TALLINN UNIVERSITY OF TECHNOLOGY

School of Information Technologies

Department of Health Technologies

Mousomi Akter

177315YVEM

IMPORTANCE AND FEASIBILITY OF REAL-LIFE TYPHOID FEVER INCIDENCE DATA COLLECTION IN BANGLADESH- COMPARATIVE STUDY OF LITERATURE REVIEW AND SINGLE SITE RESULTS.

Master's thesis

Supervisor: Peeter Ross

MD, PhD

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Infotehnoloogia teaduskond
Tervisetehnoloogiate instituut

Mousomi Akter

177315YVEM

TÜÜFUSE ESINEMUSE ANDMETE REAALAJAS KOGUMISE TÄHTSUS JA TEOSTATAVUS BANGLADESHIS – KIRJANDUSE ÜLEVAATEL JA ÜHEL ANDMEKOGUMISKOHAL PÕHINEV VÕRDLEV UURING.

Magistritöö

Juhendaja: Peeter Ross,

MD, PhD

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis and this thesis has not been presented for examination or submitted for defense anywhere else. All used materials, references to the literature and work of others have been cited.

Author: Mousomi Akter,

20.05.2019

Acknowledgements

This dissertation is the result of my own work conducted on Typhoid incidence in an urban area and compare the result to previous studies in Dhaka. As the main objective is to promote data collection from single hospital of a selected area with typhoid endemic and make comparison with previous collected data of public hospitals, it was mandatory to collect data from a single hospital. I am grateful for number a number of friends and colleagues in encourage me to start the work, they assisted to get authentic permission for collecting data of typhoid fever.

In Dhaka I thank to my colleague Mehedi Hassan to support me and send all the reports of typhoid fever from September 2018 to March 2019 via post and through online.

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Abstract

Enteric fever is a vulnerable and somewhere it becomes fatal disease that spread through contaminated food and water by Salmonella Typhi in endemic area. The people living in slum and density area of the developing countries, bear highest incidence of having typhoid fever.

The goal of this study is to find out, if the method implemented to collect data about typhoid fever incidence in a selected area of Dhaka, Bangladesh, is feasible for the real-life data collection and are the results comparable with the incidence of typhoid fever in different parts Dhaka metropolitan areas from earlier conducted studies. Additionally, to promote attention to prevent typhoid incidence by collecting and analyzing real-life data in other endemic areas of Dhaka.

Approximately, 677 Widal test reports and corresponding clinical histories of 6 months were collected from a single hospital of the selected area for statistical analysis. The real-life data was collected from the hospital database with authentication and data of different areas was collected from online publication of different renounced public hospitals of Bangladesh. The incidence of typhoid fever of this area was 700 per 100 000 population. The age-specific incidence was highest (44%) for the 6 to 20 years age groups, while 12% for children under 5 years old for 6 months of period. The gender specific ratio was for female and male as 23:13, female showed more incidence than male. The highest amount of confirmed cases was got in September to December 2018 (62%) after that it started to decreased, 5% in March. In monsoon and post monsoon season had higher incidence that other seasons of the year. Moreover, typhoid infection showed more number of cases than paratyphoid, it was 53:7. To compare with other data the findings were similar except two parameters; the highest risk group was school going children rather than under 5 years old group and female showed higher incidence than male ratio.

The results represented the real scenario of a typhoid diagnostic of an area that can draw attention of health decision makers to take immediate vaccination steps for prevention and encourage to collect more real-life data from different areas; these would be assisting to apply gradually further long- term prevention methods to reduce typhoid incidence.

Key words: Typhoid, paratyphoid fever, incidence, gender specific distribution, age specific distribution, urban, vaccination.

The thesis is in English and contains 52 pages of text, 8 chapters, 9 figures, 3 tables.

Abstrakt

Kõhutüüfus on kurnav haigus, mis võib lõppeda surmaga Haiguse tekitaja on Salmonella Typhi, mis levib saastunud toidu ja vee kaudu endeemilises piirkonnas. Inimestel, kes elavad arengumaade slummide ja tihedalt asustatud piirkondades, esineb kõhutüüfust kõige sagedamini.

Uuringu eesmärk on välja selgitada, kas meetod, mida on kasutatud andmete kogumiseks kõhutüüfuse esinemise kohta valitud piirkonnas Dhakas, Bangladeshis, on sobilik tegelik andmete kogumiseks ja kas tulemused on võrreldavad kõhutüüfuse esinemissagedusega Dhaka linnapiirkondades varasemalt, tehtud uuringutega. Lisaks soovib autor tähelepanu pöörata kõhutüüfuse esinemise ennetamise tähtsusele. Selleks tuleks- koguda ja analüüsidsa tegelikke andmeid ka Dhaka teistes endeemilistes piirkondades.

Valitud piirkonna ühest haiglast koguti statistiliseks analüüsiks ligikaudu 677 Widal-testi aruannet ja vastavalt 6 kuu kliinilisi andmeid. Haigusandmed koguti uuringuobjektiks oleva haigla andmebaasist, teiste piirkondade andmed koguti veebiotsingu kaudu teadusartiklitest. Uuritud piirkonnas oli kõhutüüfuse esinemissagedus 700 100 000 elaniku kohta. Vanusepõhine esinemissagedus oli kõige kõrgem (44%) vanuses 6 kuni 20 aastat, 12% alla 5-aastastel lastel 6 kuu jooksul. Soospetsiifiline suhe oli naiste ja meeste puhul 23:13, naistel oli suurem esinemissagedus kui meestel. Kõige suurem arv kinnitatud diagnoose saadi septembrist detsembrini 2018 (62%). Pärast seda, hakkas esinemissagedus langema olles, 5% märtsis. Monsooni ajal ja monsoonijärgsel hooajal esines suuremat esinemissagedust, kui teistel aastaaegadel. Uuring näitas, et kõhutüüfuse infektsiooni esines rohkem, kui paratüüfust vastavlt 53: 7. Võrreldes teiste veebipäringust saadud uuringute andmetega olid tulemused sarnased, välja arvatud kaks parameetrit: kõrgema riskiga rühm oli pigem koolis käivad lapsed, kui alla 5-aastased ja naistel esines haigust rohkem kui meeste.

Tulemusete põhjal saab hinnata uuritava piirkonna tüüfuse diagnostika tegelikku olukorda. Töö tulemused võivad juhtida tervishoiu otsustajate tähelepanu sellele, et võtta viivitamatult kasutusele ennetusmeetmeid ja julgustada koguma rohkem tegelikke andmeid erinevatest piirkondadest. See omakorda aitaks järk-järgult rakendada pikaajalisi ennetusmeetodeid kõhutüüfuse esinemissageduse vähendamiseks.

Märksõnad: tüfoid, paratüüfne palavik, esinemissagedus, soospetsiifiline jaotus, vanusepõhine jaotus, linna- ja vaktsineerimine

Lõputöö on kirjutatud Inglis keeles ning sisaldab teksti 52 leheküljel, 8 peatükki, 9 Figuret, 3 tabelit.

Abbreviation

S.typhi	**Salmonella Typhi**
S. Paratyphi	**Salmonella Paratyphi**
Vi	**Virulence factors**
AH	**Flagella antigen type A**
BH	**Flagella antigen type B**
TO	**The lipopolysaccharide-protein somatic antigens**
TH	**The lipopolysaccharide-protein flagella antigens**
NC	**Negative control**
PC	**Positive control**
TPTest	**Typhoid/Paratyphoid Diagnostic Assay**
CBC	**Complete Blood Count**
PBF	**Peripheral Blood Film**
MP	**Membrane Preparation**
ELISA	**Enzyme-linked Immunosorbent Assay**
ViCPS	**Vi capsular Polysaccharide Vaccine**
HIV	**The human Immunodeficiency Viruses**
WHO	**World Health Organization**
SSFH	**Shishu Shasthya Foundation Hospital**
TESSy	**TESSy**
EU	**European Union**
EEA	**The European Economic Area**
ICDDRB	**International Centre for Diarrhoeal Disease Research, Bangladesh.**

The Table of Content

1. Introduction

Enteric fever is one of the most vulnerable causes of morbidity and mortality in the world - wide (Nagashetty et al. 2010) and the most incidence is occurred in the developing countries, particularly typhoid and para-typhoid represent as continuous common causes of illness and death among the young children and adolescents in South Asia, including Bangladesh. According to resent estimation, new typhoid cases approximately 22 million occur each year in the world and 200,000 of these resulting in death (Crump el al, 2014). In Asia, there is 90% of typhoid fever cases are accounted where Bangladesh and India have the highest incidence of Typhoid disease among the young children under 5 years old and in Vietnam, peak incidence occuring in children with 5-9 years of age group (Sinha et al, 1999; Lin et al. 2000; Brooks et al.2005). Recently, Salmonella enterica serotype Typhi has become more concerning issue due to resistance in fluoroquinolone and treatment options of Typhoid fevers are limited in these endemic countries (Parry et al. 2002; Chau et al. 2007; Slinger et al. 2004); for minimizing this health problem the World Health Organization has taken several steps to promote of typhoid immunization for young children in Asia (WHO, 2008). The transmission routes of this pathogen involve in many factors like hygiene, water quality, food handling and sanitation system (Karkey et al. 2010), close contact with carrier person (Tran el al. 2005), education level, household hygiene, flooding (Vollaard et al. 2004), personal hygiene, close to waterbodies and travel to endemic areas (Whitaker et al.2009). furthermore, variable of climates like monsoon rain, vapor pressure and temperature show a significant impact on the transmission and having typhoid infection in the population (Kelly-Hope et al. 2007; Wang et al. 2012). Likely, Pakistan has the highest incidence 451.7 per 100,000 persons/years and India ha 214.2 per 100,000 persons/year; the mean age of infected with typhoid is 7.0 years and 15.5 years respectively (Ochiai et al. 2008). Bangladesh has a large population with mostly impoverished, thus the incidence of typhoid will be high, a population-based study showed that young children under 5 years old and young adult had the highest rate of all enteric infection (Stoll et al. 1983). According to the community - based study by Brooke et al 2005., the overall incidence was 3.9/1000 persons/year and the incidence rate was higher in young children <5 (18.7 per 1000 persons/years). Additionally, a high-incidence of multidrug-resistant strains was found in children aged under 5 (10.5/1000 persons/year) in endemic areas where overall incidence rate was 2.0/1000 persons/year (Naheed et al. 2010). The age distribution data of

incidence represent that the infection was lower in older age group 0.9/1000 persons-year than the young children group (Naheed et al. 2010). Another important finding was that the incidence of Typhoid fever is higher than the incidence of paratyphoid in the slum Dhaka, Bangladesh (Naheed et al. 2010); (Brooke et al 2005). The income level has the impact on the incidence of typhoid fever such as the children of low incomed group has higher incidence rate than the higher incomed families in a semi-urban setting (Rahman et al. 2011).

The aim of my study is to reveal out the incidence of typhoid fever in an urban area of Dhaka from previous research and make a comparison with real-time incidence of typhoid infection in a selected urban area. Additionally, attempt to draw attention of health authorities to take more steps for collecting data from every urban areas of Dhaka and implying prevention initiatives to reduce typhoid infection. Jurain, a small town of south part of Dhaka is an over-populated area close to 25 000 people. Most of the population belong to middle- and low-income status (latlong.net). They are deprived from healthy lifestyle and health care services. The lower socioeconomical condition became a life threatened property for the inhabitants (Kabir et al.2018). They are separated from the basic social facilities such as sterile water supply, sewerage system, they live unhygienic lifestyle with contaminated food and water, low literacy rate, and unawareness of the health (Hossain et al. 2010).

1.1. Enteric fever

"Enteric fever is an acute, generalized infection of the reticulo-endothelial system, intestinal lymphoid tissues and gallbladder caused by *Salmonella typhi* (Myron et al, 1999)." The causing pathogen is highly specific human adopted, causes febrile illness and death in population living in over-crowded and under sanitized environment.

1.2. Type of Enteric fever

Two types of enteric fever: 1. Typhoid fever 2. Paratyphoid

1.3. Typhoid fever

Typhoid fever is an infectious disease caused by bacteria “Salmonella Typhi” (Wain et al. 2015). This bacterium is also known as the Salmonella enterica serotype Typhi, these organisms grow in the intestines and blood. This highly adapted, human-specific pathogen has evolved remarkable mechanisms for persistence in its host that help to ensure its survival and transmission (Sattar et al.2012).

1.4. Paratyphoid fever

Paratyphoid fever is caused by any of three strains of *Salmonella* paratyphoid; these are *S.* Paratyphi A, *S. schottmuelleri* (also called *S.* Paratyphi B), or *S. hirschfeldii* (also called *S.* Paratyphi C).

1.5. The organism

Salmonella are gram-negative, rod-shaped bacilli that can cause salmonellosis, a diarrheal illness in humans, they have a cell wall composed of a thin layer of peptidoglycan, covered by a membrane. There are over 2,300 subtypes of the Salmonella enterica bacterium, including serovars enteritidis, Salmonella Agbeni, and typhimurium. Salmonella Typhi is serological positive for lipopolysaccharide antigens O9 and O12, protein flagellar antigen Hd and polysaccharide capsular antigen Vi. The significant fact is that the Vi capsular antigen is restricted to S. enterica serotype typhi (Parry et al.2002).

1.6. Pathogenesis

The infection in patient depends on the variation of infectious dose of S. Enteric serotype typhi. the Vi- positive strains are more infectious and virulent than Vi – negative strain of S. Enteric serotype. These serotypes able to survive in gastric acid and transport to the small intestine where they can defense in low gastric pH level. There are several variables that can affect to infective dose to reduce its activity like achlorhydria cause of aging, previous gastrectomy, treatment with proton-pump inhibitors or huge amount of antacids (Chowdhury et al. 2014). The organism adheres to mucosal cells and then invade the mucosa in the small intestine, by the support of microfold cells or enterocytes, they rapidly penetrate the mucosal epithelium

and reach to the lamina propria. They expose an influx of macrophage swiftly and without killing they invade the bacilli, consequently some bacilli remain into the macrophage of the small intestinal lymphoid tissue and others shift to the intestinal lymphoid follicles and disperse to mesenteric lymph nodes and eventually they reach to the thoracic duct and the general circulation (WHO 2003; Parry et al.2002). it takes 24 hours after ingestion to reach intracellular and pathogens able to survive and multiply within the mononuclear phagocytic cells of the lymphoid follicles, liver, spleen and bone marrow (primary level bacteremia). The incubation of this organism is usually 7 to 14 days that period is depend on the number of bacteria, their virulence and the host response. Clinical sickness depends on low amount of the presence of bacteria in blood (secondary bacteremia) like one bacterium per ml of blood and almost 10 bacteria per ml of bone marrow (Crump et al. 2010; Parry et al. 2002; WHO 2003). Though typhoid set on into systemic and local humoral cellular immune response, they confer incomplete protection against relapse and reinfection. In sever cases, the interaction between host immunologic mediators and bacterial factors in victim tissue, it may lead to the necrosis of Peyer's patches (Parry et al. 2002; House et al.2001).

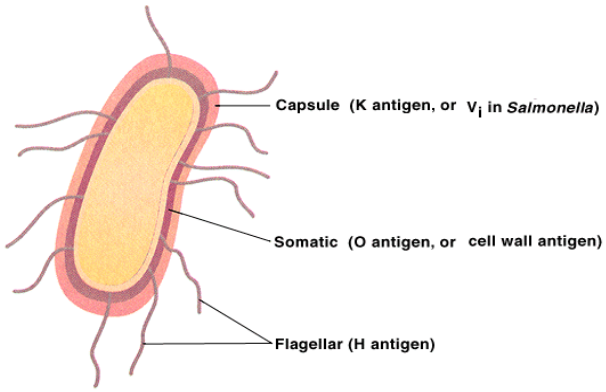

Fig 1. Salmonella Typhi.

1.7. Causes

There are several causes are considered as risk factor for getting typhoid fever. Typhoid is transmitted by eating or drinking food or water that is contaminated with the feces of the infected person (WHO, 2008). The risk factors are accounted including poor sanitation and poor hygiene. (WHO,2008). The risk of causing typhoid fever has increased due to unsafe water and food for traveler visiting to endemic country (Crump et al. 2010). Beside these,

unhygienic life style, poor sanitation, low literacy, poor sewerage system is the common risk factor for causing enteric fever (Wain et al.2015).

1.8. Symptoms

The incubation period of S. Typhi is 7 to 14 days, after this period the onset of bacteremia is expressed with fever, malaise, headache, anorexia, nausea, abdominal discomfort, dery cough and myalgia. The common symptoms are coated tongue, tender abdomen, hepatomegaly and splenomegaly in severe cases (Ahasan et al.1993, Parry et al. 2002). Typhoid presents more complications in children younger than 5 years and required to hospitalization like diarrhea, toxicity and disseminated intravascular coagulation are very often in infant (Parry el al.2002). In pregnancy typhoid presents more complication with miscarriage, otherwise vertical intrauterine transmission from mother may come out to neonatal typhoid, some cases it become as life threatening condition (Parry et al.2002). after 2 to 3 weeks of resolution of fever almost 5 to 10 percent patient shows relapses, this infection might be milder than original onset, they carry similar antibiotic susceptibility (Hermans et al.1996). moreover, almost 5% patients become long term carrier, it may be for one year (WHO 2003) and more common chronic carrier are young women, elderly patients who are suffering from cholelithiasis and schistosomiasis (Pegues et al.2008). Patient do not die due to intestinal hemorrhage or peritonitis; 15% patient are died with chronic fever and undiagnosed reason.

1.9. Complications

Complications are appeared by typhoid infection usually in patient with chronic untreated or have not been treated with appropriate antibiotics typhoid infection. The most common complications are intestinal bleeding or perforation in the intestine and internal bleeding in digestive system that develop in third week of illness (Parry et al.2002). To management of complications surgery is indicated in severe cases and surgeons prefer simple closure of affected area with drainage of the peritoneum, small bowel resection is required with multiple perforations (GlobalSurg Collaborative, 2018).

Here is a list of complications that effect other organs in chronic cases:

System	Complication
Orodental	Parotitis
Chest	Bronchitis, pneumonia
Heart	Myocarditis
Hepato-biliary	Fatty liver, hepatitis, abscess, cholecystitis, panceatitis
GIT	Perforation,peritonitis, hemorrhage
CNS	Encephalitis, meningtis, transverse myelitis
Musculosketal	Chronic osteomyelitis, arthritis, myositis

Table 1. Complication of Typhoid fever.

1.10. Diagnosis

After appearing clinical symptoms after incubation 7 to 14 days, diagnosis can be performed to detect typhoid and bacterial antigens. By screening blood, 15 to 25 % pateints have leucopenia and neutropenia. In secondary infection and intestinal perforation, leucocytosis is common (Pegues et al.2008).

Blood culture is considered as standard diagnostic method, almost 60 to 80% positive cases can be detected with typhoid fever. During the first week of illness, blood culture shows more sensitivity. Children have higher level of bacteremia than adult. Bone marrow culture is more sensitive than blood culture because of lower number of organisms in blood than bone marrow. Another significant diagnosis is stool culture, sensitivity depends on the amount of faeces cultured where positivity increased severity of illness. 30 % of patients show typhoid positve with stool culture in acute typhoid fever (WHO 2003, Parry et al.2002). urine culture show 0 to 58% sensitivity (Bhutta, 2006).

1.10.1. Widal test

Widal test is belong to serological test and it is more than 100 years old diagnostic method. This test detects agglutinating antibodies against the O and H antigent of S. Typhi (Jason et al. 2015). Infection with typhoid and paratyphoid bacilli, antibodies against flagellar antigen of S. Typhi H, S. Paratyphi A (AH), S.paratyphi B (BH) and Somatic Antigen of S.Typhi O generally detectable in blood after 7 days of infection. Though this method is simple to perform, it has moderate sensitivity and specificity like 70 to 80% (Chowdhury et al.2014).

1.10.2. Principle

Widal test is carried out based on antigens and anitbodies reaction method. Bacterial suspesion contained antigens react to antibodies of Salmonella organisms that present in pateint serum and appeare as agglutinaiton form. If patient serum contains homologous antibodies it will react with respective antigen in the reagent and represents a visible agglutination on test slides or tube.

The test kit contains 4 types of stained antigen of Salmonella.

- S. Typhi- O antigen
- S. Tyhhi- H antigen
- S. Paratyphi- AH antigen
- S. Paratyphi- BH antigen

1.9.3. Test Method

Widal test is done by two different methods:

A. Slide agglutination Widal test
B. Tube agglutination Widal test.

Both methods has two properties:

1. Qualitative Slide Test

2. Quantitative Slide Test

A. Slide agglutination test

Fixed amount (50 micro litter) of serum is mixed with fixed amount(50 micro litter) of reagent and mix well within the circle shape on a slide. Shake the slide till 1 minute and observe reaction. Serum was collected from the centrifuged blood sample.

Circle	**Serum volume**	**Antigen drop**	**Approx. test tube titer**
1st	0.08 ml	1 drop	1 : 20
2nd	0.04 ml	1 drop	1 : 40
3rd	0.02 ml	1 drop	1 : 80
4th	0.01 ml	1 drop	1 : 160
5th	0.005 ml	1drop	1 : 320

Table 2. Agglutination reaction.

* Positive Test : Agglutination within a minute
* Negative Test : No agglutination.

The slide contains 6 circles with leveled as O, H, AH, BH, NC and PC for different anitigen-antibodie reactions. NC and PS are show the clumping status either it negative or positive and make a comparison report for remaining parameters. In NC slide no clump is seen that means the report is negative while positve case shows visible agglutination in PC slide.

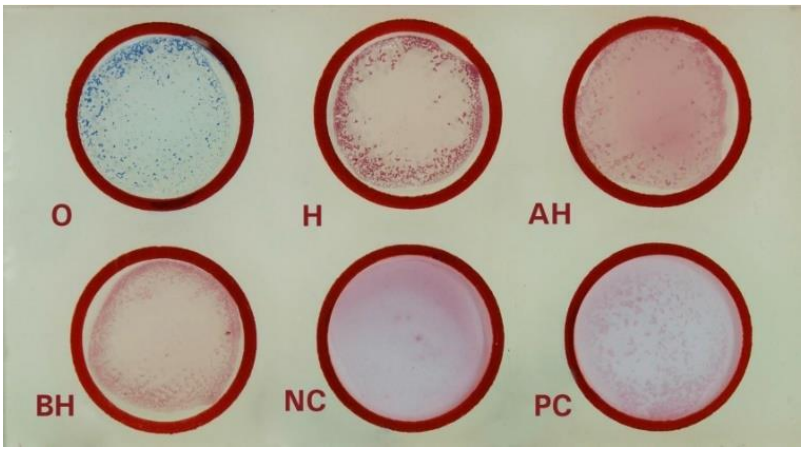

Fig 2.Widal test- slide procedure.

B. **Tube agglutination Widal test**

The antibody titer of the test sample is its highest dilution that gives a visible agglutination. Agglutinin titer greater than 1:80 is considered as significant infection and low titers indicate absence of infection.

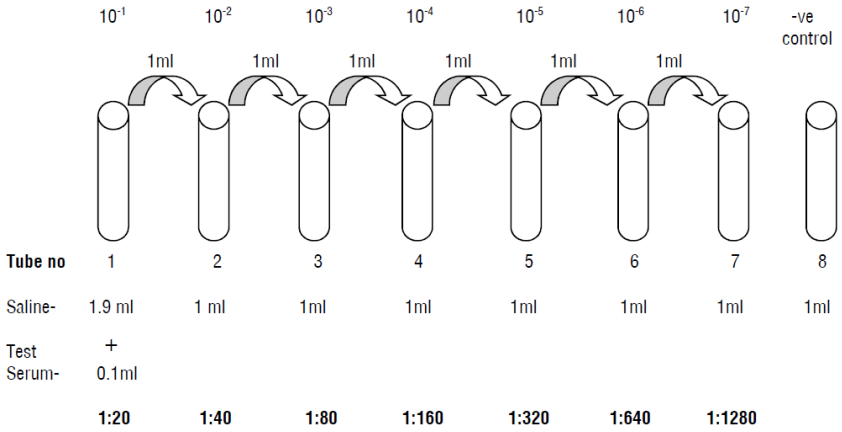

Fig 3. Widal test- tube procedure.

1.9.4. Interpretation of test result

Agglutination titre > 1: 80 considered as positive and significant for Salmonella infection.

Agglutination titre < 1: 80 considered as negative.

1.10. Prevention

It is clear that, urbanization is rapidly developing in Bangladesh compared to other countries of the world. According to the several studies it has been established that typhoid fever incidence rate is higher in urban areas. The main causes that are seemed to be responsible for illness are unplanned water supply sytem and inadequalte sanitation, sewearage system. To reduce the number of cases in inhabitants needs the provision of safe drinking water and hygienic sanitation system. The sewerage system will be required more protective and secure that ensure of no contamination. By washing hand and maintaining hygienic life-style can prevent transmission with food and drink. Drinking water should be boiled before properly and avoid street food. Most of the urban grew nearby river and they use surface water for drinking

and daily household purpose where S. Typhi can survive for days, so contaminated surface water act as etiological agents of typhoid (Dewan et al. 2013).

1.11. Treatment

For appropriate management it is very important early diagnosis and quick implementation of antimicrobial treatment. Literally, 90% of patients are managed by treating with oral antibiotic at home and regular follow up to physician. Ciprofloxacin is the first line antibiotic is prefered if resistance is uncommon (Perry et al.2009), besides this a third generation antibiotic cephalosporin like ceftriaxone or cefotaxime is choosen first (Dutta et al. 2001). In severe cases, patient suffering from frequent vomiting, severe diarrhea, high fever, and abdominal distension emergency to admit in hospital and continue parenteral antibiotic treatment (Chowdhury et al. 2014).

1.12. Vaccination

Due rapid growing of urbanizattion, incidence of typhoid show high infection rate in this over crowded population (Brooks et al.2005). To reduce this prevalence almost all researcher mentioned that vaccination against S. Typhi would be an emergent step (Naheed et al.2010; Chowdhury et al.2014, Khanum et al. 2015, Alexander et al. 2018,). In 1896, first vaccine was introduced in England and Germany and it was parental whole-cell typhoid vaccine, but this procedure had been withdrawn due to strong side effects (Marathe et al. 2014).

1.12.1. Types of vaccine

Currently two types of vaccine are available:

A. The oral vaccine: This vaccine is prepared with live, attenuated mutant strain of S. typhi Ty21a, available as enteric coated capsules. 3 tables are taken on days like 1, 3, and 5; this episode is repeated in every year for people who travelling from nonepidemic to epidemic countries (WHO).
B. The injectable Vi capsular polysaccharide vaccine (ViCPS vaccine): This vaccine administrates in intramuscularly in a single dose. Immunization ability is induced after

7 days of administration. This vaccine is eligible for aged more than 2 years; revaccination is required in every 3 years to control and maintain protection (WHO).

2. Objective of the study

The main objective of this study is to explore possible effects of data collection about infectious diseases by single hospital to propose actions to fight against typhoid fever in low- and middle-income population. A single hospital data in low- and middle-income district of Dhaka was taken to find out incidence of typhoid fever in this endemic area and to compare collected data with data of public hospitals. Another objective is to draw attention of the health authorities to take initial steps for prevention of typhoid fever by research with different areas of Dhaka. This study also brings up probable causes and effects of contextual factors that are responsible for Typhoid infection based on the previously conducted studies. The results of this study might be offered for taking initiative to collect data from other urban areas hospitals to reveal out the incidence of Typhoid fever and apply compulsory vaccination schedule for under 5 years old age children.

3. Method and Materials

3.1 Study site

As the hypothesis of this study is to find out the role of data collection in fighting against Typhoid fever of defined area in Dhaka region, the incidence of typhoid fever and age specific distribution of incidence in a selected endemic area and the causes for this incidence is collected. Jurain is an over-crowded area with highly risk health issue in Dhaka, Bangladesh. The residents are mostly living in low quality lifestyle with unhygienic water supply and sanitation system. Additionally, most of the people are illiterate and unconscious on their health, even they do not get proper treatment. Most people are not able to bear treatment cost for better treatment because the medical cost totally depends on out of pocket payment. They are frequently suffering from enteric fever, diarrhea, and infectious diseases. Concerning with health issue it become a vulnerable reason to point out the present situation of enteric fever among the people of this area. Furthermore, couple of study were done in different area of

Dhaka city. Dhaka city corporation is divided into two parts: north city corporation and south city corporation. The north parts are containing Mirpur, Mohammadpur, Sher-e-Bangla Nagar, Pallabi, Adabor, Kafrul, Dhaka Cantonment, Tejgaon, Gulshan, Rampura, Banani, Bimanbandar, Khilkhet, Vatara, Badda, Uttara. The north city corporation consist of Paltan, Sabujbagh, Jatrabari, Motijheel, Dhaka Kotwali, Sutrapur, Bangsal, Wari, Ramna, Gendaria, Chowkbazar, Lalbagh, Hazaribagh, Dhanmondi, Shahbagh, New Market, Khilgaon, Kamrangirchar (bdnews24. 2011). Though few studies were conducted in south part of Dhaka city corporation, maximum portions are still in unconscious about typhoid incidence. Moreover, there were several studies done related with child health issue, child labor, drug addiction and child abuse in this part (Halder et al. 2009).

Fig 4. Metropolitan cities of Dhaka, Bangladesh.

We contact with a primary level private hospital of this town, which is working for the poor people with their standard services. By seeking permission, the researcher has collected data of Typhoid fever laboratory reports of 6 months from September 2018 to 13th of March 2019.

3.2. Methodology: Action Research

The researcher follows action research methodology because of several reasons. According to (Reason and Bradbury, 2001) action research is an interactive investigation process that measures problem-solving operations and applied in a collaborative context that related to data-

driven study to realize fundamental causes, qualifying future predictions about personal and organizational change. Action research acts with traditional social science by forwarding to reflective knowledge generated by outside sampling variables, to theorize the action in every changing moment, to collect data and inquire with an emergent structure. “knowledge is always gained through action and for action. From this starting point, to question the validity of social knowledge is to question, not how to develop a reflective science about action, but how to develop genuinely well-informed action- how to conduct an action science” (Torbert et al, 1981). The objective of this method is to generate and share knowledge in the social sciences. According to this reference, action research is a scale of problem-based inquiry that is applied by the investigators and directly related to generate solution. The practitioners will able to go ahead to further steps by predestining the future action, so action research is an empirical process.

Action research method is involved into five phases:

A. Problem: Generally, couple of public hospitals revealed out data on incidence and prevalence rate of typhoid infection from number of areas in Dhaka metropolitan area but most areas are still unexposed. By focusing on present situation, the researcher has tried to collect data and disclose incidence of typhoid infection from a single private hospital in Jurain. This data was compared with data of previously published research from different areas of Dhaka. The collection of real-life data in highly endemic area might help to reduce incidence of typhoid fever by taking emergency action for prevention.
B. Design: this phase consists of preparing a structure or designing a plan for accomplishing the inquiry with goal, objectives and action steps that helps to guide the inquiry. This study has been conducted by following a plan including data collection, seeking permission of hospital authorities, using online data base publications for earlier exposed data, data analysis and make comparison between two data sets.

C. Action: This step involves into three steps, control the progress, collect data and present periodic reports. The researchers must be ensured on the validity and reliability of data. Data should be maintained standard quality, feasibility and controlled evidence. The researcher has collected data from well-established private hospital. The data quality might be considered as standard. The prediction was that it is possible to find out the

real scenario of typhoid fever incidence in this endemic area. The strong and week point can be detected by comparing with earlier studies.

D. Reflection: A process of entering dialogue based on the data collected and guided by a systematic framework to discover the root causes of the problem. This phase has some question that helps to clarify the concept.
   What did I expect would happen?
   What happened?
   Why did this happen?
   What is the next step?
   By answering these questions, the researchers can get a better understanding of the problem under investigation and as a result can conclude by creating grounded theory regarding the solution to improve the situation. This study would expect the real time typhoid incidence of specific area based on a single hospital data make comparison to others hospital data. The result would support the decision makers to conduct more research in wide range and take immediate step for prevention. Though few dissimilarities were got from comparison the soul predictions were identical. There were several facts and limitations responsible to induce differences. The further step would be taken by health experts to imply prevention steps to less incidence of typhoid infection based on data from other areas.
E. Capture / learning: finally, the results must be recorded and stored, the recorded information must be shared to the world to get feedback. This will stimulate to go ahead to further research with new and modified knowledge. This step involves report distribution, follow-up contacts, advisory group facilitates meetings of Task groups, feedback on proposed action, further search conferences, widen network, and continuing evaluation of outcomes.

There are couple of attributes of action research method that makes a special value and differs from other types of method. Its directly focus on turning the people involved into researchers, so they learn best, get more willing to implement what they have learn. Moreover, it is also reflexed as a social dimension- the study take place in real world situation and goals to solve the real problems.

3.3. Importance

Urbanization and environmental changes are responsible to increase the prevalence of typhoid. Moreover, antibiotic resistance treatment system also has potentiality to spread typhoid in overcrowded population in cities. Jurain, a small town of south part of Dhaka is an over populated area close to 25,000 people and situated nearby a river Burigonga. Most of the population are belong to middle and low earned status. They are deprived from healthy life style and health care services. The lower socioeconomical condition became a life threatened condition for these inhabitants. They are separated from the basic social facilities such as sterile water supply, sewerage system, whereas they lead an unhygienic life style with contaminated food and water, low literacy rate, and unawareness of the health. Therefore, they often suffer from several types of transmitted disorders, these are common in maximum residents such as diarrhea, flue, typhoid fever, rheumatic fever, viral fever, cholera and so on. Repeated enteric fever is very common in this area. So, the goal of my study to find out the incidence of typhoid fever in this endemic area corresponding with previous conducted studies.

3.4. Ethical statement

The data collection carried out with the permission of the Director of Genome Hospital, Bangladesh, granted on September 2018. Data was collected from the data store system, computer- based and paper-based, only typhoid test reports has been provided with patient history.

3.5. Genome Hospital

In Bangladesh, the 64.4% medical expense is out of pocket, there is no health insurance facilities for most of public (WHO, 2017). Genome hospital is a private hospital established in 2013. The hospital provides primary care to the patients. Generally, they work for the poor people who are underserved and deprived from health services with low cost. There are several departments dealing with different health services such as pathology, digital X-ray, consultation, ultrasonography, ECG, pre-maternal care unit. The pathology department deals with hematology, biochemistry, microbiology, sperm, urine and stool examination. They have special care unit for mother health care with maintaining a record book. From

the very beginning of the pregnancy, this hospital provides book to pregnant women for keeping all the medical history, doctor visit information, advices, test reports ultrasonography reports. This makes easy to follow up the patients and keep them in a track. This record book is valid till one month after delivery with prescription and follow up checking. The book holder gets special discount on medical costs and doctor visits. This hospital organizes free campaign for the local people at different places and provide free medical check-up, free blood grouping and quick diabetic check once a month. They also deliver some awareness programs on helminth, HIV, pregnancy care and TB. This hospital has got permission from health ministry to have 20 beds for indoor facilities. They maintain both paper-based and computer-based system to store patient reports and records.

3.6. Data collection

As the first action of this study is to find out incidence of typhoid fever of a selected endemic area, the researcher has collected data set of 6 months, from September 2018 to 13th of March 2019.677 reports were collected (n=677) from patients of a private hospital that is located at one urban area. The patients attended outpatient department complaining of fever of more than 7 days duration for 6 months. These data were selected as randomly from the patient database. Diagnosis was made based on clinical features like continued fever, diarrhea or constipation, diffuse tenderness and discomfort of abdomen. The blood samples were tested as serology by Widal test with titer of TO>1:160, that was taken as diagnostic criteria. The physician evaluated the detailed history and comprehensive physical examination by following standard procedure and all information was documented in patient registered book and in-patient database. These blood samples were investigated particularly CBC, Platelet count, PBF, and Widal test. An amount of 3 ml of blood was taken for Widal test and a raised titer of anti O > 1: 160 with relevant clinical features along with other parameters were considered as significantly having typhoid fever (Chowdhury, 1999). The ethical issue was permitted from the authority of this hospital, and they considered to provide data for medical research purpose.

Socio-demographic information was considered by having reputation of underserved and crowded area is a part of old Dhaka. This area is over-populated with low leveled income status. The citizens are deprived from basic socioeconomical rights such as planned and hygienic water supply, proper sewerage system, literacy and health care. Jurain is the south

part of Dhaka nearby the river Burigonga and this area is downward than other part of capital city, additionally sedimented water are found almost everywhere during monsoon seasons due to unplanned houses and roads system. Thus, the inhabitants, mostly children and teenagers, are often suffering from many contagious diseases like flue, diarrhea, enteric fever, hepatitis and sometimes this condition turns into endemic.

There are 677 test report of different age groups from September 2018 to March 2019.

Age group	Test	Positive case
< 5	120	21
6 to 10	90	29
11 to 15	76	20
16 to 20	92	28
21 to 25	90	21
26 to 30	71	17
31 to 35	36	8
36 to 40	28	8
> 41	74	23
Total test	677	175

Table 3. Data of Typhoid Fever.

3.7. Result

Out of 677 sample, 175 (25.8%) patient were isolated serologically positive with relevant factors, suffering from typhoid fever while rest amounts were serologically negative, but they were having other disease and treated accordingly. The data has been considered as statistical approach with a descriptive analysis. Statistical analysis has been categorized into five parameters such as age specific distribution, gender-specific distribution, typhoid and paratyphoid ratio, monthly based distribution and season specific distribution. The findings are described below.

3.7.1. Incidence rate

The typhoid cases and demographic data were used to examine typhoid epidemiology. The annual incidence rate of enteric fever for each year was calculated as:

$$\text{Incidence rate} = \frac{\text{Total typhoid cases}}{\text{Total population}} \times 100{,}000$$

$$\frac{175}{25\,000} \times 100{,}000 = 700$$

The incidence rate is calculated based on new positive cases divided by total cases of investigation and multiplied by 100,000 persons. There is 25,000 people in Jurain where typhoid incidence is 700 thus this area might be known as endemic.

3.7.2. Age-specific distribution

Age are categorized into 4 groups:

- Under 5 years
- 6 - 10 years of old
- 11 - 20 years of old
- more than 20 years of old

Young adult

For 6 months, 12% under 5 years old children was infected while 44% infection were detected in adult to old aged group, more than 20 years old. The second highest infected group was young adult group 6 to 20 years of age with 44%, higher than under 5 children group. These groups were considered as school going and they were victims of typhoid infection due to having more contaminated food, water and unhygienic life style.

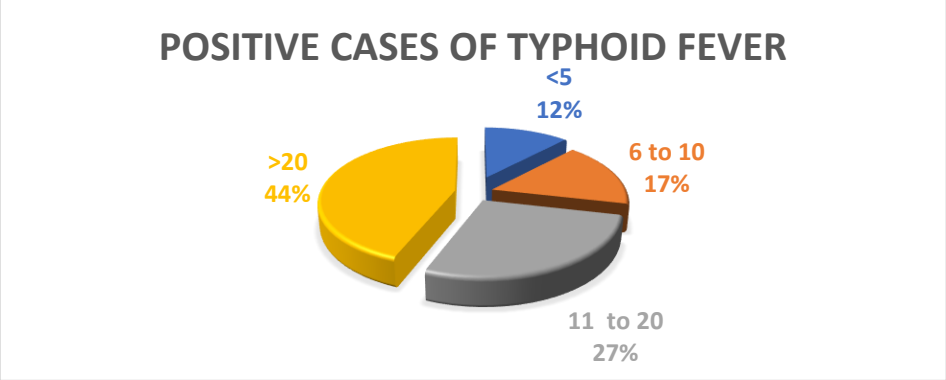

Fig 5. Age-specific distribution of Typhoid Fever.

According to the chart the most risk group is 6 to 10 years old, the fluctuation amount is shown in different age group till 40 years old. Additionally, the under 5 years age group as well as more than 40 years age group also has the higher risk incidence while the adult group is less infected by enteric fever.

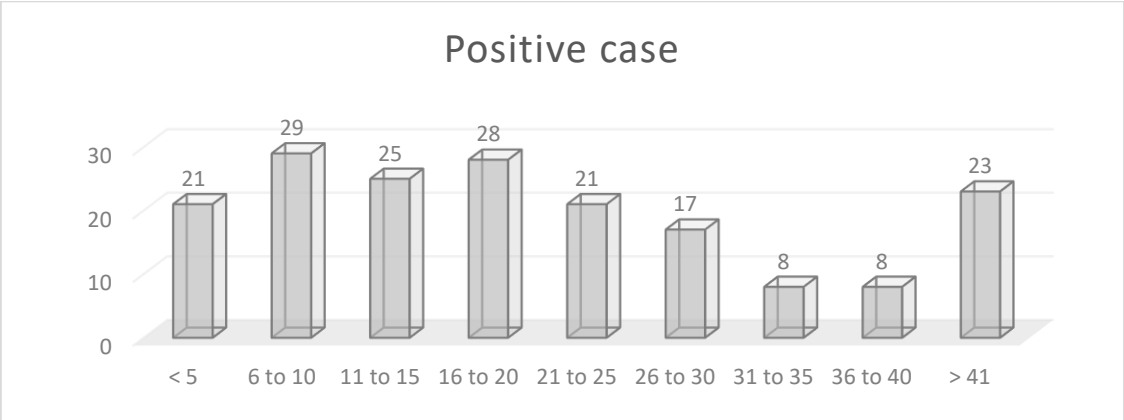

Fig 6. Positive case among different age groups.

3.7.3. Gender-specific distribution

The female group showed the higher incidence than the male for 6 months and it was 64% and 36% where total cases were 367 and 310 respectively.

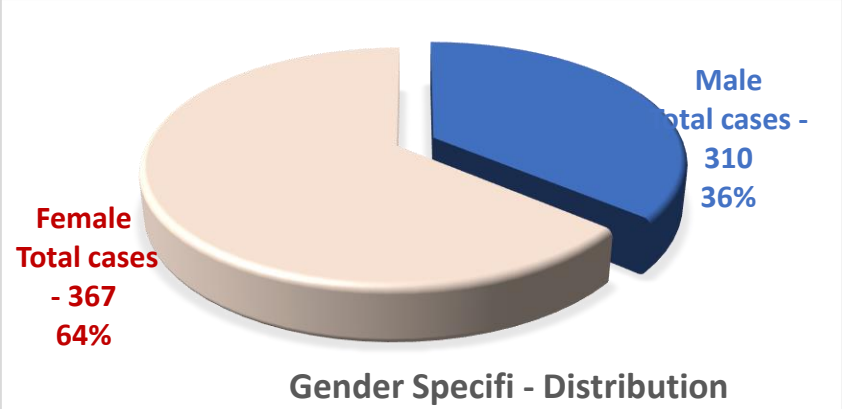

Fig 7. Gender-specific distribution.

3.7.4. Percentage of typhoid and paratyphoid fever

Most of the patient were infected by typhoid fever like 88% while the percentage of paratyphoid was only 12% during the observing period. Typhoid infection was more frequently occurred due to organism sustainability features and it being a very common disease in urban.

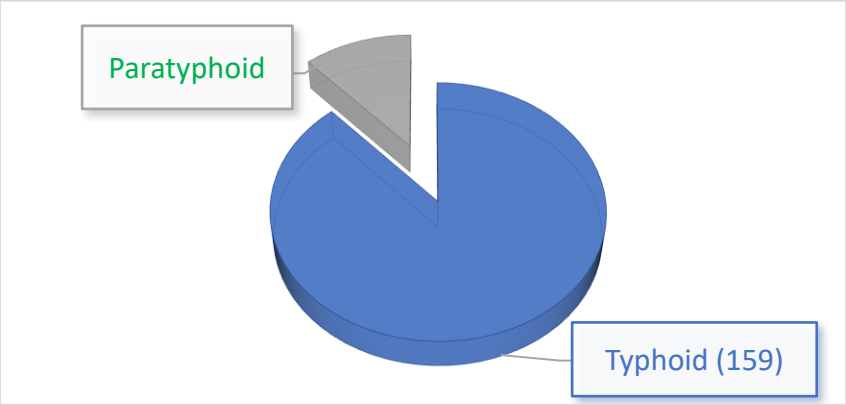

Figure 8. Percentage of typhoid and paratyphoid fever.

3.7.5. Monthly-based distribution

The investigation was detected from the September 2018 to March 2019. From September to November the positive cases were detected in higher range, after that the incidences were started to decline. In peak season, the positive cases were 60 in a month while it decreased to 7 cases. In rainy season typhoid germs more contaminate in water and food break thorough. Out-going peoples are getting infection and spread -out though the community. In winter, organism do not show virulence due to adverse climate and people are not get infection very often.

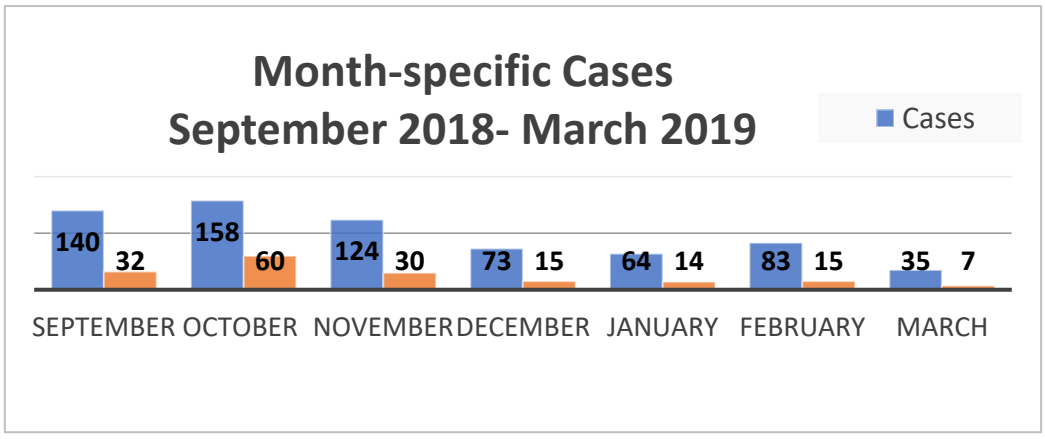

Fig 9. Monthly based distribution.

3.8. Findings of review data

To compare with earlier data of typhoid incidence and associated causal factors in different zones of Dhaka metropolitan, several number of previously conducted studies of Bangladesh were chosen. The researcher has selected five literature sources related to typhoid and paratyphoid fever. The selected relevant articles were published between 2010 to 2018 related to typhoid and paratyphoid fever were collected from different sources like electronic database, e-journals (national and international). The following terms were applied to search relevant articles such as Typhoid fever, para typhoid fever, enteric fever, Salmonella Typhi, drug resistance, socioeconomic environment, incidence, prevalence and age-specific in Dhaka and language in English as well. there are almost 20 studies are show the same inclusion criteria though some of them are duplicated with same authors name and conducted years. To make the studies more concreate 5 relevant articles were selected. These studies have been conducted in urban rather than rural part of Bangladesh. The purposes of these studies are to find out the real scenario of Enteric fever of other parts of Dhaka city. The findings are described in literature review section. Excluded articles were duplicated and most of these were focused on different countries of South Asia rather than Bangladesh.

4. Literature review

4.1. Typhoid Fever and Its Association with Environmental Factors in the Dhaka Metropolitan Area of Bangladesh: A Spatial and Time-Series Approach (Dewan et al.2013)

This research presents the prevalence of typhoid in Dhaka Metropolitan area (DMA) of Bangladesh. The researchers collected the data over the period 2005 to 2009, from 11 major hospitals, they applied geocode to census tract level, conducted in a spatio- temporal analysis with a range of demographic, environmental and meteorological variables. The aims of this study are: (i) to identify the epidemiological cases from 2005 to 2009, (ii) to indicate the hydro-climatological factors related with typhoid prevalence, (iii) to determine the endemic infection based on two spatial hypotheses. They represent the age and gender specific differences, where males and infant being are infected in disproportion ratio. Moreover, another finding is that the male and female ratio of cases are reported to be 1.36, and the median age of getting infection is 14 years. The male shows the higher typhoid incidence than female (χ^2=5.88, p<0.05). the highest occurrences are isolated from the monsoon months and it is 44.62% whereas the pre-monsoon and post-monsoon show 30.54% and 24.85% respectively. They do not get significance difference between the urban and rural environments (p>0.05). They able to find out the statistical significance that have a relation of the incidence of typhoid with the major waterbodies. This study found out a significant clustering of typhoid distribution in the selected area by applying the spatial pattern analysis. Additionally, increasing trend of having typhoid infection is showed with temperature, rainfall and river levels at time lags varying from three to five weeks, like typhoid cases increased by 4.6% (95% CI: 2.4–2.8) for a 0.1meter rise in river levels where the threshold level is of 4.0 meters (95% CI: 2.4–4.3). furthermore, the incidence of infection could increase by 14.2% (95% CI: 4.4–25.0) with a 1 degree rise in temperature.

Typhoid incidence was higher in male population than female (χ^2=5.88, p<0.05). The age-specific incidence rate was highest for the 0–4 years age group (277 cases), followed by the 60+ years age group (51 cases), then there were 45 cases for 15–17 years, 37 cases for 18–34 years, 34 cases for 35–39 years and 11 cases for 10–14 years per 100,000 people.

4.2. Typhoid Fever in Young Children in Bangladesh: Clinical Findings, Antibiotic Susceptibility Pattern and Immune Responses. (khanum et al 2015)

This article focused on the clinical and immunological characteristics of young children with S. Typhi bacteremia and antimicrobial susceptibility patterns of isolated strains as immune responses marker. Scientists select the antibody-in-lymphocyte secretion (TPTest) as a recent infection marker for the acute typhoid fever infected group. On the other hand, for the young children group (under 5 years age), they assessed Membrane preparation (MP) IgA responses at clinical presentation, then 7-10 days and 21-28 days later and during this period they also measured plasma IgA, IgG and IgM responses and T-cell responses to MP. The authors made a comparison all these selected assessment result among the young children (1-5), older children group (6-17) adult group (18-59) and age-matched healthy controls. This article presents the highest risk incidence of Salmonella enterica serotype typhi in children under 5 years old in endemic areas. They investigated mucosal and systematic immune reactivity in S. Typhi bacteremic of these children group. They measured S.typhi membrane preparation (MP) specific IgA reaction in lymphocyte culture secretion as well as plasma IgA, IgG and IgM also react in ELISA. They also investigated that T cell proliferation reacted in 3H-thymidine incorporation assay. Additionally, they compared the responses to S. Typhi bacteremic in older children group (6 to 17 years) and adults (18 to 59 years) with the healthy control group. These three groups show comparable responses in lymphocyte secretions after onset of illness. They found out the variable reaction of plasma antibody responses to MP between young children and other groups, it was significantly more reacted at clinical presentation, but this value fell in all group by convalescence whereas T-cell proliferation reactions showed an increased level in all age group during late convalescence. Moreover, plasma IgA reactions showed an increased trend in clinical presentation in young children group where IgA and IgG value being raised in acute and convalescence in adult. The common findings are, clinical features were similar in all age groups and natural infections do same induce immune response in these sample groups. Approximately 15% of multi-drug resistant were present in each age cohort and strains showing resistance to nalidixic acid were 97%.

4.3. Burden of typhoid and paratyphoid fever in a densely populated urban community, Dhaka, Bangladesh. (Naheed et al.2010)

This study has been conducted among the urban slum areas in Dhaka, Bangladesh to detect the incidence of typhoid and paratyphoid fever by assessing blood culture examination of infected sample. The sample group was categorized into different age groups. They collected data between 2003 to 2004, field research workers were involved to visit the patient weekly and collected data on household and fever history during the past seven days. The selected samples had consented to participate in the surveillance to access the free medical care that was provided by the study clinic. For data assessment they considered the patient group under 5 years old with history of fever of any duration, patient ≥5 years of age having fever within ≥3 days duration. Blood sample were collected for blood culture to detect antimicrobial susceptibility of Salmonella from the patient with a history fever was ≥38 °C (axillary temperature) at clinical presentation. They isolated 40 Salmonella typhi and 8 Salmonella Paratyphi A from 961 blood cultures. The result shows that the incidence of typhoid was 2.0 episodes/1000 person-years. The young children group (<5 years) carried the higher incidence 10.5/1000 person-years than the older group 0.9/1000 person-years (relative risk = 12, 95% confidence interval (CI) 6.3–22.6) and for all age group the incidence of paratyphoid was 0.4/1000 person-years. The indicating observation was that typhoid fever is more common than paratyphoid in that selected urban area and multidrug resistance was common in S. typhi with prolonged illness. The suggestion for preventing this incidence in young children was immunization, targeted vaccination against the bacteria would be the urgent step to decrease infection burden. They also demonstrated for reducing the paratyphoid infection need longer investment to improve sterilization of sanitation service and water supply that might help to reduce the risk of multiple fecal- oral transmitted pathogens in this communities.

4.4. Enteric Fever and Related Contextual Factors in Bangladesh (Shampa et al. 2018)

This purpose of this study to demonstrate the whole scenario of enteric fever of Dhaka city from 1990 and 2014. The objectives of this research were to figure out the reducing incidence of enteric fever associated with development of contextual factors of enteric infection such as

improving of socioeconomic factors, water supply and sanitation during 1990 to 2014. They selected couple of public hospitals for collecting retrospective data of enteric fever like Dhaka Shishu Hospital, Shishu Shasthya Foundation Hospital, International Center for Diarrheal Disease Research, Bangladesh and popular Diagnostic Center. For gathering the contextual factors data, they contacted with relevant organizations and their websites and plotted against time to see the trends. They collected the reports of blood culture of total of 131,449 from these hospitals from 2001 to 2014 and they isolated a total of 7,100 enteric fever cases of S. Typhi, average rate was 5.4%. Though there were significant developments for water supply, sanitation facilities, female literacy and less poverty through this period, population density also raised in significant way. The incidence of enteric fever showed the steady trends despite of improving these contextual factors, the authors considered the causes for this scenario was high population density from 814 to 1,222 people per km^2, poor planned water supply and sewerage system. they suggested that proper vaccination system might help to prevent this disease, especially for young children. According to the authors there are several limitations in this study; they collected different level of data from different center in different durations, no control groups were considered. Additionally, generated data were not seemed harmonized, so the criteria of inclusion and exclusion were different and blood collection procedure was not well controlled. However, though multiyear data was collected from different sources like inpatient, outpatient departments, private diagnostic centers and research institutes; the findings indicated the increased trend of incidence of enteric fever. Therefore, by improving the contextual factors alone are not enough to reduce typhoid and paratyphoid fever, government should be implemented must to have immunization schedule immediately for the young children what can be prevent this disease within short time.

4.5. Enteric Fever Cases in the Two Largest Pediatric Hospitals of Bangladesh: 2013–2014 (Shampa et al. 2018)

The authors collected data from two large children hospitals in Bangladesh as prospective cohort study for supporting enteric fever prevention and control. They also conducted a descriptive study of enteric fever among children admitted in 2013 to 2014 under the World Health Organization- supported Invasive Bacterial Vaccine Preventable Disease surveillance platform. The age range were from 1 day to 18 years and median age was 7 months (IQR, <1 month – 24 months). Most of the admitted children were less than 5 years of age (88.2%, 45790

of 51923) and 73.9% (38364 of 51923) younger than 2 years. They collected 15917 blood sample from infected children for blood culture, 443 (2.8%) were reported as culture positive for significant bacterial growth. From these 63% (297 of 443) were isolated and confirmed as the case of enteric fever, where 241 cases were Salmonella typhi and 38 were Salmonella Para-typhi. The study represented that children under 5 are the most risk group with enteric fever and they were infected by S.Typhi, among them Typhoid is more common than Paratyphoid.

5. Discussion

5.1. General discussion

In this study, 677 reports were collected on clinical basis to find out the incidence of typhoid associated with different age group, gender specific, seasonal distribution and ratio of typhoid and paratyphoid cases of typhoid within a defined period. Widal test was measured in all the cases for confirmation of clinical diagnosis and 175 cases 25.8% were Widal positive with agglutination titer of 1:160 or more like 1:360. I did not get the blood culture reports because many of the sample not having this diagnosis. Results show that incidence of enteric fever is 25489.3 per year, whereas the total population of this area are almost 25,000 according to the country population statistical bureau. The prevalence of typhoid fever was distributed into 4 different categories, the highest (44%) among the adult group age more than 20. The children with under 5 group having 12% during this period though the appointed cases were 120 out of 677. So, the remaining amount were also suffering from other diseases. The result shows that prevalence of typhoid fever was highest among the older age group they were more than 20 years old, several ages were included in this group like young adults within 20 years old, adult group within 40 years old and aged people who were more than 40 years old. The large amount of cases was investigated with this group size like almost 299 cases where the children with under 5 were 120. The study shows that 77 positive cases were detected from large group of more than 20 years old while 21 positive cases were found out from 120 appointed cases of under 5 years old. So, prevalence of old age group was 44% and 12% was for under 5 years old group. On the other hand, the selected studies conducted in different parts Dhaka showed the opponent results. The highest risk of typhoid fever in age group was children under 5 years old (Khanum et al 2015, Rahman el al. 2011, Dewan et al 2013, Naheed et al 2010). They surveyed at north and east parts of Dhaka, area was Tongi, savar, kamrangichar,

Kamalapur. In these endemic areas, the highest disease burden of typhoid fever caused by Salmonella enterica serotype Typhi was found in children under five years of age, by investing both mucosal and systemic immune responses in S.typhi bacteremic young children. By measuring S.typhi membrane preparation (MP) specific IgA reaction in lymphocyte culture secretion as well as plasma IgA, IgG and IgM also react in ELISA. (Khanum et al 2015). 84(87.50%) patients were suffering from typhoid fever assured by clinical examination and serological test result, Widal test where prevalence of enteric fever was high almost 66.67% among the school going children group 6 to 20 years old. (Rahman et al.2011). The reasons of infection were considered as habituated with unsafe drinking water and unhygienic junk food 58.33% and 72.92% respectively (Rahman et al.2011). Additionally, the another causes of getting frequent and high level of typhoid fever infection in young children group was in low education level parents, they remain outside during the maximum time of the day for work (Rahman et al.2011). similar findings were out from earlier studies. (Kidgell, 2002; Mahle1993; Park 1999). The researchers considered that more chances of getting infection in school going children group might be due to having unsafe drinking water and contaminated street food. This study also shows the similar finding with the school going children group, if it was combined with two groups like the age group 6 to 10 and 11 to 20 group; 46% patients having typhoid fever. (Figure.2). the old aged people had great chances to get enteric fever (44%) as well, this result was like previously conducted studies.

The 6 months' time frame shows the various incidence of typhoid fever infection. Fig6-monthly based distribution. The month was counted from September 2018 to March 201. In Bangladesh July to November is monsoon period, the climate become gloomy and dull, the roads are flooded with rain water. As Jurain is a downward area the rain water is sedimented for long time more than 2 months, water is contaminated with infectious germ, and peak time to grow flies one of the major carrier of bacteria of S. typhi. Consequently, typhoid fever appears as high incidence, according to Figure.6 maximum cases were appointed in September and October and positive cases were also shown an upward trend, whereas the incidence became decreased from December winter season. 62% cases were handled during September to November and remaining months were shown the decreased incidence, from December the cases started to less in number like 11%, 10%, 12% and 5% till March. This result was like previous studies like in monsoon season the highest occurrences of typhoid fever 44.62% (July to October) and 24.85% was in post-monsoon season (Dewan 2014). They got the result of the x2 test of the relationship between distance to water bodies and the number of typhoid cases

and it was significant ($p<0.05$) per 100,000 persons. They used Kendall's τ-B and Goodman-Kruskal γ tests to indicate the strength and direction of association, and both tests were reported that there is a negative association between typhoid incidence and distance to water bodies. The inhabitants living close to water bodies had a higher infection rate than the population of farther away. (Dewan 2014). Jurain is located nearby the river Burigonga, and 3 to 5 weeks rain fall and temperature respectively like earlier studies, though they counted at different place, pathogens and population behavior reasons. (Dewan 2014; Reyburn 2011; Hashizume 2009). Typhoid organism can survive in water for days and contaminated surface water acts as etiological agent of typhoid.

The study presents that 64% females are infected with typhoid fever and 36% were male during this selected period, almost 367 females and 115 males were investigated, infected ratio is 23:13. Females are mostly suffering from various types of disease including enteric fever 18%, urinary tract infection 7%, PID 11%, Diarrhea 15% and skin disease 14% in urban area (Alak et al. 2014). Previous studies showed that children group age of 5-9 years had the highest prevalence rate and male population affected disproportionately, the male cases dominated the female in the age group of till 34 years old with higher incidence, but female cases were higher in age group of 35 to more than 60 (Butler, 1991). Similar results found out in other studies that's were done in different countries with different socio contexture in another epidemic setting. (Karkey, 2010; Tran, 2005; Sur, 2007; Vollaard, 2004). Another study in Bangladesh presented different result, males 0 – 17 age group were higher risk of getting typhoid infection than female. Health care seeking behavior might reflect as a risky variable in gender in Bangladesh because of cultural beliefs like religion and patriarchy, the young males more valuable than young females and thus they get more advantage to get treatment in hospital than female patients (Butler et al. 1991). the male population is more extrovert than female because of working or other purposes, it might be another issue to get more incidence of typhoid fever in male group (Moris et al. 1984).

Typhoid has more frequent incidence than paratyphoid, we got the ratio between typhoid and paratyphoid was 53:7. From 175 Widal test positive cases, 159 cases showed interactive to either TO or TH and some cases were interacted with both parameters. The titer was started with 1:180 to 1:360. On the other hand, 27 positive cases showed agglutination reaction with AH or BH, some cases reacted in both parameters. The reaction ratio was 1:180 to 1:360, so that these were considered as paratyphoid. This result was like previous studies. According to (Naheed et al.2010) S. Typhi bacteremia represented the huge number of positive cases than S.

Paratyphi. Other studies revealed out that recently in few countries of Asia has been increased in S. Paratyphi A infection in urban setting like India and Pakistan (Sur et al.2007; Khan et al. 2006). One study of Bangladesh showed that children with paratyphoid were older than the children with typhoid though 9.4% and 31.5%of paratyphoid cases happened in children under 2 and 5 years old the same incidence occurred in young adults as well (Senjuti et al.2019). The researcher observed that these two diseases showed the flocculation in the proportion varied in year to year, the number of factors were related to the changes like the antimicrobial susceptibility of Salmonella Typhi and Paratyphi A or other environmental factors. The multidrug resistance of Salmonella Typhi like resistance to ampicillin, contrimoxazole and chloramphenicol has significantly decreased in recent years; but these was no multidrug resistant Paratyphi A strain was found (Saha et al.2018). Since antibiotic consumption prior to seeking care is very usual in Bangladesh because of the available antibiotic in the market and dynamic patterns of antimicrobial susceptibility, rates of treatment failure in this community became higher (Saha et al. 1997).

However, the importance of correct actions also depends on the reliability of blood test. As indicated in the research by Khan (Khan et al. 2018) Widal test interpretation in Bangladesh remains controversial because in several cases tests of healthy people have the value which is above the normal limit. This in turn demands ordering of more specific tests and would make the diagnosis expensive. Only the price of Widal test in Bangladesh appears to be around 5 US dollars. Therefore, it could be argued that instead of extensive use of Widal test in endemic regions, the patients with Enteric fever should receive empiric antibiotic treatment without expensive diagnostic workout. This approach could be justified for instance with the cost of Gatifloxacin, the medicine that is used to treat Enteric fever, which price for treatment is about 2-3 US dollars.

5.2. **Importance of real-life data analysis**

In health industry, real time data become one of the most dedicating applications to create actionable insights on a minute by minute basis that can tackle crucial problems. This data is feasible to present a deeper understanding of single patient situations at the point of care and it assists to improve outcomes (Silvana et al. 2013). By analyzing real-life data of any incidence of disease, it helps to implement a monitoring patient care plans and gives opportunity for health decision makers to proactively care for patients. This process act with current data of

medical records to find out the recent situation of incidence; provide immediate action to prevent. the researchers conduct combined analysis along with large data sets and current data of medical records to identify high-risk patients, who require immediate attention to prevent (Cragg et al2018).

5.3. **Suggested Solutions**

By epidemiological studies it has been emerged that typhoid fever incidence is highly remarkable in Dhaka city, so this is appropriate time to prevent. The studies presented that children under 5 years old age and school going group were the most risk group due to active and passive infection by contaminated water and foods as they belonging to low and middle-income families. The researchers suggested couple of solutions to control; the decision makers should explore data of every endemic area and provide vaccination (S. typhi) for children under 5 years old group because they carried highest risk of incidence. Secondly, they should arrange health education campaign for parents to let them inform about healthy lifestyle like maintaining hygienic household works, safe drinking water and sanitation.

6. **Comparison with different studies**

6.1. **Compare with earlier studies**

The study is conducted to find out the incidence of an endemic area because of many infectious disorders are counted as regular phenomena for the population of this location. From the geographical point of view, Jurain is located beside the river with downward land along with poor socio-texture added a surplus step to get contaminated disease frequently. The infant and school going children are suffering often from enteric fever with diarrhea, vomiting, malnutrition and cholera. The previous studies conducted in different parts of Dhaka with same topic as prevalence of typhoid fever that were related to different age distribution, gender distribution, prevention method, vaccination, multidrug resistance and so on. The researcher also tried to find out the causal and risk factors of typhoid fever that were associated with

socioeconomic status like low income, low literacy rate, unhygienic life style, drinking contaminated water and food, poor sanitation system, sedimented water around living place. Most of the studies were deal with public hospital and ICDDRB institute. They collected data from the renowned public hospital like Dhaka Medical college Hospital, Dhaka Shishu Hospital, Shishu Shasthya Foundation Hospital (SSFH), these hospitals provide primary to tertiary care to patients, where 47% patients are treated as free of cost. The researchers collected data with long duration like 2 years or more than that, they conducted observational cohort study with prospective records. During the study period they arranged field workers to visit these patients weekly and collected history during the past 7 days. All participated patients got free medical treatment and clinical assessment by qualified study physician.

To compare with these previous studies, my study presents two different results from them. First, the incidence of typhoid fever in under 5 years age group, this study shows that 12% are infected while adult group held higher score 44%, on the other hand these previous studies presented that the highest burden of typhoid fever in under 5 years old group. The possible reasons for this changed result might be the duration of study period, because only 6 months data was collected for this study. Another cause might be improper patient history, because typhoid antigens only react after 7 days of fever history. There is no evidence that these patients were investigated after 7 days or not. The second opposite result is male and female patient ratio of having risk of typhoid fever. The earlier studies represented that males group had more chances to get infection with typhoid fever because they were usually more exposed to out for working, one more causes they expressed that the social beliefs and value, female proportion was low because they did not get equal priority as male to get medical treatment. the opposite result was revealed from this study that 115 positive cases was detected form female patient while 65 positive cases for male for 6 months, and ratio was 23:13. The reasons might be seasonal effect, because most of the cases was investigated during monsoon season. The other results like school going group had the higher incidence (44%) of typhoid fever, this result is like other studies 66.67% due to consumption of junk food, contaminated water, unhygienic sanitary system (Rahman et al. 2011; Naheed et al.2009; Alexander et al 2018). In addition, the typhoid and paratyphoid infection ratio are like others that was typhoid was higher prevalence than paratyphoid. The causes of less paratyphoid incidence were considered as, taking of conscious health maintenance it is possible to reduce paratyphoid infection (Naheed et al.2010, Senjuti et al 2019, Saha et al 2018). The climate and seasonal effect showed the same result, from rainy season to post monsoon months there was highest incidence of typhoid in both cases, due to life persistency of Salmonella Typhi (Dewan et al. 2013).

6.2. **Comparison with Europe**

According to the report of The European Surveillance System (TESSy), 18 EU/EEA countries has reported 845 confirmed typhoid /paratyphoid fever cases and the incidence rate was 0.23 cases per 100000 population in 2015 what was the lowest recorded with both case number and notification rate in the period 2011 to 2015. Three countries showed the highest notification rates like the United Kingdom 0.63 cases per 100000 population, France 0.53 per 100000 population and Denmark 0.32 cases per 100000 in 2015. 474 cases (84%) out of 566 typhoid and paratyphoid cases were gained while travelling to outside of EU/EEA. 94% cases were arrived from south Asia especially typhoid infection dominating countries like India, Pakistan and Bangladesh. On the other hand, Greece presented the opposite direction, they reported that large number of their cases almost 71% were with known travel in domestic provinces. There are nine countries, they did not report any typhoid infection cases, Belgium, Cyprus, the Czech Republic, Hungary, Iceland, Italy, Latvia, Malta and Slovakia. Gender specific distribution did not present significantly differences between male and female patient, it was 1.06:1, where In Bangladesh showed that male acquired more typhoid infection than female. Among the age specific distribution, the number of notification and case rate were almost similar in children, young adult and adult patient, the ranges between 0.30 and 0.39 cases per 100000 population. In Bangladesh children under 5 years old were highest risk of getting typhoid infection and second level hold by young adult school going children. Seasonal trend of typhoid infection was shown different from the previous years like September and May was the highest with cases rated, but in 2015 report there was no significant trend on these months. between April and August 2015, the number of cases was lower than previous years, so a reducing trend was noticed in typhoid and paratyphoid cases in the EU/EEA. Compare to Bangladesh, in monsoon and post monsoon season got the increased amount of incidence rate of typhoid fever due to poor water drainage system. Beside this, almost 60% cases noted as typhoid and remaining ratio for paratyphoid (dominating by Paratyphoid A serotype than B and C), typhoid incidence is higher than paratyphoid that was like Bangladesh.

6.3. **Typhoid infection in Estonia**

TESSy reported that in Estonia, the confirmed case in 2011 was zero, while in 2012 and 2013 they got 2 confirmed cases. In 2014 this number was decreased by 1 but in 2015 they have

experienced with 2 confirmed cases per 100000 population (The European Surveillance System, 2017)

7. **Limitations**

This study has several limitations. 1. This study is relied on only Widal test reports, not included other test parameters like blood cultures. 2. The patient sample size was small that failed to find out expected results in gender specific distribution and age specific distribution. 3. This study was hospital data based and did not involve active community-based case detection. 4. It depended on patient disease history that did not make clear conception about family background that is an important of socioeconomic status. 5. The collected data may have underestimated or overestimated the typhoid records, because these are historical records of a private hospital and we had no valid method to control and observe the sample.

Despite of these limitations this study able to present the real scenario of incidence of typhoid in this endemic area. This result suggests that young children and females of this resident area are more infected, so immediate prevention action plan should be taken to reduce disease burden.

8. **Conclusion**

It has been cleared that enteric fever still a vulnerable health issue in Bangladesh that become a major public health challenge. the research on this topic was not covered the whole area of Bangladesh so it is difficult to assume the exact data regarding epidemiology, most of the research conducted in Dhaka metropolitan areas (Dewan et al.2013). Jurain can be recognized as epidemic area of typhoid fever due to incidence of typhoid fever with 6 months. Based on my study and previous findings, it may be concluded that higher incidence of typhoid fever belonged to young adult age group 6 to 20 who are directly involve using unhygienic water and food. Infant under 5 years old has noticeable risky incidence of typhoid fever. The seasonal changes make the incidence of typhoid fever in great ratio, during monsoon and post monsoon seasons has higher level of typhoid infection than other seasons. Typhoid infection discrimination was found among gender specific distribution that males are frequently infected

than female, where my study shown that female patient were more reported in hospital than male for 6 months. Additionally, paratyphoid fever occurred less frequent than typhoid fever. Though this study presented number of different results, it contained similar core values with previous studies. To prevent this incidence, vaccination would be an initial step along with the other measures such as ensure hygienic water supply, developed sanitation system with sewerage management. The local public health official community can be arranged must be basis immunization schedule for the children under 5 years old. Beside this, health awareness campaign would be taken as parental education regarding practice of healthy life style with increase consciousness to child health.

The real time data from single hospital able to present the recent crucial health status of an endemic area. The recent incidence of typhoid fever has been revealed out by analyzing the current data from the hospital record; it has been suggested that to prevent this incidence health authorities must take initial step like immunization for under 5 years old group as short-time solution along with long term solution like as improvement of socio-contextual factors such as water supply, planned sewerage system and awareness health campaign for the citizens.

The future goal of this study to work with socio contextual factors of this area in a wide range and will be included others significant diagnosis parameters like as blood culture, urine culture multidrug resistance examination. Though prevention of growing typhoid incidence need long term investment, statistical data on typhoid prevalence in such location would be help to health sector to take immediate initiatives.

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Appendix-i

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Appendix-ii

The literature review from the e journal and PubMed database with free full text in latest 8 years. There are 5 research papers using as secondary data.

Name	Year
Burden of typhoid and paratyphoid fever in a densely populated urban community, Dhaka, Bangladesh.	2010
Typhoid Fever and Its Association with Environmental Factors in the Dhaka Metropolitan Area of Bangladesh: A Spatial and Time-Series Approach	2013
Typhoid Fever in Young Children in Bangladesh: Clinical Findings, Antibiotic Susceptibility Pattern and Immune Responses.	2015
Enteric Fever and Related Contextual Factors in Bangladesh	2018
Enteric Fever Cases in the Two Largest Pediatric Hospitals of Bangladesh: 2013–2014.	2018