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Title

Prevalence Of Typhoid Fever Among Population in Shendi locality River Nile State 2014

A thesis submitted for the requirement of the master degree of public health

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الآيـة

قال تعالى:

(وعلم أدم الأسماء كلها ثم عرضهم علي الملائكة

فقال أنبئوني بأسماء هؤلاء إن كنتم صدقين)

صدق الله العظيم
سورة البقرة31

Dedication

To my parents whom awarded

me a sense of life

To my small family, my life

(husband & babies)

To my lovely sisters whom pave to me

the way

I dedicate this study with much

love And best wishes to all.

ACKNOWLEDGEMENTS

I would like to start by thanking GOD for his help during all the conduction of this work, as a little part of his generous help throughout my life.

I would like to express my deepest and sincere gratitude, and appreciation and thanks to my Supervisor Dr. ***Suleiman Elkamil Ahmed****, for his very kind invaluable help and unyielding patience in directing and supervising this work.*

I am truly thankful to the staff of public health office and EPI in Shendi locality) for their continuous help during my study.

I would like to thank all my colleagues who helped me to accomplish this work.

Abstract

The study was conducted as a community based descriptive cross sectional study to assess prevalence of typhoid disease among population in Shendi locality, River Nile State, Sudan, during the period 2012-2014. In this study 384 households were included .Questionnaire and observation were used as tools for data collection. The households were selected through a multistage cluster-sampling technique to determine the prevalence of typhoid disease, 384 respondent were selected through systemic random sampling.

I found that The overall prevalence of typhoid disease was 46.4% among the population surveyed. The study found that the knowledge and awareness among the general population about typhoid disease is high 84.6%, and the study found that typhoid disease was more prevalent among age group (11-20 year) which represent (38.8%) of person who has typhoid disease. Also study showed that deep bore wells represent the common source of drinking water used (77.9%), while surface wells were the least common one (9.4%) and there are strong correlation between type of latrine and distribution of typhoid disease in shendi locality. The study demonstrated that correlation is significant at 0,01 level between awareness and prevalence of typhoid.

Finally, the study recommends that, the locality of Shendi must renewed efforts to reinforce focus on sanitation, water purification and solid waste management, the ministry of heath should take action through intervention strategies, intensive community health education about typhoid disease control protocol, and also the study advice Shendi university to support the community and health authority to contain the disease through lectures, workshop and other community based programs.

مستخلص الدراسة:

أجريت هذه الدراسة الوصفية المقطعية في مجتمع محلية شندي لدراسة إنتشار مرض التيفويد لدي مجتمع محلية شندي بولاية نهر النيل في الفترة من 2012- 2014م . شملت هذه الدراسة 384 منزل. تم إستخدام الإستبيان والملاحظة كوسائل لجمع البيانات, استخدمت الطريقة العنقودية لأختيار المنازل لتحديد نسبة الإنتشار. وتم توزيع الإستبيان علي 384 شخص بالطريقة العشوائية البسيطة المنتظمة.

أظهرت الدراسة أن معدل إنتشار مرض التيفويد الكلي بالمحلية (46,4%) لدي المجتمع,

الدراسة توصلت علي أن معظم المجتمع 84,6% لديهم معرفة بمرض التيفويد, كما أوضحت الدراسة أن إنتشار مرض التيفويد أكثر شيوعا في الفئة العمرية (11-20سنة) حيث مثلت 38,8% من الأشخاص المصابين بالمرض

أوضحت الدراسة أن الأبار هي أكثر المصادر إستخداما في مياه الشرب بنسبة تقدر ب77,9% بينما المياه السطحية مثلت أقل نسبة 9,4%, وقد أثبتت الدراسة أن هنالك علاقة قوية بين نوع الحمات المستخدمة وإنتشار مرض التيفويد, كما تبين ان هنالك علاقة منطقية بين الإنتشار والمعرفة .

ختاما فإن الدراسة توصي محلية شندي بتجديد الجهود بالتركيز علي الأصحاح وتنقية مياه الشرب وإدارة النفايات الصلبة. كما توصي وزارة الصحة بإتخاذ القرارات اللازمة ووضع إستراتيجيات للتدخل في مجال التثقيف الصحي المكثف للمجتمع عن مكافحة مرض التيفويد. كما أوصت الدراسة جامعة شندي بالقيام بدورها تجاه المجتمع والإهتمام بمشاكله الصحية من خلال المشاركة عبر ورش العمل والمحاضرات والبرامج الصحية المختلفة حتى تزيد من وعي المجتمع بأهمية الإصحاح ومكافحة الأمراض .

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List of abbreviation

Abbreviation	*Meaning*
ASC	American Society of Cinematographers
CI	Confidence Interval
CVD	Chemical Vapor Deposition
DNA	Deoxyribonucleic Acid
MDRST	Multi Drug Resistant Salmonella Typhi
MHC	Major Histocompatibility Complex
NAFDAC	National Agency for Food and Drug Administration Center.
PPS	Probability Proportional to Size.
SPSS	Statistical Package for social sciences
TF	Typhoid Fever
USA	United State of America
VI	Virgin Islands
WHO	World Health Organization.

1.1-Introduction

Typhoid fever continues to be a major public health problem in many developing countries. Its etiological agent is Salmonella typhi. Globally, Typhoid fever is an important cause of morbidity and mortality in many regions of the world, with an estimated 12 - 33 million cases leading to 216,000 - 600,000 deaths annually (De Roeck, 2007). The disease is endemic to areas of Africa, India, South and Central America, which characterized by rapid population growth, increased urbanization, and limited safe water, infrastructure and health systems (Uneke, 2008). The biggest challenge perhaps is the emergence and spread of multidrug-resistant strains of bacteria causing TF, and the complication with malaria co-infection, leading to significant morbidity and mortality (Siddiquia et al., 2006).

The disease is transmitted through faecal-oral route via contaminated water and food, especially by food-handling carriers and human beings are the only known reservoir and host for typhoid fever. Typhoid fever is of important socioeconomic impact because, most of the time, several months are necessary for a patient to recover and be able to work normally again. Although, the etiologies of typhoid fever and malaria are different, typhoid fever by a bacteria, malaria by a protozoan and transmitted via different mechanisms, both diseases share rather similar symptomatology (Uneke, 2008). Because both diseases share social circumstances which are important to their transmission, individuals in areas endemic for both diseases are at substantial risk of contracting both these diseases, either concurrently or an acute infection superimposed on a chronic one (Keong and Sulaiman, 2006).

A mild form of disease, paratyphoid fever, is caused by serovars paratyphi A, B and C of *Salmonella* subspecies *enterica*. The bacteria is generally carried in the blood stream, intestinal tract and faecal matter of a human host and therefore, highly contagious. It can be acquired by ingestion of food and water contaminated by feaces of infected human or person to person contact. Developing countries with low level of public hygiene are frequently reported with endemic typhoid infection. (Punjabi, etal 2007)

Salmonella enterica serovar *typhi* is now known to be markedly resistant to commonly prescribed antibiotics and there has been increasing concern about the prevalence of multi-drug resistant *Salmonellatyphi* and *Salmonella paratyphi* strains in developing countries (ahmed, 2006). There have been several reports of multi-drug resistant *Salmonella typhi* with plasmid-mediated resistance to conventional antibiotics such as chloramphenicol, co-trimoxazole and ampicillin in different parts of the world (zhang, etal, 2006)

Multi-drug resistant *Salmonella typhi* to antibiotic such as chloramphenicol, amoxicillin, co-trimoxazole, and fluoroquinolone have emerged as new challenges to the treatment of typhoid fever, (Dutta, etal 2008)

1.2- Rational:

Despite the increasing workload due to typhoid fever at all levels of the health system, there is no satisfactory documentation showing the magnitude of the problem in health facilities. The rationale of this study was divided into different reasons. Firstly, no work was done in this area of study in shendi; therefore, this study was aimed at investigating new knowledge that may be added into the school of knowledge in the district and country as a whole.

Secondly, the study was aimed at determining the prevalence and distribution of typhoid fever among age and gender of population, and assessment of environmental and social factors that contribute in spread of typhoid fever, and as a result, the findings will be useful in planning, management and evaluation of health services in the district. The information will also provide the health system with intervention strategies to curb the problem of typhoid fever. This study will also provide opportunities for future studies to fill in the gaps that this study could not address. Finally, on completion, this study will be published both in regional and international journals. That is, the academicians and the scientific community will benefit from the findings of the study.

1.3- Justification:

Majority of patients attending the general hospitals present with signs and symptoms of typhoid fever such as headache, fever, abdominal pains, nausea. Diarrhea, slowly progressive fever as high as 40 °C (104 °F), profuse sweating and gastroenteritis. Knowing the causative agents and environmental and social factors of this condition and monitoring the pattern of distribution of this disease will help in achieving proper control for the infected population.

Lack of sanitation, studies of epidemiologic, soci-behaivour and knowledge of health culture as well as increasing of un cooking food (vegetables) in summer season, may contributing on occurrence of typhoid fever in a study area.

The absence of an affordable programmer to assure safe water and better sanitation conditions in the study area, vaccination of high-risk populations is considered the important element for the control of typhoid fever.

1.4 Objectives

1.4.1- General objective:

To study the prevalence of Typhoid Fever among population in Shendi locality River Nile State.

1.4.2- Specific objectives:

1. To determine the knowledge of population about typhoid fever.
2. To determine the most affected age group in the study area.
3. To assess the environmental factors that contributes to spread of the disease.
4. To identify the prevention measures that utilized to eliminate typhoid fever

2. Literature review

2.1-background

The TF prevalence records revealed a fluctuating trend with annual incidence rate of 580 – 1,400/100,000 persons, and an overall increase from 771 – 942 cases/100,000 persons (p _ 0.0001) between 2003 and 2007. While 88% of the respondents were aware of TF disease, 53% were unaware of its control methods. The study also revealed an acute shortage of diagnostic laboratory services which indicated that, 75% of health facilities had no such services. In adequate knowledge about personal hygiene, scarcity or lack of access to safe water, improper drainage systems and problems of unsanitary toilets in Singida urban were some of the obstacles to effective TF control. (Allen, 2010).

Effective TF control measures in the study district, as in other areas in the tropics, requires integration of intensive health education as a public health tool, provision and access to safe water supply and adequate strengthening of health systems.(Allen, 2010).

A total of 441 435 persons in the targeted age groups were under surveillance for one year, during which 21 874 fever episodes lasting 3 days were detected and 475 persons had blood culture-confirmed S. typhi. The overall incidence of fever lasting ³ 3 days for the five sites combined was 49.6 per 1000 person-years, ranging from 12.4 to 184.9 for the sites in China and Pakistan, respectively. The incidence of typhoid ranged from 15.3 cases per 100 000 person-years among those aged 5–60 years in China to 451.7 cases per 100 000 person-years among 2–15 year-olds in Pakistan. Overall, the S. typhi isolation rate (prevalence) was 23.1 per 1000 cultured febrile episodes and ranged from 5.0 to 33.1 per 1000.(Ochiai, et al, 2008)

Because the age groups under study varied by site, they compared the incidence in 5–15 year-olds, as this age group was surveyed in each site. Among the 159 856 such persons under surveillance in the five sites, 273 typhoid cases were detected. The overall incidence was 170.8 cases per 100 000 person-years, ranging from 24.2 to 493.5 for the sites in Viet Nam and India, respectively ($P < 0.0001$ for the overall difference of incidence among the five sites). The rates were significantly higher ($P < 0.0001$) in the south Asian sites (Pakistan and India) than in the south-east and north-east Asian sites (Viet Nam, Indonesia and China). Within this age group, the mean age at onset of typhoid was 8.5 years for the site in Pakistan, 10.0 years in India, 10.2 years in Indonesia, 10.5 years in Viet Nam and 12.0 years in China ($P < 0.0001$ for differences among the five sites). The mean age of onset of typhoid was significantly lower in the south Asian sites that in the south-east and north-east Asian sites ($P = 0.003$) and suggested that there was an inverse correlation between typhoid incidence and the mean age of typhoid cases in the five sites. The prevalence of typhoid-positive blood cultures among 5–15 year-olds was 24.7 per 1000 febrile episodes, and ranged from 4.7 to 61.4 per 1000 ($P < 0.0001$). The prevalence of positive cultures was significantly ($P < 0.0001$) higher in the three sites with the highest incidence (India, Indonesia, and Pakistan) than in the other two sites. (Ochiai, et al, 2008)

The incidence of typhoid among children aged 2–5 years was 573.2, 340.1 and 148.7 per 100 000 person-years in the sites in Pakistan, India and Indonesia, respectively, and was similar to that in school-aged children and adolescents at these sites. (Ochiai, et al, 2008)

A total of 42 typhoid cases required hospitalization: 6 (40% of all cases) in China, 2 (2%) in India, 26 (20%) in Indonesia, 3 (2%) in Pakistan, and 5

(28%) in Viet Nam (P < 0.0001 for overall heterogeneity of these proportions in the five sites). Altogether, 15 hospitalized cases (36% of all hospitalized cases, 5% of all cases from the age group) were in children aged 5–15 years: 2 in the sites in China, 1 in India, 7 in Indonesia, 2 in Pakistan, and 3 in Viet Nam. With the exception of the Chinese and Indonesian sites, the majority of the inpatient cases involved children aged 5–15 years. All detected cases recovered and no death due to typhoid was reported. (Ochiai, et al, 2008)

The antimicrobial susceptibility of S. typhi isolates varied between sites. All S. typhi isolates were tested for antimicrobial susceptibility, except for those from the Pakistani site where 127 out of 189 isolates (67%) detected during the surveillance period were tested using all six susceptibility tests. Nearly 60% of these 127 isolates were resistant to chloramphenicol, ampicillin, TMP-SMX and nalidixic acid. In contrast, all isolates from sites in China and Indonesia were susceptible to all antimicrobial agents. Multidrug resistance (resistance to chloramphenicol, ampicillin and TMP-SMX) was observed in 83 (65%) isolates from the site in Pakistan, 4 (22%) from the site in Viet Nam, and 9 (7%) from the site in India, but not in isolates from the Chinese or Indonesian sites ($P < 0.0001$ for overall heterogeneity of these proportions among the five sites). Nalidixic acid resistance was found in 75 (59%) isolates from the site in Pakistan, 69 (57%) from that in India, and 8 (44%) from that in Viet Nam, but from no isolates in the Chinese or Indonesian sites ($P < 0.0001$ for overall heterogeneity of these proportions among the five sites). Two isolates (1.6%) from the Indian site were resistant to ciprofloxacin. (Ochiai, et al, 2008)

Typhoid is used worldwide as an indicator of the level of public health, since it is caused mainly by unhygienic conditions. Samir describes geographic and temporal trends of typhoid in northern Sudan as indicative of the level of community hygiene from 2000 to 2008, based on official governmental statistics published in 2009-10. Southern Sudan was excluded for that period because of lack of data. The main findings showed that typhoid has a general fluctuating pattern, while three-year prevalence rates depict a steady increase. Regional differences by three-year prevalence rates were remarkable between the central region, including Khartoum and Gezira, and other regions of Sudan; these differences were statistically significant at all significance levels. Geographic proximity is influential in the distribution of typhoid within Sudan's states. The three-year prevalence rates distinguished two major groups of spatial distribution of typhoid by state. The first group shows a continuous increase in typhoid and includes central and western Sudan; the second group consists of two separated pockets of a fluctuating pattern of typhoid in eastern and western Sudan. Proportional change by state before the base year of 2004 shows a lower percentage relative to the period 2005-8, with few exceptions. Rank correlation between percent change in population and percent change in typhoid by state is weak at 0.01. The author propose the model to assess and reduce typhoid in Sudan.(Samir, 2011).

2.2-Definition:

Typhoid fever is an acute systemic infection caused by the bacterium Salmonella enterica serovar Typhi. Salmonella enterica serovars Paratyphi A, B, and C cause the clinically similar condition, paratyphoid fever. Typhoid and paratyphoid fevers are collectively referred to as enteric fevers.

In most endemic areas, approximately 90% of enteric fever is typhoid. Typhoid is transmitted by the fecal-oral route via contaminated food and water and is therefore common where sanitary conditions are inadequate and access to clean water is limited. Although typhoid fever was common in the United States and Europe in the 19th century, it is now encountered mostly throughout the developing world. In the last fifteen years, the emergence of resistance to the antibiotics used for treatment has led to large epidemics, and complicated the management of this serious disease. (Parry, 2005).

2.2.1 Salmonella history:

The story of the term *Salmonella* starts in 1885 with the discovery of the bacterium *Salmonella enterica* (var. Choleraesuis) by medical research scientist Theobald Smith. At the time Theobald was working as a research laboratory assistant in the Veterinary Division of the United States Department of Agriculture. The department was under the administration of Daniel Elmer Salmon, a veterinary pathologist, and that is for whom the Salmonella was named.(FDA/CFSAN, 2009).

During the search for the cause of hog cholera it was proposed that the causal agent be named *Salmonella*. While it happened eventually that Salmonella did *not*cause that cholera (its enteric pathogen was actually a virus),[4] it turned out that all species of the bacterial genus *Salmonella* cause infectious diseases. In 1900 J. Lignières re-adopted the name for the many subspecies of *Salmonella*, after Smith's first type-strain *Salmonella cholera*. .(FDA/CFSAN, 2009).

2.2.2 **Feature:**

Salmonella are non-spore-forming,predominantly motile enterobacteria with diameters around 0.7 to 1.5 µm, lengths from 2 to 5 µm, and

peritrichous flagella (flagella that are all around the cell body). They are chemoorganotrophs, obtaining their energy from oxidation and reduction reactions using organic sources, and are facultative anaerobes. (Fabrega, etal, 2013).

2.2.3 Detection, culture and growth condition:

Most subspecies of *Salmonella* produce hydrogen sulfide, which can readily be detected by growing them on media containing ferrous sulfate, such as is used in the triple sugar iron test (TSI). Most isolates exist in two phases: a motile phase I and a nonmotile phase II. Cultures that are nonmotile upon primary culture may be switched to the motile phase using a Cragie tube. (Clark, 2009)

Salmonella can also be detected and subtyped using PCR from extracted salmonella DNA, various methods are available to extract salmonella DNA from target samples.(Winfield, 2003).

Mathematical models of salmonella growth kinetics have been developed for chicken, pork, tomatoes, and melons. *Salmonella* reproduce asexually with a cell division rate of 20 to 40 minutes under optimal conditions.(Carmen, 2010).

Salmonella lead predominantly host-associated lifestyles, however the bacteria were found to be able to persist in a bathroom setting for weeks following contamination, and are frequently isolated from water sources, which act as bacterial reservoirs and may help to facilitate transmission between hosts.(Beuchat, et al, 2010)

The bacteria are not destroyed by freezing, but UV light and heat accelerate their demise—they perish after being heated to 55 °C (131 °F) for 90 min, or

to 60 °C (140 °F) for 12 min. To protect against *Salmonella* infection, heating food for at least ten minutes at 75 °C (167 °F) is recommended, so the centre of the food reaches this temperature.(Sorrells, etal , 2010).

2.2.4 Salmonella as pathogens:

Salmonella species are facultative intracellular pathogens. Many infections are due to ingestion of contaminated food. They can be divided into two groups—typhoidal and nontyphoidal *Salmonella* serovars. Nontyphoidal serovars are more common, and usually cause self-limiting gastrointestinal disease. They can infect a range of animals, and are zoonotic, meaning they can be transferred between humans and other animals. Typhoidal serovars include *Salmonella* Typhi and*Salmonella* Paratyphi A, which are adapted to humans and do not occur in other animals.(Jantsch, etal 2011).

2.3 Epidemiology of typhoid fever:

Typhoid fever is an endemic throughout Africa and Asia and persists in the middle east, a few southern and eastern European countries and central and South America. In the USA and most of Europe, apart from occasional point source epidemics, typhoid is predominately a disease of the returning traveler.

A recent study estimated there to be approximately 22million cases of typhoid each year with at least 200,000 deaths. However, the true magnitude is difficult to quantify because the clinical picture is confused with many other febrile illness and most typhoid endemic areas lack facilities to confirm the diagnosis. (Park, 2005)

Twenty-five studies were identified, all of which contained incidence data on typhoid fever and 12 on paratyphoid fever. Five advanced

surveillance systems contributed data on typhoid fever; 2 on paratyphoid fever. Regional typhoid fever incidence rates ranged from <0.1/100 000 in Central and Eastern Europe and Central Asia to 724.6/100 000 in Sub-Saharan Africa. Regional paratyphoid incidence rates ranged from 0.8/100 000 in North Africa/Middle East to 77.4/100 000 in Sub-Saharan Africa and South Asia. The estimated total number of typhoid fever episodes in 2010 was 13. million (interquartile range 9.1–17.8 million). The adjusted estimate accounting for the low sensitivity of blood cultures for isolation of the bacteria was 26.9 million (interquartile range 18.3–35.7 million) episodes. These findings are comparable to the most recent analysis of global typhoid fever morbidity, which reported crude and adjusted estimates of 10.8 million and 21.7 million typhoid fever episodes globally in 2000.(Buckle etal,2010).

2.4 Epidemiological determinants:

2.4.1-The organism

Typhoid fever is caused by Salmonella typhi, a Gram-negative bacterium. A very similar but often less severe disease is caused by Salmonella serotype paratyphi A.

The nomenclature for these bacteria is confused because the criteria for designating bacteria as individual species are not clear. Two main views on the nomenclature of the genus Salmonella have been discussed. Le Minor and Popoff suggested that two species should be recognized: Salmonella bongori and Salmonella enterica. S. enterica included six subspecies, of which subspecies I (one) contained all the pathogens of warm-blooded animals. S. typhi was a serotype within subspecies I: Salmonella enterica subspecies I serotype typhi. This proposal was rejected by the International Judicial Commission because the name was not well known to clinicians and its use might cause accidents endangering health or life. The original rules

therefore remain in force. Ezaki and colleagues have noted in the International Journal of Systematic and Evolutionary.

Microbiology that the correct nomenclature for the causal agent of typhoid fever is Salmonella typhi and have requested that the current subspecific status of serotypeparatyphi A should be raised to specific status, i.e. Salmonella paratyphi A, S. typhi has several unique features, the genetic basis of many of which is known as a result of early genetic studies and the recent sequencing of the whole genome.

Although many genes are shared with E. coli and at least 90% with S.typhimurium, there are several unique clusters of genes known as pathogenicity islands and many more single genes that seem to have been acquired by S. typhi during evolution.

S.typhi can be identified in the laboratory by several biochemical and serological tests. One of the most specific is that of polysaccharide capsule VI, which is present in about 90% of all freshly isolated S. typhi and has a protective effect against the bactericidal action of the serum of infected patients. This capsule provides the basis for one of the commercially available vaccines.Vi antigen is present in some other bacteria (*Citrobacter freundii, Salmonella paratyphi C and Salmonelladublin*) but not in exactly the same genetic context. The ratio of disease caused by *S. typhi* to that caused by S. paratyphi is about 10 to 1 in most of the countries where this matter has been studied. (WHO.2003).

2.4.2- Reservoir of infection:

Man: is the only known reservoir, and consist of cases and carriers.

I)Case:

The case may mild, missed or severe. A case (or carrier) is infectious as long bacilli appear in stools or urine.

II) Carriers:

Many patients excrete S. enterica ser. Typhi or Paratyphi in their stools or urine for some days after starting antibiotic treatment. Convalescent carriers excrete for periods of up to 3 months. Patients still excreting at 3 months are unlikely to cease and at 1 year meet the formal definition of ‘chronic carrier’. Among carriers detected by screening, 25% give no history of acute typhoid. Faecal carriage is more frequent in individuals with gallbladder disease and is most common in women over 40; in the Far East there is an association with opisthorchiasis. Urinary carriage is associated with schistosomiasis and nephrolithiasis. Acute typhoid in carriers has been repoted. There is an increased risk of carcinoma of the gallbladder. (Parry, 2010)

Patients discharged after treatment for typhoid with six negative stool and three negative urine specimens and negative Vi serology are considered free of infection. Most patients with positive stools at the completion of treatment excrete temporarily and can be safely followed up. Antibiotic eradication of carriage is advised in those still excreting at 3 months, or earlier in those at particular risk of communicating infection to others. The patient with a persistently elevated or rising Vi antibody titre is likely to be a carrier. Repeated checks of urine and faeces should be made and consideration given to obtaining bile cultures if these are negative. (Parry, 2010)

Eradication of carriage requires prolonged, high-dose antibiotics, Ampicillin, amoxicillin, and co-trimoxazole have been used with some success. More recently, good results have been reported with fluoroquinolones. Cholecystectomy and nephrectomy, once used to eliminate carriage (and not without operative mortality), are hard to justify

on public health grounds alone, but can be considered if antibiotic methods fail and there are additional indications for operation. The success rates of surgery are increased by giving antibiotics as well.(Parry, 2010)

2.4.3-Source of infection:

The primary source of infection is feces and urine of cases and carriers: the secondary sources of contaminated water, food, finger and flies. There is no evidence that typhoid bacilli are excreted in sputum or milk.

2.4.4-Host factor

A) Age

Typhoid fever may occur at any age highest incidence of this disease occurs in the 5 up to 19 year of age.

B) Sex

More cases are reported among male than female, probably as a result of increased exposure to infection but carrier rate is more than in female.

C) Immunity

All ages are susceptible to infection antibody may stimulate by the infection or by immunization; however the antigen to the somatic antigen (o) is usually higher in the patient with the disease and anti body the flagella antigen (h) is usually higher in immunized individuals .

Serum antibodies are not primary defenses against infection; salmonella typhi ping intercellular organism cell-mediated immunity implies a major role in compact the infection.

Natural typhoid fever does not always confer immunity; second attacks may when a changed with a large oral dose.

Among the host factors that contribute to resistance to s.typhi are gastric acidity and local intestinal immunity.(park, 2005)

2.5 Environmental and social factors:

Enteric fever is observed all through the year the peak incidence is reported during July-September on summer time. This period coincides with the rainy season and an increase fly population. Outside the human body, the bacilli are found in water, ice, food, milk and soil for varying periods of time. Typhoid bacilli do not multiply in water; many of them perish within 48 hours, but some survive for about 7 days. They may survive for over a month in ice and ice cream they may survive for up to 70 days in soil irrigated with sewage under moist winter conditions, and for half that period under drier summer conditions. Food being a bad conductor of heat provides shelter to the bacilli which may multiply and survive for sometime in food.(park, 2005)

Typhoid bacilli grow rapidly in milk without altering its taste or appearance in anyway .Vegetables grown in sewage farms or washed in contaminated water are a positive health hazard. These factors are compounded by such social factors as contamination of drinking water supplies, open air defecation and urination, low standards of food and personal hygiene and health ignorance. Typhoid fever may therefore be regarded as an index of general sanitation in any country. (park, 2005)

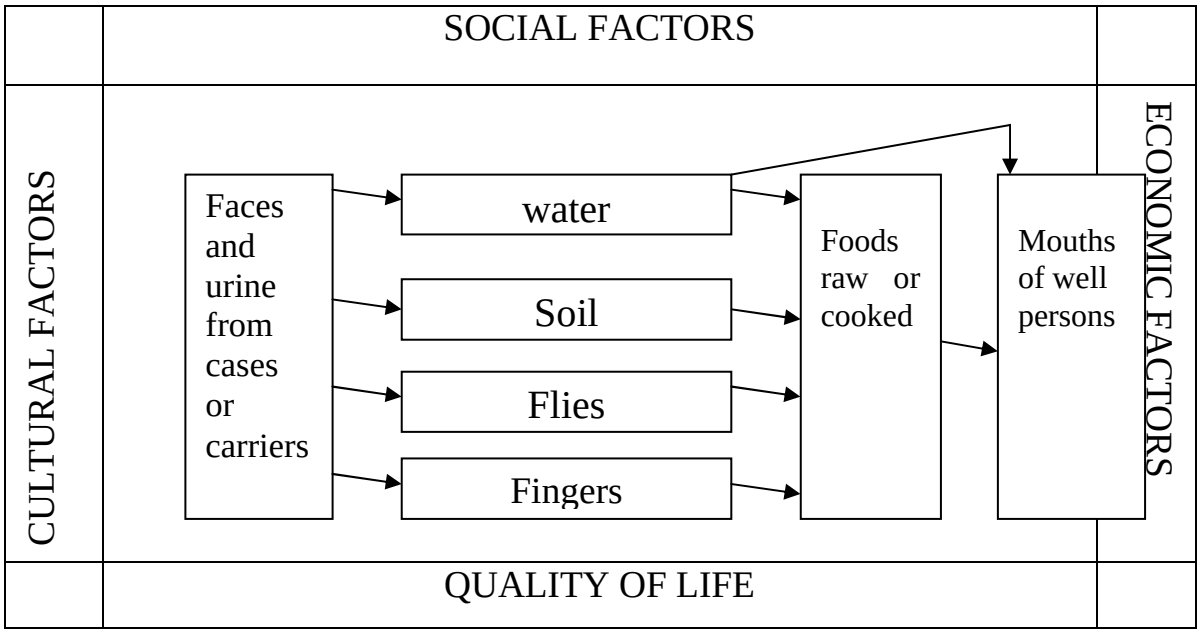
2.6 Mode of transmission:

The main method of transmission is water, contaminated by faecal material from a carrier. These water-borne outbreaks may not always be explosive and where low-grade infection of the water source is taking place, groups of cases, spread over time, may occur.(Webber ,2005)

S. enterica has been found to survive periods of 4 weeks in fresh water, but if the water is stored in bright sunlight (as in a reservoir), then the number of organisms rapidly dies off. It can survive in aerobic conditions with organic nutrient present, as found in contaminated streams. If the stream is polluted with raw sewage, then the organism can survive over 5 weeks and within solid faecal material for considerable periods of time. Seawater is bactericidal, but where a sewage outfall is near a shellfish bed, then the organism is filtered and concentrated providing a potent source of infection if the shellfish are eaten raw. (Webber ,2005)

Milk and dairy products provide ideal culture media and can become infected during handling by a carrier, or rinsing of containers with polluted water. Contaminated ice cream has been responsible for several outbreaks. Pasteurization of milk at 60C is effective in killing *S. enterica*. Infection of meat products and canned foods is less common, but can occur in the cooling process (if carried out in polluted water).

Flies can transmit the organism from faeces to food, whereas person-to-person infection is uncommon. Secondary cases form a very small proportion of an epidemic; so serial transmission in an unhygienic environment is not a feature.(Webber ,2005)



***Dynamics of typhoid fever transmission.* (park, 2005)

2.7 Incubation period:

Incubation period is 3–30 days, with a mean of 8–14 days. The length of the incubation period is inversely proportional to the infecting dose.(Webber ,2005)

2.8 Period of communicability:

Period of communicability From 1 week after the start of illness for a period of 3 months, except in the chronic carrier where it continues for years.(Webber ,2005)

2.9 Occurrence and distribution:

Occurrence and distribution in most tropical areas, the disease is endemic with seasonal outbreaks. Water is probably the main vehicle of transmission, but may be more related to the gathering of people at scarce water sources (as occurs in the dry season), rather than epidemics occurring with the early rains. Endemic typhoid is maintained by sub-clinical infections, especially in undiagnosed children, who obtain a degree of immunity. It has been suggested that these sub-clinical infections result from

persons swallowing lower bacterial doses than the critical threshold. In endemic areas, the peak of infection is in children between 5 and 12 years of age. (Webber ,2005)

Typhoid is a worldwide disease and serious outbreaks, generally epidemic in nature, have occurred in developed countries from contamination of the water supply or food produce. Repair work on water supplies or an accidental interruption of chlorination has led to epidemics. Typhoid organisms have persisted in canned meat cooled in infected water thousands of miles away from the outbreak. Many well-known outbreaks have been due to ice cream. The movement of carriers can be followed from the outbreaks they produce as they travel around. (Webber ,2005)

2.10 Signs and symptoms

Typhoid fever is characterized by a slowly progressive fever as high as 40°C (104 °F), profuse sweating and gastroenteritis. Less commonly, a rash of flat, rose-colored spots may appear. (Ryan, 2004) Classically, the course of untreated typhoid fever is divided into four individual stages, each lasting approximately one week. In the first week, there is a slowly rising temperature with relative bradycardia, malaise, headache, and cough. A bloody nose (epistaxis) is seen in a quarter of cases and abdominal pain is also possible. There is leukopenia, a decrease in the number of circulating white blood cells, with eosinopenia and relative lymphocytosis, a positive reaction and blood cultures are positive for *Salmonella typhi* or *paratyphi*. The classic Widal test is negative in the first week.(Ryan, 2004).

In the second week of the infection, the patient lies prostrate with high fever in plateau around 40 °C (104 °F) and bradycardia (sphygmothermic

dissociation), classically with a dicrotic pulse wave. Delirium is frequent, frequently calm, but sometimes agitated. This delirium gives to typhoid the nickname of "nervous fever". Rose spots appear on the lower chest and abdomen in around a third of patients. There are rhonchi in lung bases. The abdomen is distended and painful in the right lower quadrant where borborygmi can be heard. Diarrhea can occur in this stage: six to eight stools in a day, green with a characteristic smell, comparable to pea soup. However, constipation is also frequent. The spleen and liver are enlarged (hepatosplenomegaly) and tender, and there is elevation of liver transaminases. The Widal reaction is strongly positive with antiO and antiH antibodies. Blood cultures are sometimes still positive at this stage. The major symptom of this fever is that the fever usually rises in the afternoon up to the first and second week. (Ryan, 2004) In the third week of typhoid fever, a number of complications can occur:

- Intestinal hemorrhage due to bleeding in congested Peyer's patches; this can be very serious but is usually not fatal.
- Intestinal perforation in the distal ileum: this is a very serious complication and is frequently fatal. It may occur without alarming symptoms until septicaemia or diffuse peritonitis sets in.
- Encephalitis
- Neuropsychiatric symptoms (described as "muttering delirium" or "coma vigil"), with picking at bedclothes or imaginary objects.
- Metastatic abscesses, cholecystitis, endocarditis and osteitis

The fever is still very high and oscillates very little over 24 hours. Dehydration ensues and the patient is delirious (typhoid state). By the end of

third week the fever has started reducing this (defervescence). This carries on into the fourth and final week. (Ryan, 2004).

2.11 Factors that influence the prevalence of typhoid fever :

2.11.1 Poor environmental sanitation:-

Adequate sanitation is the safe water management of human excreta and include both 'hard ware' (sanitation technology, such as toilets and hygienic latrines) and 'soft ware' (hygiene, such as hand washing with soap).

The WHO stated in the year 2000, that 40% (2.4 billion) of the world's population lacked access to basic sanitation. (Park, 2010).

One of the major public health concerns in cities in developing economies is slum with overcrowding at its worst. Poor urban planning regardless to waste disposal and drainage facilities, all these tend to encourage transmission of infectious diseases. An international workshop in 1986 identified ingestion of food or water contaminated by acutely infected persons or chronic typhoid carriers as the most common in communities where contaminated water and food is common. (Park, 2010).

2.11.2 Potable water

Availability and portability of drinkable water is still a Luxury in most developing nations of the world.

The WHO estimated that 1.2 billion of the world's population Lack access to potable water at the peak of the dry season, especially in developing countries, water is often sourced from various doubtful places most of which are contaminated by human waste. (Park, 2010).

2.11.3 Health Education

Knowledge is limited about many infectious diseases In developing countries as many diseases are still attributed to spiritual attacks by the common folks.

Also, as a result of illiteracy, half-measures are often taken by self-medicating, in order to avoid the unaffordable cost of modern healthcare in a situation, where there is no health insurance cover. This often leads to mismanagement with unsubstantiated remedies and misplaced spiritual intervention. As a consequence of this, patients with typhoid fever often present late and so with complications. (Park, 2010).

2.11.4 Laboratory Facilities

It is very difficult to isolate Salmonella typhi from urinate and stool specimens in most developing countries. This is often due to lack of culture media, expertise and sometimes, Previous exposure to inadequate doses of antibiotics (Park, 2010)..

Another major problems relating to the laboratory is the abuse of the Widal test. Some clinician will not treat or suspect the disease unless the Test is positive, while others treat with a positive result even in low titers for an endemic zone of typhoid fever or in the absence of clinical symptoms and signs. Ohanu *et al* showed that malaria could interfere with serological diagnosis of typhoid fever leading to over diagnosis.

Typhoid fever in most developing countries is thus a disease of over- and under diagnosis. It would be wise to carry out studies of baseline value of typhoid. Agglutinins for every locality as have been done in some areas to know the diagnostic utility of the Widal's test. Advances in diagnosis of typhoid fever with the use of enzymelinked immunosorbent assay are still beyond the reach of most developing nations.**(** (Park, 2010).**)**

2.11.5 Confounding Diseases

Typhoid fever, as a multi systematic disease has been dubbed the great mimicker especially in the tropical and subtropical environment, where several other confounding infections and infestations present with febrile illness. Many of these febrile illnesses such as Malaria, viral hepatitis and liver abscess, often present in a similar way as typhoid fever or even co-exist with typhoid fever. This often leads to delay or misdiagnosis and subsequent increased incidence of complications and mortality.((Park, 2010).)

2.11.6 Drug Resistance

Resistance to Chloramphenicol developed two years after its discovery in 1948; this phenomenon has since become a major challenge to contend with in the management of typhoid fever. Resistance has since been noticed with virtually all drugs including Trimethoprim and Ampicillin.

Recent studies have shown resistance and reduced susceptibility to Ceftriazone and the Quinolones, however, Quinolones are still regarded as the best and first line drugs in the management of typhoid fever.((Park, 2010).)

2.11.7 Personal and Communal Hygiene

Poor personal and communal hygiene is a common occurrence in less developed nations of the world especially among the illiterate population.

Lack of public sanitation as a result of ineffective health policies leads to reckless deposition of wastes and use of bush paths and riverbanks as refuse dumps and defecation points. During the early rainy season, faecal matter from some carriers of typhoid fever is washed into rivers and brooks. (Park, 2010).

2.11.8 Fake and Counterfeit

In 2001, the National Agency for Food and Drug Administration (NAFDAC) in Nigeria, reported that 50% of cases in circulation in Nigeria is fake. The problem of counterfeit and fake drugs no doubt has compounded the problem of management of typhoid fever, with a great potential for increased morbidity and mortality (Park, 2010).

2.12 Diagnosis of typhoid fever

The definitive diagnosis of typhoid fever depends on the isolation of S. typhi from blood, bone marrow or a specific anatomical lesion. The presence of clinical symptoms characteristic of typhoid fever or the detection of a specific antibody response is suggestive of typhoid fever but not definitive. Blood culture is the mainstay of the diagnosis of this disease.

Although ox bile medium (Oxgall) is recommended for enteric fever pathogens (S. typhi and S. paratyphi), only these pathogens can be grown on it. In a general diagnostic laboratory, therefore, where other pathogens are suspected, a general blood culture medium should be used. More than 80% of patients with typhoid fever have the causative organism in their blood. A failure to isolate the organism may be caused by several factors:

(i) the limitations of laboratory media.

(ii) The presence of antibiotics.

(iii) The volume of the specimen cultured.

(iv) The time of collection, patients with a history of fever for 7 to 10 days being more likely than others to have a positive blood culture. Bone marrow

aspirate culture is the gold standard for the diagnosis of typhoid fever. And is particularly valuable for patients who have been previously treated, who have a long history of illness and for whom there has been a negative blood culture with the recommended volume of blood. (WHO.2003).

Duodenal aspirate culture has also proved highly satisfactory as a diagnostic test but has not found widespread acceptance because of poor tolerance of duodenal aspiration, particularly in children. (WHO.2003).

2.12.1 Specimens:

If a bacteriology laboratory is not available on site, clinical specimens for culture can be transported to a main laboratory for processing. For blood culture it is essential to inoculate media at the time of drawing blood. For other specimens it is advisable to make the time of transportation to the laboratory as short as possible. It is more important to process the specimens quickly than to keep them cold. Once they have been inoculated, blood culture bottles should not be kept cold. They should be incubated at 37°C or, in tropical countries, left at room temperature, before being processed in the laboratory.

2.12.2 Blood

The volume of blood cultured is one of the most important factors in the isolation of S. typhi from typhoid patients: 10_15 ml should be taken from school children an adults in order to achieve optimal isolation rates; 2_4 ml are required from toddlers and preschool children. This is because children have higher levels of bacteraemia than adults. In some regions it may be impossible to collect such large volumes of The diagnosis, treatment

and prevention of typhoid fever blood and so alternative diagnostic methods may be necessary for cases in which blood cultures are negative. Because reducing the blood volume reduces the sensitivity of the blood culture, however, an effort should be made to draw sufficient blood if at al possible. Blood should be drawn by means of a sterile technique of venous puncture and should be inoculated immediately into a blood culture bottle with the syringe that has been used for collection. (WHO.2003).

Several reports of pseudobacteraemia have been associated with the reinoculation of blood culture bottles after the collection of blood in contaminated vessels. The practice of inoculating blood culture bottles from specimens taken for biochemical or haematological analysis should therefore be avoided. The optimum ratio of the volume of blood to traditional culture broth should be 1 to 10 or more. (WHO.2003).

Some commercial blood culture systems have special resins in the media which allow higher volumes of blood to be used. The instructions with commercial blood culture systems should always be read and the recommended amounts should not be exceeded. In general, if 5 ml of blood are drawn they should be inoculated into 45 ml or more of broth. If 10_15 ml of blood are drawn the specimen can be divided into equal aliquots and inoculated into two or more blood culture bottles. This allows the use of standard blood culture bottles of 50 ml. For small children the volume of blood drawn can be reduced but should still be inoculated into 45 ml of culture broth. In order to assist the interpretation of negative results the volume of blood collected should be carefully recorded. The blood culture bottle should then be transported to the main laboratory at ambient temperature (15°C to 40°C) as indicated above. Blood cultures should not be

stored or transported at low temperatures. If the ambient temperature is below 15°C it is advisable to transport blood cultures in an incubator. In the laboratory, blood culture bottles should be incubated at 37°C and checked for turbidity, gas formation and other evidence of growth after 1, 2, 3 and 7 days. For days 1, 2 and 3, only bottles showing signs of positive growth are cultured on agar plates. On day 7 all bottles should be subcultured before being discarded as negative. (WHO.2003).

2.12.3 Serum

For serological purposes, 1_3 ml of blood should be inoculated into a tube without anticoagulant. A second sample, if possible, should be collected at th convalescent stage, at least 5 days later. After clotting has occurred the serum should be separated and stored in aliquots of 200 ml at +4°C. Testing can take place immediately or storage can continue for a week without affecting the antibody titre. The serum should be frozen at -20°C if longer-term storage is required. (WHO.2003).

2.12.4 Stool samples

Stools can be collected from acute patients and they are especially useful for the diagnosis of typhoid carriers. The isolation of S. typhi from stools is suggestive of typhoid fever. However, the clinical condition of the patient should be considered. Stool specimens should be collected in a sterile wide-mouthed plastic container. The likelihood of obtaining positive results increases with the quantity of stools collected. Specimens should preferably be processed within two hours after collection. If there is a delay the specimens should be stored in a refrigerator at 4°C or in a cool box with

freezer packs, and should be transported to the laboratory in a cool box. Stool culture may increase the yield of culture-positive results by up to 5% in acute typhoid fever. If a stool sample cannot be obtained, rectal swabs inoculated into Carry Blair transport medium can be used but these are less successful. (WHO.2003)

2.13 Microbiological procedures:

2.13.1 Blood culture:

A typical blood culture bottle contains 45 ml of tryptic soy broth or brain heart infusion broth. These are inoculated with 5 ml of fresh blood and incubated at 37°C. Negatives should be kept for at least seven days. Because S. typhi is not the only bacterial pathogen found in blood, subculturing is performed on days 1, 2, 3 and 7 on non-selective agar. (WHO.2003).

The best agar is blood agar (horse or sheep blood) as this allows the growth of most bacterial pathogens. If blood agar is not available, nutrient agar can be used in combination with MacKonkey agar. In some laboratories the use of MacConkey agar alone is preferred as this allows the growth of only bile-tolerant bacteria such as S. typhi and does not allow the growth of many Gram-positive contaminants. (WHO.2003).

The contamination of blood cultures reduces isolation rates for S. typhi and should be prevented as far as possible. It is important to identify contaminating bacteria that come from the skin of patients or the air of the laboratory so that measures can be taken to prevent further problems. MacKonkey agar should therefore not be used as the only agar for the sampling of blood cultures in a diagnostic microbiology laboratory.

Furthermore, because it is selective, MacKonkey agar does not permit the growth of Gram-positive pathogens or even all E. coli. For suspected tyhoid fever, subculture plates should be incubated at 37°C for 18_24 hours in an aerobic incubator. (WHO.2003).

2.13.2 Stool or rectal swab culture

This involves inoculating 1 g of stool into 10 ml of selenite F broth and incubating at 37°C for 18_48 hours. Because selenite broth is very sensitive to heat the manufacturer's instructions should be carefully followed during preparation and overheating of the broth during sterilization should be avoided. Once a batch is prepared it should be stored at 4°C. Selenite broth inhibits the motility of E. coli found in stools but does not kill this bacterium. A subculture of selenite broth on a selective agar is therefore made from the surface of the broth without disturbing the sediment. The choice of agar media includes Mac Conkey agar, desoxycholate citrate agar, xylose-lysinedesoxycholate agar, and hektoen enteric agar or SS (Salmonella_Shigella). The plate is incubated at 37°C for 24 hours. Different batches of agar plates can give slightly different colonies of S. typhi and it is therefore important to keep one strain of S. typhi for use in quality control for each batch of agar plates and selenite broth. New batches of media are inoculated with the control strain and the amount of growth and the appearance of the colonies are recorded. If S. typhi does not grow as well as usual in any batch of medium, discard the medium and make a fresh one.

The identification of colonies as S. typhi is straightforward if reagents of satisfactory quality are available. Colonies from solid media can be used for agglutination with specific antisera. Several salmonellae may share the same

antigenic structure. Consequently, confirmation by means of biochemical tests is always necessary. (WHO, 2003).

2.14 Diagnosis of carriers:

The detection of carriers is important for epidemiological and public health purposes. The identification of faecal carriers is by isolation of bacillus from faeces or from bile. It is important test reported samples for the detection of urinary carriers. The widal test has no role, the demonstration of Vi antibody indicates the carrier state, confirm by culture. (jaggi, 2003).

2.15 Differential diagnosis

Many viral, bacterial, and protozoal infections as well as noninfectious conditions characterized by fever, including lymphoproliferative disorders and vasculitides, resemble enteric fever. Typhoid should always be considered when suspected malaria has not been confirmed or has not responded to antimalarial therapy. In areas of endemicity, typhus, leptospirosis, and dengue should be considered in the differential diagnosis. (Parry, 2010)

2.16 Traditional Treatment:

The incidence of typhoid fever can be subsequently reduced by providing clean water and proper hygienic conditions to the population. The traditional treatment for typhoid fever was obtained with Chloramphenicol, Ampicillin, Trimethoprim and Sulphamethoxazole, the so-called first line antibiotics. Effective antibiotic therapy with the advent of chloramphenicol, which was first used to treat typhoid in the 1940s, has also dramatically altered the natural course of disease and reduced the mortality rate from

around 25% to as low as 1%. Antibiotics that were used for the treatment of typhoid fever were listed in the following table:

Drugs in concerned with typhoid			
S.N	**Drugs**	**S.N**	**Drugs**
1	Azithromycin	6	Cotrimoxazole
2	Ceftriaxone	7	Fleroxacin
3	Chloramphenicol	8	Fluoroquinolone drug
4	Ciprofloxacin	9	Norfloxacin
5	Ampicillin	10	Ofloxacin

2.17 Short course treatment of typhoid fever:

Since 1990, multidrug resistant variety of typhoid fever had been prevalent in many parts of India, caused by S.typhi resistant to Chloramphenicol, Ampicilin Trimethoprim and Sulphamethoxazole. Studies evaluating the results of short course therapy for typhoid fever have attested to the efficacy of both fluoroquinolones and third generation cephalosporins. Fluoroquinolones are efficient antimicrobiol drugs for the treatment of enteric fever. The fluoroquinolone antibacterial agent fleroxacin has a broad spectrum of invitro activity which encompases most Gram-negative species and has been used against typhoid fever. Quinolones treatment of bacterial enteritis is further limited because of the failure of the compounds to eradicate Salmonella spp. Uncomplicated typhoid fever was cured by Norfloxacin, Pefloxacin and Afloxacin with a dose of 400 mg twice daily for 7-14 days or Ciprofloxacin 500 mg for 10 days. It is regrettable that resistance to ciprofloxacin has now emerged in MDR S.typhi and is a paramount importance to limit the unnecessary use of this vital drug so that its efficacy should not be further jeopardiz. The treatment with

Azithromycin has also been reported against typhoid (Duran and Amsden, 2000). It was then reported in the year 2006 that Ciprofloxacin therapy for typhoid fever needs reconsideration (Chitnis *et al.,* 2006). Later it was reported about Ciprofloxacin treatment failure in a case of typhoid fever caused by Salmonella enterica serotype Paratyphi A with reduced susceptibility to ciprofloxacin (Dimitrov *et al.,* 2007).

2.18 Prevention and control of typhoid fever:

The major routes of transmission of typhoid fever are through drinking water or eating food contaminated with *Salmonella typhi*. Prevention is based on ensuring access to Safe water and by promoting safe food handling practices. Health education is Paramount to raise public awareness and induce behavior change. (Park, 2010).

2.18.1 Safe water:

Typhoid fever is a waterborne disease and the main preventive measure is to ensure access to safe water.

The water needs to be of good quality and must be sufficient to Supply all the community with enough drinking water as well as for all other domestic purposes such as cooking and washing.

During outbreaks the following control measures are of particular interest:

- **In urban areas**, control and treatment of the water supply systems must be strengthened from catchment to consumer. Safe drinking water should be made Available to the population trough a piped system or from tanker trucks.
- **In rural areas**, wells must be checked for pathogens and treated if necessary.
- **At home**, a particular attention must be paid to the disinfection and the storage of the water, however safe its source. Drinking-water can be

made safe by boiling it for one minute or by adding a chlorine-releasing chemical.

Narrow-mouthed pots with covers for storing water are helpful in reducing secondary transmission of Typhoid fever Chlorine is ineffective when water is stored in metallic containers.

- **In some situations**, such as poor rural areas in developing countries or refugee camps, fuel for boiling water and storage containers may have to be supplied. (Park, 2010).

2.18.2 Food safety:

Contaminated food is another important vehicle for typhoid fever transmission.

Appropriate food handling and processing is paramount and the following basic hygiene measures must be implemented or reinforced during epidemics:

- Washing hands with soap before preparing or eating food;
- Avoiding raw food, shellfish, ice;
- Eating only cooked and still hot food or re-heating it. During outbreaks, food safety inspections must be reinforced in restaurants and for Street food vendor's activities.
- Pasteurilize or boil milk, or exclude milk supply and other foods suspected on epidemiological evidence until safety is assured.
- Encourage breast feeding throughout infancy; boil all milk and water used for infant feeding limit the collection and marketing of shellfish to supplies from approved sources.
- Boil or steam (for at least 10 minutes) for serving.

- Uses scrupulous cleanliness in food preparation and handling; refrigerated as an appropriated.
- Particular attention should be directed to the proper storage of salads and other foods served cold.

These provisions apply equal to the home and public eating places.

If uncertain about sanitary practice, selected food that are cooked and served hot and fruits, peeled by the consumer (Park, 2010).

Typhoid can be transmitted by chronic carriers who do not apply satisfactory Food-related hygiene practices. These carriers should be excluded from any activities Involving food preparation and serving. They should not resume their duties until they have had three negative stool cultures at least a month apart (Park, 2010) .

2.18.3 Sanitation

Proper sanitation contributes to reducing the risk of transmission of all diarrheal Pathogens including *Salmonella typhi*.

Appropriate facilities for human waste disposal must be available for all the community.

In an emergency, pit latrines can be quickly built. Collection and treatment of sewage, especially during the rainy season, must be implemented in areas where typhoid fever is known to be present, the use of human excreta as Fertilizers must be discouraged.

Fly Control by screening, spraying with insecticides, and using insecticidal baits and traps must be implemented. Frequently collection and disposal of garbage and use of fly measures in latrine construction and maintenance to control fly breeding. Concurrent disinfection of feces and articles soiled therewith. In communities with modern and adequate sewage disposal

systems, feces and urine can be disposal of directly into sewers without preliminary disinfection (Park, 2010).

2.18.4 Health education

Health education is paramount to raise public awareness on all the above mentioned Prevention measures. Health education messages for the vulnerable communities need to be adapted to local conditions and translated into local languages. In order to reach Communities, all possible means of communication (e.g. media, schools, women's groups, and Religious groups) must be applied.

Community involvement is the cornerstone of behavior change with regard to hygiene and for setting up and maintenance of the needed infrastructures. In health facilities, all staff must be repeatedly educated about the need for:

- Excellent personal hygiene at work;
- Isolation measures for the patient;
- Disinfection measure.

2.18.5 Vaccination:

The Centre For Disease Control and Prevention has identified immunization as the most important public health advance of the 20th century. Vaccination is an easy and highly effective way to keep travelers healthy (Sturchler and Steffen, 2001). Despite effective treatment of typhoid fever, the increasing report of MDRST make it necessary for vaccine to be used as a public health tool in developing countries. The design of new Salmonella vaccines, must be based on the identification of suitable virulence genes and on the knowledge of the immunological mechanisms of resistance to the disease. Control and clearance of a vaccine strain rely on the phygocyte oxidative burst, reactive nitrogen intermediates, inflammatory cytokines, CD4 (+) TCRalphabeta T cells and are controlled by genes

including NRAMPI and MHC class 11. Vaccine-induced resistance to re-infection requires the presence of TH1-type immunological memory and anti-Salmonella antibodies. The interaction between T and B cells is essential for the development of resistance following vaccination (Mastroeni and Menager, 2003).

Considerable progress has been made in the last decade to develop vaccines against the enteric infections which is of greatest public health importance. Two vaccines against typhoid fever (Parenteral Vi polysaccharide and oral Ty21a) have been licensed in many countries. A new typhoid vaccine composed of the Vi capsular polysaccharide has been reported. Vi polysaccharide is a well standardized antigen that is effective in a single parenteral dose. It is safer than whole cell vaccine and may be used in children of two years of age or older. The Vi vaccine compares favorably with other typhoid vaccine in regard to safety, patient compliance, immunogenicity and efficacy.(khan, 2008)

Typhoid Vi capsular polysaccharide vaccine represents important additions to immunization agents. It is immunogenic, clinically effective, and generally safe, with infrequent and usually mild adverse reaction.

In the recent years there has been significant progress in the development of attenuated Salmonella enterica Serover typhi strains as candidate typhoid fever vaccines. In clinical trials these vaccine have been shown to be well tolerated and immunogenic. For example, the attenuated S.enterica var. typhi strains CVD 908-htr A (aroC aroD htrA), Ty 800 (pho P pho Q) and chi 4073 (cya crp cdt) are all promising candidate typhoid vaccine (Garmory *et al.*, 2002).

Live vaccine Ty21a given by the oral route has been exclusively tested in several studies in developing countries. Its liquid formulation was the most effective, providing more than 60% of protection after 7 years of follow up.

The Vi polysaccharide vaccine has been put to trial and provided more than 65% protection; after 3 years of follow up the Vi antibody was still at a high level. These two vaccines are therefore candidates for use in public health control programs. Aromatic dependent Salmonella live vaccine has been also reported (Stocker, 2000). Killed whole cell bacterial vaccines of typhoid generally show a high degree of stability of potency. Live attenuated vaccines such as Ty21a typhoid vaccines loose potency through loss of viability when exposed to adverse conditions. (khan, 2008)

Ty21a vaccine is susceptible to ultraviolet irradiation and has low thermal stability. Specific antibody secreting cells (ASC) appear in the blood as a response to oral vaccination in humans. Based on information from animal experiments, these cells are believed to be migrating to the mucosa lining. A series of studies aimed at a detailed characterization of the ASC response to a prototype oral vaccine Salmonella typhi Ty21a with respect to its kinetic, Ig class distribution, antigen specificity, influence of the administrative route, nature of the antigen, and the corresponding antibody responses in serum. (khan, 2008)

Live Salmonella vaccine has been reported as a route towards oral immunization. Live vaccines are composed of viral or bacterial strains, which are deprived of their pathogenicity but can still replicate in the organism. The preparation of vaccine strain using gene deletion or attenuation directed mutagenesis makes it possible to develop highly genetically stable vaccines, in particular against orally transmitted bacterial diseases like typhoid fever. (khan, 2008)

Attenuated Salmonella type vaccine Strain CVD 908, which harbors deletion mutation, in aro-C and aro-D has been shown to be well tolerated and highly immunogenic, eliciting impressive serum antibody, mucosal IgA and cell mediated immune response. A further derivative prepared by introducing a deletion in htr-A resulted in CVD 908-htr A. Both CVD 908 and CVD 908-htrA are useful as live vector vaccines to deliver foreign antigens to the immune system. (Birkenfeld, 2006).

Genetically defined live attenuated Salmonella vaccines are useful both as oral vaccine against Salmonellosis and for the development of multivalent vaccines based on the expression of heterologous antigens in such strains. Several candidate attenuated S. typhi strains are at present being evaluated as new single dose oral typhoid vaccines in human volunteers. The emergence of such a vaccine will facilitate the development of multivalent vaccines for humans. (Guzman *et al.*, 2006)

The world history and current status of typhoid fever vaccination was also reported. Attenuated *Salmonella enterica* serover *typhi* (*S.typhi*) strains can serve as safe and effective oral vaccine to prevent typhoid fever and as live vectors to deliver foreign antigens to the immune system, either by the bacteria expressing antigens through prokaryotic expression plasmids or by delivering foreign genes carried on eukaryotic expression system (DNA vaccination). The practical utility of such live vector vaccines relies on achieving a proper balance between minimizing the vaccines reactogenicity and maximizing its immunogenicity (Pasetti et al., 2003). Bacterial live vaccines *S. typhi* Ty21a has been reported to be employed as vaccine against typhoid (Dietrich *et al.*, 2003). Various reviews and reports have been done on vaccine/vaccination in concerned with typhoid fever (Haditsch, 2005); (.

A number of vaccine against typhoid has been represented in the following table:

Vaccine against typhoid its composition, dose, efficacy and side effect:

S.N	Vaccine type	Composition	Dose	Efficacy	Side effects
1	Inactivated Parenteral Whole cell vaccine	It is composed of heat phenol inactivated whole cell vaccine	It is composed of heat phenol inactivated whole cell vaccine	60-67%	Frequent side effects. Severe local reactions
2	Parenteral Capsular poly accharide vaccine Vi [ViCPs]	It is composed of virulence antigen which is the capsular polysaccharide elaborated by *S. Typh*i isolated from blood cultures.	Single injection 25 mcg (0.5 ml) No booster effect	64-72%	Well tolerated. Local mild reaction. Safe
3	Attenuated Live Vaccine Oral Ty21a vaccine	It is live attenuated Ty21a strain of *S. Typhi*	Primary: 3-4 capsules taken on alternative day. Booster: Every five years	60-96%	Well tolerated. Fewer side effects.

Zhang *et al*, 2008)

Chapter three

3.Methodology:

3.1 Study design:

A descriptive cross sectional community based study will be conducted to determine the prevalence of Typhoid Fever among population in Shendi locality River Nile State.(2014)

3.2 Study area:

Shendi is a town in northern Sudan, located on the east bank of the Nile, and north of Khartoum about 175km, and south of Damer (capital) about 140 and area of 56km^2.

The number of people residents in the Shendi locality is about **269446** person.

Shendi is the center of ja,alin tribe and important historic trading center. Most of population working in factories, agricultures governmental organization and free business.

The side of the education, Shendi University is the largest educational institutions in the city and it includes a number of collages, and there are a number of secondary school and primary and pre-school education.

The side of health, there is prevention management, part of vaccination of the children, and department of maternal and child welfare.

In the term of treatments, there is Shendi teaching hospital, Mak Nimr, military hospital, and a number of health centers and clinics and a large number of private clinics and laboratories for examination and medical tests.

The term of cultural, there is cultural office and information department where there are local TV and there are various services such as Secondary Education which consist of (17) schools..

Primary schools are consisting of 32 schools. 13 are girls school, 13 are boys school, and six is mixed school because of include both boys and girls.

The side of climate is hot climates, the temperature of month in May, June and July is very hot about overage highest 42-52°c to lowest 20°c rain is 117mm.Relative humidity 20-42%. Latitude is 16-42N, 33-26E elevation 360m.

3.3 Period of study:

The study were curried out through the period (December 2012 to July 2014) **.**

3.4 Study population:

The target group of this study was the population of Shendi locality which is estimated at the number of (53889) households.

3.5 Sampling and sample size:

In the study area the number of households was 53889, and the samples were taken by using the following formula:

$$N = \frac{Z^2 . PQ}{D^2}$$

Where:

N= Sample size.

Z= the value of the standard normal variable corresponding to is %level of significance (1, 96).

P= Expected prevalence = (50%)

Q= 1-P

D= marginal error (0, 05).

Accordingly after calculation a sample size of 384 households were considered.

The sample size of households surveyed was based on the assumed tyhpoid prevalence rate of 50% (as there was no available information on likely prevalence in the study district), confidence interval (CI) of 95%, and a relative precision of 10%. A sample size of 384 households were considered sufficient to establish whether typhoid fever was present.

The sample size was distributed for each administrative unit using the following formula:

Ns = $\frac{n*ws}{N}$

Where:

Ns = sample size in each administration.

n= total sample size.

ws= number of population in each administration.

N =number of total population.

The distribution of sample size by administrations:-

administrative units	**Number of population**	**Sample size**
Shendi town	65263	117
Kabosheia	49632	88
Rural (north & south)	100230	179
Total	215125	384

3.5 Sampling techniques:

The multistage cluster-sampling technique was followed for select the study population in three stages .

First stage:

The locality was divided into five administration units, the four clusters were selected using the 'probability proportional to size' (PPS) sampling method.

Second stage:

All administration units were divided into cluster villages or blocks (cluster sampling technique). A random sampling technique is then used on any relevant clusters to choose which villages or block to include in the study in each identified cluster.

Third stage:

All individuals of the selected cluster enlisted. An attempt was made to select an equal number of individuals in the unit as far as possible. The required number of individuals in each village and block was selected by following the systemic random sampling technique .The sample size was distributed for each village using the following formula:

K= N/n

Where:

K= interval.

N= population.

n= sample.

3.6 Data collection:

The methods were used in data collection to satisfy the objective of this study :

1- Questionnaire.

2- Interview with health managers.

3- Written record data review with focus on laboratory results.

3.7 Data Analysis:-

Data collected was analyzed by using (SPSS) program. The following statistical measures were used:

1. Descriptive measures include frequencies, percentage, standard deviation, minimum and maximum.
2. statistical test include : Chi square test , T test was used for quantitative variables
3. Graphical presentation includes Bar graph, Pie graph.
4. The level of significance selected for this study was P value equal to or less than 0.05.

3.8 *Ethical considerations*:

The proposal was approved by faculty of public health board then submitted to the post graduate board and approved too. The consent letter was obtained from health authority (head quarter of general administration for health and population).

At the initial interview of each potential subject was informed about the nature, purpose and benefits of the study, and informed that his participation is voluntary.

Chapter four
Results

Table (1): Father educational level in Shendi locality River Nile state.

Educational level	Frequency	Percent
Illiteracy	49	12.8
basic school	77	20.1
intermediate school	67	17.4
Secondary school	125	32.6
University	57	14.8
post graduate	9	2.3
Total	384	100

Table (1): indicates that the educational level of father is higher in the Secondary school level (32.6%) while the post graduate level has a very low one (2.3%) .

Table (2): fathers occupation in Shendi locality River Nile State.

Occupation of father	Frequency	Percent
Farmer	88	22.9
Laborer	137	35.7
Government employee	104	27.1
Un employed	55	14.3
Total	384	100

Table (2): describes occupation of father, the data reveals that (35.7%) of population were laborer and (14.4%) have not specific occupation.

Table (3): The educational level of Mother in Shendi locality River Nile state

educational level	Frequency	Percent
Illiteracy	52	13.5
basic school	89	23.2
intermediate school	66	17.2
Secondary school	126	32.8
University	44	11.5
post graduate	7	1.8
Total	384	100

Table (3): indicates that the educational level of mother is high in the Secondary school level (32.8%) while the post graduate level is very low (1.8%) .

Table (4) : Family income per month in Shendi locality River Nile state.

Family income per month	Frequency	Percent
Less than 500 pound	101	26.3
500 - 1000 pound	209	54.4
Above 1000 pound	74	19.3
Total	384	100

Table (4): Shows the monthly income of families which is varied, the category (500-1000 pound) represent the highest frequency among population, while the category above 1000 has the lowest frequency.

Figure(1): Knowledge of respondents about typhoid fever in Shendi locality River Nile state

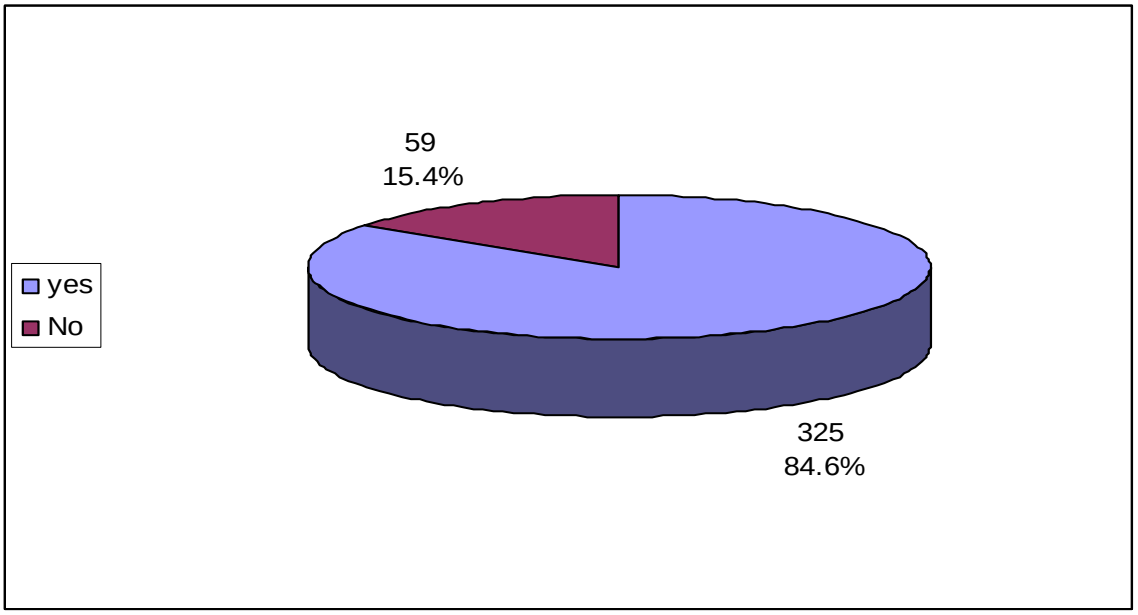


Figure (1): demonstrates knowledge of population about typhoid disease, most of population have knowledge (84.6%).

Table (5): agent factor that cause typhoid fever according to respondents in Shendi locality River Nile state

The agent factor	Frequency	Percent
Bacteria	227	69.8
Virus	76	23.4
Fungi	14	4.3
Other	8	2.5
Total	325	100

Table (5): Shows that the bacteria was represented a high frequency in the study (69.8%), while other (2.5%) suggest that there are other causes like depression.

Table (6): Mode of transmission of typhoid fever according to respondents in Shendi locality River Nile state

The agent factor	Frequency	Percent
food and drinking	230	70.8
Insects	50	15.4
direct from patient to healthy	45	13.8
Total	325	100

Table (6): demonstrates that food and drinking are more tools for transmission of typhoid fever (70.8%),

Table (7): Knowledge of respondents about sign and symptoms of typhoid fever in Shendi locality River Nile state

The agent factor	Frequency	Percent
constant fever	176	41.4
Diarrhea	76	17.9
Constipation	32	7.5
Stomach pain	70	16.5
Headache	51	12
nonproductive cough	20	4.7
Total	425	100

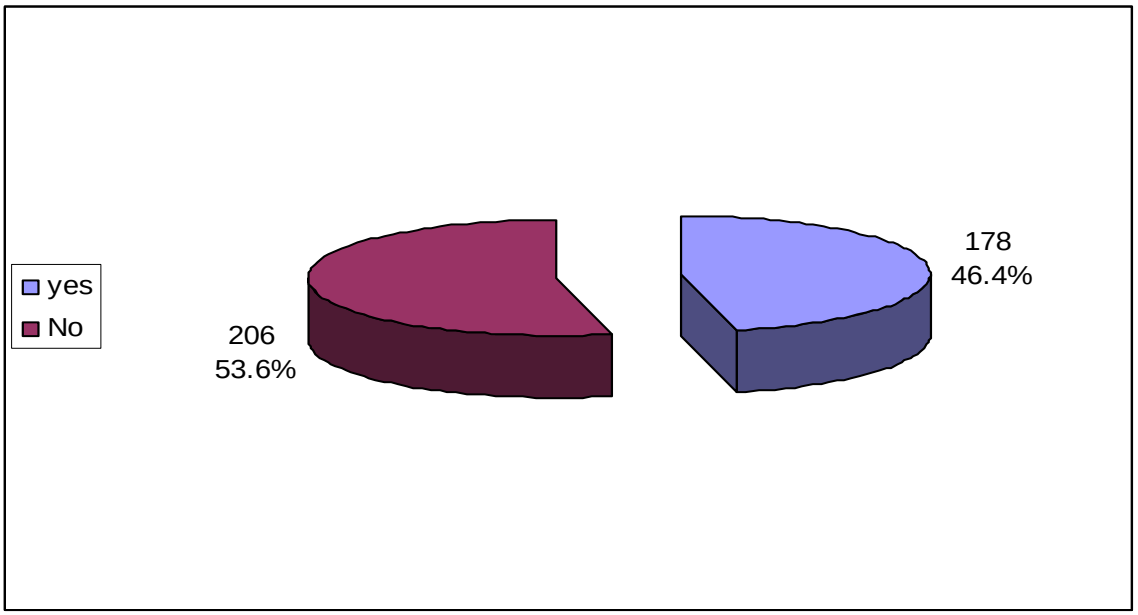
Table: (7): shows the Knowledge of respondents about sign and symptoms, it was revealed that constant fever represent most sign appearance (49.6%)

Table (8): Sources of information about definition, agent factor, sign and symptoms of typhoid fever food in Shendi locality River Nile state.

Sources of information	Frequency	Percent
Television	119	36.6
Radio	96	29.5
Lecture	98	30.2
Reading	12	3.7
Total	325	100

Table (8): Shows the source of information, the study revealed that television is a good medium of a communication (36.6%) as well as Lecture (30.2%).

Figure (2): Distribution of typhoid fever among population in Shendi locality River Nile State.



The study demonstrate that (46.4%) of population have typhoid disease while (53.6%) have not as in figure no.(2).

Table (9): prevalence of typhoid fever among population in administrative units / Shendi locality River Nile State.

Prevalence	distribution in administrative unites							
	Shendi town		Rural		Kaboshia		Total	
	No	%	No	%	No	%	No	%
Present	70	18.3	62	16.1	46	12	**178**	**46.4**
No present	47	12.2	117	30.5	42	10.9	**206**	**53.6**
Total	**117**	**30.5**	**179**	**46.6**	**88**	**22.9**	**384**	**100**

The total prevalence rate of typhoid fever were 46.4% **.** the high rate were showed in shendi town, (18.3%), rural (North and South) (16.1%) and Kaboshia (12%) respectively.

Table (10): Methods of early detection of typhoid fever among patient in Shendi locality River Nile State.

Detection of typhoid fever	**Frequency**	**Percent**
through symptoms	17	9.5
laboratory diagnosis	108	60.7
from physician	53	29.8
Total	178	100

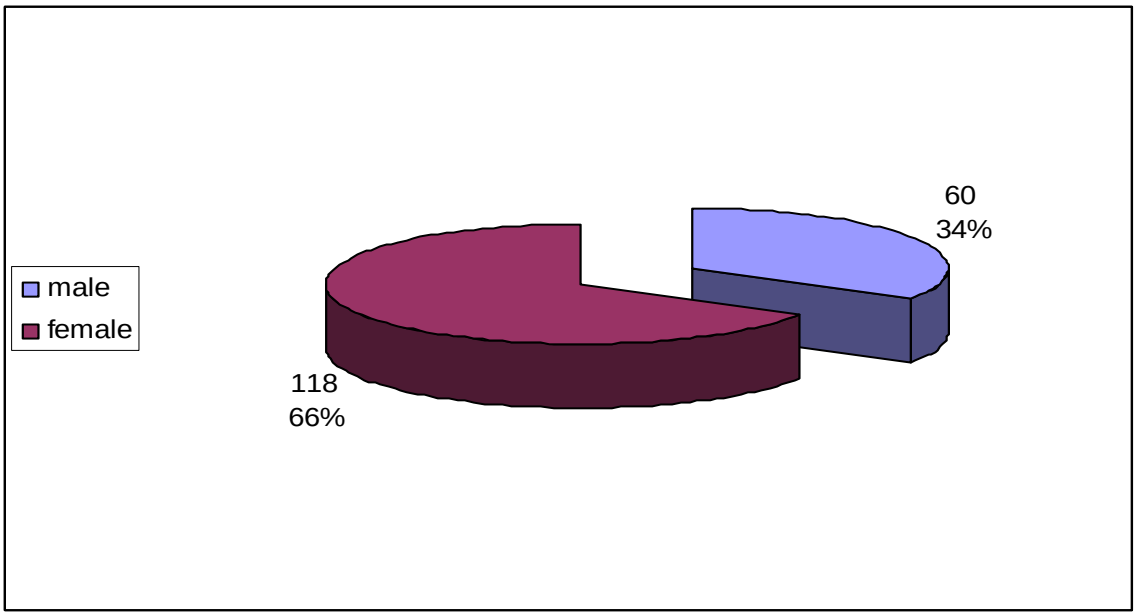
Table (10): Shows the Methods of early detection, the study revealed that laboratory diagnosis is a common methods for early detection (60.7%) .

Table (11): Age distribution among patients of typhoid disease in population of Shendi locality River Nile State.

Ages of patient affected by typhoid disease	Frequency	Percent
less than 10 years	11	6.2
11 -20 years	69	38.8
21 -30 years	49	27.5
Above 30 years	49	27.5
Total	178	100

It can be observed that the age group (11-20 year) represents the common age group of the cases (38.8%), while (less than 10 year) is the least common one as in table (11).

Figure (3): Distribution of gender among patient in Shendi locality River Nile State.



Figure(3): The distribution of typhoid disease in population according to gender, revealed that the majority of them were female (66%).

Table (12): prevalence of typhoid fever through seasons in Shendi locality River Nile State.

Distribution through year	Frequency	Percent
summer	80	44.9
winter	71	39.9
rainy season	27	15.2
Total	178	100

Table: (12): describe the prevalence of typhoid fever through years , it revealed that typhoid is high in summer (44.9%) while rainy season was lowest (15.2%).

Table (13): Type of latrine used among population in Shendi locality River Nile State.

Type of latrine	Frequency	Percent
Bore hole latrine	269	70
pit latrine	49	12.8
septic tank	66	17.2
Total	384	100

Table (13): demonstrate that the Bore hole latrine represent high utilization 70% while pit latrine is lowest one.

Figure (4): Hand washing by soap after defecation and urination among respondent in Shendi locality River Nile State.

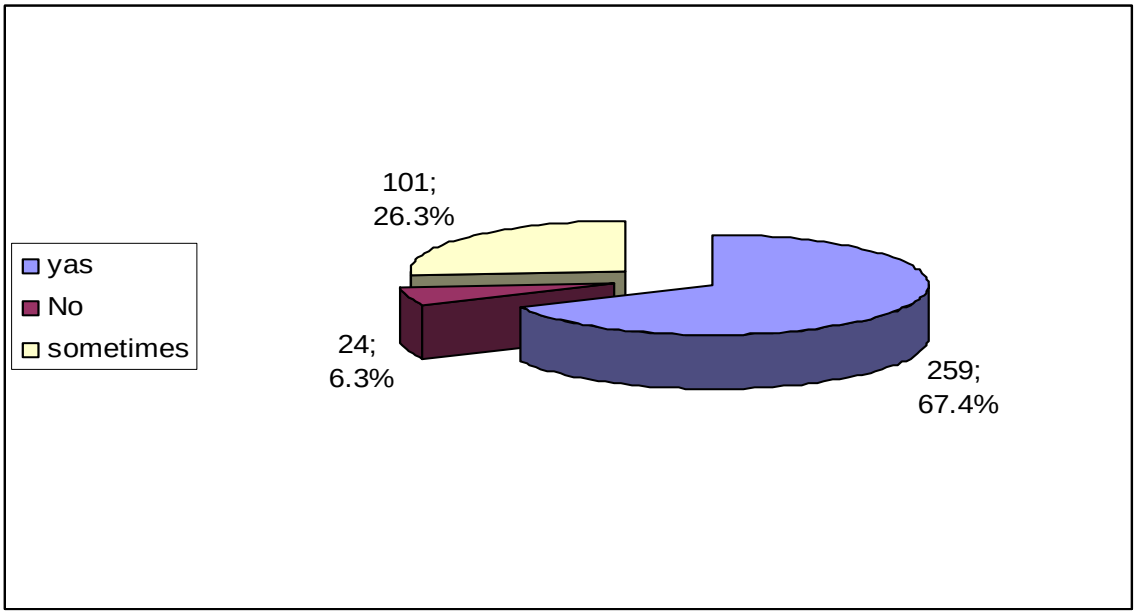


Figure (4): show most population (67.4%) wash their hand with soap after visit latrine and only (6.3%) of them they can not wash.

Table (14) : Sources of drinking water in Shendi locality River Nile State.

Sources of drinking water	Frequency	percent
deep bore wells	299	77.9
Surface wells	36	9.4
Untreated water from River Nile	49	12.8
Total	384	100

It can be observed that the deep bore wells represent the common source of drinking water used (77.9%), while surface wells were the least common one (9.4%) as in table (14).

Table (15): Preservation tools of drinking water in Shendi locality River Nile State.

preservation tools	Frequency	percent
Refrigerator	168	43.8
Bottles	96	25
Other	120	31.2
Total	384	100

Table (15): describe that refrigerator represent a common tool of for preservation of drinking water (43.8%).

Table (16): Food preparation for eating among respondent in Shendi locality River Nile State.

Food preparation for eating	Frequency	percent
prepared in house	343	89.3
Ready to eat food	39	10.2
Uncooked food	2	0.5
Total	384	100

Table (16): shows most of respondent (89.3%) they prepared food at their home, and only (10.2%) gating ready to eat food.

Figure (5): Food heating before meal among respondent in Shendi locality River Nile State.

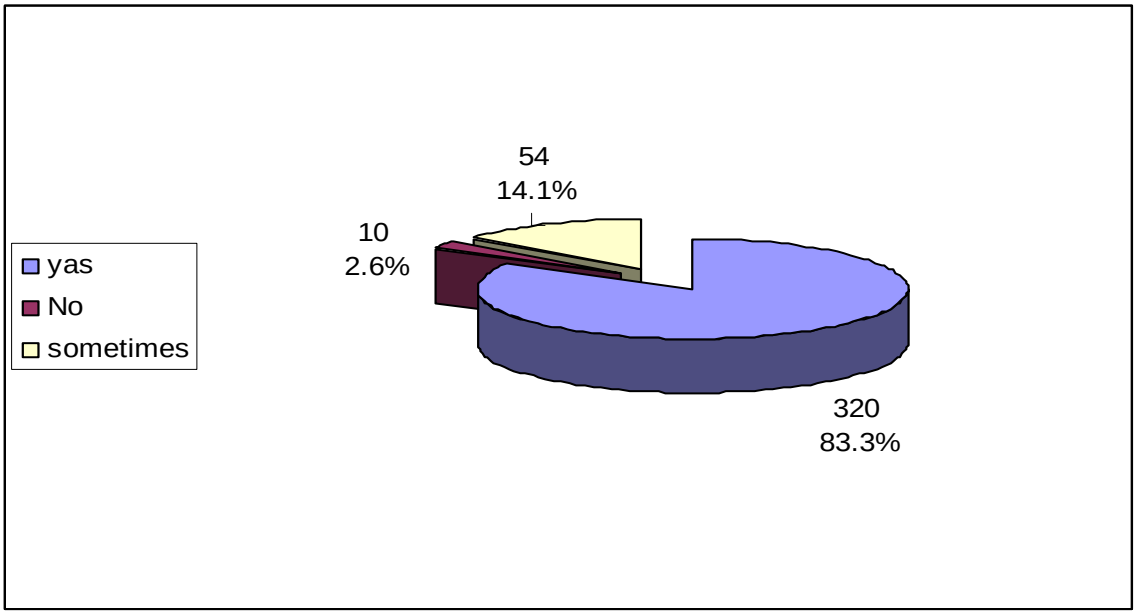


Figure (5): demonstrate that the majority of respondent are heating food before meal (83.3%) while (2.6%) they can not heat food before meal.

Table (17): prevention measure that eliminate the typhoid fever among respondent in Shendi locality River Nile State.

prevention measure	Frequency	percent
Heating food	138	28
Purification of drinking water	99	20.1
Improvement of basic sanitation	132	26.8
Personal hygiene	80	16.2
Immunization	44	8.9
Total	493	100

Table (17): shows the heating food represent highest measure used for elimination of typhoid fever (27.6%) while immunization is lowers one.

Table (18): Percent type of latrine and prevalence of typhoid fever in population / Shendi locality. N= (384)

Prevalence of typhoid	Type of latrine			Total	P. value
	Bore hole latrine	Pit latrine	Septic tank		
Yes	37.7%	3.9%	4.7%	46.3%	0.000
No	32.3%	8.9%	12.5%	53.7%	
Total	70%	12.8%	17.2%	100%	

P<0.05 (chi-square test).

Table (19): correlation between types of latrines and typhoid fever in Shendi locality.

	Prevalence of typhoid disease (N=384)	Type of latrines (N=384)
Prevalence of typhoid disease	1	,223**
Type of latrines	,223**	1

There are strong correlation between type of latrine and distribution of typhoid disease in shendi locality.

Table (20): Percent knowledge of typhoid fever and prevalence of typhoid fever among population / Shendi locality. N= (384)

knowledge of typhoid fever	Prevalence of typhoid		Total	P. value
	yes	No		
Yes	41.9%	42.7%	84.7%	0.002
No	4.5%	10.9%	15.4%	
Total	46.4%	53.6%	100%	

P<0.05 (chi-square test).

Table (21): correlation between Prevalence of typhoid disease and Awareness in Shendi locality.

	Prevalence of typhoid disease (N=384)	Awareness (N=384)
Prevalence of typhoid disease	1	,150**
Awareness	,150**	1

Correlation is significant at 0,01 level between awareness and prevalence of typhoid.

Table (22): Percent knowledge of typhoid fever and hand washing hand by sap after defecation among population / Shendi locality. N= (384)

knowledge of typhoid fever	Hand washing by sap			Total	P. value
	yes	No	sometimes		
Yes	59.5%	5.1%	20.1%	84.7%	0.005
No	8%	1%	6.3%	15.3%	
Total	67.5%	6.1%	26.4%	100%	

P<0.05 (chi-square test).

Table (23): correlation between Awareness and hand washing in Shendi locality.

	Awareness (N=384)	hand washing (N=384)
Awareness	1	,142**
hand washing	,142**	1

Correlation is significant at 0,01 level between awareness and hand washing according to population in Shendi locality.

Chapter five

Discussion

Typhoid fever continues to be a major public health problem in many developing countries and still remains a major endemic public health problem in Sudan especially in areas where healthcare facilities being limited and peoples are illiterate, living in unhygienic surroundings, drink raw-water from tube- wells and not habitual of hand-washing from toilet by soap.

The study demonstrated that the educational level of father is higher in the Secondary school level (32.6%) while the post graduate level has a very low one (2.3%), this may be due to the lack of population concern about education as in table (1).

The study showed that the knowledge of population about typhoid fever disease is very high, that most of population have knowledge (84.6%), (69.8%) of population thought that the causative agent of typhoid disease is bacteria, and (70.8%) of them suggest that food and contaminated drinking water are the most common tools for transmission of typhoid fever(Webber ,2005). He was Saied the main method of transmission is water, contaminated by faecal material from a carrier. (36%) of this information was obtained through television as a communication tool of health education.

Typhoid fever is an acute systemic infection caused by the bacterium Salmonella enterica serovar Typhi. The study demonstrate that (46.4%) of population have typhoid fever while (53.6%) have not and most of them they detected disease through laboratory methods technique (60.7%), as in table (9). This indicate to lake of sanitation and availability of factor that contribute in predispose of typhoid fever such as, typhoid organisms have

persisted in canned meat cooled in infected water thousands of miles away from the outbreak, Many well-known outbreaks have been due to ice cream, the movement of carriers can be followed from the outbreaks they produce as they travel around.

Occurrence and distribution in most tropical areas, the disease is endemic with seasonal outbreaks. Water is probably the main vehicle of transmission, but may be more related to the gathering of people at scarce water sources (as occurs in the dry season), rather than epidemics occurring with the early rains. The study showed that the high prevalence rate were showed in shendi town, (18.3%), rural (North and South) (16.1%) and Kaboshia (12%) respectively, this indicate to poor sanitation and fails of diagnostic which led to increase of typhoid fever carrier.

The study showed that the age group (11-20 year) represents the common age group of the cases (38.8%), while (less than 10 year) is the least common one, this agreed with park 2005. which said Typhoid fever may occur at any age highest incidence of this disease occurs in the 5 up to 19 year of age. This age characterized by high movement.

More cases are reported among male than female, probably as a result of increased exposure to infection but carrier rate is more than in female. The study showed the majority of cases were female (64.6%).as in figure (3). This may be due to close contact of female with contaminated water and food through preparing, cooking, and organizing.

Enteric fever is observed all through the year the peak incidence is reported during July-September on summer time. This period coincides with the rainy season and an increase fly population, the study revealed that

typhoid is high in summer (44.9%) while rainy season was lowest (15.2%) this is very significant because food being a bad conductor of heat provides shelter to the bacilli which may multiply and survive for sometime in food.(park, 2005)

Adequate sanitation including drinking water and human excreta and include both 'hard ware' (sanitation technology, such as toilets and hygienic latrines) and 'soft ware' (hygiene, such as hand washing with soap).the study demonstrated that the Bore hole latrine represent high utilization 70% while pit latrine is lowest one, and there are strong correlation between types of latrines and typhoid fever as in table (12) .

The study showed that most population (67.4%) wash their hand with soap after visit latrine and only (6.3%) of them they can not wash. This reveled correlation is significant (P= 0,01) between awareness and hand washing as in figure (4). This confirmed cross contamination occur through preparation of gathering water from the lake after rain in the rural.

Availability and portability of drinkable water is still a Luxury in most developing nations of the world. The WHO estimated that 1.2 billion of the world's population Lack access to potable water at the peak of the dry season, especially in developing countries, water is often sourced from various doubtful places most of which are contaminated by human waste. (Park, 2010). The study observed that the deep bore wells represent the common source of drinking water used (77.9%), while surface wells were the least common one (9.4%). And refrigerator represent a common tool of preservation of drinking water (43.8%). As in table (14).

Contaminated food is another important vehicle for typhoid fever transmission. Appropriate food handling and processing is paramount. The

study showed that most of respondent (89.3%) prepared food at their home, and only (10.2%) gating ready to eat food as in table (16).

Eating only cooked and still hot food or re-heating it. During outbreaks, food safety inspections must be reinforced in restaurants and for Street food vendor's activities. And Pasteurilize or boil milk, or exclude milk supply and other foods suspected on epidemiological evidence until safety is assured is a basic hygiene measures must be implemented or reinforced during epidemics. The study showed that the heating of food represent the highest measure used for elimination of typhoid fever (27.6%) while immunization is lowers one this agreed with park 2010.

Conclusion

From the study we conclude the following:

- 46.4% of population have typhoid disease while (53.6%) have not.
- 84.6% of population have knowledge about typhoid fever disease in shendi locality river Nile state.
- The study observed that the age group (11-20 year) represents the common age group of the cases (38.8%), while (less than 10 year) is the least common one.
- Deep bore wells represent the common source of drinking water used (77.9%), while surface wells were the least common one (9.4%)
- The Bore hole latrine represent high utilization 70% while pit latrine is lowest one this indicate poor environmental sanitation.
- Eating only cooked food or re-heating represent common method of control measures of typhoid fever disease.

Recommendations

From the finding of the present study the following recommendations could be suggested:

- The ministry of health should take action for regular monitoring of endemic disease through surveillance to avoid prevalence of typhoid fever.
- The locality of shendi must to renewed efforts to reinforce focus on sanitation, water purification and solid waste management.
- The ministry of heath should take action through intervention strategies, intensive community health education on typhoid disease control protocol.
- The university of Shendi should participate through work shops , lectures , and health programs to educate population about importance of personal hygiene and sanitation.
- The university of Shendi should conduct further studies on typhoid fever with focus on modern technique of diagnostic and environmental factors managment.

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Appendix 1

بسم الله الرحمن الرحيم

University of Shendi

Faculty of Graduate Studies and Scientific Research

Questionnaire to identify the prevalence of Typhoid fever among population in Shendi locality-River Nile state- Sudan.(October 2013- May 2014)

* Questionnaire No:……..……...

1- Name of household……..…….

2- father educational level:

a- illiteracy ( ) b- basic school ( ) c- intermediate school ( )

d- Secondary school ( ) e- university ( ) f- post graduate ( )

3- The father occupation:

a- farmer ( ) b- Employee ( ) c- provisional ( ) d- other ( )

4- Mother educational level:

a- illiteracy ( ) b- basic school ( ) c- intermediate school ( )

d- Secondary school ( ) e- university ( ) f- post graduate ( )

5- Monthly income:

a- less than 500 pounds ( ) b- 501-1000 ( ) c- above 1000 ( )

6- family size:

a- male ( ) b- female ( )

7- do you know typhoid fever?

a-yes ( ) b- no ( )

8- If yes what is agent factor :

a-bacteria ( ) b- virus ( ) c- fungi ( ) d- other ( )

9- Typhoid fever transmitted by:

a- ingestion of food and water ( ) b- insects ( ) direct from patient to healthy ( )

10-What are the symptoms:

a- constant fever ( ) b- diarrhea ( ) c- constipation ( )

d- Stomach pain ( ) e- headache ( ) f- nonproductive cough ( )

11- from where you get this information?

a-television ( ) b- radio ( ) c- lectures ( ) d- other ( )

12- Is there any one infected with typhoid fever?

a- yes ( ) b- No ( )

13- If yes how patient know typhoid fever?

a- through symptoms ( ) laboratory diagnosis ( )from physician ( )

14- If yes what the age of patient:

a- less than 10 years ( ) b- 11-20 years ( ) c- 21-30years ( )

d- above than 30 years ( )

15- Gender of patient:

a- Male ( ) b- female ( )

16- The typhoid fever occurs in season of:

a- summer ( ) b- winter ( ) c- rainy season ( )

17- Type of latrines:

a-Bore hole latrine ( ) b- pit latrine ( ) c- septic tank ( ) d- others ( )

18- Is the hand washing by sop after defecation and urination?

a- yes ( ) b- no ( ) c- sometimes ( )

19- Source of water:

a- river Nile ( ) b- well ( ) c- network ( )

20- Preservation of water:

a- Refrigerator ( ) b- Bottles ( ) c- Other ( )

21- how to deal with vegetables before eating?

a- eating directly ( ) b- washed by tab water ( ) c- washed by constant water ( )

22- The preparation of food is:

a- prepared in house ( ) b- Ready to eat food ( ) c- Uncooked food ( )

23- Is the food heating before meal?

a- yes ( ) b- no ( ) c- some times ( )

24- What the prevention measure that eliminate the typhoid fever:

a- Heating food ( ) b- Purification of drinking water ( )

c- Improvement of basic sanitation ( ) d – Personal hygiene ( )

e- Immunization ( ) f- other ( )

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ملحق رقم2

بسم الله الرحمن الرحيم
جامعة شندي
كلية الدراسات العليا والبحث العلمي

إستبيان للتعرف علي إنتشار حمي التيفويد لدي المجتمع بمحلية شندي- ولاية نهر النيل في الفترة من (اكتوبر 2013 إلي مايو 2014م).

* رقم الإستبيان.....

1- إسم الحي أو المربع.....

3- المستوي التعليمي للأب:

أ- أمي ( ) ب- أساس ( ) ج- متوسطة ( ) د- ثانوي ( ) ه- جامعي ( )
و- فوق الجامعي ( )

4- مهنة رب الأسرة:

أ- مزارع ( ) ب- عامل ( ) ج- موظف ( ) د- أخري حد.....

5- المستوي التعليمي للأم:

أ- أمي ( ) ب- أساس ( ) ج- متوسطة ( ) د- ثانوي ( ) ه- جامعي ( )
و- فوق الجامعي ( )

6- الدخل الشهري :

أ- أقل من500 ( ) ب- 501-1000 ( ) ج- أكثر من 1000 ( )

7- عدد أفراد الأسرة.

أ- ذكور ( ) ب- إناث ( )

7- هل تعرف مرض التيفويد؟

أ/ نعم ( ) ب/ لا ( )

8- إا كانت الإجابة نعم ما هوالمسبب:

أ/ بكتيريا ( ) ب/ فيروسات ( ) ج/ فطريات ( ) د/أخري حدد ( )

9- ينتقل هذا المرض عن طريق:

أ/ الأكل والشرب ( ) ب/ الحشرات ( ) ج/ مباشر من المريض للسليم ( )

10 ما هي أعراض المرض:

أ- حمي ( ) ب- إسهال ( ) ج- إمساك ( ) د- ألام في البطن ( )
ه- صداع ( ) و- إنخفاض ضربات القلب ( )

11- من اين تلقيت هذه المعلومات:

أ/ التلفزيون ( ) ب/ الراديو ( ) ج/ المحاضرات والندوات ( ) د/ أخري حدد ( )

12- هل هنالك اي شخص من الأسرة اصيب بحمي التيفويد ؟

أ- نعم ( ) ب- لا ( )

13- كيف تعرف المريض علي حمي التيفويد ؟

أ- من الأعراض ( ) ب- من الفحص المختبري ( ) ج- من الطبيب ( )

14- إذا كانت الإجابة نعم كم عمر المريض؟

أ- أقل من 10 سنوات ( ) ب- من11 --20 سنة ( ) ج- من 21- 30سنة ( )
د- أكثر من 30 سنة ( )

15- جنس المريض:

أ- ذكر ( ) ب- أنثي ( )

16- الأصابة بحمي التيفويد حدثت في فصل:

أ- الصيف ( ) ب- الشتاء ( ) ج- الخريف ( )

17- نوع المرحاض:

أ- حفرة العادي ( ) ب- مرحاض المهواء المحسن ( ) ج- مرحاض السايفون ( )

18- هل يتم غسل الأيادي بالماء والصابون بعد الخروج من الحمام؟

أ- نعم ( ) ب- لا ( ) ج- أحيانا ( )

19- ما هو مصدر مياه الشرب:

أ- نهر النيل ( ) ب- الآبار( ) ج – من الشبكة ( ) د- أخري حدد.....

20- أين تحفظ مياه الشرب:

أ- الثلاجات ( ) ب- الخزانات ( ) ج- البراميل ( ) د- الأزيار ( ) ه- أخري حدد .....

21- كيف ينم التعامل مع الخضروات قبل الأكل؟

أ- يتم أكلها مباشرة ( ) ب- تغسل بالماء الجاري ( ) ج- تغسل بالماء الثابت ( )

22- أين يتم تحضير الطعام:

أ- في المنزل ( ) ب- أطعمة جاهزة ( ) ج- أطعمة غير مطهية ( )

23- هل يتم تسخين الطعام قبل تناول الوجبة؟

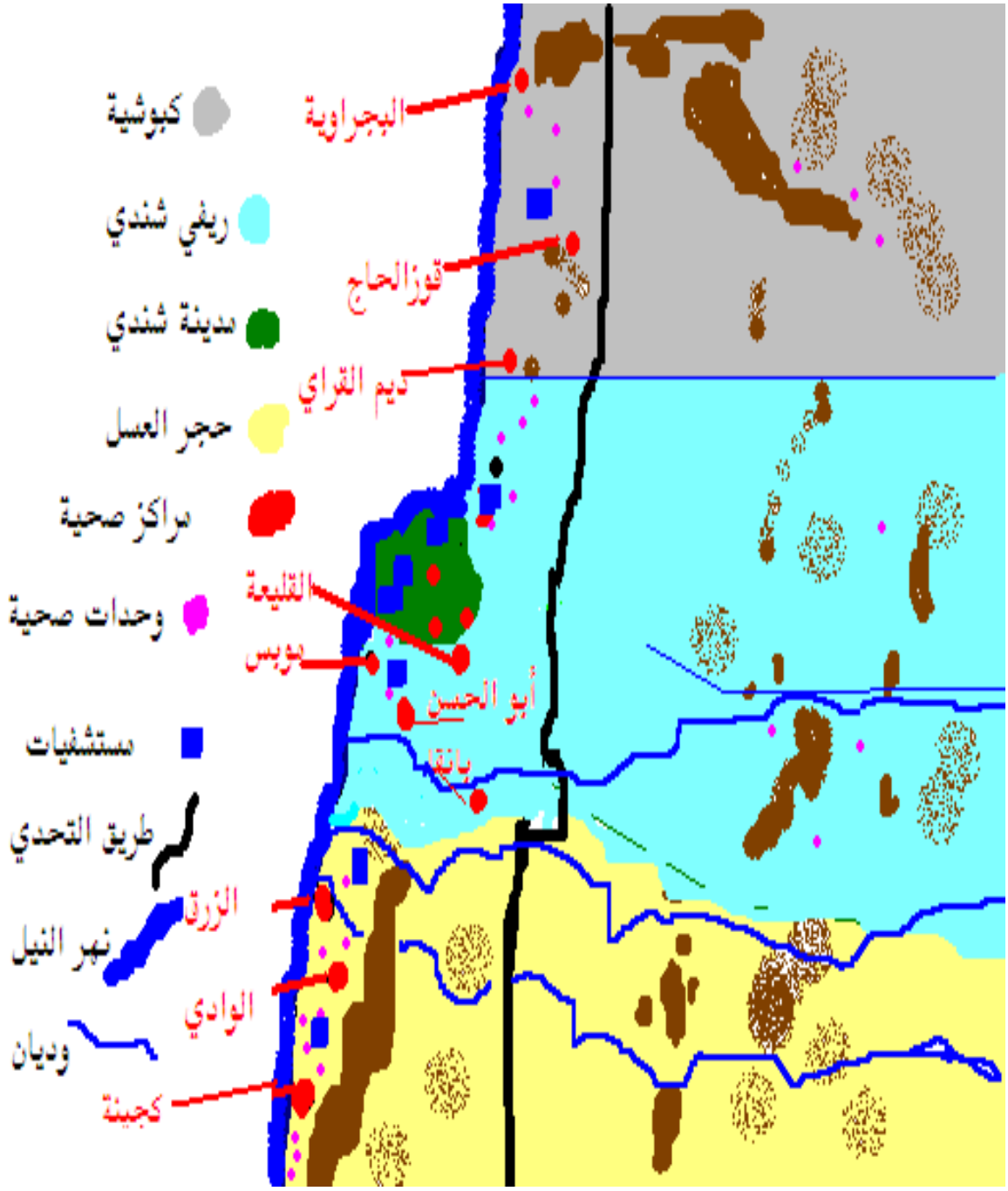
أ- نعم ( ) ب- لا ( ) ج- أحيانا ( )

24- ماهي إجراءات الوقاية للحد من الإصابة بحمي التيفويد:

أ- تسخين الطعام ( ) ب- تنقية مياه الشرب ( ) ج- تحسين الإصحاح ( )

د- الصحة الشخصية ( ) ه- التحصين ( ) و- أخري حدد.....

Appendix 4: Map of Shendi locality (study area):



The total prevalence rate of typhoid fever were 46.4% **.** the high rate was showed in shendi town, (18.3%), rural (North and South) (16.1%) and Kaboshia, (12%) respectively.