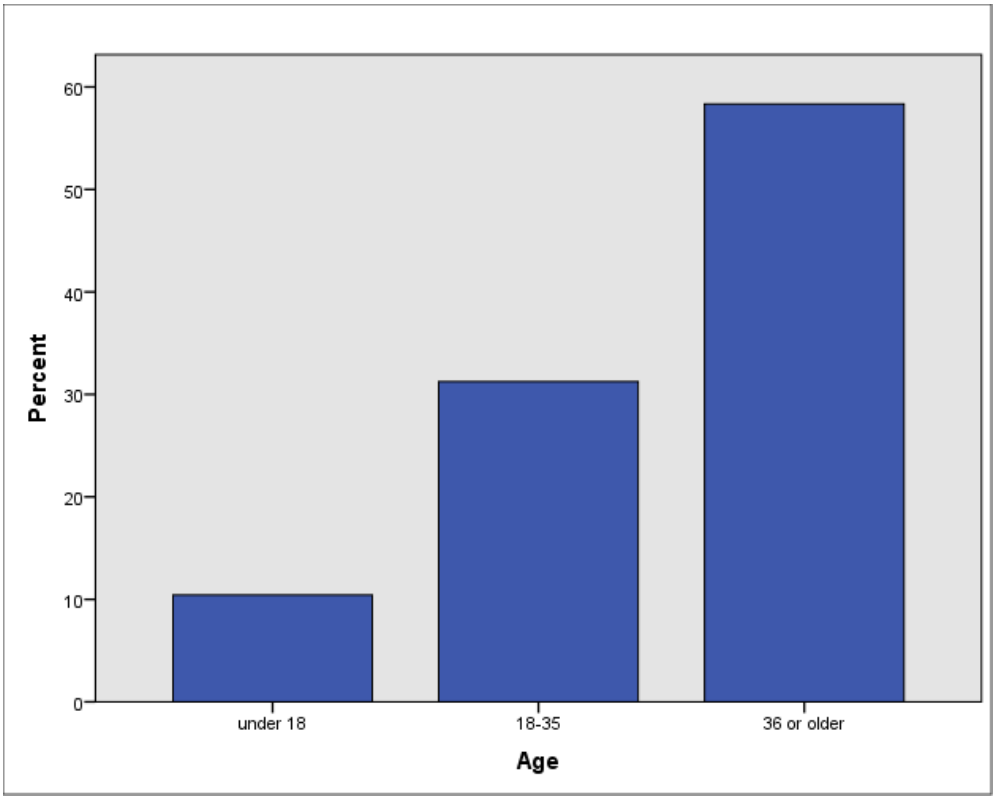


Figure 3.4: Responses on age question.

Section 1B: Household characteristics

1. How close is nearby water source?

According to the analysis, 5.6% malaria infected people live in range 5-10 yards, 11.8% live in 11-20 yards and rest of the 82.6% live in 21-more larger yards. Depending on that analysis, it has shown that, distance of water source is not a good malaria causing factor in Bandarban area.

Water source

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5-10 yards	8	5.6	5.6	5.6
	11-20 yards	17	11.8	11.8	17.4
	21- more yards	119	82.6	82.6	100.0
	Total	144	100.0	100.0	

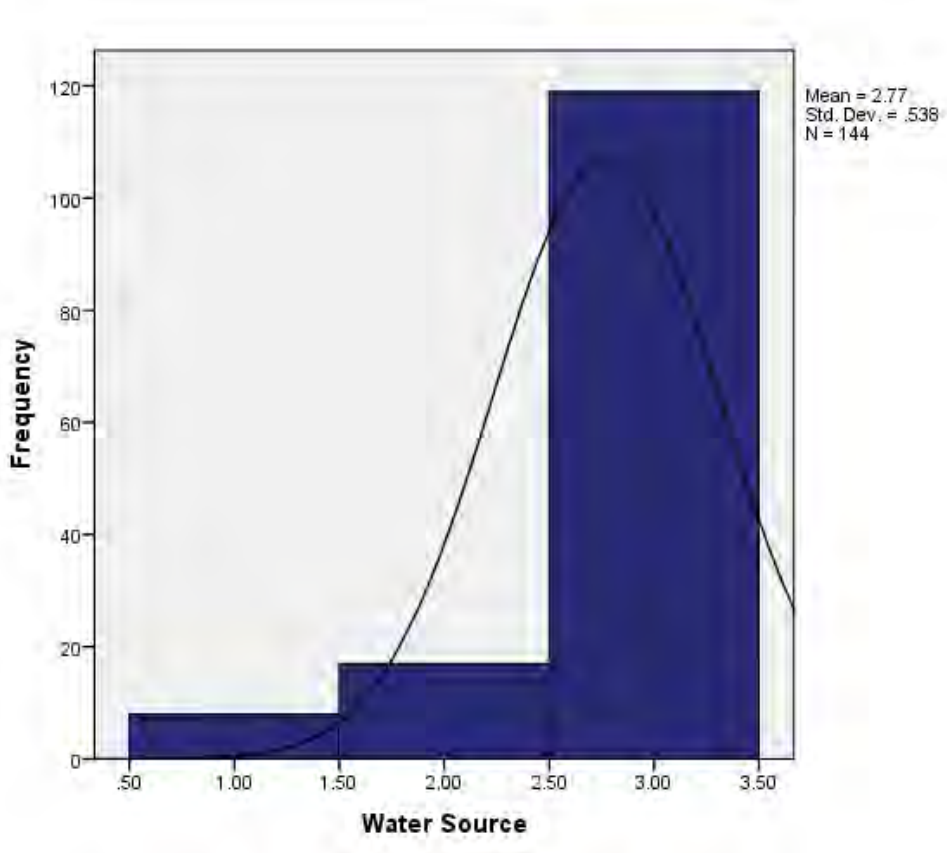


Figure 3.5: Responses of samples on water source question

2. Is there any nearby drainage system?

Drainage system are 5-10 yards distance for 5.6% malaria infected people, 11-20 yards distance for 16% infected people and 21-more yards for 78.5% malaria infected people. Depending on that analysis, it has shown that, distance of drainage system is not a good malaria causing factor in Bandarban area.

Drainage system

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5-10 yards	8	5.6	5.6	5.6
	11-20 yards	23	16.0	16.0	21.5
	21- more yards	113	78.5	78.5	100.0
	Total	144	100.0	100.0	

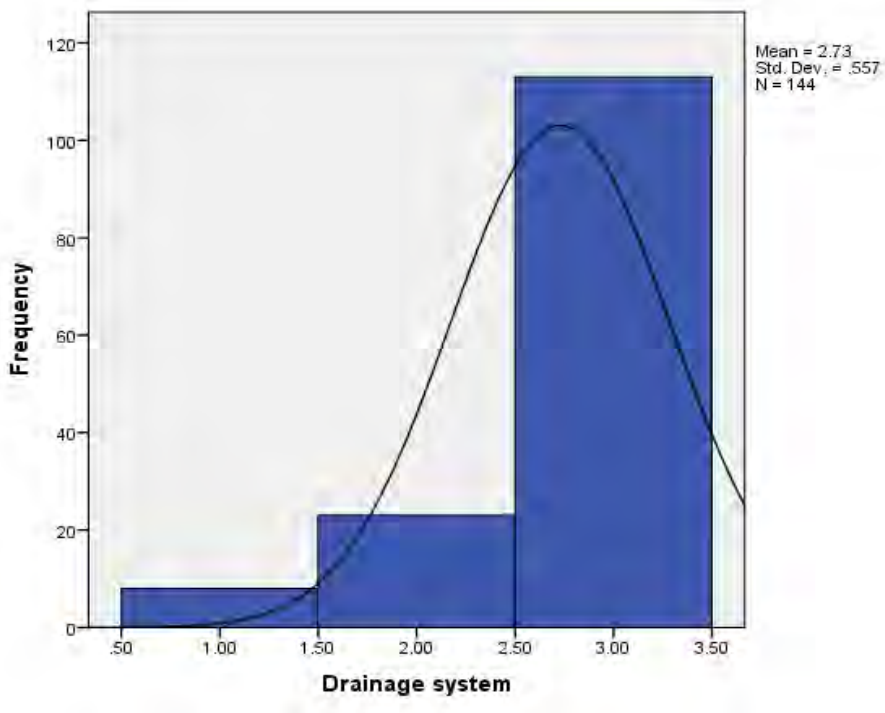


Figure 3.6: Responses on drainage system question

3. What is the main material of the floor?

Based on the responses of the samples, 9.7% malaria infected people have concrete floor, 44.4% malaria infected people have soil floor and 45.8% infected people have wood floor.

Floor material

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Concrete	14	9.7	9.7	9.7
	Soil	64	44.4	44.4	54.2
	Other(wood)	66	45.8	45.8	100.0
	Total	144	100.0	100.0	

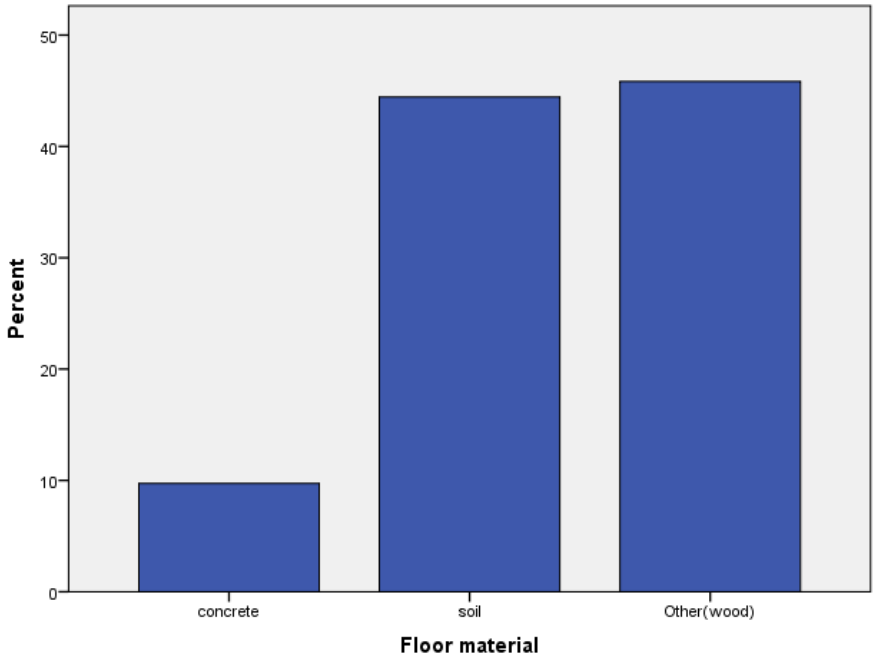


Figure 3.7: Responses of the question on floor material

4. What is the main material of the roof?

9.7% of the sample have concrete material, 61.1% of the sample have tin material and 29.2% of the sample have other material for the roof. It is shown that, most of the samples have the tin material as their roof.

Roof material

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Concrete	14	9.7	9.7	9.7
	Tin	88	61.1	61.1	70.8
	Other	42	29.2	29.2	100.0
	Total	144	100.0	100.0	

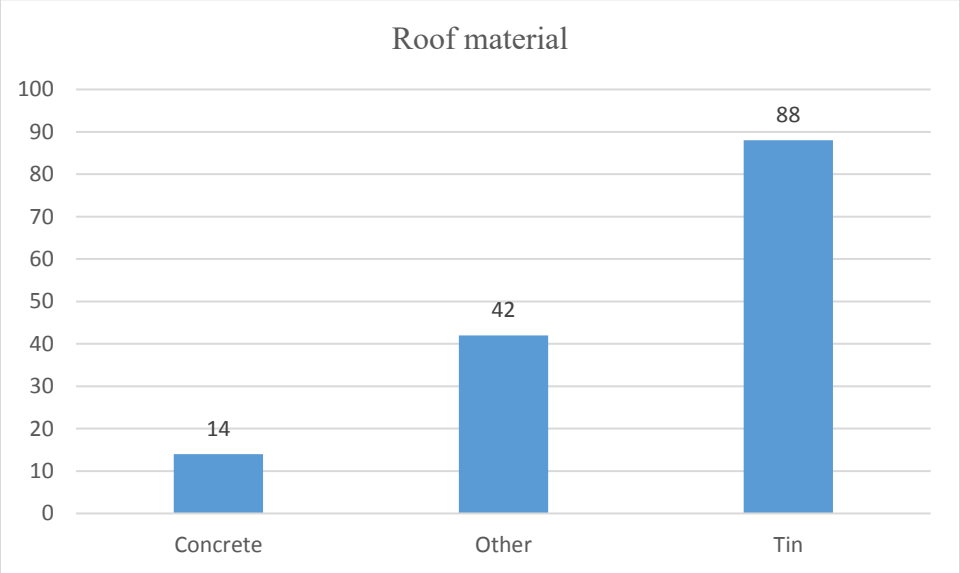


Figure 3.8: Responses of the question on roof material.

5. What is the main material of the exterior walls?

According to the analysis, 10.4% of samples have bricks, 42.4% of samples have soil and 47.2% of samples have other material for exterior wall. Most of the samples have used soil for exterior wall of living place.

Wall material

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bricks	15	10.4	10.4	10.4
	Soil	61	42.4	42.4	52.8
	Other	68	47.2	47.2	100.0
	Total	144	100.0	100.0	

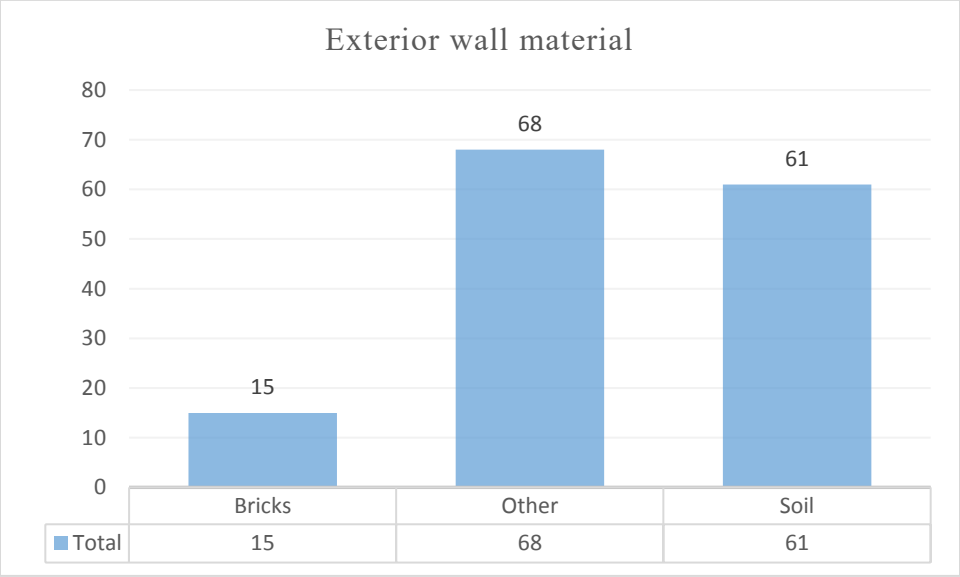


Figure 3.9: Response of the questions on exterior wall material

6. Do you use standard toilet facility?

122 samples do not use standard toilet facility, 16 samples use standard toilet facility and only 6 sample use standard toilet facility occasionally.

Toilet facility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	16	11.1	11.1	11.1
	No	122	84.7	84.7	95.8
	Occasionally	6	4.2	4.2	100.0
	Total	144	100.0	100.0	

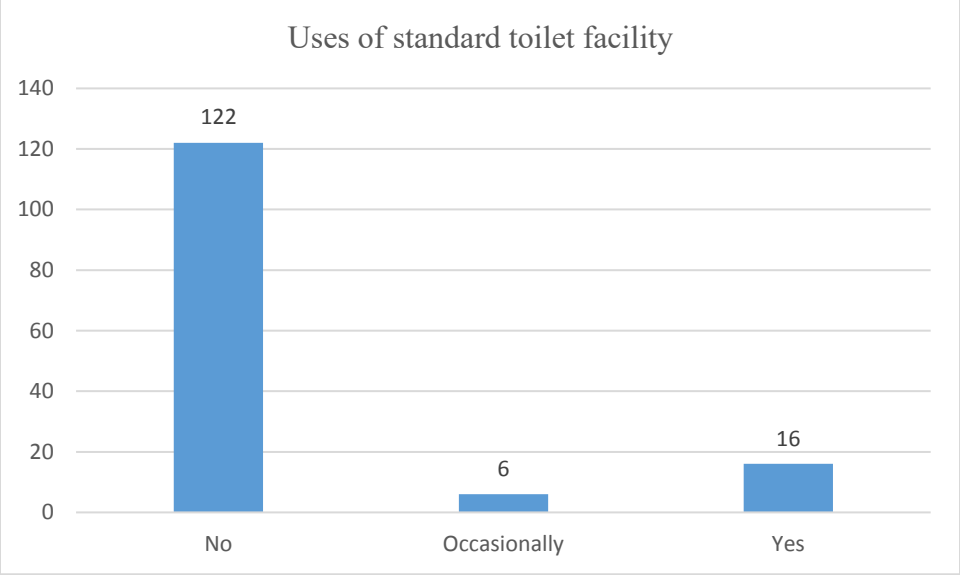


Figure 3.10: Responses on use of standard toilet facility question

7. How frequently is anti-mosquito chemical sprayed in your area?

According to the analysis, 0.7% people responded every week, 2.8% people responded every month and 96.5% people responded every year about the anti-mosquito chemical spray frequency.

Chemical spray

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Every week	1	.7	.7	.7
	Every month	4	2.8	2.8	3.5
	Every year	139	96.5	96.5	100.0
	Total	144	100.0	100.0	

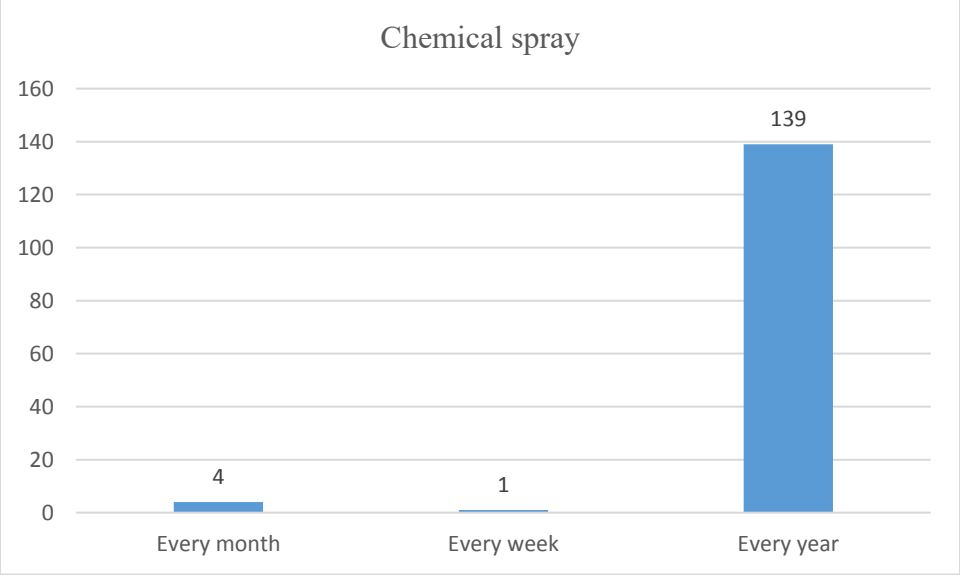


Figure 3.11: Responses on frequency of chemical spray.

8. Who sprayed anti-mosquito chemical past twelve months?

22.2% people have responded govt. personnel and rest 77.8% people have responded non-govt. personnel on anti-mosquito chemical spray authority question. It is shown that, non-govt. organization are more active in the hill-districts of Bangladesh.

Spray personnel

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Government personnel	32	22.2	22.2	22.2
	Non-government personnel	112	77.8	77.8	100.0
	Total	144	100.0	100.0	

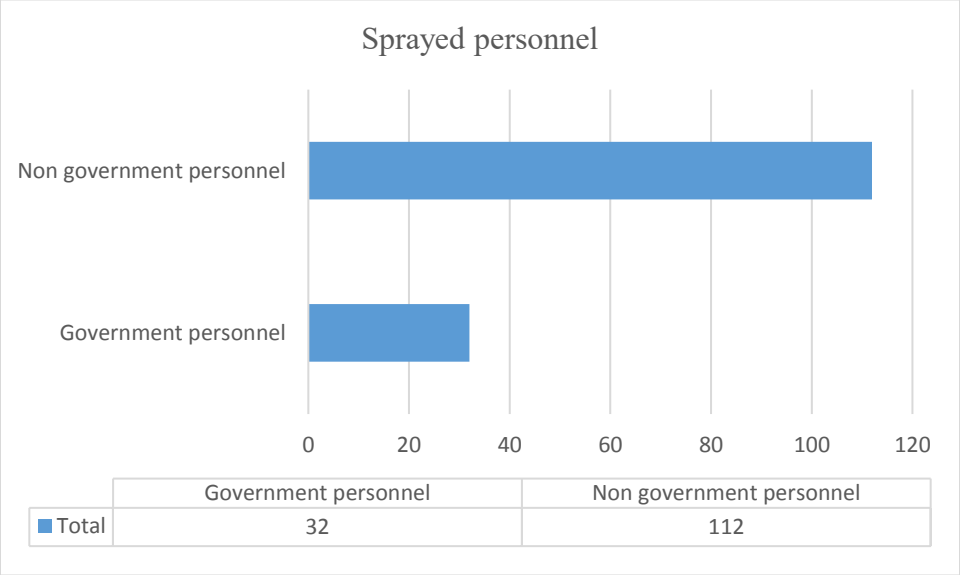


Figure 3.12: Responses on chemical spray personnel.

9. Do you use mosquito nets?

Among 144 samples, 86.1% of people are using mosquito nets and rest 13.9% people are not using mosquito nets. So, 13.9% of people are in danger of being infected by malaria.

Mosquito nets

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	124	86.1	86.1	86.1
	No	20	13.9	13.9	100.0
	Total	144	100.0	100.0	

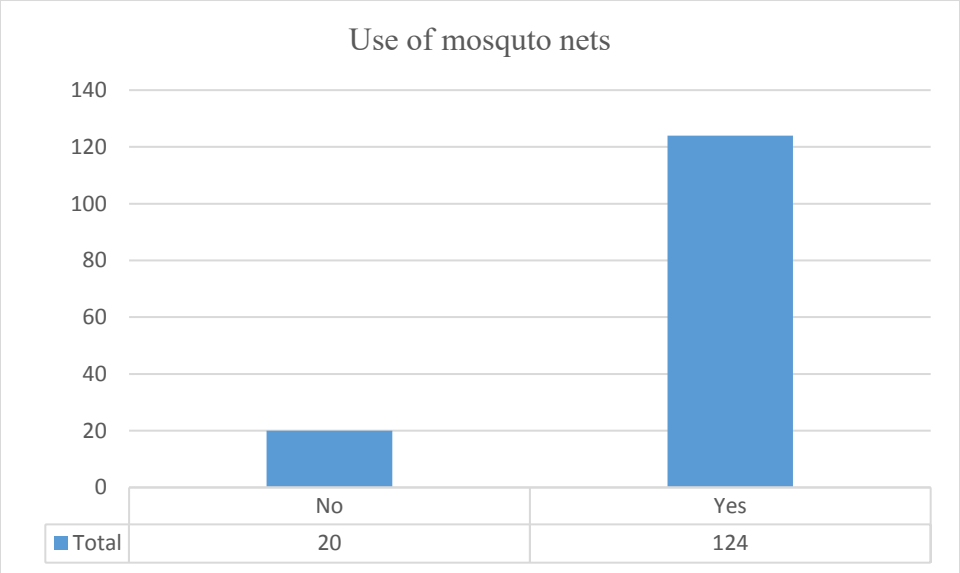


Figure 3.13: Responses on use of mosquito nets use question.

10. Do you use mosquito coils?

77.1% people are using mosquito coil and 22.9% people are not using mosquito coil. This study shows that, 77.1% of people are in danger to face complications cause by mosquito-coil. They must have avoid the mosquito coils and must use the Long Lasting Insecticidal Nets (LLIN).

Mosquito coil

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	111	77.1	77.1	77.1
	No	33	22.9	22.9	100.0
	Total	144	100.0	100.0	

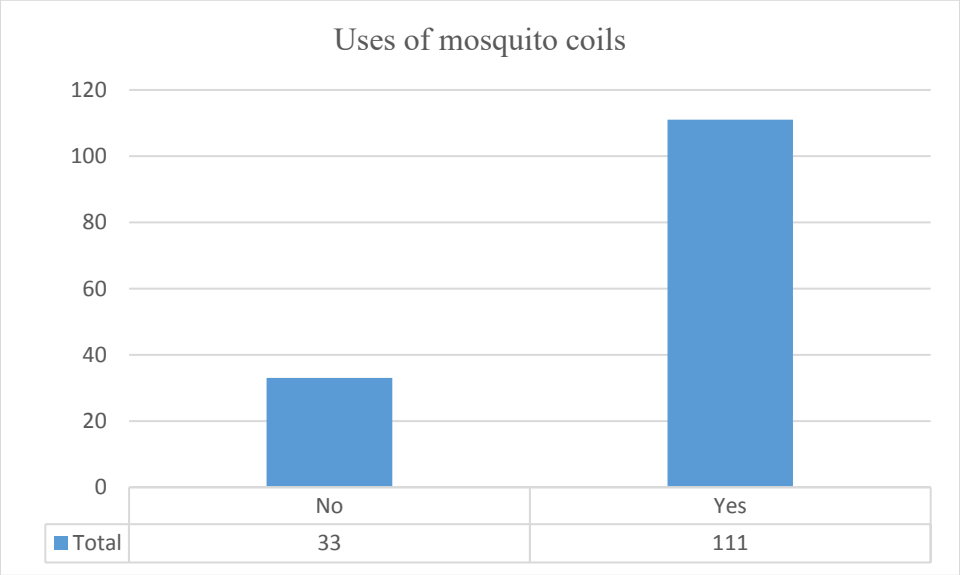


Figure 3.14: Responses on uses of mosquito coils question

11. Do you use electric mosquito bat?

Among the samples, 23.6% people are using mosquito bat and 76.4% people are not using mosquito bat.

Mosquito bat

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	34	23.6	23.6	23.6
	No	110	76.4	76.4	100.0
	Total	144	100.0	100.0	

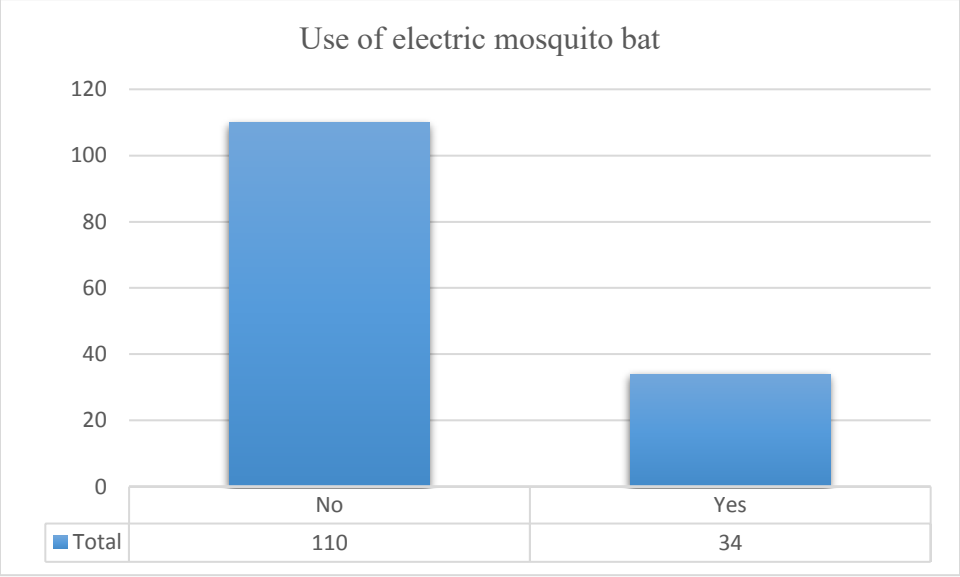


Figure 3.15: Responses on use of electric mosquito bat.

12. Do you have any electronic devices such as smartphone, TV or computer at your home?

Only 6.9% of people don't have electronic device at their home, rest 93.1% people have electronic device at their home. It is shown that, any information regarding malaria or other endemic disease or any kind of warning against any communicable disease, govt. and NGO can use SMS, TV commercial to reach them.

Electronic device

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	134	93.1	93.1	93.1
	No	10	6.9	6.9	100.0
	Total	144	100.0	100.0	

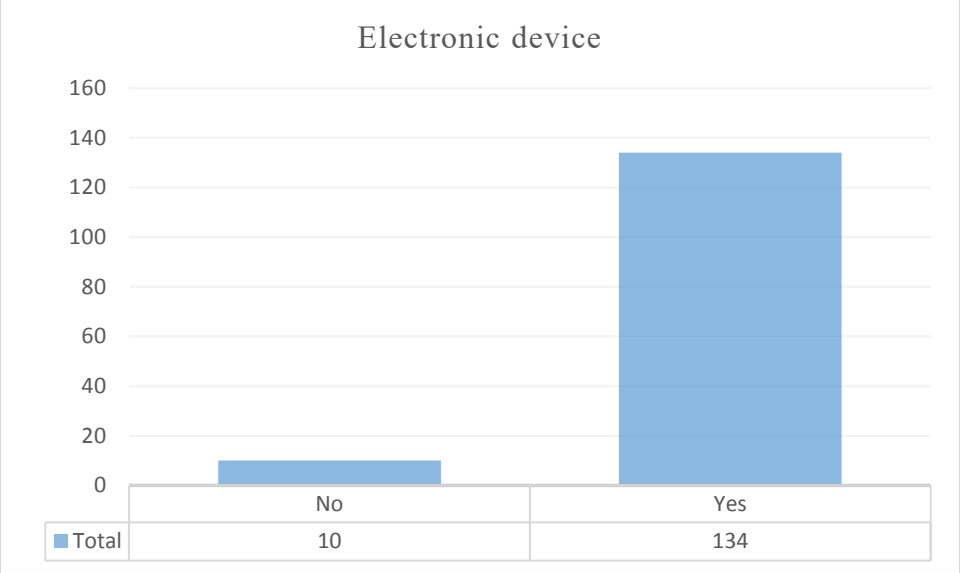


Figure 3. 16: Responses of samples depend on owning of electronic device

Section 2A: General knowledge and awareness of malaria

1. Do you know about malaria?

94.4% of people know about the malaria even after infected after malaria parasite and 5.6% of malaria infected people don't know about malaria.

Malaria knowledge

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	136	94.4	94.4	94.4
	No	8	5.6	5.6	100.0
	Total	144	100.0	100.0	

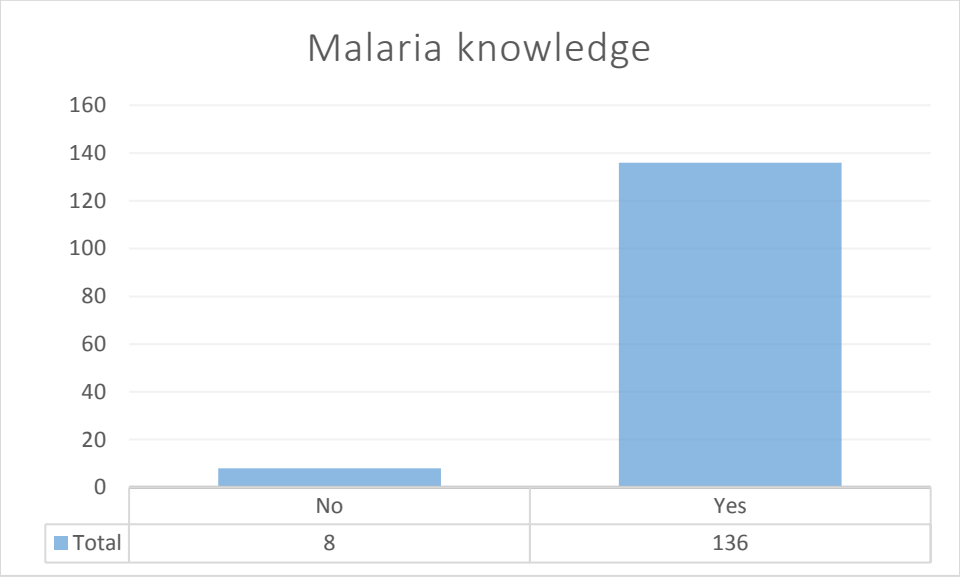


Figure 3.17: Reponses on malaria knowledge question

2. Do you know how one is affected by Malaria?

Based on the study, 93.8% people know about the cause of malaria and 6.3% people don't know about the cause of malaria. It is shown that, 6.3% people have possibility of being infected by malaria again.

Affected by malaria

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	135	93.8	93.8	93.8
	No	9	6.3	6.3	100.0
	Total	144	100.0	100.0	

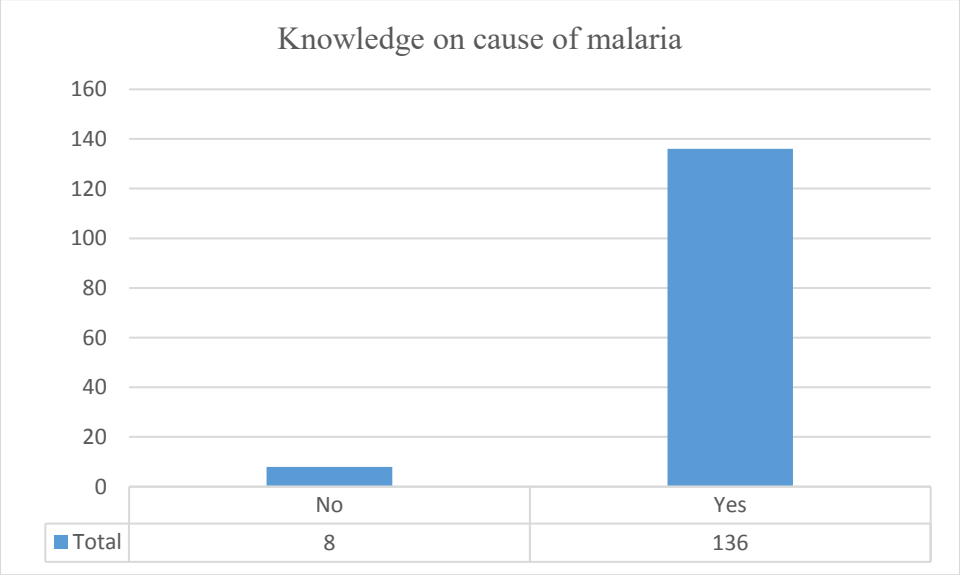


Figure 3.18: Responses on the question of cause of malaria.

3. Do you know the name of the parasite which causes malaria?

6.3% malaria infected people don't know malaria parasite name and rest 93.8% malaria infected people know the name of malaria parasite.

Malaria parasite

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	9	6.3	6.3	6.3
	No	135	93.8	93.8	100.0
	Total	144	100.0	100.0	

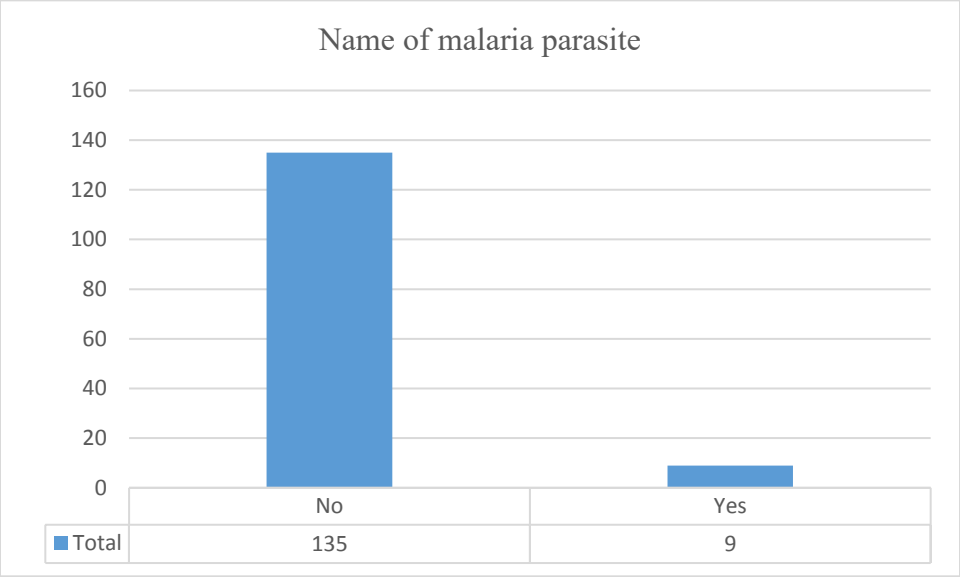


Figure 3.19: Responses on the question of name of malaria parasite

4. Do you think that you can identify malaria at first glance?

According to the study, 14.6% people can identify the malaria at first glance and rest 85.4% people cannot identify the malaria at first glance. Being malaria infected people, they must have known about the symptoms of malaria.

Identify

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	21	14.6	14.6	14.6
	No	123	85.4	85.4	100.0
	Total	144	100.0	100.0	

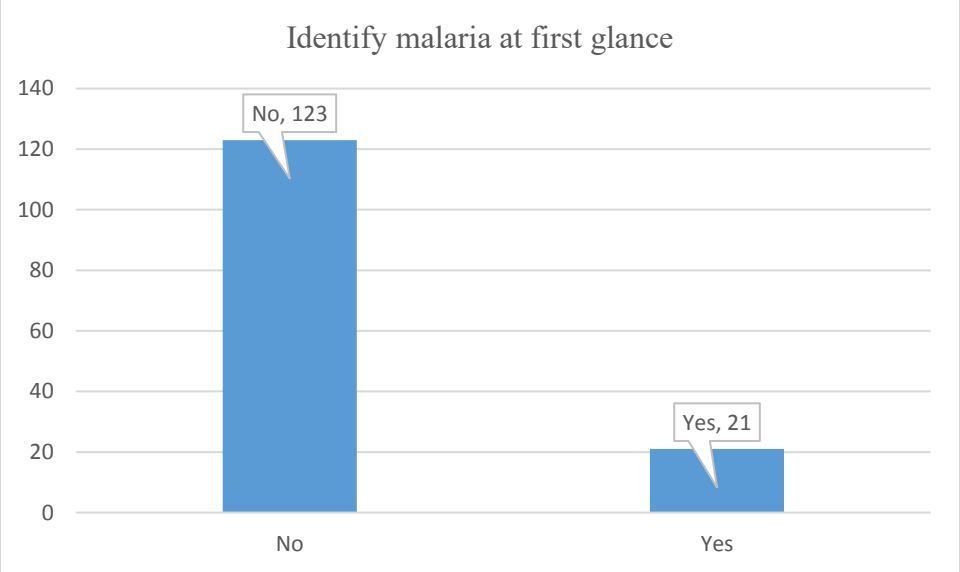


Figure 3.20: Responses on the question of identifying malaria at first glance

5. Do you know about sanitary latrine?

89.6% malaria infected people know about sanitary latrine and rest 10.4% people don't know about sanitary latrine according to this study.

Sanitary latrine

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	129	89.6	89.6	89.6
	No	15	10.4	10.4	100.0
	Total	144	100.0	100.0	

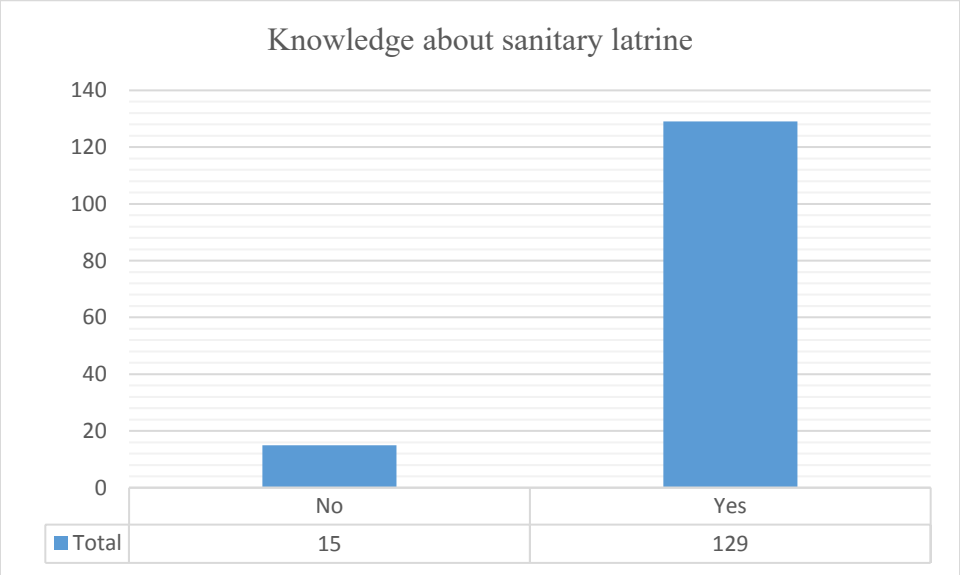


Figure 3.21: Responses on knowledge about sanitary latrine

6. Do you know the necessity of hand washing after using latrine?

Among 144 samples, 93.1% people know about the hand washing after using latrine and rest 6.9% people don't know. This study reflects that, 6.9% people are in risk of getting complications cause by lacking of proper hand wash after using sanitary latrine.

Hand wash

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	134	93.1	93.1	93.1
	No	10	6.9	6.9	100.0
	Total	144	100.0	100.0	

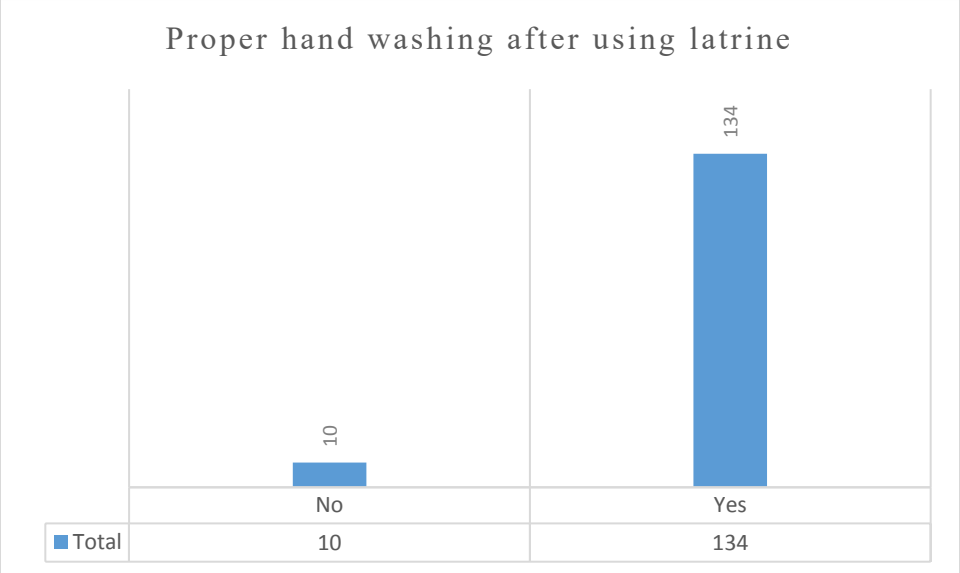


Figure 3.22: Responses on the question of knowledge of proper hand washing after using latrine

7. Do you know about water borne disease?

Among 144 samples, 46.5% people know about water borne disease and 53.5% people don't know about water borne disease. More than half of the population don't know about the water borne disease according to this study. This study suggests that, campaign and utilizing electronic media, the knowledge about water borne disease must be spread among the people of Bandarban.

Water borne diseases

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	67	46.5	46.5	46.5
	No	77	53.5	53.5	100.0
	Total	144	100.0	100.0	

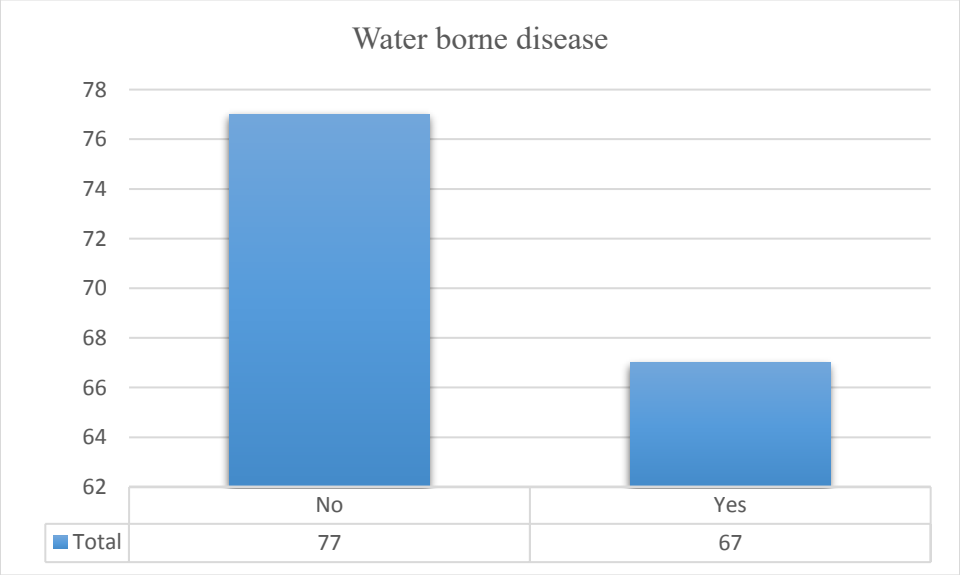


Figure 3.23: Responses on the knowledge of water borne disease

8. Do you know how to purify water?

77.1% people know and 22.9% people don't know about the purification process of water according to this study.

Purify water

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	111	77.1	77.1	77.1
	No	33	22.9	22.9	100.0
	Total	144	100.0	100.0	

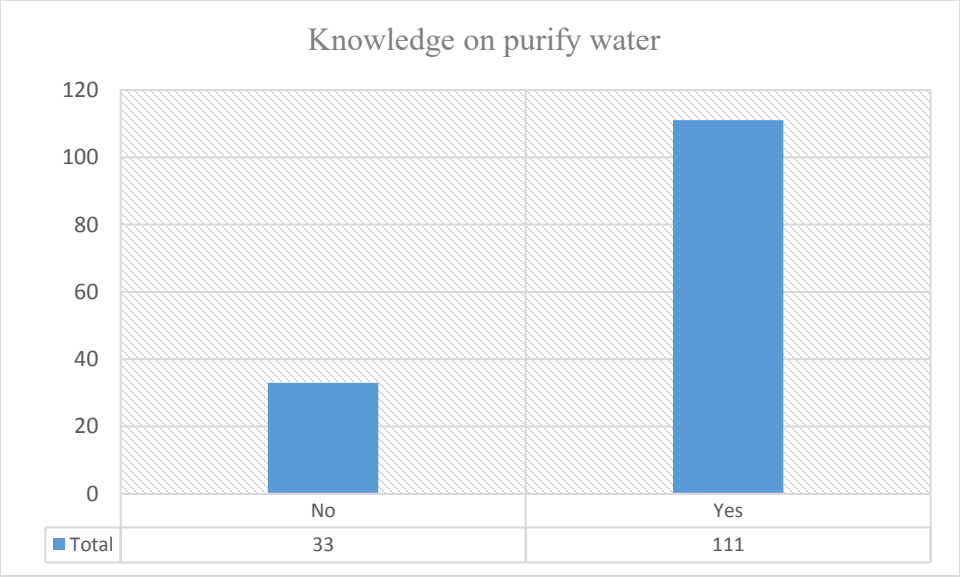


Figure 3.24: Responses on the question of knowledge on purify water

9. Do you know the symptoms of malaria?

Based on this study, 90.3% people (130 people) have knowledge about symptoms of malaria and 9.7% people (14 people) don't have any knowledge of symptoms of malaria. After being infected by malaria, they don't know about symptoms of malaria. The local Upazilla Health Complex (UHC) and field health worker of NGO must have look after this situation to complete the objectives of Govt. of Bangladesh.

Knowledge in symptoms of malaria

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	130	90.3	90.3	90.3
	No	14	9.7	9.7	100.0
	Total	144	100.0	100.0	

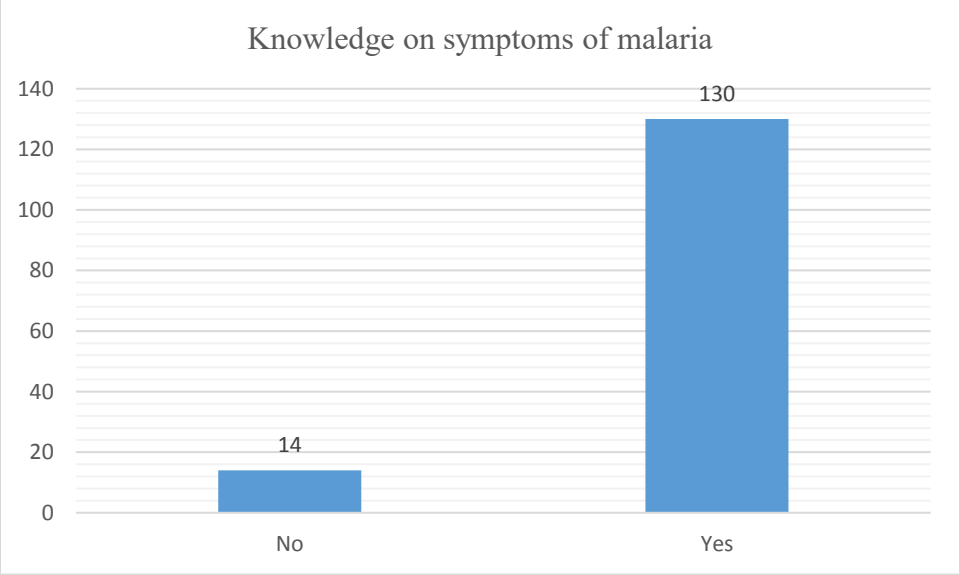


Figure 3.25: Responses on the question of symptoms of malaria.

Section 2B: Source of malaria related information

1. Source of information?

Among 144 samples, 3.5% of people get information from health worker of govt., 65.3% of people get from health worker of NGO, 6.3% of people get information from radio or television, 0.7% people get from poster or leaflet, 23.6% people get from neighbors and 0.7% get from others. This study shows that, health worker of NGO are more responsible for reaching information to the people.

Source of information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Health worker of govt.	5	3.5	3.5	3.5
	Health worker of NGO	94	65.3	65.3	68.8
	Radio/television	9	6.3	6.3	75.0
	Poster/leaflet	1	.7	.7	75.7
	Neighbors	34	23.6	23.6	99.3
	Others	1	.7	.7	100.0
	Total	144	100.0	100.0	

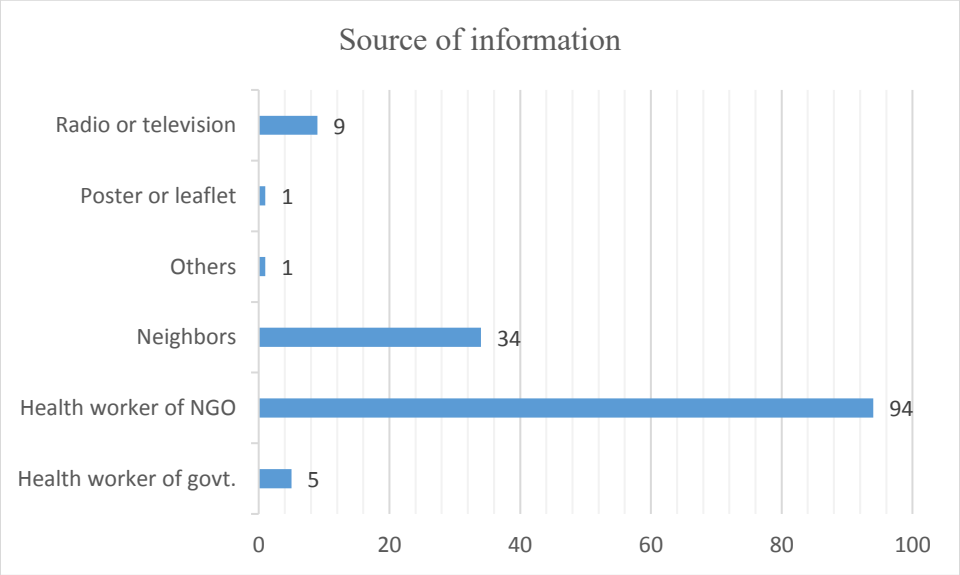


Figure 3.26: Responses on the question of source of information

Section 3A: Specific information of malaria patient

1. Have you ever been encountered with malaria in last two years?

4.9% people are encountered with malaria in last two years and 95.1% people are not encountered with malaria in last two years according to this study. This study also shows the possibility of elimination of malaria from Bangladesh. Most of the malaria patient are before 2016 and it proves that the malaria cases are decreasing.

Encountered

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	4.9	4.9	4.9
	No	137	95.1	95.1	100.0
	Total	144	100.0	100.0	

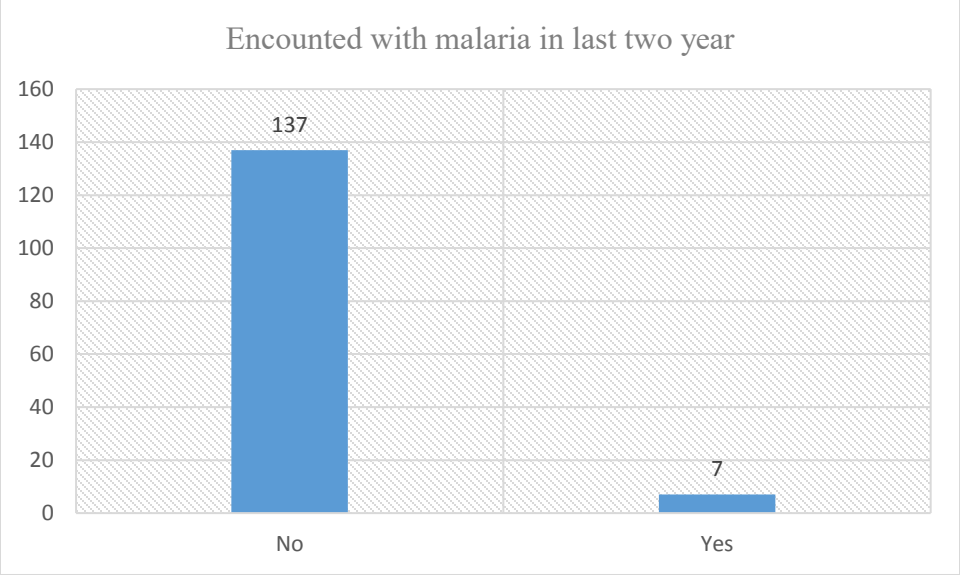


Figure 3.27: Responses on the question of encountered with malaria in last two years.

2. Have you suffered from malaria before 2015?

According to the analysis, 94.4% of people are infected by malaria and 5.6% of people are infected by malaria before 2015. Ratio of being infected by malaria shows that, malaria is getting eliminated rapidly.

Suffering from malaria before 2015

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	136	94.4	94.4	94.4
	No	8	5.6	5.6	100.0
	Total	144	100.0	100.0	

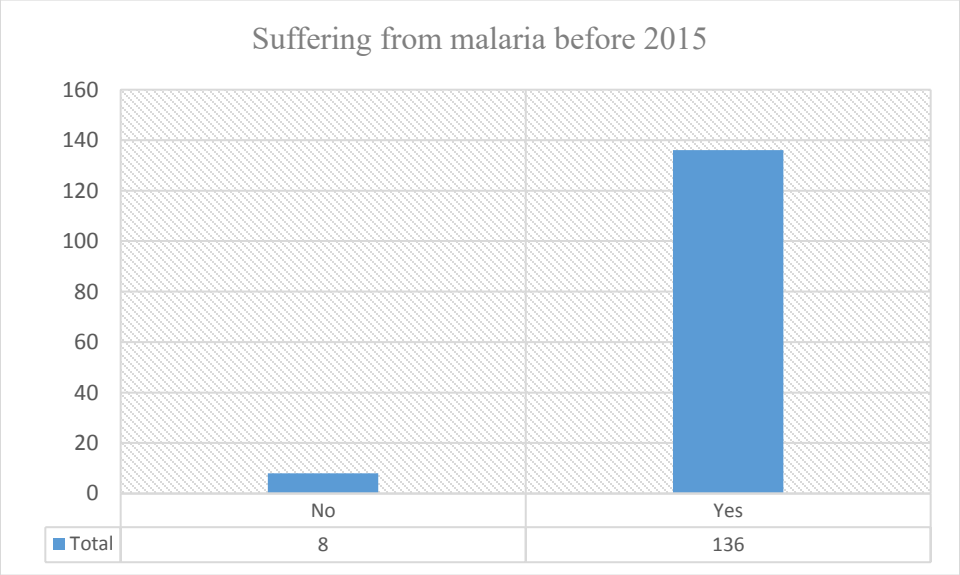


Figure 3.28: Responses on the question of suffering from malaria before 2015

3. Have you suffered from malaria more than once in your lifetime?

20.8% people suffer malaria multiple times and 79.2% people suffer malaria multiple times in their lifetime. So, it has high possibility of being infected multiple times in their lifetime.

Several times

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	30	20.8	20.8	20.8
	No	114	79.2	79.2	100.0
	Total	144	100.0	100.0	

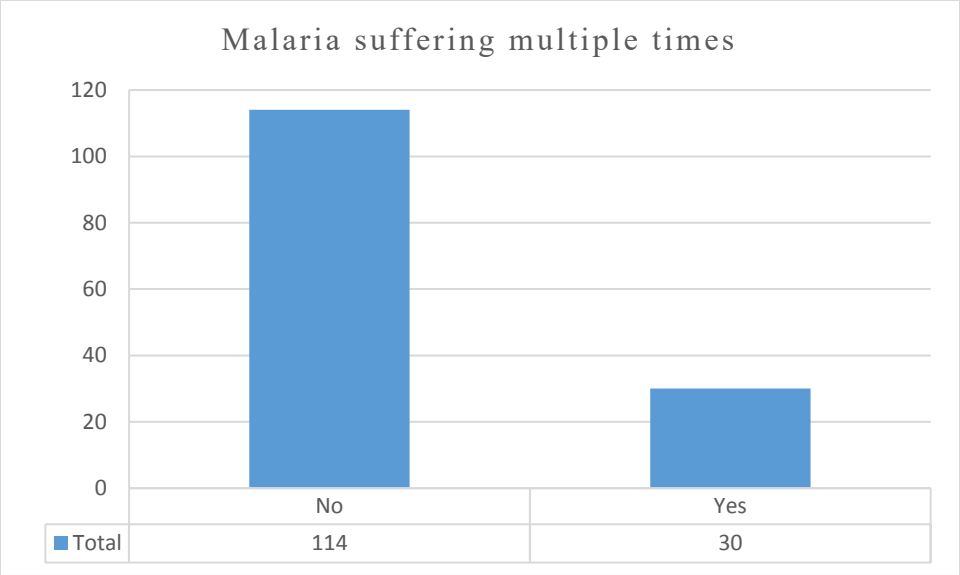


Figure 3.29: Responses on the question of malaria suffering multiple times.

Section 3B: Treatment of malaria

1. Which type of treatment did you seek for Malaria?

Based on the study, 97.2% infected people take allopathic treatment, 0.7% people homeopathic treatment, 1.4% infected people take traditional treatment and 07% infected people take mix treatment. Allopathic treatment are more preferable and most effective treatment mode among malaria patient. For malaria, only allopathic mode of treatment can cure malaria. 100% use of allopathic treatment would be success of govt.

Treatment mood

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Allopathic	140	97.2	97.2	97.2
	Homeopathic	1	.7	.7	97.9
	Traditional	2	1.4	1.4	99.3
	Mix	1	.7	.7	100.0
	Total	144	100.0	100.0	

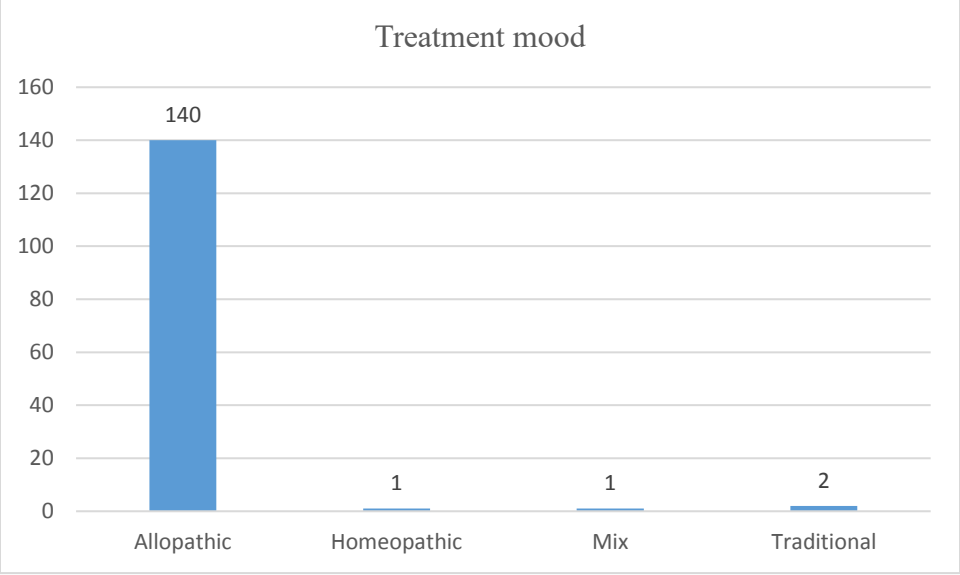


Figure 3.30: Responses on the question of treatment mode.

2. Where did you take the treatment?

Among 144 samples, 17.4% of malaria infected people go to public hospital, 1.4% of malaria infected people go to drug store and 81.3% of malaria infected people go to NGO for urging treatment. Most of the infected people go to NGO for treatment according to this study.

Treatment place

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Public hospital	25	17.4	17.4	17.4
	Drug store	2	1.4	1.4	18.8
	Mix	117	81.3	81.3	100.0
	Total	144	100.0	100.0	

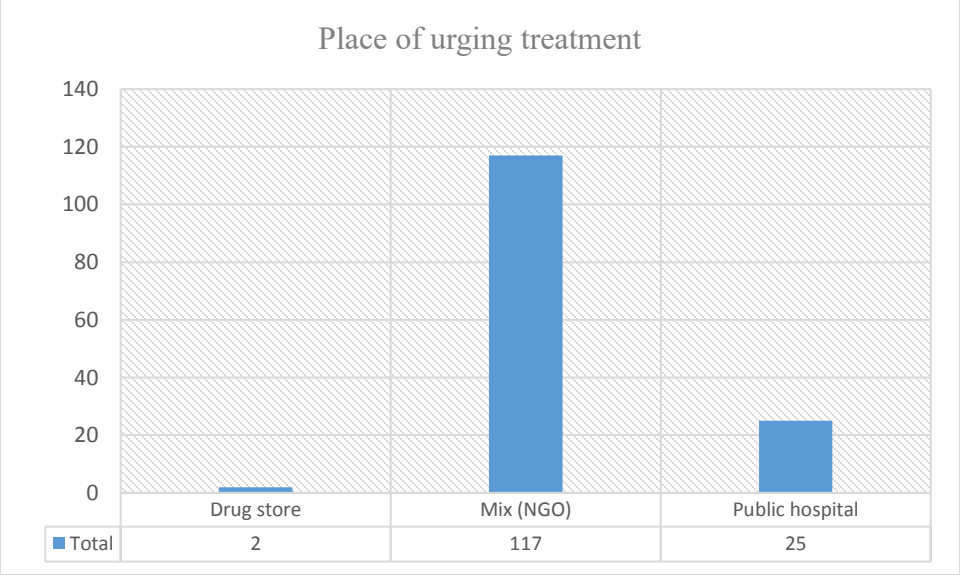


Figure 3.31: Responses on the question of place of urging treatment.

3. Which anti-malarial drug did you take?

98.6% of infected people take artemisinin and 1.4% of infected people take quinine according to this study. Artemisinin and its derivatives are mostly used for the *P. falcifarum* malaria. By this study, it is proved that, 98.6% malaria cases are the *P. falcifarum* malaria and rest is *P. vivax*.

Drug name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Quinine	2	1.4	1.4	1.4
	Artemisinin	142	98.6	98.6	100.0
	Total	144	100.0	100.0	

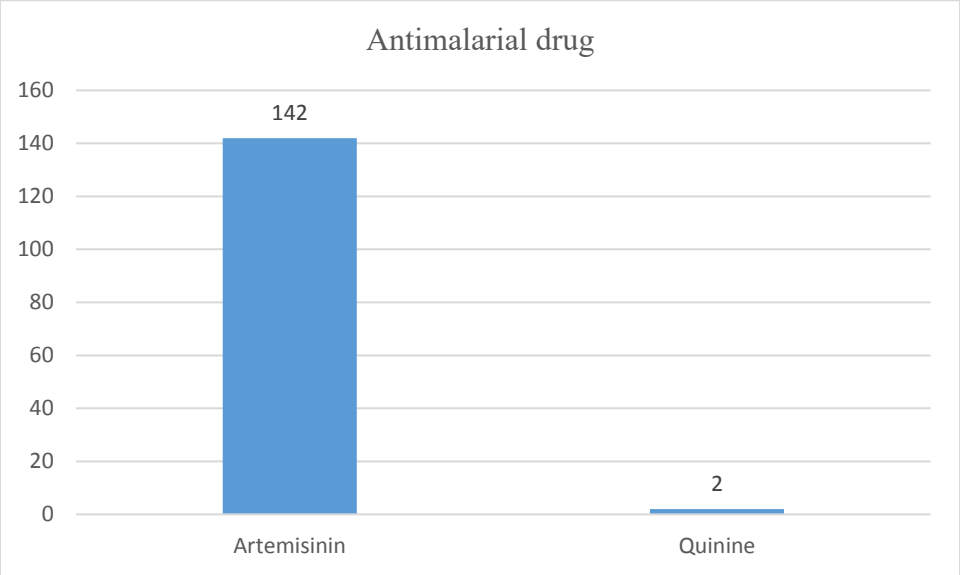


Figure 3.32: Responses on the question of anti-malarial drug.

Section 3C: Duration of treatment

1. How long have you been ill?

Duration of illness from malaria are less than 3 days for 1.4% of people, 3-7 days for 45.8% of people and more than 7 days for 52.8% of people. Most of malaria infected people are being ill for more than 7 days based on this study.

Illness duration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<3 days	2	1.4	1.4	1.4
	3-7 days	66	45.8	45.8	47.2
	>7 days	76	52.8	52.8	100.0
	Total	144	100.0	100.0	

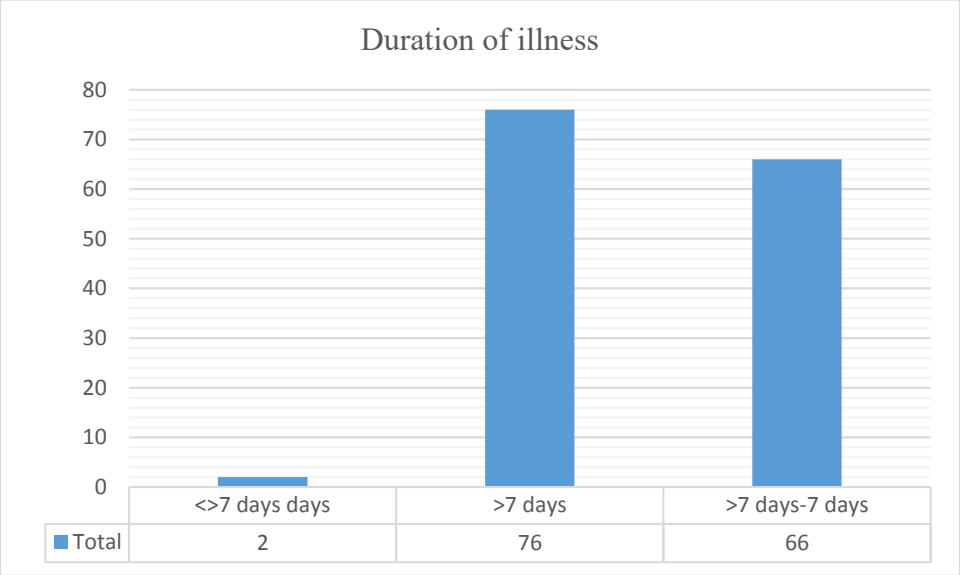


Figure 3.33: Responses on the question of duration of illness.

2. When did your treatment start?

According to this study, 4.9% of malaria infected people start their treatment within 24 hours, 41.7% of malaria infected people start their treatment within 48 hours and 52.1% of malaria infected people start their treatment start their treatment after 48 hours. 75 people start their treatment after 48 hours and 60 people start their treatment within 48 hours among 144 samples.

Treatment time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Within 24 hours	7	4.9	4.9	4.9
	Within 48 hours	60	41.7	41.7	46.5
	After 48 hours	75	52.1	52.1	98.6
	Other	2	1.4	1.4	100.0
	Total	144	100.0	100.0	

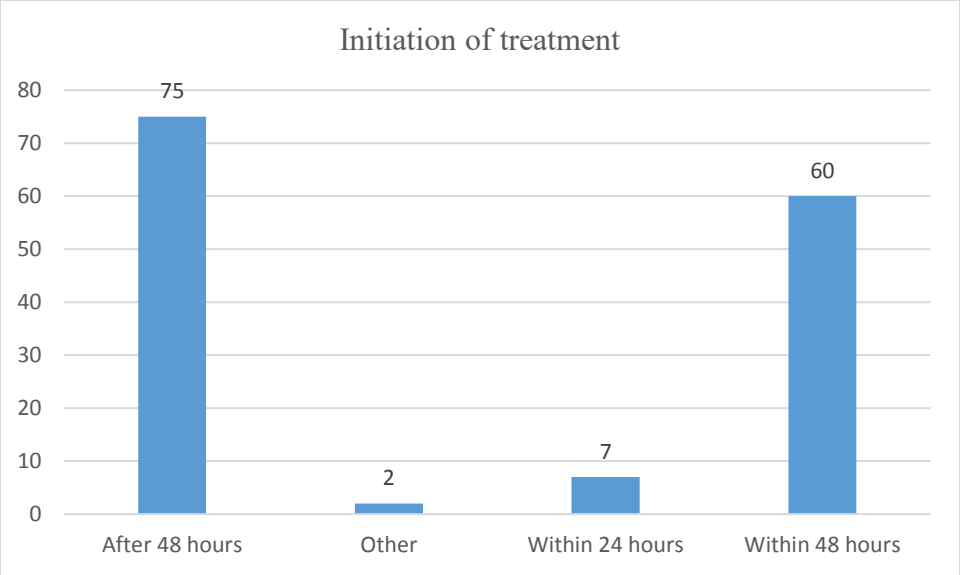


Figure 3.34: Responses on the question of the initiation of treatment.

4. Discussion

This study was done in Bandarban pouroshova and other local area and local area of Thanchi. Based on this study, the male was more infected by malaria compare to female. Moreover, 79.2% was male and other 20.8% was female according to the analysis. Here, most of the tribal people didn't like to talk to strangers. For that reason, female patients might be uncomfortable to response the questionnaire.

LLIN use is mandatory in Bandarban. Govt. and NGO health worker visit every house and check and question them whether they use it or not. 86.1% infected people used LLIN and rest didn't. Health worker pay visit every house to convince them to use LLIN and not to be get infected by malaria. 100% use of LLIN will be full success rate of the Govt. and NGO. Travelers also are told by health worker to use mosquito net or take precautions to prevent malaria disease. Moreover, 52.1% malaria infected people sought treatment after 48 hours of symptoms noticing based on this study. It is very common thing among hill-tribes. Symptoms are negligible to them. Headache, nausea, vomiting, fever are very common symptoms for malaria, but these kind of symptoms are negligible not only to the tribes of Bangladesh but also to the tribes of other south-Asian countries. Late treatment can cause deaths from malaria. A survey had been conducted in the Thailand-Myanmar border to see the treatment seeking time from that area. For seeking treatment, 79.4% participants had experienced a delay (Sonkong, Chaiklieng, Neave, & Suggaravetsiri, 2015). 65.3% infected people were getting their malaria related information from health worker of NGO. So, it is clear that, NGO are more successful in this area. A health worker from BRAC told us the hard working and enough manpower of NGO are doing best in this hilly area. So, Govt. also allow them totally to help Govt. out to reach the objectives.

Almost all infected people are now getting ACT for free by the health worker. Our data analysis also support that. Among 144 participants, 142 participants were take ACT and fully recovered. ACT has 95% of efficacy rate. Though, during the pregnancy time, arthemeter/lumefantrine or artemisinin/amodiaquine are suggested according to centers for disease control and prevention (CDC). Malaria can be occurred multiple times within a human body. We have found 30 participants among 144 participants who have infected multiple times by malaria.

5. Conclusion

Bandarban has 07 upazila and NGO are working in 31 union of Bandarban. Among those union, there are 1554 villages and among thos village 298 village are spotted as endemic village. ACT drug is must for malaria infected patient. It has the high efficacy rate. Traveling to those endemic districts, someone must take some precautions. WHO and Govt. are keeping prioritize to malaria prevention program to make the elimination of malaria from endemic regions. If anyone live in those endemic regions or travel those regions and any symptoms like fever, headache, nausea, vomiting are showing, a malaria test is must. Any community health clinic have the facility to run the malaria test or BRAC has malaria unit in every region to check the malaria. We design our methodology focusing our objectives and find out the samples from most endemic regions among three hilly districts.

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