Knowledge and Awareness of Medical Students Regarding the Neglected Tropical Diseases in Chattogram

Dr. Saira Nusrat

Roll No: 0120/30

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A thesis submitted in partial fulfillment of the requirements for the degree of Masters in Public Health

One Health Institute

Chattogram Veterinary and Animal Sciences University

Chattogram-4225, Bangladesh

August 2022

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This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects, and that all revisions required by the thesis examination committee have been made

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Supervisor

Prof. Dr. ASM. Lutful Ahasan

Department of Anatomy and Histology

Director, One Health Institute

One Health Institute

Chattogram Veterinary and Animal Sciences University

Chattogram-4225, Bangladesh

August 2022

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List of symbols and abbreviations

AIDS	: Acquired Immune Deficiency Diseases
ALB	: Albendazole
AOR	: Adjusted Odd Ratio
BMI	: Body Mass Index
CDC	: Centers for Disease Control and Prevention
CI	: Confidence Interval
DEC	: Diethylcarbamazine
etc	: et cetera
Fig	: Figure
i.e.	: That is
LF	: Lymphatic Filariasis
MBBS	: Bachelor of Medicine and Surgery
Min	: Minutes
MoHFW	: Ministry of Health and Family Welfare
NTD	: Neglected Tropical Disease
N	: Total number of samples
^{o}C	: Degree Celsius
Sec	: Seconds
SDG	: Sustainable Development Goal
STH	: Soil Transmitted Helminthiosis
VL	: Visceral Leishmaniasis
WHO	: World Health Organization
%	: Percentage
>	: More than
<	: Less than

Abstract

Neglected tropical diseases (NTDs) cause the infection of one billion people in 149 countries. Besides, loss of lives, NTDs create a huge socio-economic burden on the country through long-term disabilities of poor people. Proper knowledge and awareness of healthcare professionals are imperative for the control and eradication of NTDs. The study was aimed to measure the present level of knowledge and awareness of medical students in Bangladesh to facilitate control strategies. Data were collected through a questionnaire-based survey and found complete responses from 382 participants. The responses were analyzed with the socio-demographic characteristics using the Chi-square and Fisher exact probability tests. Among the total 55.5% were female and the rest (44.5%) were male. Of total 51.6 % participants acknowledged that they had never seen someone with NTDs. Moreover, 36% of 3rd year students and 28.9% of final year did not know the definition of NTD. Thirty eight percent (38%) of participants in both groups said they had no idea about the visual and physical impairments caused by NTDs. Most of the 3rd year students were correctly recognized leishmaniasis (25.11%) and lymphatic filariasis (23.18%) are the NTD of Bangladesh. On the other hand, 27.80% of final year incorrectly identified diarrhea as an NTD. Participants placed the greatest emphasis on mass awareness (83.8 %) followed by easy diagnostic facilities (71.2%). More than 70% of the participants expressed an interest in participating in NTD prevention activities. Study findings recommended focusing on NTDs in the medical education curriculum and professional training especially on the common NTDs of Bangladesh to confirm the active involvement of these primary stakeholders for the prevention and control of NTDs in Bangladesh.

Keywords: Knowledge and awareness, Medical students, Neglected tropical disease, Prevention and control.

1. Introduction

The neglected tropical diseases (NTDs) are a group of chronic, debilitating, and poverty-promoting diseases caused by parasitic, bacterial, and some viral and fungal infections (Centers for disease control and prevention, 2021; Elfar et al., 2020). These conditions are typically prevalent in rural or pre-urban areas of low-income communities in tropics and subtropical areas of the world mainly in Africa, Asia, and Latin America (Elfar et al., 2020). The impact of NTD in public health around the world is notorious. More than 3 billion people are at risk of infection by NTD and over 350 million people are already disabled or severely impaired by them (Gautam and Bhanwra, 2008). Over one billion people are infected with at least an NTD and more than 6 million deaths occur per year (Peter et al., 2007). NTDs exerts several additional negative direct and indirect effects on people's livelihood, poor people get even poorer due to treatment cost, long-term disabilities prevent the victims from returning to their previous work, pushing entire families into lifelong debt-ridden poverty. Economic burden of these diseases is massive.

The World Health Organization (WHO) currently recognizes 20 diseases like Dengue, Leishmaniasis, Leprosy, Lymphatic filariasis etc. as neglected tropical diseases (Bodimeade et al., 2019). NTDs mostly affect the poor communities that have been deprived of safe water, sanitation, and basic health services. For these reasons, the control and elimination of NTDs are now highly prioritized in the Sustainable Development Goal (SDG) for sustainable poverty reduction. The SDG, and the international community has committed to eliminating NTDs by 2030 (Addisu et al., 2019). However, the Government of Bangladesh has been striving to improve the health care delivery and health status of the people. Appreciating the burden of the neglected tropical diseases (NTDs), the government responded to global health initiatives to control and eliminate them. Bangladesh was one of the first countries to respond to the WHO's calls to formulate and maintain programs to eradicate the country's NTDs from 2001 (Ministry of health and family welfare, 2010).

In Bangladesh, more than 164 million people are at risk for one or more (NTD) (Act to end NTDs east, 2021). The major NTDs in Bangladesh are Lymphatic filariasis (LF), Visceral leishmaniasis (VL), and Soil transmitted helminth infections (STH) including hookworm,

ascariasis, and trichuriasis. LF is the second highest vector borne parasitic disease causing chronic disabilities after mental illness (Gautam and Bhanwra, 2008). In Bangladesh, 69 million people living in 34 endemic districts especially in Dinajpur, Pabna, Dhaka, and Rangpur are at risk where 16.8% people are infected and 10.1% living with chronic LF disease (Hossain, 2016). In Bangladesh, soil transmitted helminth infection causes severe morbidity in children and creates risk for pregnant women with anemia. The parasite worm invades the adult intestine and replicates there causing the disease and the prevalence still higher in the northeastern part of the country (Dhakal et al., 2020). Visceral leishmaniasis mainly known as 'Kala-azar' is transmitted by the bite of sand flies and in Bangladesh, 26 districts are declared as endemic where almost 32 million people lives (DGHS, 2020). Mymensingh district is a highly infected area having 54% of the total reported VL cases and Pabna, Tangail, and Jamalpur districts possessing 25% cases (Ministry of health and family welfare, 2010).

NTDs are amenable to control, elimination, or eradication through targeted treatments using mass drugs and therefore recognized as "targets of opportunity" by WHO and CDC. China started this strategy using mass drugs like diethylcarbamazine for lymphatic filariasis and praziquentel for schistosomiasis (Gautam and Bhanwra, 2008). Bangladesh also has started similar program for LF in all 19 endemic districts with albendazole (ALB) and diethylcarbamazine (DEC) (Act to end NTDs east, 2021). In accordance with its resolve to control and eliminate NTDs, the Ministry of Health and Family Welfare (MoHFW) initiated intervention programs to eliminate LF and VL and control STH. These programs made significant progress during the last decade. National rabies elimination program set goal to eliminate dog mediated human rabies by 2022 through mass dog vaccination (Rana et al., 2020)

The impact of NTDs is still not well known by the professionals and people are also not concerned enough about the extent of effects of these diseases. Hence increased awareness among the community as well as healthcare professionals, and policymakers are needed to reduce the burden of these diseases. NTDs are slowly developing and get worse while undetected and untreated; causing long-term consequences including severe pain and lifetime disabilities (David Molyneux, 2013). Therefore, these diseases should be tackled at an early stage to avoid some major complications. Thus, medical students and doctors

should know the NTDs and their management in detail (Gautam and Bhanwra, 2008). The new roadmap of WHO 2021 to 2030 focusing on the holistic coordinating approach to minimize the complexity regarding the control and elimination of NTDs (Laing et al., 2021).

A cross-sectional study in Egypt showed that about one fourth of the medical students have knowledge on NTDs however, only 5% knew specific prevention and control activities (E et al., 2020). Another study in Peru found less awareness among the students with a progressive significant increase in the knowledge on NTD of medical students throughout the 7 curricular years (Errea et al., 2015). A survey of the general public in Nigeria had found a lack of the basic knowledge about these diseases including the causative organism and transmission among individuals (Olamiju et al., 2014). Results of poor knowledge and awareness revealed by previous literature indicate a serious threat to the control of NTDs. Delay in proper identification and starting of treatment is a potential factor for failure of preventive efforts (Karoke and Karoke, 2018). To confirm the early diagnosis and prevention of NTDs, there is a significant need for proper knowledge and consciousness among the health care professionals specially doctors (Mankbadi et al., 2016). Due to high attention to communicable diseases, very little to no work had conducted regarding this crucial aspect of NTDs in Bangladesh. This study covered medical students to assess their existing knowledge and awareness regarding NTDs as well as to identify their perception towards the control activities throughout the country.

Objectives

The overall objectives of the study were to understand the knowledge and perception on NTDs of current medical students studying in different medical colleges in Chattogram. However, specific objectives are following

1. To assess the current level of knowledge of NTDs of medical students in Chattogram
2. To understand the awareness of medical students towards the control of NTDs
3. To assist the revision of national strategy by providing baseline data.

2. Literature Review

NTDs are a group of infections that predominantly affect the poorest and most vulnerable populations. Nowadays, 20 diseases are defined by WHO as NTDs (WHO, 2013). These are endemic in 149 countries, affecting more than 1.4 billion people, including half a billion children, and costing developing economies billions of dollars every year (WHO, 2015b). NTDs are divided in four main groups, according to the kind of etiologic agent causing them: - Protozoa (Chagas' disease, human African trypanosomiasis or sleeping sickness, leishmaniasis), Bacteria (Buruli ulcer, Leprosy or Hansen disease, Trachoma, Yaws), Helminth (cysticercosis/taeniasis, dracunculiasis or guinea-worm disease, echinococcosis, foodborne trematodiases, lymphatic filariasis, onchocerciasis or river blindness, schistosomiasis, soil-transmitted helminthiasis) and Virus (dengue and chikungunya, rabies).

The term 'neglected' does not mean that such diseases are unknown, but that they do not receive the deserved attention from side of pharmaceutical companies. Malaria and tuberculosis, for instance, used to be part of this group, but due to recent increase in investments to tackle them they are no longer considered as 'neglected'. Most NTDs are preventable and treatable, some even curable (The Lancet, 2014). However, the population generally affected cannot afford the costs of long treatments. Moreover, the drugs currently available often have severe side effects, leading people to abandon the therapy. As a consequence, resistant strains of the pathogens have the chance to develop (Izumi et al., 2008). In order to overcome this problem, the WHO put together an initiative called 'Uniting to combat NTDs', composed by public and private partners (pharmaceutical companies, donors and governments). Together they have signed the '2012 London Declaration' to control, eliminate or eradicate by 2020 ten NTDs (lymphatic filariasis, trachoma, soil-transmitted helminthiasis, onchocerciasis, schistosomiasis, leprosy, guinea worm, visceral leishmaniasis, Chagas disease and human African trypanosomiasis). Some of the promises made involved the supply of drugs, to advance research and development, to enhance collaboration and coordination at national and international levels, to enable adequate funding and to monitor programs (The Lancet, 2014).

Table 01: Description of 20 Neglected Tropical Diseases

Disease /Condition	Causative Agent	Host	Mode of Transmission	C/F	Most prevalent countries	Control Measures
Bruli ulcer	Mycobacterium ulcerans	N/A	Unknown	Causes ulcers (mostly on the limbs) that affect the skin and sometimes bone and cause permanent disfigurement and long-term disability	In 2019, it was endemic in 33 countries in Africa, Latin America and the Western Pacific.	No known prevention against the disease
Chagas Disease	Trypanosoma Cruzi	Triatomine bugs	(i) vector-borne (through the faeces and urine of triatomine bugs) (ii) oral/ foodborne, (ii) congenital, (iv) transfusional (v) organ transplantation and (vi) lab accidents	most patients have no (or nonspecific) symptoms; without treatment, up to 30% has cardiac and up to 10% digestive, neurological or mixed alterations.	In 21 continental Latin American countries. During the past decades, also in the USA, Canada, many European and some Western Pacific countries.	WASH, , Vector control, Blood screening
Dengue	Dengue Virus (Flaviviridae)	female Aedes aegypti and Aedes albopictus mosquitoes.	Transmitted to people through bites	fever, muscle and joint pain, severe headache, pain behind the eyes, nausea, rash and vomiting; severe dengue causes severe abdominal pain resp	Africa, Asia and Latin America.	WASH, Vectrol control

				distress, organ impairment and death.		
Chikungunya	Chikungunya (Togaviridae)	female Aedes aegypti, Aedes albopictus and other species of Aedes mosquitoes.	Human infection is transmitted through bites	sudden onset of fever and joint pain, muscle pain, headache, rash and lymphopenia; joint pain may persist for months or years.	South-East Asia, Africa and Latin America.	WASH, Vectrol Control
Dracunculiasis	Dracunculus medinensis (Guinea worm)	Water fleas(Int Host) Human	through drinking stagnant water containing parasite-infected water fleas	a painful burning blister	Angola, Chad, Ethiopia, Mali and South Sudan have indigenous transmission	WASH, Vector control, Conduct COMBI, Surveillance
Echinococcosis	Tapeworm	Host:Dogs for CE, foxes and other canids intermediate hosts (livestock, mainly sheep for CE, small rodents); humans are accidental intermediate host	Through faecal-oral route f	abdominal pain, nausea, vomiting, chronic cough, chest pain and other symptoms depending on the organs affected;	at least 111 countries; cystic echinococcosis is spread across all continents except Antarctica	WASH Periodic deworming of dogs, Vaccination of sheep, etc
Foodborne trematodiases	trematode worms ("flukes"): Clonorchis sinensis, Opisthorchis viverrini, Opisthorchis felineus, Fasciola and	freshwater fish, aquatic vegetables, crabs and crayfish	transmitted through raw or undercooked food (freshwater fish, aquatic vegetables, crabs and crayfish) infected	severe pain in abdominal region, general malaise, inflammation and fibrosis of the liver, -fatal bile duct cancer (clonorchiasis and opisthorchias	endemic in 92 countries across all continents except Antarctica	Preventive chemotherapy, WASH

	Paragonimus spp.		with larvae.	is), blockage, colic pain and jaundice		
Human African trypanosomiasis	Trypanosoma brucei gambiense, Trypanosoma brucei rhodesiense.	tsetse fly	transmitted through the bite of an infected tsetse fly ,congenital	fever, headaches, joint pains , enlarged lymph nodes and sleep disturbances, behavioural changes, confusion, sensory and motor disturbances	endemic in sub-Saharan Africa	WASH, Vector control
Leishmaniasis/ Kala Azar	Leishmania parasite,	female phlebotomine sandflies	transmitted by the bite of female phlebotomine sandflies	CL:permanent scars and serious disability, stigmatization and mental health problems ,severe mutilations VL: irregular bouts of fever, weight loss, enlargement of the spleen and liver and anaemia; if left untreated, death	87 countries are endemic for CL (2016). 75 countries are endemic for VL including Bangladesh (2016).	Vector control, Rodent control
Leprosy (Hansen's disease)	Mycobacterium leprae	N/A	transmitted by droplets from the nose and mouth during prolonged close contact	affects the skin and peripheral nerves and can cause permanent damage to the skin, nerves, face, hands and feet; untreated leprosy can lead to impairment, disabilities and exclusion	In 2019, leprosy was reported from 119 countries (including imported cases)	Preventive chemotherapy, WASH

Lymphatic filariasis /Elephantiasis	Wuchereria bancrofti, Brugia malayi and B. timori	Culex, Anopheles, Mansonia and Aedes.	Transmitted by mosquito species	overt manifestations of lymphoedema and hydrocele as well as acute episodes of adenolymphangitis. disability, stigmatization and mental health co-morbidity	endemic in 72 countries across WHO's African, Americas, Eastern Mediterranean, South-East Asia and Western Pacific regions.	WASH, Vector control, Preventive chemotherapy
Mycetoma, chromoblastomycosis and other deep mycoses (mycetoma) /Madura Foot	several microorganisms of bacterial or fungal origin	N/A	Not well understood	chronic infection of skin, connective tissue, muscle and bone, eventually leading to deformities and disabilities; it is associated with severe morbidity and increased mortality.	endemic in tropical and subtropical areas in Africa, Latin America and Asia,	WASH, Wearing protective clothes, Pet control (feral cats) etc
Onchocerciasis (river blindness)	Onchocerca volvulus	Simulium blackflies	transmitted through repeated bites of infective Simulium blackflies	severe itching, disfiguring skin conditions and visual impairment and can result in permanent blindness.	Eastern mediterranean,America, Africa	Preventive Chemotherapy, Vector control
Rabies	Rabies virus	Dogs Other mammals(bats)	transmitted to humans mainly through the bites of domestic dogs (up to 99%) but also by various other mammals	Furious rabies (80% of cases) in which hyperactivity and excitable behaviour are exhibited and death occurs within a few days; and - Paralytic rabies (20% of cases) in	Dog-transmitted human rabies is present or suspected in 89 countries, mostly in Africa and Asia.	WASH Mass vaccinations of dog, Dog population management

			(such as bats).	which the muscles gradually become paralysed and eventual coma and death result.		
Scabies and other ectoparasitoses	Sarcoptes scabiei var hominis	N/A	transmitted through close contact with the skin,	intense itching and rash. Bacterial infections can complicate the disease, leading to severe soft tissue infections, sepsis, kidney disease and, possibly, RHD.	endemic across all continents; the highest burden is in Asia	Preventive chemotherapy WASH
Schistosomiasis	Schistosoma trematodes including S. mansoni, S. japonicum, s. mekongi, S. guineensis	freshwater snails, the intermediate host	transmission occurs through contact with water	abdominal pain, diarrhoea, blood in the stool, Katayama fever , in advanced stages, enlargement of the liver and spleen, fibrosis, portal HTN bloody urine, fibrosis of the bladder and damage to the ureter and kidneys	Americas Western Pacific Eastern Mediterranean African	Preventive Chemotherapy, WASH, Vector control etc
Soil-transmitted helminthiases	(Ascaris lumbricoides and Trichuris trichiura), hookworms (Necator americanus and	Human	Faeco-oral route	anaemia, malnutrition, impaired physical and cognitive development, abdominal pain and diarrhoea	In 2019, 92 countries required MDA, mostly in tropical and subtropical areas across sub-Saharan Africa, Latin America	Preventive Chemotherapy, WASH

	Ancylostoma duodenale) and roundworms (Strongyloides stercoralis)				and Asia but also in some areas of the European Region	
Snakebite envenoming	N/A	N/A	following the bite of a venomous snake or from venom sprayed into the eyes by certain species of snakes.	shock paralysis that may arrest breathing, and bleeding disorders that can lead to fatal haemorrhage or cause other effects such as acute kidney injury and tissue damage leading to permanent disability, limb amputation and other physical and psychological sequelae	There are an estimated 132 countries with incidence of snakebite,	Housing Improvements, Behavioural change (wearing footwear, use of light outdoors) , Community education
Taeniasis and cysticercosis	Taenia solium	Pig	Faeco-oral route	asymptomatic, may cause abdominal pain, nausea, diarrhoea or constipation whereas neurocysticercosis can cause chronic headaches, epilepsy, intracranial hypertension and other neurological symptoms	s endemic in more than 75 countries; the heaviest burden is in Africa, Latin America and Asia.	Preventive chemotherapy, WASH, Pig vaccination, Improved pig husbandry

Trachoma	Chlamydia trachomatis.	Muscid flies	spread through personal contact (e.g. hands, clothes, bedding) or by flies through contact with ocular or nasal discharge of infected individuals	repeated episodes of infection can scar the eyelids and cause eyelashes to turn inwards and rub the surface of the eye (trichiasis). This causes pain and may permanently damage the cornea, resulting in irreversible visual impairment or blindness	Western Pacific Americas South-East Asia Eastern Mediterranean African	Preventive chemotherapy, WASH, Vector control

In 2013 this group met again in Paris to discuss the advances and aims reached. All results presented by the members were compiled in a report called 'Delivering on Promises and Driving Progress' (WHO, 2014). In fact, it seems that many positive changes were achieved. For instance, pharmaceutical companies have donated about 1.35 billion treatments (a 35 % increase since 2011), meeting 100 % of requests for drugs. The number of countries requesting and receiving NTD drug donations also increased from 37 in 2011 to 55 in 2012. Over 70 countries have developed national governmental politics involving the combat to NTDs. Moreover, a new oral drug for human African trypanosomiasis will undergo clinical trials (WHO, 2014). It seems to be the ideal time to invest in the search for new compounds for the treatment of NTDs. Even pharmaceutical companies are supporting this cause, by opening their compound libraries and the Drugs for Neglected Disease initiative (DNDi) is screening more than 7000 compounds (WHO, 2014). Even though impressive progress was observed in the last two years, there is still much to do in order to improve the life quality of people suffering from NTDs. In this context, the present project aimed to contribute in the drug discovery process by optimizing analytical methods

that can be useful for the purification of new lead compounds. The main focus of this thesis will be on the diseases of the Protozoa group.

Leishmaniasis

Leishmaniasis is a disease caused by parasitic protozoa of the genus Leishmania. There are over 20 Leishmania species that can be transmitted to humans by the bite of over 90 different species of infected female sandflies of the genus Phlebotomus, Psychodopygus and Lutzomyia (Fig. 1). Beside humans, other 70 animal species can be natural reservoir hosts of Leishmania parasites. According to WHO (2015), over 98 countries and 3 territories, mainly in Africa, Asia and Latin America, are endemic for this disease and 350 million people are at risk. Additionally, it is estimated that 1.3 million new cases and 20000 to 30000 deaths occur annually because of it. This disease can manifest in three main forms – cutaneous, mucocutaneous and visceral. The cutaneous leishmaniasis is the most common form and causes skin lesions, mainly ulcers, on exposed parts of the body, such as the face (Fig. 1), arms and legs, leaving life-long scars and serious disability. This lesions generally disappear spontaneously within 6 months. Most of the cases (95 %) are found in the Americas, the Mediterranean basin, the Middle East and in Central Asia. Cutaneous leishmaniasis is generally caused by five species of Leishmania: *L. infantum, L. tropica, L. major, L. aethiopica* and *L. donovani*. also a different manifestation of this disease, the diffuse one, has been associated with *L. mexicana* and *L. amazonensis* (WHO, 2010a). In mucocutaneous leishmaniasis, the lesions can affect the mucous membranes of the nose, mouth and throat cavities, as well as surrounding tissues, causing gross mutilation. It is caused mainly by *L. braziliensis* and *L. panamensis* and almost 90 % of reported cases occurred in Bolivia, Brazil and Peru. Finally, the visceral leishmaniasis (also known as kala azar) is the most lethal form of this disease, with fatality rate of virtually 100 % within two years if left untreated. This form is mainly caused by *L. infantum* and is characterized by high fever, anaemia, severe weight loss and swelling of the spleen and liver (Fig. 1). More than 90 % of reported cases are concentrated in six countries: Bangladesh, Brazil, Ethiopia, India, South Sudan and Sudan (WHO, 2010a, 2015b).

Independently of the manifested form of the disease, the transmission cycle is the same (Fig. 1). The ‘human’ stage actually applies also to any animal species infected. For the

tests performed during the realization of this project, three species of Leishmania sp. parasites in two different development stages were used. One of them was the promastigote form L. infantum, which can cause cutaneous and visceral leishmaniasis. This is the form developed in the sand fly (vector) and responsible for starting the infection in humans and other animals. Moreover, axenic amastigotes of *L. amazonensis*, related to diffuse cutaneous leishmaniasis, and *L. donovani*, which causes mainly cutaneous leishmaniasis, were used. Axenic amastigote forms are similar to those intracellular parasites, generally found in the hosts' macrophages.

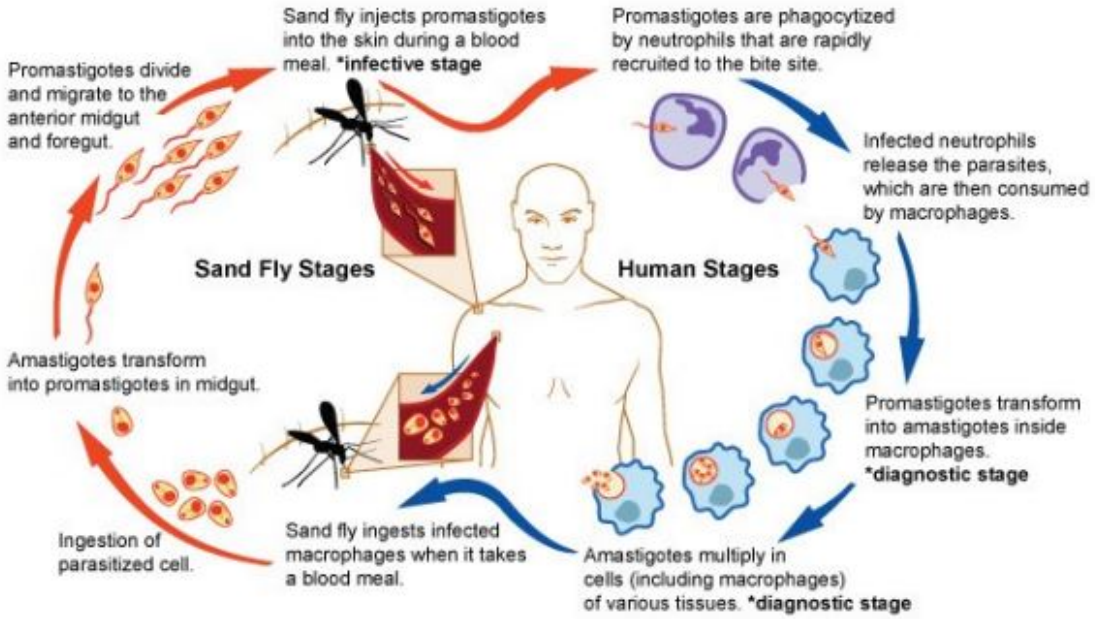

Figure 1: Life cycle of Leishmania parasites showing the sand fly and human stages. Source: NIAID (2008).

However, in this case the transformation of the Leishmania was induced by incubating the promastigotes in a culture under pH and temperature conditions that imitate the biological environment in a cell free medium (Teixeira et al., 2002). Although leishmaniasis is mainly related to developing nations, the fact that it may also represent a potential threat to industrialized countries should not be ignored. Several cases of this disease have been reported in Europe, especially in the warmer southern regions like Albania, Georgia, Italy and Spain. Also in Germany, ten cases were described, including patients that had never

left the country before (Ejov et al., 2014). Moreover, sand flies have been recently detected in the region of Hessen (Spiegel, 2014). The proof of the gravity of the situation is a program launched in 2013 by the WHO regional office for Europe, which sets a strategic framework for the control of leishmaniasis in the WHO European Region for the period of 2014 to 2020 (Ejov et al., 2014). Although many advances were made in the understanding of the biochemistry and molecular biology of the parasite, the current therapy recommended by WHO is still potentially toxic and often ineffective (WHO, 2010a). The success of the treatment is also complicated by differences in the susceptibility of the parasites to the recommended drugs, which are highly geographical and species specific (Dorlo et al., 2012). Therapy generally includes the administration of pentavalent antimonials, amphotericin B, paromomycin and, more recently, miltefosine as first choice drugs for the several forms of leishmaniasis

Despite their life-threatening toxicity, pentavalent antimonials intravenous or intramuscular injections have been used against all forms of leishmaniasis since their discovery in the 1940s. Amphotericin B in liposomal formulations is nowadays preferred over conventional infusion, due to its lower toxicity profile. This application, however, is still very limited due to its very high costs. Paromomycin is an antibiotic that has been used as intramuscular injection alone or in combination with several other drugs and therapies, although with variable success rate (WHO, 2010a). Since 2002, miltefosine was successfully introduced as the first, and still only, oral agent for the treatment of all types of leishmaniasis (Dorlo et al., 2012).

Trypanosomiasis

Trypanosomiasis is a general term for diseases caused by parasitic protozoan of the genus Trypanosoma. This thesis will focus on its two major representatives – the American form, also known as Chagas disease, caused by *T. cruzi* – and the African trypanosomiasis or sleeping sickness, which can be caused by either *T. brucei* gambiense or *T. brucei* rhodesiense (WHO, 2013). Although both diseases are caused by protozoa of the same genus, similarly to the different forms of leishmaniasis, in this case the vectors and mode of parasite transmission are different (Fig. 2). While *T. cruzi* is mainly transmitted by contact with the faeces of infected hematophagous triatomine bugs, *T. brucei* are

disseminated by the bite of tsetse flies. However, in both cases the vectors carry the parasites in the form of metacyclic trypomastigotes.

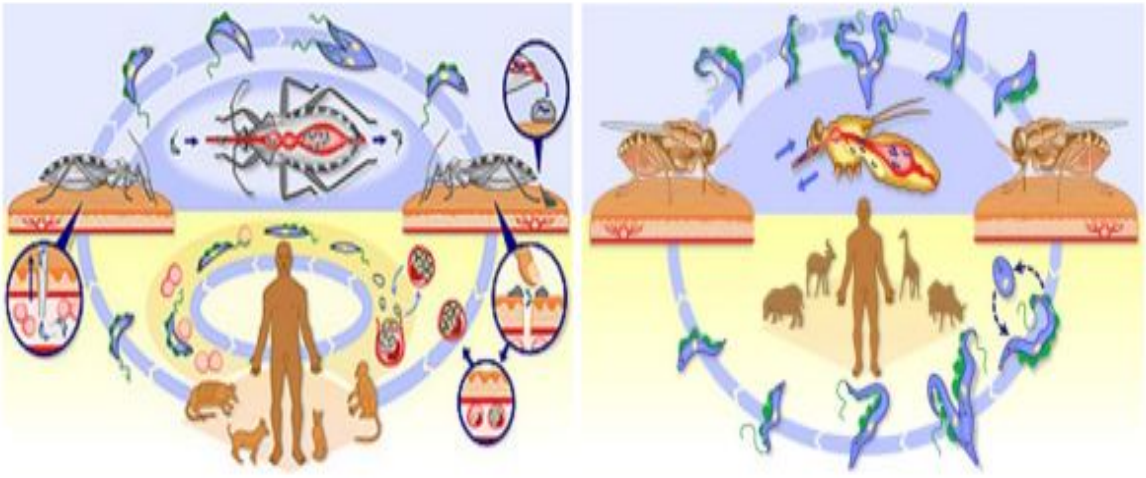

Figure 2: Life cycle of *T. cruzi* with the transmission between animals through triatomine bugs (left) and the life cycle of *T. brucei* and the transmission between animals through tsetse flies (right). Source: WHO (2015c).

When triatomine bugs bite the human skin, they deposit their faeces beside the wound. As they are generally night active, people are bitten during sleep and instinctively scratch the wound, inoculating the parasites through the open tissue. When they reach the blood stream, they penetrate white blood cells and transform into amastigotes. These are able to divide by binary fission and before leaving the cell cytoplasm they transform back to trypomastigote forms, which will infect other cells or be collected from the blood stream by other triatomine bugs. When these trypomastigotes are swallowed by the bugs, they transform into dividing epimastigotes and then back to trypomastigotes that will infect other animals in the vector's next blood meal (WHO, 2015a). In the case of African trypanosomiasis, the metacyclic trypomastigotes of T. brucei are transferred to the hosts' blood stream during the tsetse fly bite. There, these trypomastigotes turn into a longer slender trypomastigote form that is able to divide by binary fission. This form is distributed to the whole body through the blood circulation and may reach the central nervous system. After some days, when the parasitaemia reaches its higher levels, these trypomastigotes turn back into the shorter non-dividing ones to be re-collected by another vector. In the

tsetse fly, these short forms turn into longer dividing procyclic trypomastigotes. After this, they become even longer mesocyclic trypomastigotes that are able to swim back to the salivary glands of the fly, where they transform back to the shorter trypomastigote forms to restart the cycle (WHO, 2015c). As consequence of such distinct life and transmission cycles, the manifestation of the signals also occurs in different ways for both diseases. The biological evaluations performed with both species of parasites for this project used the same trypomastigote forms that can be found in the blood stream of the hosts.

American – Chagas' Disease

The American trypanosomiasis is also called Chagas' disease, in honor to the Brazilian physician Carlos Chagas who identified *T. cruzi* as its etiologic agent in 1909 (Clayton, 2010). This disease has its origins in the Americas, but nowadays it has spread also to other continents due to increased population movements (Coura et al., 2010). Chagas' disease is mainly transmitted by contact with faeces or urine of a large diversity of infected hematophagous triatomine bugs of the Reduviidae family. At least 20 species of triatomines are involved in transmission of the parasite from multiple species of sylvatic and domestic mammalian hosts to humans (Nouvellet et al., 2013). Other know forms of transmission are through the consumption of food contaminated with *T. cruzi*, blood transfusion from infected donors, passage from an infected mother to her newborn during pregnancy or childbirth, organ transplants using organs from infected donors and laboratory accidents (WHO, 2013)

Chagas' disease is a potentially life-threatening illness that affects 7 to 8 million of people, mainly in 21 Latin American countries. It manifests in two phases – an acute and a chronic phase. The initial acute phase is almost asymptomatic and lasts for about 2 months after infection. In this period, a high number of parasites circulate in the blood, but in less than 50 % of people visible signs of infection can be detected. One characteristic feature can be a skin lesion or a purplish swelling of the lids of one eye. The other symptoms are very unspecific, such as fever, headache, enlarged lymph glands, pallor, muscle pain, difficulty in breathing, swelling and abdominal or chest pain. This makes the early diagnosis of this

disease very difficult, so that it often develops to a chronic phase. In this later stage, the parasites are hidden mainly in the heart and digestive muscles. In worst cases the infection can lead to sudden death or heart failure caused by progressive destruction of the heart muscle and its nervous system, the so-called Chagas cardiomyopathy (WHO, 2013)

The only therapy available is over 40 years old and uses benznidazole and nifurtimox as first choice drugs (Clayton, 2010). Both medicines are very effective in curing the disease if given in its early acute phase, but their efficiency decreases the longer a person has been infected. This treatment is also indicated as preventive, in case a patient was infected and has not yet develop the symptoms. The potential benefits of medication, however, must always be weighed against the long duration of treatment (up to 2 months) and possible adverse reactions (occurring in up to 40% of treated patients). Moreover, these drugs are not recommended to be taken by pregnant women or by people with kidney or liver failure. Additional specific treatment for cardiac or digestive manifestations is also generally required (WHO, 2013).

African – Sleeping Sickness

The human African trypanosomiasis or sleeping sickness is a highly debilitating disease and usually fatal, if no prompt diagnosis and treatment are made. In the course of the infection, the parasites multiply in the body, cross the blood–brain barrier and culminate invading the central nervous system. At this stage, patients generally present changes in personality, alteration of the biological clock, confusion, slurred speech, seizures and difficulty in walking and talking. Differently from the Chagas disease, the human African trypanosomiasis is transmitted by the bite of infected tsetse flies (Glossina sp) (WHO, 2013). Sleeping sickness can be presented two forms – the chronic disease is caused by infection with *T. brucei* gambiense and represents 98 % of the reported cases, being endemic in 24 African countries, and the acute form is developed from infections with T. brucei rhodesiense, being endemic in 13 countries (WHO, 2013)

Thanks to strong disease control policies, the number of reported cases annually has substantially decreased in the last decade, reaching values lower than 10000 in 2009 for the first time in 50 years. The Democratic Republic of Congo is the only country that has reported more than 1000 new cases annually (Simarro et al., 2011). Nevertheless, still many cases were exported all over the world, with 43 % of the cases diagnosed in Europe and 23 % in North America. The number of cases of Sleeping sickness outside the endemic countries, although low, should not be overlooked (Simarro et al., 2012).

Currently available treatments are few, old and limited due to toxicity, low efficacy in several geographical regions and complexity of use. Only four drugs are registered for the treatment of human African trypanosomiasis - pentamidine and suramin for stage 1, and the highly toxic melarsoprol together with eflornithine for stage 2. The intravenous administration required for these drugs, however, is very difficult and painful (Torreele et al., 2010). Since 2007, efforts have been made in order to implement melarsoprol-free treatment. This measure, though, has the limitation of increasing in over 10-fold the costs to treat each patient and is not effective against *T. brucei* rhodesiense (WHO, 2013)

Since 2009, a therapy combining infusions of eflornithine with oral nifurtimox is being used to replace eflornithine monotherapy. Also, a new treatment based on oral administrations of the compound fexinidazole, rediscovered by the Drugs for Neglected Diseases initiative (DNDi) is undergoing clinical trials for the treatment of advanced-stages of sleeping sickness (Torreele et al., 2010). Nevertheless, new drugs for the therapy of acute and chronic forms of this disease are urgently needed.

Schistosomiasis haematobium

Schistosomiasis, also known as bilharziasis, is caused by parasitic water-borne worms. It is a neglected tropical disease (further referred to as NTD) that infects over 200 million people worldwide, making over 650 million people at risk. (Nour, 2010). The problem with Schistosomiasis can be traced back at least to Ancient Egypt, as Schistosomiasis was diagnosed in a mummy 5000 years old (Deelder, 1990). It is surprising to know such an ancient parasitic disease is still haunting more than two hundred million people even today.

Schistosomiasis is an acute and chronic disease caused by parasitic blood flukes: Schistosoma. While the eradication and control have been successfully seen in some countries, the disease Schistosomiasis is still considered a public health challenge mostly in economic developing tropical countries. (Bonds, 2012). Contact with inadequate hygiene and Schistosomiasis contaminate freshwater expose people to the risk of infection. Via freshwater snails, Schistosomes larval forms of the parasite can penetrate the skin and enter the human body during contact with infested water. The larvae develop into adult worms inside the blood vessels of the infected person, where the females release eggs. These eggs can be either trapped in body tissue, causing the immune response of one's body and leading to organ damage, or being released outside the human body via feces or urine in freshwater, which allows the egg to hatch and continue the parasite's life cycle (Figure 3). Due to the infectious agents of freshwater, snail host, and human host, the unique schistosomal life cycle can limit endemic areas to certain (sub)tropical zones where humans perform aquatic activities (Medscape, n.d.). A common source of the disease can be freshwater lakes, streams, reservoirs, and irrigation systems. People with the occupation that bring them in contact with infected water in these endemic areas, such as fishermen, farmers, irrigation workers, and domestic tasks workers are considered as high-risk target group (WHO). Water resource engineering and the migration of infected populations can also stimulate the geographic spread

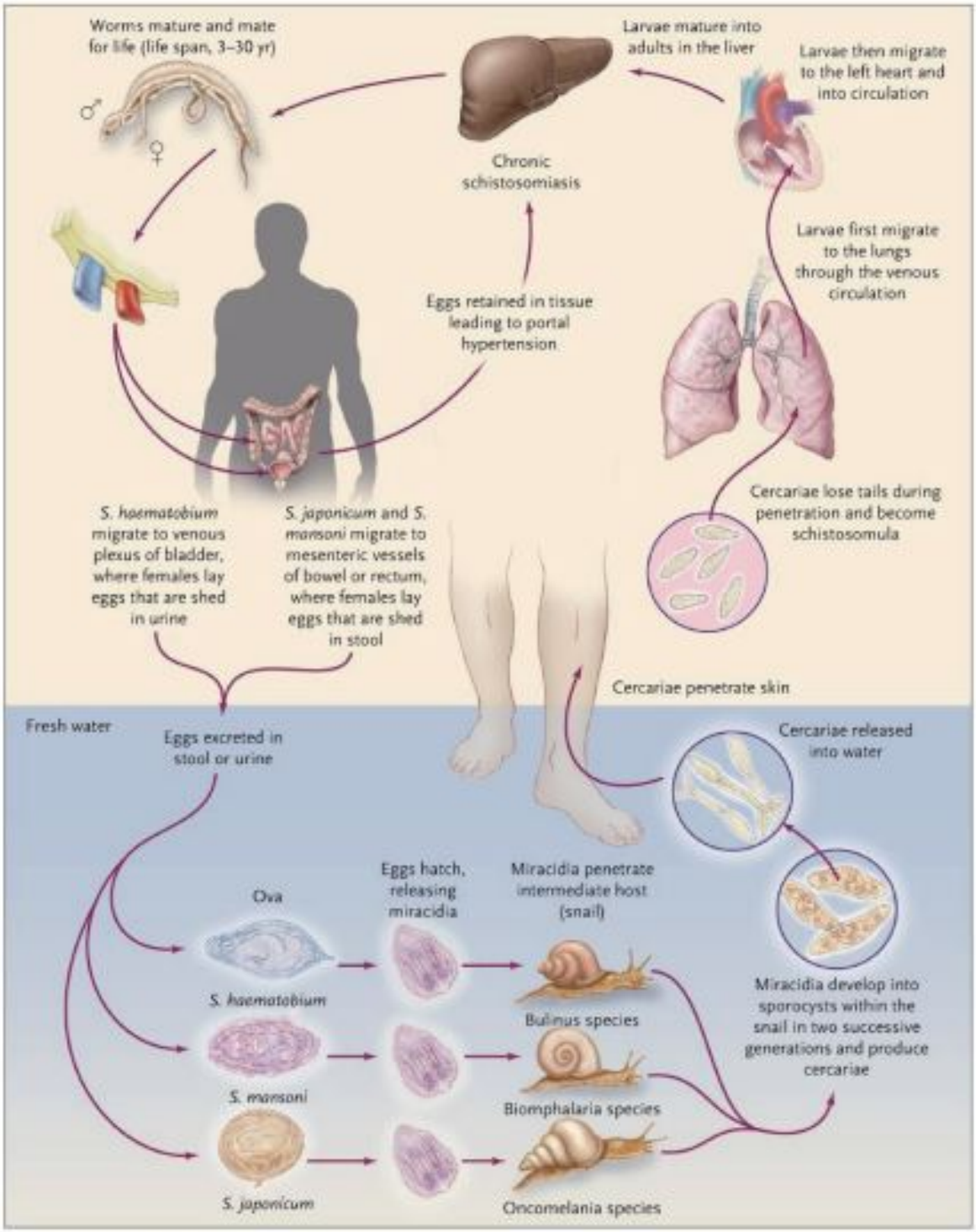

Figure 3: The life cycle of *Schistosoma spp.* (Ross, 2002).

Current disease ending approach

Based on the principles of preventive chemotherapy-- mass drug administration, (further referred to as MDA) with praziquantel was developed in the 1970s. It has become the "gold standard approach" to control Schistosomiasis since 2002 (Gryseels, 2013). Inexpensive drug treatment was offered to the entire target group (school-age children and high-risk adults) without an individual diagnosis (WHO, 2006) and irrespective of infection status individually (WHO, 2011). High-coverage MDA in endemic areas is aimed to alleviate symptoms by killing adult worms and reduce transmission, to ease disease burden in a low-resource setting countries with limited access to medical health (Webster, 2014). With the intention of "leaving no one behind," universal health coverage came to be a crucial component. According to the current WHO guidelines, prevalence (the percentage of individuals in a population who are infected) is the key indicator for the selection of control School-age children are the most vulnerable target group, due to undergoing intense periods of physical growth, as being infected with schistosomiasis can affect growth and diminish learning capability. School-age children are thus seen as the primary target group undergoing survey testing when determining illness prevalence. It is also easier to target school-aged children with efficiency through the educational system as school infrastructure reduces cost and poses as a good opportunity for the education of personal hygiene awareness. School-aged children are the most important high-risk group for schistosomiasis (WHO, 2011). The drug coverage of school-aged children in an endemic area is an important indicator in goal achievement according to the WHO guidelines. The elimination goal for 2020 is to successfully treat at least 75% of school-aged children (WHO, 2011). Repeated treatment is necessary through MDA to tackle re-infection of the disease. A sustainable MDA intervention can take five years or more, depending on the funding and elimination strategy in different countries. The drug used in the African region is mainly through the Praziquantel Donation Program of Merck KGaA, via the World Health Organization (Pediatric praziquantel consortium). The locally produced drug is, however, the best option, as it can reduce cost in transportation, avoid possible delays in the invoice, and can potentially stimulate the local economy (WHO, 2011)

Control is one of the most important steps to tackle this neglected disease. However, due to the complexity of disease causes, it can be hard to grasp every piece of information. One

main problem, for example, is the difficulty in keeping track of the real drug adherence via MDA either school-based or community-based. According to the current MDA goal pledged by WHO, countries are urged to reach 75% drug coverage of school-aged children. However, studies have shown that the amount of drug reported as given may not be the same as the number of drugs swallowed (Shuford, 2016). A variety of factors can result in this inadequate control of non-adherence to MDA drugs, such as the accessibility of treatment, the relationship between drug distributors and the citizens, and the low awareness of MDA drug benefits (Krentel, 2013). These persistent non-adherers pose as a loophole in the disease elimination process, as the infected non-adherers continuing carries the Schistosoma parasite, and can release the eggs back into the environment (Farrell, 2017). The lack of control in treatment adherence will hinder the eradication of Schistosomiasis and stimulate reinfections (Toor, 2018). The issue of treatment coverage may be greatly improved by taking into consideration social-behavioral factors when designing the MDA procedure (Krentel, 2013), as well as including individual treatment data that record longitudinal patterns of compliance during MDA (Farrell, 2017), instead of only recording the overall coverage.

3. Methodology

Study population

This cross-sectional study was conducted among medical students of Chattogram during the periods of February 2022 to July 2022. In Bangladesh, undergraduate medical degree is named as MBBS (Bachelor of Medicine & Surgery) which has a 5-year curriculum and includes a mandatory one-year long internship. The NTDs are included in the community medicine course which is studied in the third year. Therefore, the study targeted medical students at the stage of 3rd to final year in this study. Study also included foreign students as they are also studying in Bangladesh under the same curriculum. The inclusion criteria were the MBBS students studying at third and final year of their course. The study excluded students of first, second, and fourth year.

Method of estimating sample size

Sample size was determined on basis of the following formula

z = 1.96 at 95% confidence level

p = Expected proportion of occurrence, it is 50% (0.5) because it is not known

q = 1-p = 1-0.5 = 0.5

e= 10% of p = 0.05

So calculated sample size (n) was

$N= z^2pq/e^2$

$= (1.96)^2*0.5*0.5 / (0.05)^2 = 384$

Questionnaire design

A comprehensive review of the literature has been conducted to identify the factors need to assess the level of knowledge and awareness among medical students. Based on the review findings a questionnaire was prepared for data collection. Most of the questions were multiple choice checkbox types possessing Yes and No answers as well as 'other' options were also included in a few questions. The aim and objectives of the study were

clearly explained at the beginning of the questionnaire. The questionnaire was divided into two parts. Part 1 included questions on the general knowledge of participants regarding NTDs in the world and Bangladesh. Part 2 inquired the perception of participants regarding the threat of NTDs and their involvement in control activities. The questionnaire was designed in the English language which required five minutes to be filled.

Sampling strategy

This study included all medical colleges situated in the Chattogram district of Bangladesh. Two class 3rd and final year were selected from each medical college in this study to observe the present status of students and any comparison in academic position. The study followed convenient sampling for collecting data from students. The data were collected from available students found on the day of visit.

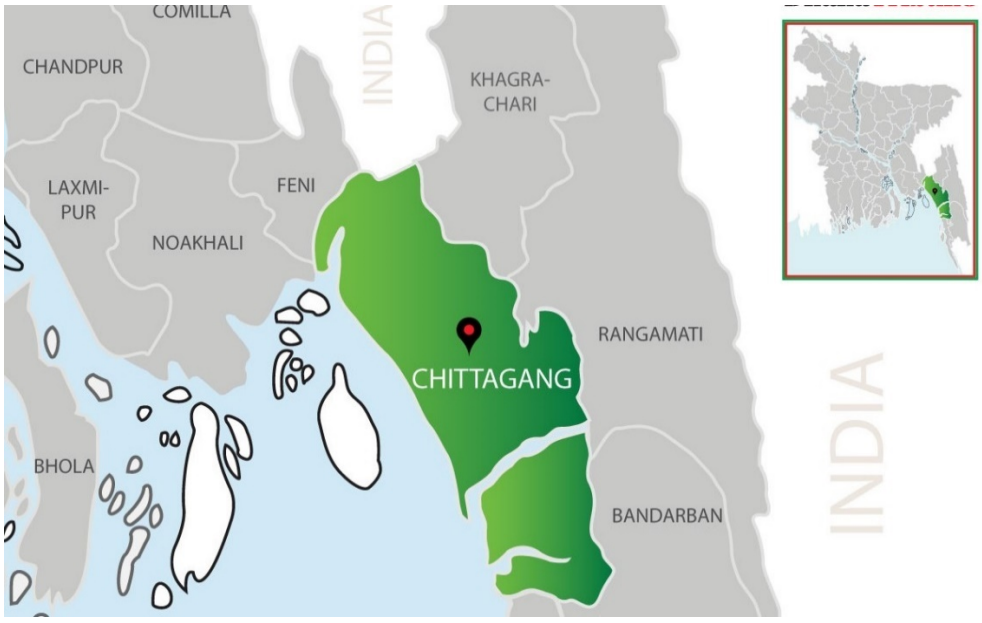

Figure 4: Map presenting study location in Chattogram, Bangladesh

Data collection

Data were collected between March 19 and May 15, 2022. The questionnaire was distributed among students attended in their classroom as well as individual face to face interview. Participation in this study was fully voluntary and proceeds to the main parts of the questionnaire upon informed consent. The response to the questionnaire was stored on the computer with a password and was accessible only to the investigators.

Data analysis

After the completion of collection, all data were placed into an excel file. Then the full dataset was checked and coded before analysis. Data analysis was performed using the SPSS software (Statistical Packages for Social Science). Descriptive analysis represented in frequencies and percentages of different variables. Associations between the level of study and socio-demographic characteristics were tested using the Chi-Square and Fisher exact probability tests. Non-overlapping 95% CI or p-values ≤5% were considered as statistically significant.

4. Results

Table 2 presents the demographic characteristics of all 382 participants. Among the total 55.5% were female and the rest (44.5%) were male. 13.6% of the participants were foreign students studying in Bangladesh. One-third of the participants (68.3%) were 3rd year students whereas 31.7% were in their final year of study. Though all the participants were studying in Chattogram but they had came from eight divisions of Bangladesh, however, the majority of them were from the Chattogram, Dhaka, and Sylhet division. 51.6 % of the participants acknowledged that they had never seen someone with NTDs.

Table 2: Demographic characteristics of the study participants

Parameters	Categories	Frequencies	Percentage
Gender	Male	170	44.5
	Female	212	55.5
Nationality	Bangladeshi	330	86.4
	Non-Bangladeshi	52	13.6
Academic year	3rd year	261	68.3
	Final year	121	31.7
Location (Division)	Dhaka	75	19.6
	Chattogram	240	62.8
	Sylhet	51	13.4
	Other	16	4.2
Have you ever seen someone affected by NTDs?	Yes	185	48.4
	No	197	51.6

Table 3 demonstrates the comparison of responses between 3rd year students and final year students. When asked about the definition of NTDs, both groups had higher responses. However, 36% of 3rd year students and 28.9% of final year did not know the definition of NTD. When questioned about the full form of NTDs, 94 percent of 3rd year students and 97.5% percent of final year students correctly answered. While asked about the long-term effects of NTDs, 38% of participants in both groups said they had no idea about the visual and physical impairments caused by NTDs. 70.5% of third year students and 64.5% of final year students said they had heard about NTDs in Bangladesh, but most of them had not enough idea on control of NTDs. A lower number of participants also wrongly marked malaria and HIV as NTD. Most of the 3rd year students were correctly recognized leishmaniasis (25.11%) and lymphatic filariasis (23.18%) are the NTD of Bangladesh. On the other hand, 27.80% of final year incorrectly identified diarrhea as an NTD.

Table 3: Comparing the knowledge of medical students regarding NTD

Questions	3rd year	Final year	P value
Do you know the definition of NTDs?			
Yes	167 (64)	86 (71.1)	0.2
No	94 (36)	35 (28.9)	
What is the full meaning of NTD?			
Natural tropical diseases	10 (3.8)	2 (1.7)	0.37
Neglected tropical diseases	246 (94.3)	118 (97.5)	
Neutral tropical diseases	5 (1.9)	1 (0.8)	
Total no of NTDs listed by WHO			
12	42 (16.1)	19 (15.7)	0.25
15	68 (26.1)	30 (24.8)	
20	133 (51)	56 (46.3)	
25	18 (6.9)	16 (13.2)	
Do you know about specific NTDs control activities?			0.2
Yes	96 (36.8)	36 (29.8)	
No	165 (63.2)	85 (70.2)	

Do you know that NTD has long-term consequences like visual and physical impairments?			0.86
Yes	162 (62.1)	74 (61.2)	
No	99 (37.9)	47 (38.8)	
Have you heard of any NTD in Bangladesh?			
Yes	184 (70.5)	78 (64.5)	
No	77 (29.5)	43 (35.5)	0.24
Mark the major NTDs found in the world			
Dengue	166 (25.26)	81 (23.14)	
HIV	85 (12.94)	48 (13.71)	N/A
Malaria	116 (17.66)	69 (19.71)	
Leprosy	172 (26.18)	89 (25.43)	
Rabies	118 (17.96)	63 (18)	
Mark the major NTDs of Bangladesh			
Lymphatic Filariasis	156 (23.18)	75 (18.29)	
Diarrhea	114 (16.94)	114 (27.80)	N/A
Kala-azar/Leishmaniasis	169 (25.11)	83 (20.24)	
Soil-Transmitted Helminthiasis	131 (19.46)	79 (19.27)	
Malaria	121 (17.98)	59 (14.39)	

The study was intended to explore the perceptions of medical students regarding the strategies for controlling NTDs. A number of suggestions were made, including increased public awareness, a simple diagnostic facility, more research, proper policy and strategy, and more funding. Participants placed the greatest emphasis on mass awareness (83.8 percent) followed by easy diagnostic facilities (71.2%). More funding was the least popular suggestion. Recommendations selected by the participants are depicted in figure 5.

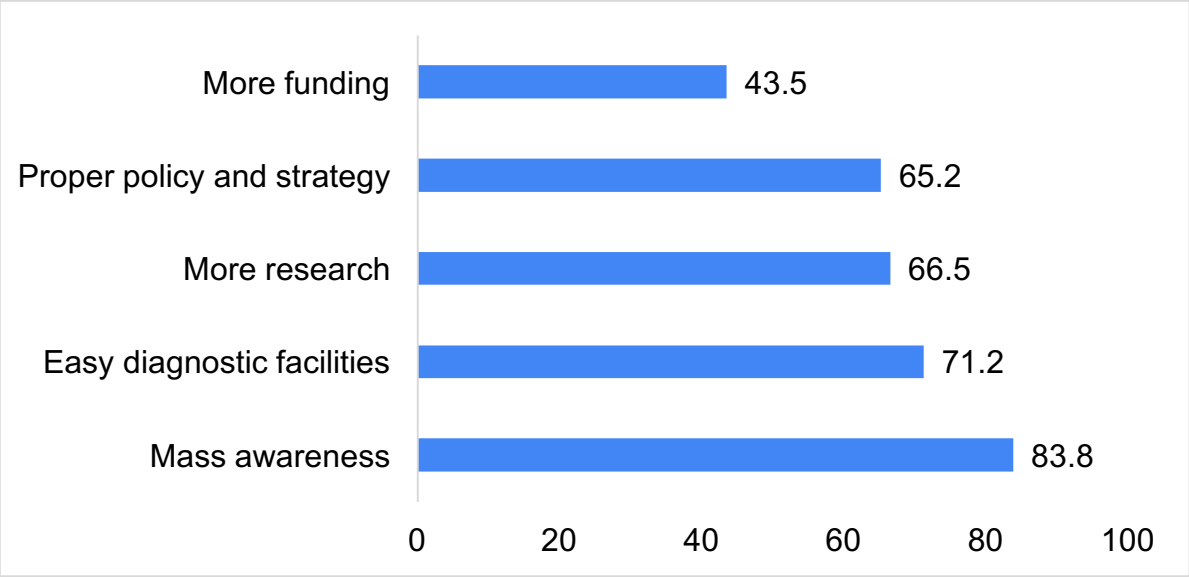

Figure 5: Perception of participants regarding control activities of NTDs

Moreover, the participants were asked if they would be willing to participate in NTD control activities. Figure 6 depicted that more than 70% of the participants expressed an interest in participating in NTD prevention activities.

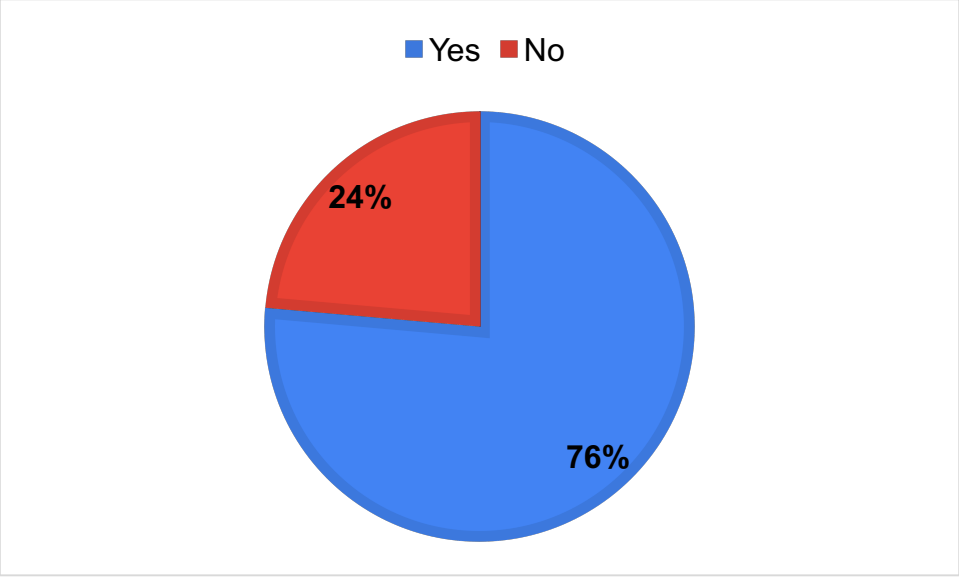

Figure 6: Willingness of participants to join in control activities for NTDs

The majority of participants (80.1%) agreed that there was insufficient awareness of NTDs in Bangladesh. Training/workshop/seminar, educational curriculum, awareness campaign in schools and colleges, use of social media, particularly television, and celebrating special days and weeks were some of the potential suggestions made by participants for raising awareness (Figure 7). Most of the participants (73.3%) considered that training or a workshop would be the best way to raise awareness. The educational curriculum was ranked second in importance. 44.8% of participants also stated the importance of Celebrating special days and weeks for creating mass awareness.

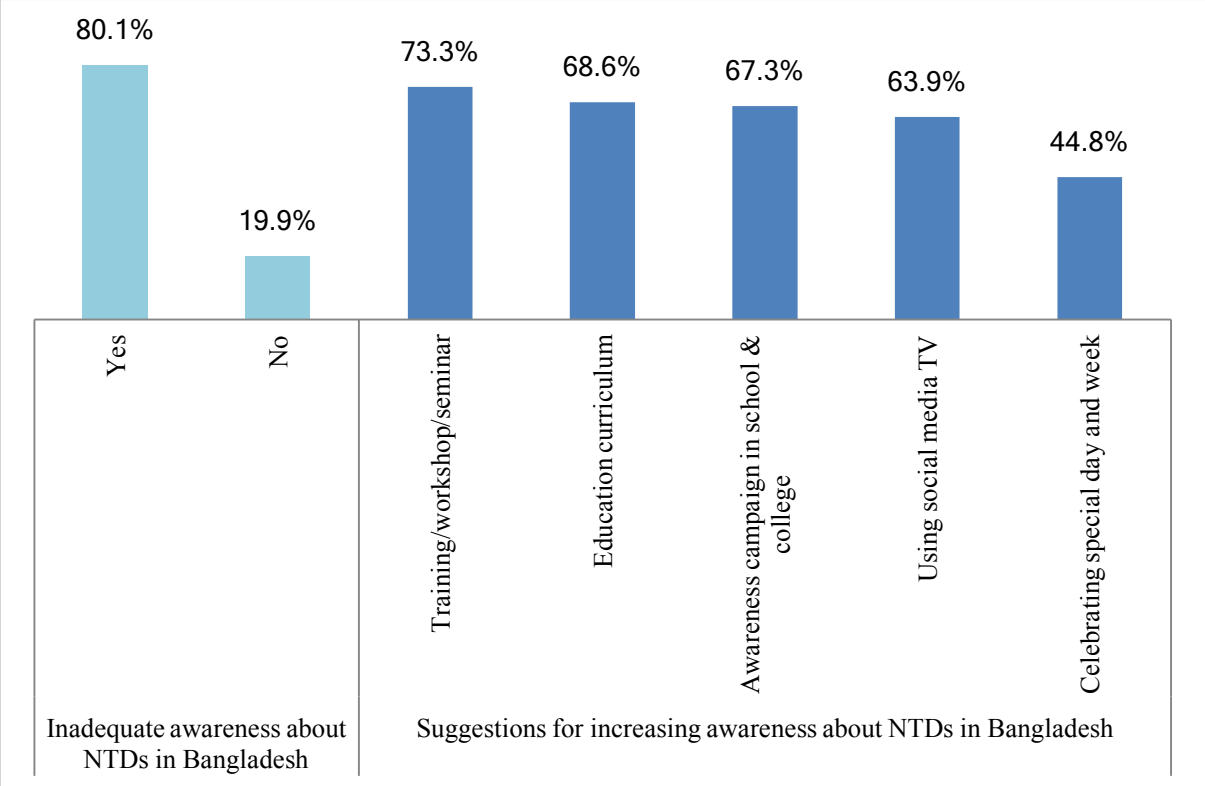

Figure 7: Perception of participants regarding awareness program of NTDs

5. Discussion

This study included 3rd year undergraduate medical students and final year students to assess and compare the level of knowledge and awareness on NTDs at different stages of medical education. Higher number of female participants reflects the increasing engagement of girls in medical education in Bangladesh. Half of the participants acknowledged that they never saw any patient with NTD. A previous study on medical and nursing students in Egypt found similar results where the majority of the people were not experienced in seeing NTD patients (Elfar et al., 2020). Controlling of NTDs is crucial for achieving the SDG 2030. This study identified knowledge gaps and medical students' attitude towards their role in prevention and control of NTDs.

Although most of the participants of both groups correctly identified the acronym of NTD, the one third of them did not know the definition of NTD and never heard about any NTD indicating that NTDs were not prioritized in their course materials. Analyses found no significant differences among knowledge and awareness scores between the students of 3rd and 4th year. It proved that the improvement of knowledge level was zero to very little with the progression of study period of medical students. A previous study also found no improvement above 4th year students on socio-demographic and epidemiological knowledge of NTDs (Errea et al., 2015). Half of the junior and final year students had no idea about the actual number of NTDs updated by WHO. One third of them even did not hear about any NTD in Bangladesh although dengue and rabies are two widely discussed disease in Bangladesh (Rahman et al., 2021; Rahman and Rahman, 2020; Rana et al., 2020). Moreover, lymphatic filariasis, visceral leishmaniasis, and soil-transmitted helminth infections (including hookworm, ascariasis, and trichuriasis) are common NTDs in Bangladesh (Ministry of health and family welfare, 2010). Moreover, a considerable number of participants incorrectly identified HIV, diarrhea, and malaria as NTD. The findings highlighted the need for structured training and teaching programs for medical students in the context of NTDs and their prevention strategies.

Three-fourth of the participants were motivated to work for controlling NTDs in Bangladesh which indicated the positive attitude of medical students towards the implementation of strategies in order to control and prevent NTDs in Bangladesh. A prior study revealed a contrasting picture, where two-thirds of the participants were unwilling or reluctant to participate in control activities (Elfar et al., 2020). In another study, 92.2 percent of respondents expressed their willingness to participate in NTD- related activities in their working station and community (Olamiju et al., 2014). However, it was concerning that more than half of the participants were less focused to increase fund, despite the funding is crucial for management and prevention of NTDs. NTDs received only 0.6% of health fund whereas, AIDS, malaria, and tuberculosis received 50% fund (Emeto et al., 2021; Liese et al., 2014). Higher number of the participants had focused on the importance of research on different aspect of NTDs. Previous studies also suggested that medical students should be actively engaged to clinical and community based field research studies (Kishore and Dhadialla, 2007).

The participants believed that the awareness of NTDs in Bangladesh is low, alike medical students in Egypt also recognized the low level of awareness (E et al., 2020). They placed the greatest emphasis on training and workshops to raise awareness among health professionals. A study in Nigeria also emphasized on public awareness indicating that the public's awareness and perception to combat NTDs (Olamiju et al., 2014). Public awareness may facilitate policy formulation and implementation in the context of NTD control. Since the fight against NTD creates a thought and understanding of multidisciplinary approach, clinical and socio-epidemiological knowledge should be intertwined from the start of a healthcare provider's career. Literature determined that updated and evidence-based knowledge about NTDs should be provided to medical students by structured curriculum, training, research, and publication (Ca and Barraviera, 2011; Nelson et al., 2012). The results will serve as a baseline document for future in-depth study throughout the country including different stakeholders and will facilitate policymaking for proper understanding knowledge gap in the action plan.

6. Conclusions

The study identified inadequate knowledge and awareness among medical students regarding NTDs in Bangladesh which is a challenge for control, elimination, and eradication of NTDs. There was average level of knowledge among medical students and the study found no significant difference between third year and final year students. Arranging training and workshops for medical professionals and providing education curriculum for students were recommended by the participants to improve the level of knowledge and awareness. Most of the participants were motivated to involve themselves in NTD control programs which could be a crucial for successful implementation of strategies towards the elimination of NTDs.

7. Limitations

- The study was only conducted in medical colleges located in Chattogram city of Bangladesh which is the big limitation of the study.
- Besides, the lack of enough local literature limits the scope of comparative discussion.

8. Recommendations

- Medical education should focus more on neglected tropical disease especially those available in Bangladesh.
- An extended KAP (Knowledge, attitude, and practice) study should be conducted covering all medical colleges to assess the overall scenario and compare the findings.
- Existing control strategies should be revised based on the findings of the study.
- Policymakers should prioritize the involvement of medical students in the early diagnosis, prevention, and control of NTDs in Bangladesh.

9. References

Act to end NTDs east, 2021. Bangladesh | Act to End NTDs. (Cited 10.17.21)Available from: https://www.acteast.org/where-we-work/bangladesh.

Addisu A, Adriaensen W, Balew A, Asfaw M, Diro E, Garba Djirmay A, Al, E. 2019. Neglected tropical diseases and the sustainable development goals: an urgent call for action from the front line Ethiopia SORT IT Neglected Tropical Diseases Group Handling editor Seye Abimbola. BMJ Glob Heal. 4, 1334.

Bodimeade C, Marks M, Mabey D. 2019. Neglected tropical diseases: elimination and eradication. Clin. Med. (Northfield. Il). 19, 157–160.

Ca C, Barraviera. 2011. Universities and neglected diseases – it is not enough to have the knowledge, it must be applied. J. Venom. Anim. Toxins Incl. Trop. Dis. 17, 1–3.

Centers for disease control and prevention. 2021. CDC - Global Health - Neglected Tropical Diseases. (Cited 10.17.21). Available from: https://www.cdc.gov/globalhealth/ntd/.

David Molyneux. 2013. Community Eye Health Journal » Neglected tropical diseases. Community eye Heal. J. 26, 21–24.

DGHS. 2020. Health Bulletin 2019. Available from: https://doi.org/https://www.dghs.gov.bd/index.php/en/publications/health-bulletin/dghs-health-bulletin

Dhakal S, Karim MJ, Al Kawsar A, Irish J, Rahman M, Tupps C, Kabir A, Imtiaz R. 2020. Post-intervention epidemiology of STH in Bangladesh: Data to sustain the gains. PLoS Negl. Trop. Dis. 14, e0008597.

Elfar E, Asem N, Yousof H. 2020. The awareness of neglected tropical diseases in a sample of medical and nursing students in Cairo University, Egypt: A cross-sectional study. PLoS Neglected Tropical Diseases. 14, e0008826.

Emeto DC, Salawu AT, Salawu MM, Fawole OI. 2021. Recognition and reporting of neglected tropical diseases by primary health care workers in Ibadan, Nigeria. PAMJ. 2021; 38:224 38.

Errea RA, Vasquez-Rios G, Machicado JD, Gallardo MS, Cornejo M, Urquiaga JF, Montoya, D, Zamudio, R, Terashima A, Marcos LA, Samalvides F. 2015. Medical

Student Knowledge of Neglected Tropical Diseases in Peru: A Cross-Sectional Study. PLoS Neglected Tropical Diseases. 9.

Gautam, Bhanwra S. 2008. Neglected tropical diseases: Need for sensitization of medical students. Indian J. Pharmacol. 40, 132.

Hossain MM. 2016. Elimination of Lymphatic Filariasis from Bangladesh: Current Status. J. Sci. Found. 14, 1–2.

Karoke W, Karoke W. 2018. Neglected tropical diseases: less known subjects amongst health care professionals. Ber. Kedokt. Masy. 34, 254–255.

Kishore SP, Dhadialla PS. 2007. A Student-Led Campaign to Help Tackle Neglected Tropical Diseases. PLOS Med. 4, e241.

Laing G, Vigilato MAN, Cleaveland S, Thumbi SM, Blumberg L, Salahuddin N, Abela-Ridder B, Harrison W. 2021. One Health for neglected tropical diseases. Trans. R. Soc. Trop. Med. Hyg. 115, 182–184.

Liese BH, Houghton N, Teplitskaya, L. 2014. Development assistance for neglected tropical diseases: progress since 2009. Int. Health 6, 162–171.

Mankbadi M, Goyack L, Thiel B, Weinstein D, Simms-Cendan J, Hernandez C. 2016. Dermatologic Simulation of Neglected Tropical Diseases for Medical Professionals. Medical Education Portal.

Ministry of health and family welfare B. 2010. A Situation Analysis: Neglected Tropical Diseases in Bangladesh.

Nelson BD, Saltzman, A, Lee PT. 2012. Bridging the global health training gap: Design and evaluation of a new clinical global health course at Harvard Medical School. Med. Teach. 34, 45–51.

Olamiju OJ, Olamiju FO, Adeniran AA, Mba IC, Ukwunna CC. 2014. Public Awareness and Knowledge of Neglected Tropical Diseases (NTDs) Control Activities in. PLoS Negl Trop Dis 8, 3209.

Peter J, Molyneux D, Fenwick, A, Kumaresan, J, Sachs S, JD S, L S. 2007. Control of neglected tropical diseases. New England Journal of Medical. 357, 1018–1027.

Rahman BMS, Mehejabin F, Rashid R. 2021. A community based case-control study to determine the risk factors of dengue fever in Bangladesh. medRxiv 2021.08.24.21262563.

Rahman MS, Rahman T. 2020. Risks of Simultaneous Coinfection of Dengue and COVID-19 in Bangladesh: Challenges and Recommendations. Dr. Sulaiman Al Habib Medical Journal. 2, 137.

Rana MS, Siddiqi UR, Ghosh S, Jahan AA, Islam MK, Ali Shah MR, Ullah SM, Ali SME, Ahmed BN, Shamsuzzaman AKM. 2020. Epidemiological study of human rabies cases in Bangladesh through verbal autopsy. Heliyon 6, e05521.

Annex 01: Questionnaire

Knowledge and Awareness of Medical Students Regarding the Neglected Tropical Diseases in Chattogram

NTDs are widely prevalent and are a serious public health problem in sub-sahara Africa, Asia and Latin America, affecting more than a billion of people and cause around 534,000 deaths every year. Bangladesh has started implementing NTD elimination programs in 2001 in respond to the calls by the WHA and WHO. The awareness of healthcare providers is crucial to improve the diagnosis, treatment and control of NTDs. Therefore, this study has conducted to understand the present status of medical students.

Participation in this study is voluntary and participants are free to withdraw at any time without explanation and without incurring a disadvantage

The target participants are 3rd and final year medical students studying in Chattogram, Bangladesh.

Data will be kept confidential. only researchers will have access to your responses. Data will be used for research purposes only. The results of the study will be published in a journal or conference article.

Participant's signature Date:

ID:

Part 01: Socio-demographic

1. Please mention your gender Male female
2. Please write your academic year 3rrd year final year
3. Your Nationality Bangladeshi foreigner
4. Where is your home town? (Division): …….
5. Have you ever seen someone affected by NTD? Yes No

Part 02: Knowledge

1. Do you know the definition of NTD?
    a. Yes

b. No

2. What is the full meaning of NTD?

a. Natural Tropical Diseases

b. Neutral Tropical Diseases

c. Neglected Tropical Diseases

d. Native Tropical Diseases

3. Write down the total number of NTDs prioritized by the World Health Organization (WHO): 12, 15, 20, 25

4. Do you know about specific NTDs control activities? Yes No

5. Which of the following are NTD around the world?

Dengue HIV/AIDS Malaria leprosy Rabies

6. Do you know many NTDs have long-term consequences, such as visual and physical impairments? Yes no

7. Have you heard of any NTD in Bangladesh?

Yes No

8. Which are the major NTDs in Bangladesh? (tick all that apply)

Filariasis, diarrhoea, kala-azar, soil transmitted helminthiasis malaria

Part 03: Awareness

1. Do you think NTDs are a threat to public health in Bangladesh?

Yes No

2. Do you think eradicating NTDs is an urgent need in Bangladesh?

Yes No

3. There is inadequate awareness about NTDs in Bangladesh?

Yes NO

4. Are you willing to participate in any control activities for NTDs?

   Yes No

5. What recommendations/suggestions do you have for preventing and eradicating NTDs?

   More research

   Policy and strategies

   More investment/funding

   Mass awareness

   Easy diagnostic facilities

   Other…….

6. What recommendations/suggestions do you have for increasing awareness about NTDs? Education curriculum

   Celebrating special day or week

   Training/workshops/seminar

   Using social media TV

   Awareness campaign in school and college

   Other…….

Signature of the researcher

…….

Brief bio-data of the author

DR. Saira Nusrat passed the Secondary School Certificate Examination in 2007 followed by Higher Secondary Certificate Examination in 2009. She obtained her MBBS Degree in 2015 from University of Science and Technology, Chittagong. Now, she is a Candidate for the degree of Masters in Public Health (One Health) under the One Health Institute, CVASU. She has immense interest to continue research on AMR, Neglected Tropical Diseases, and infectious disease epidemiology through One Health approach.