UNIVERSITI PUTRA MALAYSIA

EPIDEMIOLOGY OF TYPHOID FEVER IN GOMBE METROPOLITAN AREA OF GOMBE STATE, NIGERIA

UMAR ABDULLAHI TAWFIQ

FS 2022 32

EPIDEMIOLOGY OF TYPHOID FEVER IN GOMBE METROPOLITAN AREA OF GOMBE STATE, NIGERIA

By

UMAR ABDULLAHI TAWFIQ

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

June 2021

DEDICATION

This work is dedicated to my late mother Hajiya Hauwa'u Jummai El-Nafate Kawuwa, an epitome of knowledge, integrity, love, kindness, justice, and wisdom.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

EPIDEMIOLOGY OF TYPHOID FEVER IN GOMBE METROPOLITAN AREA OF GOMBE STATE, NIGERIA

By

UMAR ABDULLAHI TAWFIQ

June 2021

Chairman : Associate Professor Shamarina binti Shohaimi, PhD
Faculty : Science

Typhoid fever is a human-restricted acute systemic and life-threatening disease which is caused by ingesting food or water contaminated with *Salmonella typhi.* This disease affects all genders and all ages but is more prevalent in developing countries especially those of Africa and Asia. Invasive *Salmonella* infections are responsible for a significant burden of morbidity and mortality with incidences of between 11 to 21 million infections and 128,000 to 161,000 mortalities globally, with 7.2million cases annually in Africa alone. In Nigeria, proper epidemiological data regarding typhoid fever is scanty and unavailable in most of the States like Gombe where the disease has been occurring for a long time without hinderance. In Gombe, typhoid fever occurrence is believed to be aggravated by absence of epidemiological data for health policy decisions and design of health interventions, lack of constant access to safe drinking water, poor hygiene, and inefficiency of environmental sanitation efforts. Thus, the research questions here include: Is there a significant association between host-associated risk factors and the occurrence/recurrence of typhoid fever in Gombe metropolis? And Is there a significant association between weather conditions and the incidence of typhoid in Gombe metropolis? Hence the aim of the research was the epidemiology of typhoid in Gombe metropolitan area of Gombe State, while the specific objectives included determination of incidence and recurrence, host-associated risk factors, effect of weather on incidence, and overall counts of typhoid occurrences based on gender, age, and location. Incidence from 2015 to 2019 and recurrence for 2019 were determined using incidence proportions which were calculated from hospital records. A questionnaire was designed, validated, and used to obtain data for determining host-associated risk factors. Simple random sampling was used to collect information from 663 consenting respondents and the obtained data were analysed using Chi-square test for association and binomial logistic regression to obtain risk factors for typhoid occurrence and recurrence, respectively. Weather data from 2015 to 2019 were obtained from Nigeria meteorological agency, fitted to the hospital data, and analysed using Poisson regression to determine their effects on the incidence of

the disease. Sum of counts were extracted from the hospital records based on gender, age, and location. Results from the study revealed that both typhoid incidence and recurrence were high in the study area because the number of cases were all greater than 100 per 100,000 persons per year for all the years included in the study. The questionnaire was easy to read and understand based on the Flesch reading ease score of 70.8 and Flesch-Kincaid grade level test value of 6.0, had good content validity based on the overall Fleiss' (Multi rater) kappa value of 0.623, had good construct validity and internal consistency based on Cronbach's alpha and McDonald's omega values of 0.720 and 0.703 respectively, and had good test-retest reliability based on ICC value of 0.736 (99% CI = 0.533 to 0.878). Typhoid incidence was significantly associated with the variables for vaccination ($\chi^2 = 39.729$, $p < 0.01$), house help ($\chi^2 = 16.909$, $p < 0.01$), typhoid patient at home ($\chi^2 = 13.393$, $p < 0.01$), hand washing before handling food ($\chi^2 = 22.856$, $p < 0.01$), consuming iced/frozen items ($\chi^2 = 16.805$, $p < 0.01$), boiling drinking water ($\chi^2 = 49.633$, $p < 0.01$), and eating commercial foods/drinks ($\chi^2 = 27.864$, $p < 0.01$). Typhoid recurrence was significantly predicted by not sure of been vaccinated (OR = 2.962, CI = 1.290 to 6.802, $p < 0.01$), not having another typhoid patient at home (OR = 1.799, CI = 0.998 to 3.244, $p < 0.01$), and drinking unboiled water sometimes (OR = 2.130, CI = 1.023 to 4.434, $p < 0.01$). Increases in typhoid cases were also significantly predicted by increase of 1°C in minimum temperature (OR = 1.080, CI = 1.048 to 1.114, $p < 0.01$) and increase of 5% in humidity (OR = 1.041, CI = 1.031 to 1.051, $p < 0.01$). Females, individuals aged 21 to 30, and more populated areas, had the highest occurrences of the disease. At the end of this study, it was established that the designed/validated questionnaire is easy to read and understand, has moderate reliability, and good validity, hence can be used for collecting data to identify typhoid risk factors in the study area. It was also discovered that increase in typhoid incidences are related to elevations in temperature and humidity, and to some host-associated factors. It is thus believed that these findings will be invaluable to identification of populations at high risk of the disease, design of fitting prevention/control efforts, and guiding Government's decisions on resource prioritization and efficient allocation of funds for prevention and control efforts against the disease.

Abstrak tesis yang Dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

EPIDEMIOLOGI TIFOID DI KAWASAN METROPOLITAN GOMBE, NEGERI GOMBE, NIGERIA

Oleh

UMAR ABDULLAHI TAWFIQ

Jun 2021

Pengerusi : Profesor Madya Shamarina binti Shohaimi, PhD
Fakulti : Sains

Tifoid yang penyakit sistemik akut dan penyakit yang mengancam nyawa manusia yang disebabkan oleh pengambilan makanan atau air yang tercemar dengan *Salmonella typhi*. Penyakit ini menyerang semua jantina dan semua peringkat usia tetapi lebih banyak berlaku di negara-negara membangun terutamanya di Afrika dan Asia. Jangkitan Salmonella invasif bertanggung jawab atas beban morbiditi dan kematian yang tinggi dengan kejadian antara 11 hingga 21 juta jangkitan dan 128,000 hingga 161,000 kematian di seluruh dunia, dengan 7.2 juta kes setiap tahun di Afrika sahaja. Di Nigeria, data epidemiologi yang tepat mengenai tifoid masih sedikit dan tidak tersedia di kebanyakan Negara seperti Gombe di mana penyakit ini lama terjadi tanpa halangan. Di Gombe, kejadian tifoid diyakini diperburuk oleh ketiadaan data epidemiologi untuk keputusan kebijakan kesihatan dan rancangan intervensi kesihatan, kekurangan akses berterusan ke air minum yang selamat, kebersihan yang buruk, dan ketidakcekapan usaha sanitasi persekitaran. Oleh itu, persoalan kajian di sini merangkumi: Adakah terdapat hubungan yang signifikan antara faktor risiko yang berkaitan dengan inang dan berlakunya/berulang tifoid di metropolis Gombe? Dan Adakah hubungan yang signifikan antara keadaan cuaca dan kejadian tifoid di metropolis Gombe? Oleh itu, tujuan penyelidikan yang epidemiologi tifoid di daerah metropolitan Gombe, sementara objektif khusus termasuk penentuan kejadian dan kambuhan, faktor risiko yang berkaitan dengan host, kesan cuaca terhadap kejadian, dan jumlah keseluruhan kejadian tifoid berdasarkan jantina, umur, dan lokasi. Kejadian dari 2015 hingga 2019 dan berulang untuk 2019 ditentukan menggunakan perkadaran kejadian yang dikira dari rekod hospital. Soal selidik dirancang, disahkan, dan digunakan untuk mendapatkan data untuk menentukan faktor risiko yang berkaitan dengan inang. Pensampelan rawak sederhana digunakan untuk mengumpulkan maklumat daripada 663 responden yang bersetuju dan data yang diperoleh dianalisis menggunakan ujian Chi square untuk hubungan dan regresi logistik binomial untuk mendapatkan faktor risiko kejadian dan berulang tifoid. Data cuaca dari 2015 hingga 2019 diperoleh dari agensi meteorologi Nigeria, dilengkapi data

rumah sakit, dan dianalisis menggunakan regresi Poisson untuk menentukan kesannya terhadap kejadian penyakit ini. Jumlah penghitungan diambil dari catatan hospital berdasarkan jantina, usia, dan lokasi. Hasil kajian menunjukkan bahawa kejadian dan kepulangan tifoid tinggi di kawasan kajian kerana jumlah kes semuanya lebih besar daripada 100 per 100,000 orang per tahun untuk semua tahun yang termasuk dalam kajian ini. Soal selidik ini senang dibaca dan difahami berdasarkan skor kemudahan membaca Flesch 70.8 dan nilai ujian tahap Flesch Kincaid 6.0, mempunyai kesahan kandungan yang baik berdasarkan keseluruhan nilai kappa Fleiss (Multi rater) 0.623, mempunyai kesahan konstruk yang baik dan konsistensi dalaman berdasarkan nilai omega Cronbach's alpha dan McDonald masing-masing 0.720 dan 0.703, dan mempunyai kebolehpercayaan ujian semula yang baik berdasarkan nilai ICC 0.736 (99% CI = 0.533 hingga 0.878). Kejadian tifoid dikaitkan secara signifikan dengan pemboleh ubah vaksinasi ($\chi2 = 39.729$, $p < 0.01$), bantuan rumah ($\chi2 = 16.909$, $p < 0.01$), pesakit tifoid di rumah ($\chi2 = 13.393$, $p < 0.01$), mencuci tangan sebelum mengendalikan makanan ($\chi2 = 22.856$, $p < 0.01$), memakan barang ais / beku ($\chi2 = 16.805$, $p < 0.01$), air minuman mendidih ($\chi2 = 49.633$, $p < 0.01$), dan makan makanan / minuman komersial ($\chi2 = 27.864$, $p < 0.01$). Kambuhan tifoid diramalkan dengan ketara kerana tidak pasti divaksin (OR = 2.962, CI = 1.290 hingga 6.802, $p < 0.01$), tidak mempunyai pesakit tifoid lain di rumah (OR = 1.799, CI = 0.998 hingga 3.244, p kadang-kadang air tidak direbus (OR = 2.130, CI = 1.023 hingga 4.434, $p < 0.01$). Peningkatan kes tifoid juga diramalkan secara signifikan dengan kenaikan suhu minimum 1°C (OR = 1.080, CI = 1.048 hingga 1.114, $p < 0.01$) dan peningkatan kelembapan 5% (OR = 1.041, CI = 1.031 hingga 1.051, $p < 0.01$). Wanita, individu berusia 21 hingga 30 tahun, dan lebih banyak penduduknya, mempunyai penyakit yang paling tinggi. Pada akhir kajian ini, didapati bahawa kuesioner yang dirancang/disahkan senang dibaca dan difahami, mempunyai kebolehpercayaan yang sederhana, dan kesahan yang baik, oleh itu dapat digunakan untuk mengumpulkan data untuk mengenal pasti faktor risiko tifoid di kawasan kajian. Juga ditemukan bahawa peningkatan kejadian tifoid berkaitan dengan peningkatan suhu dan kelembapan, dan dengan beberapa faktor yang berkaitan dengan inang. Oleh itu, dipercayai bahawa penemuan ini akan sangat berharga untuk mengenal pasti populasi yang berisiko tinggi terhadap penyakit ini, merancang upaya pencegahan / pengendalian yang sesuai, dan membimbing keputusan Pemerintah mengenai keutamaan sumber daya dan peruntukan dana yang efisien untuk usaha pencegahan dan pengawalan terhadap penyakit ini.

ACKNOWLEDGEMENTS

Firstly, I hereby express my sincere appreciation to Assoc. Prof. Dr Shamarina Shohaimi, my Supervisor/Adviser, for her guidance, kindness, patience, and the invaluable knowledge I gained from her, which enabled me to accomplish this study. I also thank Prof. Dr Syafinaz Amin Nordin (Co-Supervisor) and Dr Mohd Noor Hisham Mohd Nadzir (Co-Supervisor) for their tremendous patience, understanding, and contribution to this study. My sincere gratitude also to the rest of the thesis committee for their various endeavours towards the completion of this study.

The following are also well-appreciated for their efforts towards the success of this study: Alh. Umar Bappah (Father, PS MOE Gombe, ret.) for his support and efforts during the research, especially during the ethical clearance process, Prof. Sani Mashi (DG NIMET) for providing the weather data used in this study, Alh. Adamu Bello Wambai (UniAbuja) for his efforts towards ensuring safe delivery of the weather data, Dr Manga M. (FMC Gombe) for his efforts during the questionnaire content validation, Mal. Hamidu U. Puma, Mal. Umar Manga, Haruna Harunfat, Anas Rasheed Adams, and various others whose names are too numerous to mention, for their assistance during the data collection for this study. I also sincerely appreciate and thank my beloved wife, Saratu and our kids Hauwa'u and Ahmad for their patience, support, and encouragement throughout my research.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Shamarina binti Shohaimi, PhD
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Syafinaz binti Amin Nordin, MBchB, MPath, MHEd
Professor
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
(Member)

Mohd Noor Hisham bin Mohd Nadzir, PhD
Senior Lecturer
Faculty of Science
Universiti Putra Malaysia
(Member)

ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 8 September 2022

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision.
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____
Name of Chairman of Supervisory Committee: Associate Professor Dr. Shamarina binti Shohaimi

Signature: _____
Name of Member of Supervisory Committee: Dr. Mohd Noor Hisham bin Mohd Nadzir

Signature: _____
Name of Member of Supervisory Committee: Professor Dr. Syafinaz binti Amin Nordin

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CDC	Centres for Disease Control and Prevention
CI	Confidence interval
DALYs	Disability-Adjusted Life-Years
DG	Director-General
DRC	Democratic Republic of Congo
EFA	Exploratory Factor Analysis
ELISA	Enzyme-Linked Immunosorbent Assay
ESBL	Extended Spectrum Beta Lactamase
FMC	Federal Medical Centre
GMA	Gombe Metropolitan Area
GSU	Gombe State University
ICC	Intraclass Correlation Coefficient
KMO	Kaiser-Meyer-Olkin
LGA	Local Government Area
LMICs	Low- and Middle-Income Countries
MDR	Multi-Drug Resistant
MLST	Multi-Locus Sequence Typing
MOE	Ministry of Education
NA	Not Available
ND	Non-Determinable
NIMET	Nigeria Meteorological Agency
NPC	Nigeria Population Commission
PHC	Primary Health Care
SD	Standard Deviation

SE	Standard Error
TCV	Typhoid Conjugate Vaccine
TSM	Trimethoprim-Sulfamethoxazole
TT	Typhoid toxoid
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
XDR	Extensively Drug-Resistant

CHAPTER 1

INTRODUCTION

1.1 Background of The Study

Typhoid fever has become a serious health problem that needs urgent and long-lasting interventions by health authorities because it is one of the major bacterial disease infecting people, especially in the sub-Saharan Africa region, where its morbidity and mortality rates are high (Masuet-Aumatell & Atouguia, 2020). Typhoid disease is projected to have resulted in 21·6 million infections and 216,500 mortalities worldwide in the year 2000 (Bhan, Bahl, & Bhatnagar, 2005), and amid 9.9 to 24.2 million illnesses and 75,000 to 208,000 mortalities per year by 2017 (Adesegun et al., 2020). It is typical in many nations where substandard sanitary facilities, unhygienic habits, poverty and lack of adequate knowledge exist (Mike et al., 2017). In West Africa, Nigeria is one of the nations with substandard water sources and poor sanitary practices due to various authorities' inept efforts, which leads to inferior standards of water and subsequent water-borne diseases, including typhoid fever (Adeyinka et al., 2014). Detailed information on typhoid disease epidemiology in Nigeria is very scanty (Wong et al., 2016), and availability and understanding of this information are crucial in directing public health efforts for typhoid disease prevention and control interventions (Crump, Luby, & Mintz, 2004). However, information regarding typhoid disease incidence has been rare in small and middle-income states (Antillón et al., 2017).

Many health information gaps exist in many states of developing nations concerning the health problems resulting from typhoid fever (Obaro, Tam, & Mintz, 2017). This typhoid disease has remained a problematic issue in less industrialised states. Most attention on typhoid fever problem lately has been on Asian towns, in which alarming incidence rates were recorded in town slums, yet, not a lot has been discussed on typhoid fever deterrence in the African continent, in which little detailed scientific investigations have been carried out (Breiman, Cosmas, Njuguna, Audi, Olack, et al., 2012).

In recent years, relatively high prevalence rates of *Salmonella* spp were documented in few parts of Nigeria (Odikamnoro et al., 2017), with one report having an overall high mortality rate (Agu et al., 2015), and another report showing a high prevalence of the disease among children aged 1 to 10 (Adabara et al., 2012). However, this principally relies on comprehensive surveillance and analysis, which are invaluable in tracking antibiotic-resistant typhoid pathogens' development and spread (Tahir, 2019).

In Lagos State, Nigeria, hospital archives ranging from those of 1993 to 2015, along with supplementary information from a preceding research carried out in seven healthcare installations in the Federal Capital Territory, Abuja, and three healthcare facilities in Kano State ranging from 2008 to 2017 and from 2013 to 2017, respectively, revealed that there were drops in drifts of positivity proportion of *Salmonella typhi* from Abuja but with added unpredictable drifts from Lagos and Kano States. But from Lagos State, above 80% of the typhoid pathogens cultured throughout the timeframe studied displayed multiple drug resistance with a largely elevating pattern (Akinyemi et al., 2018). Also, in Ituku/Ozalla area of Enugu State, Nigeria, multi-drug resistant (MDR) *S. typhi* were detected in 426 patients (52.6%) from a total of 810 feverish individuals between the years of 2013 and 2016 (Ohanu et al., 2019).

The frequency of antibiotic-resistant *S. typhi* infections has been rising worldwide, thereby heightening the need for moving forward with an all-inclusive and wide-ranging plan for efficient control and prevention of the disease (Lindsay et al., 2019). In some regions of the African continent, multi-drug resistant (MDR) *S. typhi* occurrence seems to be rising, and in some instances, outbreaks related to this MDR species were reported (Britto, Wong, Dougan, & Pollard, 2018). In the sub-Saharan region of Africa, acquired resistance to antibiotics used against typhoid has become more common, with this resistance contributing largely to undermining efforts in treating cases of the disease (Okeke et al., 2007). With hopes of availability of more successful vaccines soon, it has become necessary to recognise the various geographic outlines of typhoid fever risks and determinants to successfully identify the ideal target populations for vaccination programmes in order to successfully control and prevent the disease (Lee, Mogasale, Mogasale, & Lee, 2016).

Typhoid fever can be prevented by creating conditions that reduce or eliminate host-associated risk factors which are factors that revolve around the typhoid-risk-elevating attitudes and practices of individuals such as lack of handwashing, eating contaminated food, and drinking unboiled water. These preventive conditions include good sanitary practices, improving the hygiene of water supply, establishment of standard sewage and waste disposal systems, and effective vaccination of populations at risk (Iperepolu et al., 2008), hence, adequate information on typhoid epidemiology is required to recommend suitable, feasible, and tolerable public health interventions to control and prevent the disease menace in a community (CDC, 2012).

1.2 Problem Statement

An estimated 12 million occurrences and above 128,000 mortalities are documented each year resulting from typhoid fever. These typhoid cases are probably underreported due to poor epidemiological information which is supposed to provide comprehensive data on the diseases' occurrence, determinants, and distribution (Techasaensiri et al., 2018). Findings indicated that populations in regions of sub-Saharan Africa are still well affected by the

disease. Alarming occurrences of rampant typhoid fever were reported from a municipal populace in Kenya between 2007–2009. Since 2008, alarming outbreaks of typhoid have been documented in poorly developed parts of Malawi, Uganda, developed parts of Zimbabwe, Zambia (Carias et al., 2015), while significant prevalence of the disease has also been reported in parts of Nigeria which have poor access to safe water (Satterthwaite, 2017).

The Typhoid Fever Surveillance in Africa Program, referred to by the acronym TSAP, was purposefully created by the International Vaccine Institute in the year 2009 to bridge the existing information breaches regarding invasive *Salmonella* illnesses in sub-Saharan African nations, and to explicitly approximate the impact of the problems resulting from bloodstream contagions instigated by the main bacterial pathogen known as *S. typhi*. At the end of the program, the TSAP had successfully realised this ruthless objective, discovering extreme incidences of typhoid disease in both rural and urban populaces of numerous nations of the sub-Saharan Africa region. These outcomes produced by efforts of the TSAP had unquestionably decreed the course of forthcoming typhoid studies in the African continent (Baker et al., 2016). This venture had also created analogous enteric infections survey information within the African continent which formed the foundation for enactment of evidence-based public health intercessions comprising vaccinations and gauging of their effects (IVI, 2011).

Upon completion of TSAP, the Severe Typhoid Fever in Africa Program known with the acronym SETA was launched in the year 2015 and was targeted at advancing on the Typhoid Fever Surveillance in Africa Programs' output by exploiting and escalating on the formerly recognized typhoid survey set-up in the sub-Saharan African nations. Six nations were included in the program and were selected based on varying criteria which included demonstrating elevated and endemic typhoid occurrences for Burkina Faso, Ghana, and Madagascar, persisting requirement for within-nation surveys on typhoid disease for Ethiopia, and worth of outspreading to further research in nations with huge numbers of inhabitants for the Democratic Republic of Congo and Nigeria. The survey locations situated in these nations have already been unified into the SETA program for the purpose of data harmonization and multi-national surveillance and data comparation (Park et al., 2019).

Despite the year 2008 calls for comprehensive data collection on typhoid in Africa by the World Health Organization, there is still a dearth of epidemiological information regarding this disease in Africa. This is believed to be caused by some limiting factors like hitches in preparations for data collection from very ill patients in an already inefficient health establishment and homogenizing collection of information in the presence of scarce funds and manpower (Khatib et al., 2017). Also, other issues that are believed to contribute to this dearth of data include lack of standard local typhoid surveillance in the presence of flawed methods of diagnosis in healthcare settings, which lead to generation of records with intermittent gaps which fail to get properly accredited and unified with

national and regional health information databases or systems (Steele, Burgess, Diaz, Carey, & Zaidi, 2016a).

In a country where typhoid fever is endemic and where minimal information relating to the morbidity, mortality and determinants of the disease are available in published scientific literature, or where such information was generated using disproportionate sample sizes or executed within a limited geographical range and so cannot be used to represent the total population accurately, new and restructured information is needed in creating efficient prevention and control schemes like vaccine schedules and programmes, and also in identifying individuals at risk within the general population, for whom proper public health interventions can be initiated. In addition, a greater appreciation of socio-environmental risk factors for the disease may increase the successes of efforts in the control of the disease (Corner et al., 2013). Also, it is believed that changes in weather conditions could influence *S. typhi* transmission, even though the profile has yet to be fully understood, many reports have indicated the effects of hot weather and rains to be significant in the transmission of this disease pathogen (Pitzer et al., 2018). Dearth in surveillance data concerning invasive *Salmonella* infections in sub-Saharan Africa has since 2008 made the World Health Organization to call for a continent-wide approach to produce more precise data on the occurrences and antibiotic resistance of *Salmonella* infections (Baker et al., 2016).

The resistance of typhoid to generally utilised antibiotics is increasing and has resulted in significant concerns because some *S. typhi* strains have shown marked resistance to some oral antibiotics like cotrimoxazole, chloramphenicol, and ampicillin; this emergence has become a significant public health threat in Nigeria (Akinyemi et al., 2018), hence, precise and comprehensive typhoid disease burden assessments are required considering this increase in antibiotic resistance by the pathogen and escalating discussions regarding typhoid vaccines (Stanaway et al., 2019).

Efficient control of typhoid relies heavily on a proper understanding of disease epidemiology and clinical and diagnostic information. However, there is still a lot to understand regarding the study of this human-restricted pathogenic microorganism and the complex nature of its infections, especially in areas like Africa, where the disease is endemic. One of the main obstacles to typhoid control is developing multidrug-resistant species, which puts global antimicrobial therapy at risk.

Vaccines against typhoid fever have remained accessible to control and prevent the disease since the year 1896; however, insufficient information regarding the burden of the disease has hindered their routine use as tools for efficient prevention of typhoid in endemic locations (Khan et al., 2017). Due to the future accessibility of Vi-conjugate vaccines against typhoid, identification of populations most at risk and proper timing of vaccine schedules are needed to achieve the highest efficiency in the control efforts against the disease. This

requirement is greatly hindered due to the absence of adequate population-based information on disease incidence and burden, especially for school-aged and pre-school aged children who are deemed to benefit most from the conjugated form of the Vi polysaccharide vaccine (Pham et al., 2016).

Inadequate and imprecise disease burden estimates extremely hinder both regional and global decision-making concerning typhoid vaccines. Immunisation staff and ministries of health need adequate and precise information from several areas in the state or nation to activate a health intervention process and persuade other related ministries to fund these processes (Khan et al., 2017). This absence of accurate information has made conclusions regarding priorities and allocation of resources problematic and is thought to negatively affect ventures into control and prevention of typhoid disease (Fraser et al., 2007). In 2018, the world health organisation (WHO) stated that urgency is needed in producing information that can further help schedules of immunisations against typhoid and policies on the vaccinations against this disease (WHO, 2019).

In Gombe State, Nigeria, there have been very few scientific publications about typhoid epidemiology. These publications are deemed inadequate and imprecise due to the small number of samples, inadequate factors analysed, and small geographical area covered. This is thought to have led to the continued occurrence and spread of the disease, spread of antibiotic-resistant pathogens, and ineffectiveness of any control strategy that might be in existence since it is a known fact that without adequate epidemiological data, the true extent of a disease burden and the populations most at risk cannot be ascertained, and as such a proper target population for health interventions and the type and scale of such interventions cannot be determined. Also, based on public health records and verbal conversations with some ministry of health staff, there have been no typhoid vaccinations, health policies, or any related health program for typhoid control within the past 10 years in Gombe, and Nigeria in general.

At the end of this research, it is expected that adequate and precise epidemiological data on typhoid fever in the Gombe metropolitan area of Gombe State, Nigeria, will be obtained, and these findings are expected to provide information that can be used by relevant authorities to identify populations at risk of the disease and make calculated decisions on how, where, and when to deploy health interventions for the efficient control and prevention of the disease.

1.3 Justification for The Study

To create an investment case for disease prevention and control efforts, reliable estimates for the burden of that disease are crucial. For countries to implement the recent WHO recommendations on the usage of typhoid vaccines, a proper understanding of the disease epidemiology at both the national and state levels is required (Crump, 2015). In Asia and sub-Saharan Africa, most typhoid fever happens in developing and under-developed countries. Data on the incidence of

typhoid fever remains uncertain in the majority of countries where the disease is endemic, and along with extensive spatial and temporal heterogeneity, serious challenges result toward efforts in implementation and integration of typhoid conjugate vaccines into existing immunisation programmes against the disease (Andrews et al., 2019). There is a global need for epidemiologists to properly understand shifts in typhoid trends and its pathogen because proper management and control of the disease seriously depend on this understanding (Wain et al., 2015).

This study has both applied and technical relevance. In this research, additions are intended to be made to the works of Carias et al. (2015) and the works of Baker, Hombach, & Marks (2016), who argued that typhoid fever incidence may be much higher than currently understood in Africa, and to the works of Andrews et al. (2019) and Stanaway et al. (2019), who implied that accurate and detailed estimates of enteric fever burden are required for an effective vaccine program. This addition can be found useful in the control and prevention of the disease.

More applied relevance can be found in the fact that the data expected to be obtained at the end of this study can beneficially affect long-term health interventions for populations at risk, as was emphasised by Khan et al. (2017). In addition, decision making on priorities and resource allocation would be easier and more efficient and may positively impact ventures in typhoid fever control and prevention, as was discussed by Fraser, Paul, Leibovici, Acosta, & Goldberg (2007).

The technical relevance of this study is that the information expected to be acquired from the findings of this research can lead to further understanding of socio-environmental factors associated with risk of typhoid illness which could greatly assist in further understanding of the transmission of the disease and in targeting disease control efforts as was discussed by Corner, Dewan, & Hashizume (2013).

This study is also relevant to the achievement of the World Health Organization's third sustainable development goal (SDG), which is to "Ensure healthy lives and promote wellbeing for all at all ages", which among other things, involves the combating of water-borne diseases which includes typhoid fever (WHO, 2017a).

Also, in Nigeria, reports from a retrospective study involving documentations of typhoid cases in Lagos, Kano, and Abuja, revealed that there were drops in drifts of positivity proportion of *S. typhi* from Abuja but established unpredictable drifts from Lagos and Kano States. In addition, more than half of the isolates from Lagos were MDR strains (Akinyemi et al., 2018b). These findings further highlight the need for generation of epidemiological data to continuously monitor shifts in occurrences of typhoid and the resistance pattern drifts of the pathogens.

This study was focused on Gombe which has an approximate population of 489,000 individuals because standard published scientific literature on typhoid epidemiology is non-existent for the area even though typhoid cases have continued to be treated in many of the healthcare facilities. Thus, an understanding of the risk factors and distribution of cases will positively impact design and implementation of targeted health interventions such as vaccinations and provision of safe drinking water and sanitation in the area.

This study is also an attempt to fill the existing knowledge gap regarding typhoid epidemiology in Gombe, and if successful, will serve as a baseline or model for future detailed epidemiological studies and interventions against typhoid in other States of Nigeria.

This study will also be of benefit to the community because efforts aimed at typhoid control will be targeted at the specific problem instead of targeting problems at random, thus providing faster and more efficient effects of the health intervention to the population. In addition, organizations such as the World Health Organization will benefit from the findings of this study because data that will aid in accomplishment of some of their set goals will be made available.

Also, policy makers will have adequate data for efficient resource/funds allocation, budgeting, planning, and implementation of health interventions, thus producing efficient outcomes and eventually making efficient use of the countries funds and resources, thereby also aiding in reducing economic difficulties of the nation.

1.4 Research Questions

i. Is there a significant association between the host-associated risk factors and the occurrence and recurrence of typhoid fever in GMA?

ii. Is there a significant association between weather conditions and the incidence of typhoid in GMA?

1.5 Hypotheses

i. There is no significant association between the host-associated risk factors and the occurrence and recurrence of typhoid in GMA.

ii. There is no significant association between the weather conditions and the incidence of typhoid in GMA.

1.6 Research Objectives

General objective: To determine the epidemiology of typhoid fever in the Gombe metropolitan area (GMA) of Gombe State, Nigeria.

Specific objectives:

i. To determine the incidence and recurrence of typhoid in GMA.

ii. To determine the distribution of typhoid based on gender, age, and location in GMA.

iii. To determine the effect of weather conditions on the incidence of typhoid in GMA.

iv. To identify the host-associated risk factors (predictors) for the incidence and recurrence of typhoid in GMA.

REFERENCES

Abboubakar, H., & Racke, R. (2021). Mathematical modeling, forecasting, and optimal control of typhoid fever transmission dynamics. *Chaos, Solitons & Fractals*, *149*, 111074.

Abdullahi, A., & Abdu, A. (2018). Household Water Conditions in Gombe : A Profile of Water Scarcity in Nassarawo , Palliative and Mitigation Measures. *American Scientific Research Journal for Engineering, Technology, and Sciences*, *43*(1), 227–240.

Abdullahi, S., Abdulwahab, K., & Sadiq Abubakar, G. (2017). Gross Margin Analysis of Modern Groundnut Oil Extraction in Gombe Metropolis Gombe State, Nigeria. *World Journal of Agricultural Research*, *5*(2), 58–63.

Aboyitungiye, J. B., Suryanto, & Gravitiani, E. (2021). River pollution and human health risks: Assessment in the locality areas proximity of Bengawan Solo river, Surakarta, Indonesia. *Indonesian Journal of Environmental Management and Sustainability*, *5*(1), 13–20.

Aburto-Medina, A., Shahsavari, E., Salzman, S. A., Kramer, A., Ball, A. S., & Allinson, G. (2019). Elucidation of the microbial diversity in rivers in south-west Victoria, Australia impacted by rural agricultural contamination (dairy farming). *Ecotoxicology and Environmental Safety*, *172*, 356–363.

Adabara, N. U., Ezugwu, B. U., Momojimoh, A., Madzu, A., Hashiimu, Z., & Damisa, D. (2012). The Prevalence and Antibiotic Susceptibility Pattern of *Salmonella typhi* among Patients Attending a Military Hospital in Minna, Nigeria. *Advances in Preventive Medicine*, *2012*, 1–4.

Adesegun, O., Adeyemi, O., Ehioghae, O., Rabor, D., Binuyo, T., Alafin, B., Nnagha, O., Idowu, A., & Osonuga, A. (2020). Current trends in the epidemiology and management of enteric fever in Africa: A literature review. *Asian Pacific Journal of Tropical Medicine*, *13*(5), 204–213.

Adeyinka, S. Y., Wasiu, J., & Akintayo, C. O. (2014). Review on Prevalence of Waterborne Diseases in Nigeria. *Journal of Advancement in Medical and Life Sciences*, *1*, 5–7.

Africacheck. (2017). *Education for the Girl Child in Northern Nigeria*.

Agu, K., Nzegwu, M., & Obi, E. (2015). Prevalence, morbidity, and mortality patterns of typhoid ileal perforation as seen at the university of Nigeria teaching hospital Enugu Nigeria: An 8-year review. *World Journal of Surgery*, *38*(10), 2514–2518.

Ahmad, S., Tsagkaris, C., Aborode, A. T., Ul Haque, M. T., Khan, S. I., Khawaja, U. A., Carla dos Santos Costa, A., Essar, M. Y., & Lucero-Prisno, D. E. (2021). A skeleton in the closet: The implications of COVID-19 on XDR strain of typhoid in Pakistan. *Public Health in Practice*, *2*, 100084.

Ahsan, S., & Rahman, S. (2018). Azithromycin Resistance in Clinical Isolates of Salmonella enterica Serovars Typhi and Paratyphi in Bangladesh. *Microbial Drug Resistance*, *25*(1), 8–13.

Akinbi, J., & Akinbi, Y. (2015). Gender Disparity in Enrolment into Basic Formal Education in Nigeria: Implications for National Development. *African Research Review*, *9*(3), 11.

Akinyemi, K. O., Oyefolu, A. O. B., Mutiu, W. B., Iwalokun, B. A., Ayeni, E. S., Ajose, S. O., & Obaro, S. K. (2018a). Typhoid Fever: Tracking the Trend in Nigeria. *The American Journal of Tropical Medicine and Hygiene*, *99*(3_Suppl), 41–47.

Akinyemi, K. O., Oyefolu, A. O. B., Mutiu, W. B., Iwalokun, B. A., Ayeni, E. S., Ajose, S. O., & Obaro, S. K. (2018b). Typhoid fever: Tracking the trend in Nigeria. *American Journal of Tropical Medicine and Hygiene*, *99*(3), 41–47.

Akullian, A., Ng'eno, E., Matheson, A. I., Cosmas, L., Macharia, D., Fields, B., Bigogo, G., Mugoh, M., John-Stewart, G., Walson, J. L., Wakefield, J., & Montgomery, J. M. (2015). Environmental Transmission of Typhoid Fever in an Urban Slum. *PLOS Neglected Tropical Diseases*, *9*(12), e0004212.

Akwa, T. E. (2020). Prevalence and Associated Risk Factors of Typhoid Fever in Children Attending "Deo Gratias" Hospital in Douala, Littoral Region of Cameroon. *SSRN Electronic Journal*.

Alba, S., Bakker, M. I., Hatta, M., Scheelbeek, P. F. D., Dwiyanti, R., Usman, R., Sultan, A. R., Sabir, M., Tandirogang, N., Amir, M., Yasir, Y., Pastoor, R., van Beers, S., & Smits, H. L. (2016). Risk Factors of Typhoid Infection in the Indonesian Archipelago. *PLOS ONE*, *11*(6), e0155286.

Alba, S., Bakker, M. I., Hatta, M., Scheelbeek, P. F. D., Dwiyanti, R., Usman, R., Sultan, A. R., Sabir, M., Tandirogang, N., Amir, M., Yasir, Y., Pastoor, R., Van Beers, S., & Smits, H. L. (2016). Risk factors of typhoid infection in the Indonesian archipelago. *PLoS ONE*, *11*(6), 1–14.

Alderman, K., Turner, L. R., & Tong, S. (2012). Floods and human health: A systematic review. *Environment International*, *47*, 37–47.

Allu, M. A., Assafi, M. S., Polse, R. F., & Al-, M. I. (2019). Present status of Salmonella Typhi in different age groups hospitalized patients in Duhok City, Iraq. *Zanco Journal of Pure and Applied Sciences*, *31*(6).

Andino, A., & Hanning, I. (2015). Salmonella enterica: Survival, Colonization, and Virulence Differences among Serovars. *The Scientific World Journal*, *2015*, 1–16.

Andre, F., Booy, R., Bock, H., Clemens, J., Datta, S., John, T., Lee, B., Lolekha, S., Peltola, H., Ruff, T., Santosham, M., & Schmitt, H. (2011). WHO | Vaccination greatly reduces disease, disability, death and inequity worldwide. *Bulletin of the World Health Organization*.

Andrews, J. R., Baker, S., Marks, F., Alsan, M., Garrett, D., Gellin, B. G., Saha, S. K., Qamar, F. N., Yousafzai, M. T., Bogoch, I. I., Antillon, M., Pitzer, V. E., Kim, J.-H., John, J., Gauld, J., Mogasale, V., Ryan, E. T., Luby, S. P., & Lo, N. C. (2019a). Typhoid conjugate vaccines: a new tool in the fight against antimicrobial resistance. *The Lancet. Infectious Diseases*, *19*(1), e26–e30.

Andrews, J. R., Baker, S., Marks, F., Alsan, M., Garrett, D., Gellin, B. G., Saha, S. K., Qamar, F. N., Yousafzai, M. T., Bogoch, I. I., Antillon, M., Pitzer, V. E., Kim, J.-H., John, J., Gauld, J., Mogasale, V., Ryan, E. T., Luby, S. P., & Lo, N. C. (2019b). Typhoid conjugate vaccines: a new tool in the fight against antimicrobial resistance. *The Lancet Infectious Diseases*, *19*(1), e26–e30.

Anggeraini Hasri, D. (2020). Mathematical Model Analysis of The Spread of Typhoid Fever with Carriers and Bacteria. *International Journal of Innovative Science and Research Technology*, *5*.

Anthonj, C., Diekkrüger, B., Borgemeister, C., & Thomas Kistemann. (2019). Health risk perceptions and local knowledge of water-related infectious disease exposure among Kenyan wetland communities. *International Journal of Hygiene and Environmental Health*, *222*(1), 34–48.

Anthonj, C., Githinji, S., Höser, C., Stein, A., Blanford, J., & Grossi, V. (2021). Kenyan school book knowledge for water, sanitation, hygiene and health education interventions: Disconnect, integration or opportunities? *International Journal of Hygiene and Environmental Health*, *235*, 113756.

Anthonj, C., Rechenburg, A., Höser, C., & Kistemann, T. (2017). Contracting infectious diseases in Sub-Saharan African wetlands: A question of use? A review. *International Journal of Hygiene and Environmental Health*, *220*(7), 1110–1123.

Antillón, M., Warren, J. L., Crawford, F. W., Weinberger, D. M., Kürüm, E., Pak, G. D., Marks, F., & Pitzer, V. E. (2017). The burden of typhoid fever in low- and middle-income countries: A meta-regression approach. *PLOS Neglected Tropical Diseases*, *11*(2), e0005376.

Anyanwu, L. J., Mohammad, A., Abdullahi, L., Farinyaro, A., & Obaro, S. (2018). Determinants of postoperative morbidity and mortality in children managed for typhoid intestinal perforation in Kano Nigeria. *Journal of Pediatric Surgery*, *53*(4), 847–852.

Appiah, G. D., Hughes, M. J., & Stephens, K. C. (2020). *Typhoid & Paratyphoid Fever - Chapter 4 - 2020 Yellow Book | Travelers' Health | CDC*. Oxford University Press.

Arulogun, O. S., & Obute, J. A. (2007). Health workers' perception about the supplemental immunization activities in Gombe local government area, Gombe state. *African Journal of Medicine and Medical Sciences*, *36*(1), 65–70.

Ashurst, J. V, Woodbury, B., & Regional, K. (2019). Salmonella Typhi Pathophysiology Treatment / Management. *StatPearls Publishing*, 2–5.

Awofisayo-Okuyelu, A., McCarthy, N., Mgbakor, I., & Hall, I. (2018). Incubation period of typhoidal salmonellosis: a systematic review and meta-analysis of outbreaks and experimental studies occurring over the last century. *BMC Infectious Diseases*, *18*(1).

Awol, R. N., Reda, D. Y., & Gidebo, D. D. (2021). Prevalence of Salmonella enterica serovar Typhi infection, its associated factors and antimicrobial susceptibility patterns among febrile patients at Adare general hospital, Hawassa, southern Ethiopia. *BMC Infectious Diseases*, *21*(1), 1–9.

Ayaz, C., Loeb, M., Geyik, M. F., Acemoglu, H., Akalin, S., Hosoglu, S., & Celen, M. K. (2005). Risk factors for typhoid fever among adult patients in Diyarbakir, Turkey. *Epidemiology and Infection*, *134*(03), 612.

Aye, T., & Siriarayapon, P. (2004). Typhoid fever outbreak in Madaya Township, Mandalay Division, Myanmar, September 2000. *Journal of the Medical Association of Thailand = Chotmaihet Thangphaet*, *87*(4), 395–399.

Aye, T. T., & Siriarayapon, P. (2004). Typhoid fever outbreak in Madaya Township, Mandalay Division, Myanmar, September 2000. *Journal of the Medical Association of Thailand = Chotmaihet Thangphaet*, *87*(4), 395–399.

Baker, S., Hombach, J., & Marks, F. (2016). *What Have We Learned From the Typhoid Fever Surveillance in Africa Program?*

Bapari, Y. (2016). *Impacts of Unplanned Urbanization on the Socio – Economic Conditions and Environment of Pabna Municipality , Bangladesh*. *6*(9), 105–114.

Barac, R., Als, D., Radhakrishnan, A., Gaffey, M. F., Bhutta, Z. A., & Barwick, M. (2018). Implementation of Interventions for the Control of Typhoid Fever in Low- and Middle-Income Countries. *The American Journal of Tropical Medicine and Hygiene*, *99*(3_Suppl), 79–88.

Bee, D. T., & Murdoch-Eaton, D. (2016). Questionnaire design: the good, the bad and the pitfalls. *Archives of Disease in Childhood - Education and Practice*, *101*(4), 210–212.

Behrman, A. J. (2011). Occupational Infections. *Occupational Emergency Medicine*, *31*(1), 46–74.

Bello, O. W., Bello, O. W., Oyekunle, A., & Adeyemi, R. (2018). Analysis of the Privacy Policies of Nigerian Online Shops. *International Journal of Information Processing and Communication (IJIPC)*, *6*(2), 347–361.

Bentsi-Enchill, A. D., & Pollard, A. J. (2018). A Turning Point in Typhoid Control. *The Journal of Infectious Diseases*, *218*(suppl_4), S185–S187.

Berger, C. N., Sodha, S. V., Shaw, R. K., Griffin, P. M., Pink, D., Hand, P., & Frankel, G. (2010). Fresh fruit and vegetables as vehicles for the transmission of human pathogens. *Environmental Microbiology*, *12*(9), 2385–2397.

Bhan, M., Bahl, R., & Bhatnagar, S. (2005). Typhoid and paratyphoid fever. *The Lancet*, *366*(9487), 749–762.

Bhan, M. K., Bahl, R., Sazawal, S., Sinha, A., Kumar, R., Mahalanabis, D., & Clemens, J. D. (2002). Association between Helicobacter pylori Infection and Increased Risk of Typhoid Fever . *The Journal of Infectious Diseases*, *186*(12), 1857–1860.

Bhandari, D., & Pandey, P. (2018). Health Problems while Working as a Volunteer or Humanitarian Aid Worker in Post-Earthquake Nepal. *Journal of the Nepal Medical Association*, *56*(211), 691–695.

Bhutta, Z. A. (2019). Integrating Typhoid Fever Within the Sustainable Development Goals: Pragmatism or Utopia? *Clinical Infectious Diseases*, *68*, S34–S41.

Bhutta, Z. A., Zaidi, A. K. M., & Pangestu, T. (2018). Reducing Typhoid Burden within a Generation. *The American Journal of Tropical Medicine and Hygiene*, *99*(3_Suppl), 1–3.

Bilcke, J., Antillón, M., Pieters, Z., Kuylen, E., Abboud, L., Neuzil, K. M., Pollard, A. J., Paltiel, A. D., & Pitzer, V. E. (2019). Cost-effectiveness of routine and campaign use of typhoid Vi-conjugate vaccine in Gavi-eligible countries: a modelling study. *The Lancet Infectious Diseases*, *19*(7), 728–739.

Bitter, C. C., Ngabirano, A. A., Simon, E., & Taylor, D. M. (2020). Principles of research ethics: A research primer for low- and middle-income countries. *African Journal of Emergency Medicine*.

Blackstock, S. J., Sheppeard, V. K., Paterson, J. M., & Ralph, A. P. (2013). Erratum to: Typhoid and paratyphoid fever in Western Sydney Local Health District, NSW, January?June 2011. *New South Wales Public Health Bulletin*, *24*(1), 2.

Blazar, J., Allard, M., & Lienau, E. K. (2011). Insects as vectors of foodborne pathogenic bacteria. *Terrestrial Arthropod Reviews*, *4*(1), 5–16.

Blázquez-Sánchez, N., Rivas-Ruiz, F., Bueno-Fernández, S., Arias-Santiago, S., Fernández-Morano, M. T., & deTroya-Martín, M. (2020). Validation of a questionnaire designed to study knowledge, attitudes, and habits related to sun exposure among young adults: The CHACES questionnaire. *Actas Dermo-Sifiliográficas (English Edition)*.

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer. *Frontiers in Public Health*, *6*, 149.

Bogitsh, B. J., Carter, C. E., & Oeltmann, T. N. (2019). Arthropods as Vectors. In *Human Parasitology* (pp. 331–360). Elsevier.

Bonville, C., & Domachowske, J. (2021). Typhoid Fever. *Vaccines*, 373–381.

Boutayeb, A. (2010). The Burden of Communicable and Non-Communicable Diseases in Developing Countries. *Handbook of Disease Burdens and Quality of Life Measures*, *2010*, 531–546.

Brainard, J., D'hondt, R., Ali, E., Van den Bergh, R., De Weggheleire, A., Baudot, Y., Patigny, F., Lambert, V., Zachariah, R., Maes, P., Kuma-Kuma Kenge, D., & Hunter, P. R. (2018). Typhoid fever outbreak in the Democratic Republic of Congo: Case control and ecological study. *PLOS Neglected Tropical Diseases*, *12*(10), e0006795.

Brehm, T. T., Lütgehetmann, M., Tannich, E., Addo, M. M., Lohse, A. W., Rolling, T., & Vinnemeier, C. D. (2020). Risk factors for different intestinal pathogens among patients with traveler's diarrhea: A retrospective analysis at a German travel clinic (2009–2017). *Travel Medicine and Infectious Disease*, 101706.

Breiman, R. F., Cosmas, L., Njuguna, H., Audi, A., Olack, B., Ochieng, J. B., Wamola, N., Bigogo, G. M., Awiti, G., Tabu, C. W., Burke, H., Williamson, J., Oundo, J. O., Mintz, E. D., & Feikin, D. R. (2012). Population-Based Incidence of Typhoid Fever in an Urban Informal Settlement and a Rural Area in Kenya: Implications for Typhoid Vaccine Use in Africa. *PLoS ONE*, *7*(1), e29119.

Brenner, R. J., & Kramer, R. D. (2019). Cockroaches (Blattaria). In *Medical and Veterinary Entomology* (pp. 61–77). Elsevier.

Britto, C. D., Wong, V. K., Dougan, G., & Pollard, A. J. (2018). A systematic review of antimicrobial resistance in Salmonella enterica serovar Typhi, the etiological agent of typhoid. *PLOS Neglected Tropical Diseases*, *12*(10), e0006779.

Brooks, G. F., Carroll, K. C., Butel, J. S., Morse, S. A., & Mietzner, T. A. (2013). *Jawetz, Melnick, & Adelberg's Medical Microbiology* (26th Editi). McGraw Hill Lange.

Brown, L., & Murray, V. (2013). Examining the relationship between infectious diseases and flooding in Europe. *Disaster Health*, *1*(2), 117–127.

Buckle, G. C., Walker, C. L. F., & Black, R. E. (2012). Typhoid fever and paratyphoid fever: Systematic review to estimate global morbidity and mortality for 2010. *Journal of Global Health*, *2*(1), 010401.

Burnsed, L. J., Kovar, L. D., Angelo, K. M., Trees, E. K., Concepción-Acevedo, J., McDermott, M. D., Wagner, D., & Bradley, K. K. (2019). Use of whole genome sequencing to complement characterisation of a typhoid fever outbreak among a Marshallese community: Oklahoma, 2015. *Epidemiology and Infection*, *147*(e11), 1–7.

Capeding, M. R., Alberto, E., Sil, A., Saluja, T., Teshome, S., Kim, D. R., Park, J. Y., Yang, J. S., Chinaworapong, S., Park, J., Jo, S. K., Chon, Y., Yang, S. Y., Ham, D. S., Ryu, J. H., Lynch, J., Kim, J. H., Kim, H., Excler, J. L., … Sahastrabuddhe, S. (2020). Immunogenicity, safety and reactogenicity of a Phase II trial of Vi-DT typhoid conjugate vaccine in healthy Filipino infants and toddlers: A preliminary report. *Vaccine*, *38*(28), 4476–4483.

Carey, M. E., Diaz, Z. I., Zaidi, A. K. M., & Steele, A. D. (2019). A Global Agenda for Typhoid Control-A Perspective from the Bill & Melinda Gates Foundation. *Clinical Infectious Diseases : An Official Publication of the Infectious Diseases Society of America*, *68*(Supplement_1), S42–S45.

Carias, C., Spalding Walters, M., Wefula, E., Date, K. A., Swerdlow, D. L., Vijayaraghavan, M., & Mintz, E. (2015). Economic evaluation of typhoid vaccination in a prolonged typhoid outbreak setting: The case of Kasese district in Uganda. *Vaccine*, *33*, 2079–2085.

CDC. (2012). *Principles of Epidemiology | Lesson 1 - Section 7*.

CDC. (2020a). *Epi Info™| CDC*. Centers for Disease Control and Prevention.

CDC. (2020b). Principles of Epidemiology | Lesson 1 - Section 10. In *Cdc*.

Centre for Disease Control and Prevention USA. (2012). *Principles of Epidemiology in Public Health Practice, Third Edition: An Introduction*.

Chalya, P. L., Mabula, J. B., Koy, M., Kataraihya, J. B., Jaka, H., Mshana, S. E., Mirambo, M., Mchembe, M. D., Giiti, G., & Gilyoma, J. M. (2012). Typhoid intestinal perforations at a University teaching hospital in Northwestern Tanzania: A surgical experience of 104 cases in a resource-limited setting. *World Journal of Emergency Surgery*, *7*(1), 1–11.

Chang, L., Lim, B. C. W., Flaherty, G. T., & Torresi, J. (2019). Travel vaccination recommendations and infection risk in HIV-positive travellers. In *Journal of Travel Medicine* (Vol. 26, Issue 6). Oxford Academic.

Chao, D. L., Park, J. K., Marks, F., Ochiai, R. L., Longini, I. M., & HALLORAN, M. E. (2015). The contribution of neighbours to an individual's risk of typhoid outcome. *Epidemiology and Infection*, *143*(16), 3520–3527.

Chauhan, A. S., Kapoor, I., Rana, S. K., Kumar, D., Gupta, M., John, J., Kang, G., & Prinja, S. (2021). Cost effectiveness of typhoid vaccination in India. *Vaccine*, *39*(30), 4089–4098.

Cheng, Y.-J., Tang, F.-Y., Bao, C.-J., Zhu, Y.-F., Liang, Q., Hu, J.-L., Liu, W.-D., Wu, Y., Reilly, K. H., Shen, T.-Q., Zhao, Y., Peng, Z.-H., Yu, R.-B., Wang, H., Shen, H.-B., & Chen, F. (2013). Spatial analyses of typhoid fever in Jiangsu province, People's Republic of China. *Geospatial Health*, *7*(2), 279.

Cirillo, V. J. (2006). "'Winged Sponges'": Houseflies as Carriers of Typhoid Fever in 19th- and Early 20th-Century Military Camps. *Perspectives in Biology and Medicine*, *49*(1), 52–63.

Cissé, G. (2019). Food-borne and water-borne diseases under climate change in low- and middle-income countries: further efforts needed for reducing environmental health exposure risks. *Acta Tropica*.

Clemens, J., Jiddawi, M., von Seidlein, L., Kaljee, L. M., Puri, M., Thriemer, K., Deen, J., Pach, A., Wierzba, T., Ochiai, L., Ley, B., & Ali, S. M. (2013). Utilization and Accessibility of Healthcare on Pemba Island, Tanzania: Implications for Health Outcomes and Disease Surveillance for Typhoid Fever. *The American Journal of Tropical Medicine and Hygiene*, *88*(1), 144–152.

Cobos Muñoz, D., Monzón Llamas, L., & Bosch-Capblanch, X. (2015). Exposing concerns about vaccination in low- and middle-income countries: a systematic review. In *International Journal of Public Health* (Vol. 60, Issue 7, pp. 767–780). Birkhauser Verlag AG.

Contreras, J. D., Meza, R., Siebe, C., Rodríguez-Dozal, S., López-Vidal, Y. A., Castillo-Rojas, G., Amieva, R. I., Solano-Gálvez, S. G., Mazari-Hiriart, M., Silva-Magaña, M. A., Vázquez-Salvador, N., Rosas Pérez, I., Martínez Romero, L., Salinas Cortez, E., Riojas-Rodríguez, H., & Eisenberg, J. N. S. (2017). Health risks from exposure to untreated wastewater used for irrigation in the Mezquital Valley, Mexico: A 25-year update. *Water Research*, *123*, 834–850.

Corner, R. J., Dewan, A. M., & Hashizume, M. (2013). Modelling typhoid risk in Dhaka metropolitan area of Bangladesh: the role of socio-economic and environmental factors. *International Journal of Health Geographics*, *12*, 13.

Cousins, S. (2018). Extremely drug-resistant typhoid in south Asia. *The Lancet Infectious Diseases*, *18*(9), 950.

Crampton, A., & Ragusa, A. (2016). Exploring Perceptions and Behaviors about Drinking Water in Australia and New Zealand: Is It Risky to Drink Water, When and Why? *Hydrology*, *3*(1), 8.

Crum, N. F. (2003). Current trends in typhoid fever. *Current Gastroenterology Reports*, *5*(4), 279–286.

Crump, J. A. (2015). Building the case for wider use of typhoid vaccines. *Vaccine*, *33*(Suppl 3), C1.

Crump, J. A. (2019). Progress in Typhoid Fever Epidemiology. *Clinical Infectious Diseases*, *68*(Supplement_1), S4–S9.

Crump, J. A., Luby, S. P., & Mintz, E. D. (2004). The global burden of typhoid fever. In *Bulletin of the World Health Organization* (Vol. 82, Issue 5).

Crump, J. A., Sjölund-Karlsson, M., Gordon, M. A., & Parry, C. M. (2015). Epidemiology, clinical presentation, laboratory diagnosis, antimicrobial resistance, and antimicrobial management of invasive Salmonella infections. *Clinical Microbiology Reviews*, *28*(4), 901–937.

Cummings, I., Lamontagne, M. E., Sweet, S. N., Spivock, M., & Batcho, C. S. (2019). Canadian-French adaptation and test-retest reliability of the leisure time physical activity questionnaire for people with disabilities. *Annals of Physical and Rehabilitation Medicine*, *62*(3), 161–167.

Curtis, V., & Cairncross, S. (2003). Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. *The Lancet Infectious Diseases*, *3*(5), 275–281.

Dagher, T. N., Al-Bayssari, C., Diene, S. M., Azar, E., & Rolain, J.-M. (2020). Bacterial infection during wars, conflicts and post-natural disasters in Asia and the Middle East: a narrative review. 511–529.

Daniel, O. D., & Daniel, M. (2021). The role of Poct in delivery of standard care in war ridden and terrorized regions, in Nigeria. *International Journal of Advanced Biochemistry Research*, *5*(1), 12–13.

Darton, T. C., Blohmke, C. J., & Pollard, A. J. (2014). Typhoid epidemiology, diagnostics and the human challenge model. *Current Opinion in Gastroenterology*, *30*(1), 7–17.

Das, S., Samajpati, S., Ray, U., Roy, I., & Dutta, S. (2017). Antimicrobial resistance and molecular subtypes of Salmonella enterica serovar Typhi isolates from Kolkata, India over a 15 years period 1998–2012. *International Journal of Medical Microbiology*, *307*(1), 28–36.

Date, K. A., Bentsi-Enchill, A., Marks, F., & Fox, K. (2015). Typhoid fever vaccination strategies. In *Vaccine* (Vol. 33, Issue S3, pp. C55–C61).

Davari, B., Kalantar, E., Zahirnia, A., & Moosa-Kazemi, S. (2010). Frequency of resistance and susceptible bacteria isolated from houseflies. *Iranian Journal of Arthropod-Borne Diseases*, *4*(2), 50–55.

de Waroux, O. le P. (2011). Floods as Human Health Risks. *Encyclopedia of Environmental Health*, 744–755.

Deen, J., & Clemens, J. D. (2021). Assessment of vaccine herd protection: Lessons learned from cholera and typhoid vaccine trials. *The Journal of Infectious Diseases*.

Dekker, J. P., & Frank, K. M. (2015). Salmonella, Shigella, and yersinia. *Clinics in Laboratory Medicine*, *35*(2), 225–246.

Delpla, I., Legay, C., Proulx, F., & Rodriguez, M. J. (2020). Perception of tap water quality: Assessment of the factors modifying the links between satisfaction and water consumption behavior. *Science of the Total Environment*, *722*, 137786.

Dewan, A. M., Corner, R., Hashizume, M., & Ongee, E. T. (2013). Typhoid Fever and Its Association with Environmental Factors in the Dhaka Metropolitan Area of Bangladesh: A Spatial and Time-Series Approach. *PLoS Neglected Tropical Diseases*, *7*(1), 1998.

Dewan, A. M., Corner, R. J., & Hashizume, M. (2014). Modelling Spatiotemporal Patterns of Typhoid Cases Between 2005 and 2009 Using Spatial Statistics. In *Dhaka Megacity* (pp. 345–365). Springer Netherlands.

Dhingra, D., Marathe, S. A., Sharma, N., Marathe, A., & Chakravortty, D. (2021). Modeling the immune response to Salmonella during typhoid. *International Immunology*, *33*(5), 281–298.

Dolecek, C. (2016). Typhoid Fever and Other Enteric Fevers. In *Infectious Diseases* (Fourth Edi, Vol. 385, Issue 9973). Elsevier Ltd.

Dutta, D., Foy, C., Ramadurai, G., Obaid, M., & Bruno, A. (2020). Initial testing of an electronic application of the simplified modified Rankin Scale questionnaire (e-smRSq). *Journal of Stroke and Cerebrovascular Diseases*, *29*(9), 105024.

Duy, P. T., Thieu, N. T. V., Nguyen, T. N. T., Thanh, H. N. D., Dongol, S., Karkey, A., Carey, M., Basnyat, B., Dougan, G., Rabaa, M. A., & Baker, S. (2020). Gallbladder carriage generates genetic variation and genome degradation in Salmonella Typhi. *PLOS Pathogens*, *16*(10), e1008998.

Dworkin, J., Saeed, R., Mykhan, H., Kanan, S., Farhad, D., Ali, O., Hama, R., Abdulwahab, K., Palardy, J., Neill, M. A., & Burns, J. A. (2014). Burden of typhoid fever in Sulaimania, Iraqi Kurdistan. *International Journal of Infectious Diseases*, *27*, 70–73.

Eide, E. R., & Showalter, M. H. (2011). Estimating the relation between health and education: What do we know and what do we need to know? *Economics of Education Review*, *30*(5), 778–791.

Ekdahl, K., de Jong, B., & Andersson, Y. (2005). Risk of Travel-Associated Typhoid and Paratyphoid Fevers in Various Regions. *Journal of Travel Medicine*, *12*(4).

El-Salam, A., Zeinab, A. F. ;, Abd El-Ghany, M., & El-Tahan, M. H. (2010). The Comparison Between Different Enrichment Broth Media And Selective Solid Media For Growing Of Salmonella Typhimurium And Listeria Monocytogenes. *J. Agric. Chemistry and Biotechnology Mansoura Univ*, *7*, 351–363.

Eleyan, D., Othman, A., & Eleyan, A. (2020). Enhancing Software Comments Readability Using Flesch Reading Ease Score. *Information*, *11*(9), 430.

Emmanuel, O. E., & Emmanuel, E. (2018). In-vitro antibiotic susceptibility profile of Salmonella enterica Serovar Typhi isolated from fecal specimens of humans in Umuahia metropolis, Abia State, Nigeria. *African Journal of Microbiology Research*, *12*(20), 470–475.

Eng, S. K., Pusparajah, P., Ab Mutalib, N. S., Ser, H. L., Chan, K. G., & Lee, L. H. (2015). Salmonella: A review on pathogenesis, epidemiology and antibiotic resistance. *Frontiers in Life Science*, *8*(3), 284–293.

F.N., Q., T., Y., S., R., S., Q., A., H., & K., S. (2018). Frequency and associated factors of typhoid carrier on duodenal fluid culture in a tertiary care hospital, Karachi. *American Journal of Tropical Medicine and Hygiene*, *99*(4 Supplement), 386–387.

Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics*, *19*(4), 27–29.

Farooqui, A., Khan, A., & Kazmi, S. U. (2009). Investigation of a community outbreak of typhoid fever associated with drinking water. *BMC Public Health*, *9*(1), 476.

Farouk Mahmoud, S., & Elshahat Ibrahim, M. (2021). Effect of Educational Program on Improving Mothers' Performance towards Children with Typhoid Fever at Zagazig City. *International Journal of Novel Research in Healthcare and Nursing*, *8*(2), 151–168.

Felgner, J., Jain, A., Nakajima, R., Liang, L., Jasinskas, A., Gotuzzo, E., Vinetz, J. M., Miyajima, F., Pirmohamed, M., Hassan-Hanga, F., Umoru, D., Jibir, B. W., Gambo, S., Olateju, K., Felgner, P. L., Obaro, S., & Davies, D. H. (2017). Development of ELISAs for diagnosis of acute typhoid fever in Nigerian children. *PLOS Neglected Tropical Diseases*, *11*(6), e0005679.

Feng, Y., Chen, Y.-C., Janapatla, R. P., Wang, Z., Hsu, Y.-J., Chen, C.-L., & Chiu, C.-H. (2021). Genomic surveillance reveals international circulation and local transmission of Salmonella enterica serovars Typhi and Paratyphi A in Taiwan. *Journal of Microbiology, Immunology and Infection*.

Flesch, R. (n.d.). *Guide to Academic Writing Article - Management - University of Canterbury - New Zealand*.

Flujas-Contreras, J. M., García-Palacios, A., & Gómez, I. (2020). Spanish validation of the Parental Acceptance Questionnaire (6-PAQ). *International Journal of Clinical and Health Psychology*, *20*(2), 163–172.

Francisco, M., Costa, S. S., Belas, A., Ramos, J., Couto, I., Pomba, C., & Viveiros, M. (2018). First report on antimicrobial resistance and molecular characterisation of Salmonella enterica serotype Typhi isolated from human specimens in Luanda, Angola. *Journal of Global Antimicrobial Resistance*, *13*, 246–249.

Franklin, F., Chong, C. W., Chua, L. H., Anthony, A. A., Liew, M. W. O., Aziah, I., & Ong, E. B. B. (2020). Evaluation of Salmonella Typhi antigen YncE alongside HlyE for the detection of typhoid fever and its carriers. *Medical Microbiology and Immunology 2020 209:5*, *209*(5), 593–601.

Franz, C. M. A. P., den Besten, H. M. W., Böhnlein, C., Gareis, M., Zwietering, M. H., & Fusco, V. (2019). Reprint of: Microbial food safety in the 21st century: Emerging challenges and foodborne pathogenic bacteria. In *Trends in Food Science and Technology* (Vol. 84, pp. 34–37).

Fraser, A., Paul, M., Leibovici, L., Acosta, C. J., & Goldberg, E. (2007). Vaccines for preventing typhoid fever. *Cochrane Database of Systematic Reviews*, *5*.

Frenck, R. W., & Clemens, J. (2003). Helicobacter in the developing world. *Microbes and Infection*, *5*(8), 705–713.

Garson, G. D. (2012). Testing statistical assumptions: Blue Book Series. In *Asheboro: Statistical Associate Publishing*.

Gasem, M. H., Dolmans, W. M., Keuter, M. M., & Djokomoeljanto, R. R. (2001). Poor food hygiene and housing as risk factors for typhoid fever in Semarang, Indonesia. *Tropical Medicine & International Health : TM & IH*, *6*(6), 484–490.

Gawish, M. F., Ahmed, A. M., Torky, H. A., & Shimamoto, T. (2021). Prevalence of extended-spectrum β-lactamase (ESBL)-producing Salmonella enterica from retail fishes in Egypt: A major threat to public health. *International Journal of Food Microbiology*, *351*, 109268.

Geraldes, R., Juryńczyk, M., Dos Passos, G., Prichler, A., Chung, K., Hagens, M., Ruggieri, S., Huerga, E., Sastre-Garriga, J., Enzinger, C., Chard, D. T., Barkhof, F., Gasperini, C., Rovira, A., Deluca, G. C., & Palace, J. (2020). Distinct influence of different vascular risk factors on white matter brain lesions in multiple sclerosis. *Journal of Neurology, Neurosurgery and Psychiatry*, *91*(4), 388–391.

Gerrits, R. G., Mulyanto, J., Wammes, J. D., van den Berg, M. J., Klazinga, N. S., & Kringos, D. S. (2020). Individual, institutional, and scientific environment factors associated with questionable research practices in the reporting of messages and conclusions in scientific health services research publications. *BMC Health Services Research*, *20*(1), 828.

Getachew, D., Wale, B., Eshete, W., Getahun, B., Demise, W., Shewasinad, S., & Deres, T. (2018). Assessment of Knowledge and Risk Perception towards Typhoid Fever among Communities in Mendida Town. In *EC Paediatrics* (Vol. 7).

Gieraltowski, L., Higa, J., Peralta, V., Green, A., Schwensohn, C., Rosen, H., Libby, T., Kissler, B., Marsden-Haug, N., Booth, H., Kimura, A., Grass, J., Bicknese, A., Tolar, B., Defibaugh-Chávez, S., Williams, I., Wise, M., & Salmonella Heidelberg Investigation Team, S. H. I. (2016). National Outbreak of Multidrug Resistant Salmonella Heidelberg Infections Linked to a Single Poultry Company. *PloS One*, *11*(9), e0162369.

Ginty, A. T. (2013). Construct Validity. In *Encyclopedia of Behavioral Medicine* (pp. 487–487). Springer New York.

Gomes, A., Saha, A., Datta, P., & Gomes, A. (2013). Research ethics for young researchers. *Indian Journal of Pharmacology*, *45*(5), 540–541.

Gopinath, S., Carden, S., & Monack, D. (2012). Shedding light on Salmonella carriers. *Trends in Microbiology*, *20*(7), 320–327.

Gordon, B. W. (2019). *Questionnaire Design, Development, Evaluation, and Testing: Where Are We, and Where Are We Headed? Advances in Questionnaire Design, Development, Evaluation and Testing, 1–23 | 10.1002/9781119263685.ch1*. Division of Cancer Control and Population Sciences, National Cancer Institute, National Institutes of Health, Rockville, Maryland, USA.

Gossner, C. M., Le Hello, S., de Jong, B., Rolfhamre, P., Faensen, D., Weill, F.-X., & Giesecke, J. (2016). Around the World in 1,475 Salmonella Geo-serotypes. *Emerging Infectious Diseases*, *22*(7), 1298–1302.

Gotuzzo, E. (2018). Typhoid fever: A current problem. *International Journal of Infectious Diseases*, *73*, 46–47.

Greenaway, C., Schofield, S., Henteleff, A., Plourde, P., Geduld, J., Abdel-Motagally, M., & Bryson, M. (2018). Summary of the Statement on International Travellers and Typhoid by the Committee to Advise on Tropical Medicine and Travel (CATMAT). *Canada Communicable Disease Report*, *40*(4), 60–70.

Greenwell, J., McCool, J., Kool, J., & Salusalu, M. (2013). Typhoid fever: hurdles to adequate hand washing for disease prevention among the population of a peri-urban informal settlement in Fiji. *Western Pacific Surveillance and Response Journal*, *4*(1), 41–44.

Gu, H., Yan, C., Jiang, Z., Li, X., Chen, E., Jiang, J., Jiang, Q., Zhou, Y., Gu, H., Yan, C., Jiang, Z., Li, X., Chen, E., Jiang, J., Jiang, Q., & Zhou, Y. (2018). Epidemiological Trend of Typhoid and Paratyphoid Fevers in Zhejiang Province, China from 1953 to 2014. *International Journal of Environmental Research and Public Health*, *15*(11), 2427.

Gunn, J. S., Marshall, J. M., Baker, S., Dongol, S., Charles, R. C., & Ryan, E. T. (2014). Salmonella chronic carriage: epidemiology, diagnosis and gallbladder persistence. *Trends Microbiol*, *22*(11), 648–655.

Gutbi, S., Mohammed, S., Eldinn, N., Elhassan, E., & Abdalla, A. A. (2020). Perceived Barriers of Hands Washing Practices during Coronavirus (COVID-19) Outbreak (Sudan). *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, *3*(1), 100–104.

Habte, L., Tadesse, E., Ferede, G., & Amsalu, A. (2018). Typhoid fever: Clinical presentation and associated factors in febrile patients visiting Shashemene Referral Hospital, southern Ethiopia. *BMC Research Notes*, *11*(1), 1–6.

Hadisaputro, S. (1998). Prevention and control of typhoid fever. *Medical Journal of Indonesia*, *S7-5*(Suppl. 1), 117–123.

Hajebrahimi, F., Tarakci, D., Arman, N., Emir, A., Bursali, A., & Tarakci, E. (2020). Cross-cultural adaptation, validity and reliability of Turkish version of Oxford Ankle Foot Questionnaire for children with congenital talipes equinovarus. *Foot and Ankle Surgery*.

Halder, S., Ekhlasur Rahman, M., Mukta Sarker, M., Hannan Mone, F., Roy, K., Tajkia, G., & Professor, A. (2021). Identification of Risk Factors for Typhoid Fever in Children Admitted in a Tertiary Care Hospital. *The Asian Institute of Research Journal of Health and Medical Sciences*, *4*(2), 2021.

Hamid, N., & Jain, S. K. (2008). Characterization of an outer membrane protein of Salmonella enterica serovar typhimurium that confers protection against typhoid. *Clinical and Vaccine Immunology : CVI*, *15*(9), 1461–1471.

Hancock-Allen, J., Cronquist, A. B., Peden, J., Adamson, D., Corral, N., & Brown, K. (2016). Notes from the Field:Typhoid Fever Outbreak Associated with an Asymptomatic Carrier at a Restaurant — Weld County, Colorado, 2015. *MMWR. Morbidity and Mortality Weekly Report*, *65*(23), 606–607.

Haque, S., Swami, P., & Khan, A. (2021). S. Typhi derived vaccines and a proposal for outer membrane vesicles (OMVs) as potential vaccine for typhoid fever. *Microbial Pathogenesis*, 105082.

Harrell, M., Selvaraj, S. A., & Edgar, M. (2020). DANGER! Crisis Health Workers at Risk. *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 5270*, *17*(15), 5270.

Harris, J. B., & Brooks, W. A. (2012). Typhoid and Paratyphoid (Enteric) Fever. In *Hunter's Tropical Medicine and Emerging Infectious Disease: Ninth Edition* (9th ed., pp. 568–576). Elsevier.

Hati, S., & Dimari, G. (2011). Quality status of drinking water sources in Gombe Metropolis of Nigeria. *American Journal of Scientific and Industrial Research*, *2*(4), 537–542.

Hayat, M. J., & Higgins, M. (2014). Understanding poisson regression. *Journal of Nursing Education*, *53*(4), 207–215.

Hayes, A. F., & Coutts, J. J. (2020). Use Omega Rather than Cronbach's Alpha for Estimating Reliability. But…. *Communication Methods and Measures*.

Hinton, P. (2014). SPSS Explained. In *SPSS Explained*.

Hosoglu, S., Celen, M. K., Geyik, M. F., Akalin, S., Ayaz, C., Acemoglu, H., & Loeb, M. (2006). Risk factors for typhoid fever among adult patients in Diyarbakir, Turkey. *Epidemiology and Infection*, *134*(3), 612–616.

Hu, S. (2014). Pretesting. In *Encyclopedia of Quality of Life and Well-Being Research* (pp. 5048–5052). Springer Netherlands.

Im, J., Islam, M. T., Ahmmed, F., Kim, D. R., Islam Khan, A., Zaman, K., Ali, M., Marks, F., Qadri, F., Kim, J., & Clemens, J. D. (2021). Can Existing Improvements of Water, Sanitation, and Hygiene (WASH) in Urban Slums Reduce the Burden of Typhoid Fever in These Settings? *Clinical Infectious Diseases*, *72*(11), e720–e726.

Im, J., Islam, M. T., Ahmmed, F., Kim, D. R., Khan, A. I., Zaman, K., Ali, M., Marks, F., Qadri, F., Kim, J., & Clemens, J. D. (2020). Can existing improvements of water, sanitation, and hygiene (WASH) in urban slums reduce the burden of typhoid fever in these settings? *Clinical Infectious Diseases*.

Indhumathi, K., & Sathesh Kumar, K. (2020). A review on prediction of seasonal diseases based on climate change using big data. *Materials Today: Proceedings*.

Iperepolu, O. H., Entonu, P. E., & Agwale, S. M. (2008). A review of the disease burden, impact and prevention of typhoid fever in Nigeria. *West African Journal of Medicine*, *27*(3), 127–133.

Iqbal Ahmed Shaikh, A., & Thirumal Prabhakar, A. (2021). Typhoid Fever and Its Nervous System Involvement. In *Innate Immunity in Health and Disease [Working Title]*. IntechOpen.

Ishaku, H. T., Majid, M. R., & Johar, F. (2012). Rainwater Harvesting: An Alternative to Safe Water Supply in Nigerian Rural Communities. *Water Resources Management*, *26*(2), 295–305.

Ismail, K., Maiga, G., Ssebuggwawo, D., Nabende, P., & Mansourian, A. (2021). Spatio-temporal trends and distribution patterns of typhoid disease in Uganda from 2012 to 2017. *Geospatial Health*, *15*(2), 326–336.

IVI. (2011). *Typhoid Fever Surveillance in Africa Program (TSAP), Working Protocol ID: IVI-TSAP-01 v1.8*. 1–46.

J. Barton, A., Hill, J., J. Blohmke, C., & J. Pollard, A. (2021). Host restriction, pathogenesis and chronic carriage of typhoidal Salmonella. *FEMS Microbiology Reviews*, *014*, 1–12.

Jaroni, D. (2014). Salmonella: Salmonella typhi. In *Encyclopedia of Food Microbiology: Second Edition* (Second Edi, Vol. 3). Elsevier.

Jenkins, A. P. (2017). *A nested environmental approach to typhoid epidemiology in Central Division, Fiji*. 206.

Jerumeh, T. R., Igbinadolor, J. I., & Akinbinu, T. O. (2020). Public health implications of solid waste management in Akure, Nigeria. *GeoJournal 2020*, 1–11.

Jin, C., Gibani, M. M., Moore, M., Juel, H. B., Jones, E., Meiring, J., Harris, V., Gardner, J., Nebykova, A., Kerridge, S. A., Hill, J., Thomaides-Brears, H., Blohmke, C. J., Yu, L. M., Angus, B., & Pollard, A. J. (2017). Efficacy and immunogenicity of a Vi-tetanus toxoid conjugate vaccine in the prevention of typhoid fever using a controlled human infection model of Salmonella Typhi: a randomised controlled, phase 2b trial. *The Lancet*, *390*(10111), 2472–2480.

Jingjing, Q. (1999). *Fluoride in water: An overview*.

John, J., Van Aart, C. J. C., & Grassly, N. C. (2016). The Burden of Typhoid and Paratyphoid in India: Systematic Review and Meta-analysis. *PLoS Neglected Tropical Diseases*, *10*(4), 1–14.

Jombo, G. T., Msugh Mbaawuaga, E., Ahmed, U., Abba, P. O., & Tsor, J. O. (2019). Management of Typhoid Fever at a University Hospital in Sub-Saharan Africa: Challenges and Prospects. *International Journal of Health Sciences & Research (Www.Ijhsr.Org)*, *9*(1), 190.

Jones, D., & Helmreich, S. (2020). A history of herd immunity. *The Lancet*, *396*(10254), 810–811.

Jones, E., Jin, C., Stockdale, L., Dold, C., Pollard, A. J., & Hill, J. (2021). A Salmonella Typhi Controlled Human Infection Study for Assessing Correlation between Bactericidal Antibodies and Protection against Infection Induced by Typhoid Vaccination. *Microorganisms*, *9*(7), 1–11.

Joshi, S., Adhikary, R., Beena, H. B., Bhavana, M. V., & Bhalwar, R. (2019). Trends in antibiotic susceptibility of enteric fever isolates from South India, 2002–2013. *Medical Journal Armed Forces India*, *75*(1), 81–85.

Julius, O. O., Didlyn, M., George, Q. P., Grace, N., & Yawa, J. (2021). International Journal of Fisheries and Aquaculture Occupational hazards, risk and injuries of fish processors in Tombo a coastal fish landing site, Sierra Leone, West Africa. *International Journal of Fisheries and Aquaculture*, *13*(1), 27–39.

Kak, V. (2007). Infections in Confined Spaces: Cruise Ships, Military Barracks, and College Dormitories. *Infectious Disease Clinics of North America*, *21*(3), 773–784.

Kanj, S. S., Kanafani, Z. A., Shehab, M., Sidani, N., Baban, T., Baltajian, K., Dakdouki, G. K., Zaatari, M., Araj, G. F., Wakim, R. H., Dbaibo, G., & Matar, G. M. (2015). Epidemiology, clinical manifestations, and molecular typing of salmonella typhi isolated from patients with typhoid fever in Lebanon. *Journal of Epidemiology and Global Health*, *5*(2), 159–165.

Karkey, A., Thwaites, G. E., & Baker, S. (2018). The evolution of antimicrobial resistance in Salmonella Typhi. *Current Opinion in Gastroenterology*, *34*(1), 25–30.

Kavai, S. M., Kangogo, M., Muigai, A. W. T., & Kariuki, S. (2018). Analysis of Trends in Resistance to Fluoroquinolones and Extended Spectrum Beta-Lactams among *Salmonella* Typhi Isolates Obtained from Patients at Four Outpatient Clinics in Nairobi County, Kenya. *Advances in Microbiology*, *08*(07), 578–588.

Kavai, S. M., & Kariuki, S. (2019). Increasing multidrug and fluoroquinolone resistance among Salmonella Typhi from sporadic outbreaks in Kenya. *International Journal of Infectious Diseases*, *79*, 44.

Khaliq, A., Yousafzai, M. T., Haq, S., Yaseen, R., Qureshi, S., Rind, F., Padhani, Z. A., Khan, A., Kazi, A. M., & Qamar, F. N. (2021). A Review of Toolkits and Case Definitions for Detecting Enteric Fever Outbreaks in asian and African Countries from 1965-2019. *Journal of Global Health*, *11*, 1–12.

Khan, J., Ahmad, I., Ali, S., Sohail, M., & Ali, I. (2021). Prevalence , Risk factors and Antibiogram analysis of Nosocomial Infection in Tertiary Care Hospital of Rawalpindi , Pakistan. *Research Square*, 1–12.

Khan, K., Lu, Y., Saeed, M. A., Bilal, H., Sher, H., Khan, H., Ali, J., Wang, P., Uwizeyimana, H., Baninla, Y., Li, Q., Liu, Z., Nawab, J., Zhou, Y., Su, C., & Liang, R. (2018). Prevalent fecal contamination in drinking water resources and potential health risks in Swat, Pakistan. *Journal of Environmental Sciences (China)*, *72*, 1–12.

Khan, M. I., Franco-Paredes, C., Sahastrabuddhe, S., Ochiai, R. L., Mogasale, V., & Gessner, B. D. (2017). Barriers to typhoid fever vaccine access in endemic countries. *Research and Reports in Tropical Medicine*, *8*, 37.

Khan, M. I., Ochiai, R. L., Soofi, S. B., Von-Seidlein, L., Khan, M. J., Sahito, S. M., Habib, M. A., Puri, M. K., Park, J. K., You, Y. A., Ali, M., Nizami, S. Q., Acosta, C. J., Bradley-Sack, R., Clemens, J. D., & Bhutta, Z. A. (2012). Risk factors associated with typhoid fever in children aged 2-16 years in Karachi, Pakistan. *Epidemiology and Infection*, *140*(4), 665–672.

Khanam, F., & Qadri, F. (2021). Use of the typhoid conjugate vaccine in endemic settings. *The Lancet Global Health*, *9*(8), e1047–e1048.

Khatib, R., Giacaman, R., Khammash, U., & Yusuf, S. (2017). Challenges to conducting epidemiology research in chronic conflict areas: Examples from PURE- Palestine Bayard Roberts, Kiran Jobunputra, Preeti Patel and Pablo Perel. *Conflict and Health*, *10*(1), 1–7.

Kingsley, R. A., & Dougan, G. (2009). Typhoid Fever. In *Vaccines for Biodefense and Emerging and Neglected Diseases* (pp. 1147–1161). Elsevier.

Kingsley, R. A., Langridge, G., Smith, S. E., Makendi, C., Fookes, M., Wileman, T. M., El Ghany, M. A., Keith Turner, A., Dyson, Z. A., Sridhar, S., Pickard, D., Kay, S., Feasey, N., Wong, V., Barquist, L., & Dougan, G. (2018). Functional analysis of *Salmonella* Typhi adaptation to survival in water. *Environmental Microbiology*, *20*(11), 4079–4090.

Kipruto Bett, D., Njogu, P., & Karanja, B. (2019). Assessment of Occupational Safety and Health Awareness and Practices in Public Health Facilities Uasin Gishu County, Kenya. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN*, *18*, 42–50.

Kleinbaum, D. G., & Klein, M. (2010). *Logistic Regression: A Self-Learning Text* (3rd ed.). Springer.

Klemm, E. J., Shakoor, S., Page, A. J., Qamar, F. N., Judge, K., Saeed, D. K., Wong, V. K., Dallman, T. J., Nair, S., Baker, S., Shaheen, G., Qureshi, S., Yousafzai, M. T., Saleem, M. K., Hasan, Z., Dougan, G., & Hasan, R. (2018). Emergence of an Extensively Drug-Resistant Salmonella enterica Serovar Typhi Clone Harboring a Promiscuous Plasmid Encoding Resistance to Fluoroquinolones and Third-Generation Cephalosporins. *MBio*, *9*(1), e00105-18.

Koller, I., Levenson, M. R., & Glück, J. (2017). What Do You Think You Are Measuring? A Mixed-Methods Procedure for Assessing the Content Validity of Test Items and Theory-Based Scaling. *Frontiers in Psychology*, *8*(FEB), 126.

Koo, T. K., & Li, M. Y. (2016). A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research. *Journal of Chiropractic Medicine*, *15*(2), 155–163.

Kouadio, I. K., Aljunid, S., Kamigaki, T., Hammad, K., & Oshitani, H. (2012). Infectious diseases following natural disasters: prevention and control measures. *Expert Review of Anti-Infective Therapy*, *10*(1), 95–104.

Krosnick, J. A. (2017). Questionnaire design. In *The Palgrave Handbook of Survey Research* (pp. 439–455). Palgrave Macmillan, Cham.

Kuubiere, C. B., Mogre, V., Majeed, S. F., & Alhassan, A. (2014). Typhoid intestinal perforations in Northern Ghana. *Medicine Enlisted Journal • I S S N*, *7*(4), 251–256.

Latzka, W. A., & Montain, S. J. (1999). Water and electrolyte requirements for exercise. *Clinics in Sports Medicine*, *18*(3), 513–524.

Lauria, D. T., Maskery, B., Poulos, C., & Whittington, D. (2009). An optimization model for reducing typhoid cases in developing countries without increasing public spending. *Vaccine*, *27*(10), 1609–1621.

Lavrakas, P. (2012). Encyclopedia of Survey Research Methods. In *Encyclopedia of Survey Research Methods*. Sage Publications, Inc.

Lawal, J., Jajere, S., Mustapha, M., Bello, A., Wakil, Y., Geidam, Y., Ibrahim, U., & Gulani, I. (2015). Prevalence of Newcastle Disease in Gombe, Northeastern Nigeria: A Ten-Year Retrospective Study (2004 – 2013). *British Microbiology Research Journal*, *6*(6), 367–375.

Lee, C.-J., Su, L.-H., Huang, Y.-C., & Chiu, C.-H. (2013). First isolation of ciprofloxacin-resistant Salmonella enterica serovar Typhi in Taiwan. *Journal of Microbiology, Immunology and Infection*, *46*(6), 469–473.

Lee, D.-Y., Lee, E., Park, H., & Kim, S. (2013). Availability of Clean Tap Water and Medical Services Prevents the Incidence of Typhoid Fever. *Osong Public Health and Research Perspectives*, *4*(2), 68–71.

Lee, J.-S., Mogasale, V. V., Mogasale, V., & Lee, K. (2016). Geographical distribution of typhoid risk factors in low and middle income countries. *BMC Infectious Diseases*, *16*(1), 732.

Levine, M. M. (2018). Typhoid Fever Vaccines. In *Plotkin's Vaccines* (pp. 1114-1144.e10). Elsevier.

Levine, M. M., & Lepage, P. (2007). Prevention of Typhoid Fever. In *Hot Topics in Infection and Immunity in Children II* (pp. 161–173). Springer US.

Levine, M. M., Tapia, M. D., & Zaidi, A. K. M. (2011). Typhoid and Paratyphoid (Enteric) Fever. In *Tropical Infectious Diseases: Principles, Pathogens and Practice* (pp. 121–127). Elsevier.

Li, L., Araral, E., & Jeuland, M. (2019). The drivers of household drinking water choices in Singapore: Evidence from multivariable regression analysis of perceptions and household characteristics. *Science of the Total Environment*, *671*, 1116–1124.

Lietz, P. (2010). Research into questionnaire design: A summary of the literature. *International Journal of Market Research*, *52*(2).

Ligon, B. L. (2006). Infectious Diseases that Pose Specific Challenges After Natural Disasters: A Review. *Seminars in Pediatric Infectious Diseases*, *17*(1), 36–45.

Lindsay, S., Garrett, D., & Steele, D. (2019). Evidence to Action: The 10th International Conference on Typhoid and Other Invasive Salmonelloses. *Clinical Infectious Diseases*, *68*(Supplement_1), S1–S3.

Liu, H., Whitehouse, C. A., & Li, B. (2018). Presence and Persistence of Salmonella in Water: The Impact on Microbial Quality of Water and Food Safety. *Frontiers in Public Health*, *6*, 159.

Liu, W., Zhao, T., Zhou, W., & Tang, J. (2018). Safety risk factors of metro tunnel construction in China: An integrated study with EFA and SEM. *Safety Science*, *105*, 98–113.

Liu, Z., Lao, J., Zhang, Y., Liu, Y., Zhang, J., Wang, H., & Jiang, B. (2018). Association between floods and typhoid fever in Yongzhou, China: Effects and vulnerable groups. *Environmental Research*, *167*, 718–724.

Loyd, J. (2013). *Typographic Readability and Legibility*. Envatotuts+.

Lutterloh, E., Likaka, A., Sejvar, J., Manda, R., Naiene, J., Monroe, S. S., Khaila, T., Chilima, B., Mallewa, M., Kampondeni, S. D., Lowther, S. A., Capewell, L., Date, K., Townes, D., Redwood, Y., Schier, J. G., Nygren, B., Tippett Barr, B., Demby, A., … Mintz, E. (2012). Multidrug-Resistant Typhoid Fever With Neurologic Findings on the Malawi-Mozambique Border. *Clinical Infectious Diseases*, *54*(8), 1100–1106.

Luxemburger, C., Duc, C. M., Lanh, M. N., Wain, J., Hien, T. T., Simpson, J. A., Kam, L. H., Tu Thuy, N. T., White, N. J., & Farrar, J. J. (2001). Risk factors for typhoid fever in the Mekong delta, southern Viet Nam: A case-control study. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *95*(1), 19–23.

MacDonald, S. E., Palichuk, A., Slater, L., Tripp, H., Reifferscheid, L., & Burton, C. (2021). Gaps in knowledge about the vaccine coverage of immunocompromised children: a scoping review. *Human Vaccines & Immunotherapeutics*, 1–16.

MacFadden, D. R., Bogoch, I. I., & Andrews, J. R. (2016). Advances in diagnosis, treatment, and prevention of invasive Salmonella infections. *Current Opinion in Infectious Diseases*, *29*(5), 453–458.

Maciver, D., Tyagi, V., Kramer, J. M., Richmond, J., Todorova, L., Romero-Ayuso, D., Nakamura-Thomas, H., van Hartingsveldt, M., Johnston, L., O'Hare, A., & Forsyth, K. (2020). Development, psychometrics and feasibility of the School Participation Questionnaire: A teacher measure of participation related constructs. *Research in Developmental Disabilities*, *106*, 103766.

Mackison, D., Wrieden, W. L., & Anderson, A. S. (2010). Validity and reliability testing of a short questionnaire developed to assess consumers’ use, understanding and perception of food labels. *European Journal of Clinical Nutrition*, *64*, 210–217.

Manesh, A., Meltzer, E., Jin, C., Britto, C., Deodhar, D., Radha, S., Schwartz, E., & Rupali, P. (2021). Typhoid and paratyphoid fever: a clinical seminar. *Journal of Travel Medicine*, *28*(3), 1–13.

Mannan, A., Shohel, M., Rajia, S., Mahmud, N. U., Kabir, S., & Hasan, I. (2014). A cross sectional study on antibiotic resistance pattern of Salmonella typhi clinical isolates from Bangladesh. *Asian Pacific Journal of Tropical Biomedicine*, *4*(4), 306–311.

Marchello, C. S., Hong, C. Y., & Crump, J. A. (2019). Global Typhoid Fever Incidence: A Systematic Review and Meta-analysis. *Clinical Infectious Diseases*, *68*(Supplement_2), S105–S116.

Marie, A., Calayag, B., Widmer, K. W., & Rivera, W. L. (2021). *Antimicrobial Susceptibility and Prevalence of bla and qnr Genes in Salmonella Enterica Isolated from Slaughtered Pork*.

Marks, F., von Kalckreuth, V., Aaby, P., Adu-Sarkodie, Y., El Tayeb, M. A., Ali, M., Aseffa, A., Baker, S., Biggs, H. M., Bjerregaard-Andersen, M., Breiman, R. F., Campbell, J. I., Cosmas, L., Crump, J. A., Espinoza, L. M. C., Deerin, J. F., Dekker, D. M., Fields, B. S., Gasmelseed, N., … Wierzba, T. F. (2017). Incidence of invasive salmonella disease in sub-Saharan Africa: a multicentre population-based surveillance study. *The Lancet Global Health*, *5*(3), e310–e323.

Masuet-Aumatell, C., & Atouguia, J. (2020). Typhoid fever infection – antibiotic resistance and vaccination strategies: a narrative review. *Travel Medicine and Infectious Disease*, *40*, 101946.

Mawazo, A., Bwire, G. M., & Matee, M. I. N. (2019). Performance of Widal test and stool culture in the diagnosis of typhoid fever among suspected patients in Dar es Salaam, Tanzania. *BMC Research Notes*, *12*(1).

McCormick, K., Salcedo, J., & Poh, A. (2015). SPSS® Statistics For Dummies®, 3rd Edition. In *For Dummies, A Wiley Brand*.

McHugh, M. L. (2012a). Interrater reliability: The kappa statistic. *Biochemia Medica*, *22*(3), 276–282.

McHugh, M. L. (2012b). The Chi-square test of independence. *Biochemia Medica*, *23*(2), 143–149.

Menezes, G. A., Harish, B. N., Khan, M. A., Goessens, W. H. F., & Hays, J. P. (2012). Antimicrobial resistance trends in blood culture positive Salmonella Typhi isolates from Pondicherry, India, 2005–2009. *Clinical Microbiology and Infection*, *18*(3), 239–245.

Mermin, J. H., Villar, R., Carpenter, J., Roberts, L., Samaridden, A., Gasanova, L., Lomakina, S., Bopp, C., Hutwagner, L., Mead, P., Ross, B., & Mintz, E. D. (2002). A Massive Epidemic of Multidrug-Resistant Typhoid Fever in Tajikistan Associated with Consumption of Municipal Water. *The Journal of Infectious Diseases*, *179*(6), 1416–1422.

Mike, I., Maori, L., Adamu, A., Gushit, S., Maryam, L., Florence, G., Abdullfattah, S., & Shittu, N. (2017). *Prevalence of Malaria and Typhoid Co-Infections among Patients who Attended State Specialist Hospital Gombe from May to August 2015 for Malaria and Widal Tests*.

Mileno, M. D., Lau, C., Lonks, J. R., Garland, J. M., Sanchez, M. C., Nau, G. J., & Larkin, J. M. (2019). Vaccines for Adult Travelers: When and Why? *Vaccinations*, 163–177.

Milligan, R., Paul, M., Richardson, M., & Neuberger, A. (2018). Vaccines for preventing typhoid fever. *Cochrane Database of Systematic Reviews*, *5*.

Mishra, P., Pandey, C., Singh, U., Keshri, A., & Sabaretnam, M. (2019). Selection of appropriate statistical methods for data analysis. *Annals of Cardiac Anaesthesia*, *22*(3), 297–301.

Mogasale, V., Maskery, B., Ochiai, R. L., Lee, J. S., Mogasale, V. V, Ramani, E., Kim, Y. E., Park, J. K., & Wierzba, T. F. (2014). Burden of typhoid fever in low-income and middle-income countries: a systematic, literature-based update with risk-factor adjustment. *The Lancet Global Health*, *2*(10), e570–e580.

Mogasale, V. V., Ramani, E., Mogasale, V., Park, J. Y., & Wierzba, T. F. (2018). Estimating Typhoid Fever Risk Associated with Lack of Access to Safe Water: A Systematic Literature Review. *Journal of Environmental and Public Health*, *2018*, 1–14.

Morehead, M. S., & Scarbrough, C. (2018). Emergence of Global Antibiotic Resistance. *Primary Care: Clinics in Office Practice*, *45*(3), 467–484.

Morral-Puigmal, C., Martínez-Solanas, È., Villanueva, C. M., & Basagaña, X. (2018). Weather and gastrointestinal disease in Spain: A retrospective time series regression study. *Environment International*, *121*, 649–657.

Msemo, O. A., Mbwana, J., Mahende, C., Malabeja, A., Gesase, S., Crump, J. A., Dekker, D., & Lusingu, J. P. A. (2019). Epidemiology and Antimicrobial Susceptibility of Salmonella enterica Bloodstream Isolates Among Febrile Children in a Rural District in Northeastern Tanzania: A Cross-sectional Study. *Clinical Infectious Diseases : An Official Publication of the Infectious Diseases Society of America*, *68*(2), S177–S182.

Muhsen, K., Pasetti, M. F., Reymann, M. K., Graham, D. Y., & Levine, M. M. (2014). Helicobacter pylori infection affects immune responses following vaccination of typhoid-naive U.S. adults with attenuated Salmonella typhi oral vaccine CVD 908-htrA. *The Journal of Infectious Diseases*, *209*(9), 1452–1458.

Mukhopadhyay, B., Sur, D., Gupta, S., & Ganguly, N. (2019). Typhoid fever: Control & challenges in India. In *Indian Journal of Medical Research* (Vol. 150, Issue 5, pp. 437–447). Wolters Kluwer Medknow Publications.

Mulu, W., Akal, C. G., Ababu, K., Getachew, S., Tesfaye, F., Wube, A., & Chekol, D. (2021). Seroconfirmed Typhoid Fever and Knowledge, Attitude, and Practices among Febrile Patients Attending at Injibara General Hospital, Northwest Ethiopia. *BioMed Research International*, *2021*.

Muresu, N., Sotgiu, G., Are, B. M., Cossu, A., Cocuzza, C., Martinelli, M., Babudieri, S., Are, R., Dettori, M., Azara, A., Saderi, L., & Piana, A. (2020). Travel-Related Typhoid Fever: Narrative Review of the Scientific Literature. *International Journal of Environmental Research and Public Health*, *17*(2), 615.

Murphy, J. L., Kahler, A. M., Nansubug, I., Nanyunj, E. M., Kaplan, B., Jothikumar, N., Routh, J., Gómez, G. A., Mintz, E. D., & Hill, V. R. (2017). Environmental survey of drinking water sources in Kampala, Uganda, during a typhoid fever outbreak. *Applied and Environmental Microbiology*, *83*(23), 1–11.

Mutai, W. C., Muigai, A. W. T., Waiyaki, P., & Kariuki, S. (2018). Multi-drug resistant Salmonella enterica serovar Typhi isolates with reduced susceptibility to ciprofloxacin in Kenya. *BMC Microbiology*, *18*(1), 187.

Nabi, G., Ali, M., Khan, S., & Kumar, S. (2019). The crisis of water shortage and pollution in Pakistan: risk to public health, biodiversity, and ecosystem. *Environmental Science and Pollution Research*, *26*(11), 10443–10445.

Nahimana, M. R., Ngoc, C. T., Olu, O., Nyamusore, J., Isiaka, A., Ndahindwa, V., Dassanayake, L., & Rusanganwa, A. (2017). Knowledge, attitude and practice of hygiene and sanitation in a Burundian refugee camp: Implications for control of a Salmonella typhi outbreak. *Pan African Medical Journal*, *28*.

Namdeo, S. K., & Rout, S. D. (2016). Calculating and interpreting Cronbach ' s alpha using Rosenberg assessment scale on paediatrician ' s attitude and p erception on self esteem. *International Journal of Community Medicine and Public Health*, *3*(6), 1371–1374.

Neiderud, C. J. (2015). How urbanization affects the epidemiology of emerging infectious diseases. *African Journal of Disability*, *5*(1), 27060.

Neil, K. P., Sodha, S. V., Lukwago, L., O-tipo, S., Mikoleit, M., Simington, S. D., Mukobi, P., Balinandi, S., Majalija, S., Ayers, J., Kagirita, A., Wefula, E., Asiimwe, F., Kweyamba, V., Talkington, D., Shieh, W.-J., Adem, P., Batten, B. C., Zaki, S. R., & Mintz, E. (2012). A Large Outbreak of Typhoid Fever Associated With a High Rate of Intestinal Perforation in Kasese District, Uganda, 2008-2009. *Clinical Infectious Diseases*, *54*(8), 1091–1099.

Neupane, D. P., Dulal, H. P., Song, J., & Gómez-Laguna, J. (2021). *pathogens Enteric Fever Diagnosis: Current Challenges and Future Directions*.

Nga, T. V. T., Duy, P. T., Lan, N. P. H., Chau, N. V. V., & Baker, S. (2018). The Control of Typhoid Fever in Vietnam. *The American Journal of Tropical Medicine and Hygiene*, *99*(3_Suppl), 72–78.

Nigeria Data Portal. (2014). *Socioeconomic statistics*.

Nor, Z. M. Z. M. N., Yaacob, N. N. M., & Mohammad, J. A. M. (2019). Dimensionality and reliability of USM pre-clinical medical students' guidance and counselling needs questionnaire. *Journal of Taibah University Medical Sciences*, *14*(2), 123–130.

NPC. (2006). *2006 PHC Priority Tables*. National Population Commission.

Nyamusore, J., Nahimana, M. R., Ngoc, C. T., Olu, O., Isiaka, A., Ndahindwa, V., Dassanayake, L., & Rusanganwa, A. (2018). Risk factors for transmission of Salmonella Typhi in Mahama refugee camp, Rwanda: A matched case-control study. *Pan African Medical Journal*, *29*.

O'Connor, L., Porter, L., Dugas, J., Robinson, C., Carrillo, E., Knowles, K., Nelson, K. P., Gigiliotti, R., Tennyson, J., Weisberg, S., & Rebesco, M. (2020). Measuring Agreement Among Prehospital Providers and Physicians in Patient Capacity Determination. *Academic Emergency Medicine*, acem.13941.

Obaro, S. K., Iroh Tam, P.-Y., & Mintz, E. D. (2017). The unrecognized burden of typhoid fever. *Expert Review of Vaccines*, *16*(3), 249–260.

Oberski, D. L. (2015). Questionnaire science. In *The Oxford Handbook of Polling and Polling Methods* (pp. 113–137).

Obubu, M., Afeez Mayowa, B., & Chukwudike, N. (2019). Poisson Regression Modeling of Pregnancy Related Death in Oyo State, Nigeria. *Asian Journal of Pregnancy and Childbirth*, *2*(2), 1–5.

Odikamnoro, O. O., Ikeh, I. M., Okoh, F. N., Ebiriekwe, S. C., Nnadozie, I. A., Nkwuda, J. O., & Asobie, G. C. (2017). Incidence Of Malaria/Typhoid Co-Infection Among Adult Population In Unwana Community, Afikpo North Local Government Area, Ebonyi State, Southeastern Nigeria. *J. Infect. Dis*, *12*(1), 33–38.

Oguntade, E. S., Shohaimi, S., Nallapan, M., & Ajibola Lamidi-Sarumoh, A. (2018). Factors Influencing Malaria Knowledge, Attitude and Practice in Gwagwalada. In *International Journal of Science and Healthcare Research (www.ijshr.com)* (Vol. 3, Issue 3).

Ohanu, M. E., Iroezindu, M. O., Maduakor, U., Onodugo, O. D., & Gugnani, H. C. (2019). Typhoid fever among febrile Nigerian patients: Prevalence, diagnostic performance of the widal test and antibiotic multi-drug resistance. *Malawi Medical Journal*, *31*(3), 184–192.

Okeke, I. N., Aboderin, O. A., Byarugaba, D. K., Ojo, K. K., & Opintan, J. A. (2007). Growing problem of multidrug-resistant enteric pathogens in Africa. *Emerging Infectious Diseases*, *13*(11), 1640–1646.

Oliva-Pérez, J., Cabrero-García, J., Cabañero-Martínez, M. J., Richart-Martínez, M., & Oliver-Roig, A. (2019). Validity and Reliability of the Spanish Version of the Pregnancy-Related Thoughts Scale. *JOGNN - Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *48*(5), 526–537.

Olsen, S. J., Bleasdale, S. C., Magnano, A. R., Landrigan, C., Holland, B. H., Tauxe, R. V, Mintz, E. D., & Luby, S. (2003). Outbreaks of typhoid fever in the United States, 1960-99. *Epidemiology and Infection*, *130*(1), 13–21.

Omari, R., Frempong, G. K., & Arthur, W. (2018). Public perceptions and worry about food safety hazards and risks in Ghana. *Food Control*, *93*, 76–82.

Ommi, D., Hemmatinezhad, B., Hafshejani, T. T., & Khamesipour, F. (2017). Incidence and Antimicrobial Resistance of Campylobacter and Salmonella from Houseflies (Musca Domestica) in Kitchens, Farms, Hospitals and Slaughter Houses. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, *87*(4), 1285–1291.

Oosterveld, P., Vorst, H. C. M., & Smits, N. (2019). Methods for questionnaire design: a taxonomy linking procedures to test goals. In *Quality of Life Research* (Vol. 28, Issue 9, pp. 2501–2512). Springer International Publishing.

Outbreak Response Unit, & National Institute for Communicable Diseases. (2016). *Outbreak Response Unit National Institute for Communicable Diseases*.

Owais, A., Sultana, S., Zaman, U., Rizvi, A., & Zaidi, A. K. M. (2010). Incidence of typhoid bacteremia in infants and young children in southern coastal Pakistan. *The Pediatric Infectious Disease Journal*, *29*(11), 1035–1039.

Owoeye, J. O., & Omole, F. K. (2012). Built Environment Decay and Health Situation of Slum Dwellers in Residential Cores of Akure, Nigeria. *American Journal of Human Ecology*, *1*(2), 33–39.

Park, S. E., Toy, T., Cruz Espinoza, L. M., Panzner, U., Mogeni, O. D., Im, J., Poudyal, N., Pak, G. D., Seo, H., Chon, Y., Schütt-Gerowitt, H., Mogasale, V., Ramani, E., Dey, A., Park, J. Y., Kim, J. H., Seo, H. J., Jeon, H. J., Haselbeck, A., … Marks, F. (2019). The Severe Typhoid Fever in Africa Program: Study Design and Methodology to Assess Disease Severity, Host Immunity, and Carriage Associated with Invasive Salmonellosis. *Clinical Infectious Diseases*, *69*(S6), S422–S434.

Patalay, P., Hayes, D., & Wolpert, M. (2018). Assessing the readability of the self-reported Strengths and Difficulties Questionnaire. *BJPsych Open*, *4*(02), 55–57.

Paudel, U., Prasad PANT, K., Raj ADHIKARI, S., Silwal, S., Bista, B., Baral, B., Dhimal, M., & Paudel Nepal, U. (2021). Factors associated with typhoid fever in Western Nepal: A cross-sectional study. *The Italian Journal for Interdisciplinary Health and Social Development*, *6*, 281–292.

Paul, U. K., & Bandyopadhyay, A. (2017). Typhoid fever: a review. *International Journal of Advances in Medicine*, *4*(2), 300–306.

Perinetti, G. (2018). StaTips Part IV: Selection, interpretation and reporting of the intraclass correlation coefficient. *South European Journal of Orthodontics and Dentofacial Research*, *5*(1), 3–5.

Peter, O. J., Ibrahim, M. O., Edogbanya, H. O., Oguntolu, F. A., Oshinubi, K., Ibrahim, A. A., Ayoola, T. A., & Lawal, J. O. (2021). Direct and indirect transmission of typhoid fever model with optimal control. *Results in Physics*, *27*, 104463.

Petzold, M. B., Frank, G., Bendau, A., Plag, J., Betzler, F., & Ströhle, A. (2020). The German version of the Exercise in Mental Illness Questionnaire (EMIQ-G): Translation and testing of psychometric properties. *Mental Health and Physical Activity*, *19*, 100353.

Pham Thanh, D., Thompson, C. N., Rabaa, M. A., Sona, S., Sopheary, S., Kumar, V., Moore, C., Tran Vu Thieu, N., Wijedoru, L., Holt, K. E., Wong, V., Pickard, D., Thwaites, G. E., Day, N., Dougan, G., Turner, P., Parry, C. M., & Baker, S. (2016). The Molecular and Spatial Epidemiology of Typhoid Fever in Rural Cambodia. *PLoS Neglected Tropical Diseases*, *10*(6), 1–16.

Phung, D., Huang, C., Rutherford, S., Chu, C., Wang, X., & Nguyen, M. (2014). Association between annual river flood pulse and paediatric hospital admissions in the Mekong Delta area. *Environmental Research*, *135*, 212–220.

Pitzer, V. E., Crump, J. A., Lynch, V. D., Saad, N. J., Antillón, M., & Yang, C. (2018). Seasonal dynamics of typhoid and paratyphoid fever. *Scientific Reports*, *8*(1), 1–9.

Pollard, D. J., Young, J. C., Covarelli, V., Herrera-León, S., Connor, T. R., Fookes, M., Walker, D., Echeita, A., Thomson, N. R., Berger, C. N., & Frankel, G. (2016). The Type III Secretion System Effector SeoC of Salmonella enterica subsp. salamae and S. enterica subsp. arizonae ADP-Ribosylates Src and Inhibits Opsonophagocytosis. *Infection and Immunity*, *84*(12), 3618–3628.

Population Stat. (2021). *Gombe, Nigeria Population (2021) - Population Stat*. Gombe, Nigeria Population.

Prasad, N., Jenkins, A. P., Naucukidi, L., Rosa, V., Sahu-Khan, A., Kama, M., Jenkins, K. M., Jenney, A. W. J., Jack, S. J., Saha, D., Horwitz, P., Jupiter, S. D., Strugnell, R. A., Mulholland, E. K., & Crump, J. A. (2018). Epidemiology and risk factors for typhoid fever in Central Division, Fiji, 2014–2017: A case-control study. *PLoS Neglected Tropical Diseases*, *12*(6).

Prous, M. J. G. de Y., Salvanés, F. R., & Loreto Carmona Ortells. (2008). Validation of questionnaires. *Validation of Questionnaires*, *5*(4), 171–177.

Prouty, C., & Zhang, Q. (2016). How do people's perceptions of water quality influence the life cycle environmental impacts of drinking water in Uganda? *Resources, Conservation and Recycling*, *109*, 24–33.

Public Health England. (2017). *Interim - Public Health Operational Guidelines for Typhoid and Paratyphoid (Enteric Fever)*.

Qamar, F. N., Yousafzai, M. T., Khalid, M., Kazi, A. M., Lohana, H., Karim, S., Khan, A., Hotwani, A., Qureshi, S., Kabir, F., Aziz, F., Memon, N. M., Domki, M. H., & Hasan, R. (2018). Outbreak investigation of ceftriaxone-resistant Salmonella enterica serotype Typhi and its risk factors among the general population in Hyderabad, Pakistan: a matched case-control study. *The Lancet Infectious Diseases*, *18*(12), 1368–1376.

Radhakrishnan, A., Als, D., Mintz, E. D., Crump, J. A., Stanaway, J., Breiman, R. F., & Bhutta, Z. A. (2018). Introductory Article on Global Burden and Epidemiology of Typhoid Fever. *The American Journal of Tropical Medicine and Hygiene*, *99*(3_Suppl), 4–9.

Rahman, B. A., Hanna, N., House, B., Maksoud, M. A., Wasfy, M. O., & Dueger, E. (2014). Multi-drug resistance and reduced susceptibility to ciprofloxacin among Salmonella enterica serovar Typhi isolates from the Middle East and Central Asia. *New Microbes and New Infections*, *2*(4), 88–92.

Rahman, B. A., Wasfy, M. O., Maksoud, M. A., Hanna, N., Dueger, E., & House, B. (2014). Multi-drug resistance and reduced susceptibility to ciprofloxacin among Salmonella enterica serovar Typhi isolates from the Middle East and Central Asia. *New Microbes and New Infections*, *2*(4), 88–92.

Rahman, M. A. (2015). Antimicrobial Resistance Patterns of Salmonella Typhi Isolated from Stool Culture. *Chattagram Maa-O-Shishu Hospital Medical College Journal*, *14*(1), 26–30.

Rajendran, S., Giridhar, S., Chaudhari, S., & Gupta, P. K. (2021). Technological advancements in occupational health and safety. *Measurement: Sensors*, *15*, 100045.

Ram, P. K., Naheed, A., Brooks, W. A., Hossain, M. A., Mintz, E. D., Breiman, R. F., & Luby, S. P. (2007). Risk factors for typhoid fever in a slum in Dhaka, Bangladesh. *Epidemiology and Infection*, *135*(03), 458.

Ranjeeth, S., Latchoumi, T. P., & Paul, P. V. (2020). Role of gender on academic performance based on different parameters: Data from secondary school education. *Data in Brief*, *29*, 105257.

Rasul, F., Sughra, K., Mushtaq, A., Zeeshan, N., Mehmood, S., & Rashid, U. (2017). Surveillance report on typhoid fever epidemiology and risk factor assessment in district Gujrat, Punjab, Pakistan. *Biomedical Research (India)*, *28*(16), 6921–6926.

Riffenburgh, R. H., & Gillen, D. L. (2020). Poisson regression for count outcomes. In *Statistics in Medicine* (pp. 459–475). Elsevier.

Rizatto, A. J. dos P., Corrêa, C. de C., Martinelli, R. L. de C., & Berretin-Felix, G. (2020). Portal dos Bebês: atualização e avaliação dos conteúdos sobre as funções orofaciais. *Audiology - Communication Research*, *25*.

Roberts, S. E., & Carter, T. (2016). British merchant seafarers 1900–2010: A history of extreme risks of mortality from infectious disease. *Travel Medicine and Infectious Disease*, *14*(5), 499–504.

Ryan, K. J., & Ray, G. C. (2004). *Sherris Medical Microbiology, An Introduction to Infectious Diseases* (4th Editio). McGraw-Hill.

Saidu, I., & Lal, M. D. (2016). Development of built environment and its implication on flood risk in Gombe Metropolis, Nigeria. *African Journal of Environmental Science and Technology*, *10*(4), 111–116.

Samajpati, S., Das, S., Ray, U., & Dutta, S. (2018). Report of relapse typhoid fever cases from Kolkata, India: Recrudescence or reinfection? *Japanese Journal of Infectious Diseases*, *71*(3), 209–213.

Sanderson, K. E., Liu, S.-L., Tang, L., & Johnston, R. N. (2015). Salmonella Typhi and Salmonella Paratyphi A. In *Molecular Medical Microbiology* (pp. 1275–1306). Elsevier.

Saporito, L., Colomba, C., & Titone, L. (2016). Typhoid Fever. In *International Encyclopedia of Public Health* (Second Edi, Vol. 7). Elsevier.

Saravanan, V. S., Ayessa Idenal, M., Saiyed, S., Saxena, D., & Gerke, S. (2016). Urbanization and human health in urban India: Institutional analysis of water-borne diseases in Ahmedabad. *Health Policy and Planning*, *31*(8), 1089–1099.

Sarwar, M. (2015). Insect Vectors Involving in Mechanical Transmission of Human Pathogens for Serious Diseases. *International Journal of Bioinformatics and Biomedical Engineering*, *1*(3), 300–306.

Satterthwaite, D. (2017). The impact of urban development on risk in sub-Saharan Africa's cities with a focus on small and intermediate urban centres. *International Journal of Disaster Risk Reduction*, *26*, 16–23.

Sheded, M., Mosaad, M., Hassan, A., Faisal, A., Abbadi, S., & Ghareeb, D. (2018). Changing Patterns and Outcomes of Typhoid Fever in Egypt. *International Journal of TROPICAL DISEASE & Health*, *32*(4), 1–8.

Siddiqui, F. J., Haider, S. R., & Bhutta, Z. A. (2008). Risk factors for typhoid fever in children in squatter settlements of Karachi: A nested case-control study. *Journal of Infection and Public Health*, *1*(2), 113–120.

Siddiqui, F. J., Rabbani, F., Hasan, R., Nizami, S. Q., & Bhutta, Z. A. (2006). Typhoid fever in children: some epidemiological considerations from Karachi, Pakistan. *International Journal of Infectious Diseases*, *10*(3), 215–222.

Simon, A. K., Hollander, G. A., Mcmichael, A., & Mcmichael, A. (2015). Evolution of the immune system in humans from infancy to old age. *Proc. Biol. Sci.*, *282*(1821), 1–12.

Singh, B. (2001). Symposium : Typhoid Fever. *Indian Academy of Clinical Medicine Journal*, *2*, 11–12.

Singh, P. P., & Sharma, V. (2013). *Water and health*. Springer Science and Business Media.

Sirima, S. B., Ouedraogo, A., Barry, N., Siribie, M., Tiono, A., Nébié, I., Konaté, A., Berges, G. D., Diarra, A., Ouedraogo, M., Bougouma, E. C., Soulama, I., Hema, A., Datta, S., Liang, Y., Rotrosen, E. T., Tracy, J. K., Jamka, L. P., Oshinsky, J. J., … Laurens, M. B. (2021). Safety and immunogenicity of Vi-typhoid conjugate vaccine co-administration with routine 9-month vaccination in Burkina Faso: A randomized controlled phase 2 trial. *International Journal of Infectious Diseases*, *108*, 465–472.

Sivaji, I., Duraisamy, S., & Balakrishnan, S. (2016). Analysis of TLR polymorphisms in typhoid patients and asymptomatic typhoid carriers among the schoolchildren. *Egyptian Journal of Medical Human Genetics*, *17*(4), 353–357.

Sohn, S., Xercavins, M., Llovet, T., Navarro, F., Morera, M. A., More, J., Bella, F., Freixas, N., Simo, M., Echeita, A., Coll, P., Garau, J., & Prats, G. (1997). Epidemiology of an Unusually Prolonged Outbreak of Typhoid Fever in Terrassa, Spain. *Clinical Infectious Diseases*, *24*(3), 506–510.

Somda, N. S., Bonkoungou, I. J. O., Sambe-Ba, B., Drabo, M. S., Wane, A. A., Sawadogo-Lingani, H., & Savadogo, A. (2021). Diversity and antimicrobial drug resistance of non-typhoid Salmonella serotypes isolated in lettuce, irrigation water and clinical samples in Burkina Faso. *Journal of Agriculture and Food Research*, *5*, 100167.

Song, Y., Son, Y.-J., & Oh, D. (2015). Methodological Issues in Questionnaire Design. *Journal of Korean Academy of Nursing*, *45*(3), 323–328.

Sreejesh, S., Mohapatra, S., Anusree, M. R., Sreejesh, S., Mohapatra, S., & Anusree, M. R. (2014). Questionnaire Design. In *Business Research Methods* (pp. 143–159). Springer International Publishing.

Srikantiah, P., Vafokulov, S., Luby, S. P., Ishmail, T., Earhart, K., Khodjaev, N., Jennings, G., Crump, J. A., & Mahoney, F. J. (2007). Epidemiology and risk factors for endemic typhoid fever in Uzbekistan. *Tropical Medicine and International Health*, *12*(7), 838–847.

Stanaway, J. D., Reiner, R. C., Blacker, B. F., Goldberg, E. M., Khalil, I. A., Troeger, C. E., Andrews, J. R., Bhutta, Z. A., Crump, J. A., Im, J., Marks, F., Mintz, E., Park, S. E., Zaidi, A. K. M., Abebe, Z., Abejie, A. N., Adedeji, I. A., Ali, B. A., Amare, A. T., … Hay, S. I. (2019). The global burden of typhoid and paratyphoid fevers: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet Infectious Diseases*, *19*(4), 369–381.

Steele, A. D., Hay Burgess, D. C., Diaz, Z., Carey, M. E., & Zaidi, A. K. M. (2016a). Challenges and Opportunities for Typhoid Fever Control: A Call for Coordinated Action. *Clinical Infectious Diseases*, *62*(Suppl 1), s4–s8.

Steele, A. D., Hay Burgess, D. C., Diaz, Z., Carey, M. E., & Zaidi, A. K. M. (2016b). Challenges and Opportunities for Typhoid Fever Control: A Call for Coordinated Action. *Clinical Infectious Diseases*, *62*(suppl 1), S4–S8.

Stoltzfus, J. C. (2011). Logistic regression: A brief primer. *Academic Emergency Medicine*, *18*(10), 1099–1104.

Subhash, C. P. (2012). *A Textbook of Microbiology and Immunology* (2nd Editio). Elsevier.

Sur, D., Ali, M., Von Seidlein, L., Manna, B., Deen, J. L., Acosta, C. J., Clemens, J. D., & Bhattacharya, S. K. (2007). Comparisons of predictors for typhoid and paratyphoid fever in Kolkata, India. *BMC Public Health*, *7*, 1–10.

Sur, D., von Seidlein, L., Manna, B., Dutta, S., Deb, A. K., Sarkar, B. L., Kanungo, S., Deen, J. L., Ali, M., Kim, D. R., Gupta, V. K., Ochiai, R. L., Tsuzuki, A., Acosta, C. J., Clemens, J. D., & Bhattacharya, S. K. (2006). The malaria and typhoid fever burden in the slums of Kolkata, India: data from a prospective community-based study. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *100*(8), 725–733.

Sutiono, A. B., Qiantori, A., Suwa, H., & Ohta, T. (2010a). Characteristics and risk factors for typhoid fever after the tsunami, earthquake and under normal conditions in Indonesia. *BMC Research Notes*, *3*.

Sutiono, A. B., Qiantori, A., Suwa, H., & Ohta, T. (2010b). Characteristics and risk factors for typhoid fever after the tsunami, earthquake and under normal conditions in Indonesia. *BMC Research Notes*, *3*(1), 1–9.

Tahir, A. A. S. A. S. A. (2019). Antimicrobial resistance trends of Typhoidal Salmonellae In Southern Pakistan. *Rawal Medical Journal*, *44*(1), 7–10.

Tatavarthy, A., Luna, V. A., & Amuso, P. T. (2014). How multidrug resistance in typhoid fever affects treatment options. *Annals of the New York Academy of Sciences*, *1323*(1), 76–90.

Techasaensiri, C., Radhakrishnan, A., Als, D., & Thisyakorn, U. (2018). Typhoidal salmonella trends in Thailand. *American Journal of Tropical Medicine and Hygiene*, *99*(3), 64–71.

Teymouri, P., & Dehghanzadeh, R. (2021). Climate change and water-related diseases in developing countries of Western Asia: a systematic literature review.

Thando D. Gwebu. (2003). Environmental problems among low income urban residents: an empirical analysis of old Naledi-Gaborone, Botswana. *Habitat International* , *27*, 407–427.

Tran, H. H., Bjune, G., Nguyen, B. M., Rottingen, J. A., Grais, R. F., & Guerin, P. J. (2005). Risk factors associated with typhoid fever in Son La province, northern Vietnam. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *99*(11), 819–826.

Trizano-Hermosilla, I., & Alvarado, J. M. (2016). Best Alternatives to Cronbach's Alpha Reliability in Realistic Conditions: Congeneric and Asymmetrical Measurements. *Frontiers in Psychology*, *7*(MAY), 769.

Tsang, S., Royse, C. F., & Terkawi, A. S. (2017a). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi Journal of Anaesthesia*, *11*(Suppl 1), S80–S89.

Tsang, S., Royse, C. F., & Terkawi, A. S. (2017b). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. In *Saudi Journal of Anaesthesia* (Vol. 11, Issue 5, pp. S80–S89). Medknow Publications.

Turan, M., & Mammadov, R. (2021). Phenolic Compounds Screening and Potential of Larvicidal Activity of Water Extract of Cyclamen cilicium. *Boiss. & Heldr. Natural Products and Biotechnology*, *1*(1), 1–8.

UCLA: Statistical Consulting Group. (2011). *Factor Analysis: Spss Annotated Output* (Vol. 45, Issue 2, pp. 115–158).

Ugulu, I. (2013). *Educational Research and Reviews Confirmatory factor analysis for testing validity and reliability of traditional knowledge scale to measure university students' attitudes*. *8*(16), 1399–1408.

van Seventer, J. M., & Hochberg, N. S. (2016). Principles of Infectious Diseases: Transmission, Diagnosis, Prevention, and Control. In *International Encyclopedia of Public Health* (Second Edi, Vol. 6). Elsevier.

Vasan, P. T., Prabhu, D. I. G., & Pandian, R. S. (2008). Vector competence of Musca domestica Linn. with reference to the virulent strains of Salmonella typhi in bus stands and markets at Madurai, Tamil Nadu. *Current Biotica*, *2*(2), 154–160.

Velema, J. P., Van Wijnen, G., Bult, P., Van Naerssen, T., & Jota, S. (1997). Typhoid fever in Ujung Indonesia - High-risk groups and high-risk behaviours. *Tropical Medicine and International Health*, *2*(11), 1088–1094.

Verma, S., Bansal, A., Gaur, M., & Kumar, B. (2021). Robust immunity induced by multi-epitope DnaK peptides, potential vaccine candidates against Salmonella: An in vitro study. *Immunology Letters*, *236*, 61–67.

Vighio, A., Syed, M. A., Hussain, I., Zia, S. M., Fatima, M., Masood, N., Chaudry, A., Hussain, Z., Baig, M. Z. I., Baig, M. A., Ikram, A., & Khader, Y. S. (2021). Risk factors of extensively drug resistant typhoid fever among children in Karachi: Case-control study. *JMIR Public Health and Surveillance*, *7*(5), e27276.

Vilagut, G. (2014). Test-Retest Reliability. In *Encyclopedia of Quality of Life and Well-Being Research* (pp. 6622–6625). Springer Netherlands.

Vishwanath, M. (2014). *A Clinical Trial of Treatment of Uncomplicated Typhoid Fever: Efficacy of Azithromycin versus Ceftriaxone*.

Vollaard, A. M., Verspaget, H. W., Ali, S., Visser, L. G., Veenendaal, R. A., Van Asten, H. A. G. H., Widjaja, S., Surjadi, C., & Van Dissel, J. T. (2006). Helicobacter pylori infection and typhoid fever in Jakarta, Indonesia. *Epidemiology and Infection*, *134*(1), 163–170.

Vova-Chatzi, C., Symvoulakis, E., Parpoula, C., Sbarouni, V., & Lionis, C. (2020). Robustness of the EUROPEP questionnaire as regards data quality, reliability, and construct validity: The Greek experience before and after the economic crisis. *Health Policy*, *124*(8), 856–864.

Waheed Qureshi, A., Ullah Khan, Z.-, Khan, L., Mansoor, A., & Minhas, R. (2019). Prevalence of malaria, typhoid and co-infection in District DIR (lower), Pakistan = Prevalência de malária, febre tifóide e co-infecção no distrito DIR (inferior), Paquistão. *Bioscience Journal*, *35*(1).

Wain, J., Hendriksen, R. S., Mikoleit, M. L., Keddy, K. H., & Ochiai, R. L. (2015). Typhoid fever. *The Lancet*, *385*(9973), 1136–1145.

Walters, M. S., Routh, J., Mikoleit, M., Kadivane, S., Ouma, C., Mubiru, D., Mbusa, B., Murangi, A., Ejoku, E., Rwantangle, A., Kule, U., Lule, J., Garrett, N., Halpin, J., Maxwell, N., Kagirita, A., Mulabya, F., Makumbi, I., Freeman, M., … Mintz, E. (2014). Shifts in Geographic Distribution and Antimicrobial Resistance during a Prolonged Typhoid Fever Outbreak - Bundibugyo and Kasese Districts, Uganda, 2009-2011. *PLoS Neglected Tropical Diseases*, *8*(3), 2009–2011.

wasihun, A. G., Wlekidan, L. N., Gebremariam, S. A., Welderufael, A. L., Muthupandian, S., Haile, T. D., & Dejene, T. A. (2015). Diagnosis and Treatment of Typhoid Fever and Associated Prevailing Drug Resistance in Northern Ethiopia. *International Journal of Infectious Diseases*, *35*, e96–e102.

Watson, C. H., & Edmunds, W. J. (2015). A review of typhoid fever transmission dynamic models and economic evaluations of vaccination. *Vaccine*, *33*, C42–C54.

WHO. (2016). *WHO | Environmental risks*. World Health Organization; World Health Organization.

WHO. (2017a). WHO | SDG 3: Ensure healthy lives and promote wellbeing for all at all ages. *WHO*.

WHO. (2017b). World Health Organization, Unplanned urbanization a challenge for public health. In *SEARO*. World Health Organization, South-East Asia Regional Office.

WHO. (2019a). *Typhoid*.

WHO. (2019b). Typhoid vaccines: WHO position paper, March 2018 – Recommendations. *Vaccine*, *37*(2), 214–216.

WHO. (2020). *Nigeria consolidates efforts to curtail vaccine hesitancy | WHO | Regional Office for Africa*. WHO Africa.

WHO. (2021). *Food safety*.

Widjaja, S., Suhariah Ismid, I., Ali, S., Surjadi, C., Van Asten, H. A. G. H., Vollaard, A. M., Van Dissel, J. T., & Visser, L. G. (2004). Risk factors for transmission of foodborne illness in restaurants and street vendors in Jakarta, Indonesia. *Epidemiology and Infection*, *132*(5), 863–872.

Wikipedia. (2021). *Flesch–Kincaid readability tests - Wikipedia*.

Wireklint, S. C., Elmqvist, C., Parenti, N., & Göransson, K. E. (2018). A descriptive study of registered nurses' application of the triage scale RETTS©; a Swedish reliability study. *International Emergency Nursing*, *38*, 21–28.

Wong, V. K., Holt, K. E., Okoro, C., Baker, S., Pickard, D. J., Marks, F., Page, A. J., Olanipekun, G., Munir, H., Alter, R., Fey, P. D., Feasey, N. A., Weill, F.-X., Le Hello, S., Hart, P. J., Kariuki, S., Breiman, R. F., Gordon, M. A., Heyderman, R. S., … Obaro, S. (2016). Molecular Surveillance Identifies Multiple Transmissions of Typhoid in West Africa. *PLOS Neglected Tropical Diseases*, *10*(9), e0004781.

Yaddanapudi, S., & Yaddanapudi, L. (2019). How to design a questionnaire. *Indian Journal of Anaesthesia*, *63*(5), 335.

Yakubu Madaki, M., & Bavorova, M. (2019). Food safety knowledge of food vendors of higher educational institutions in Bauchi state, Nigeria. *Food Control*, *106*, 106703.

Yang, Y.-A., Chong, A., & Song, J. (2018). Why Is Eradicating Typhoid Fever So Challenging: Implications for Vaccine and Therapeutic Design. *Vaccines*, *6*(3), 45.

Yap, K.-P., Ho, W. S., Gan, H. M., Chai, L. C., & Thong, K. L. (2016). Global MLST of Salmonella Typhi Revisited in Post-genomic Era: Genetic Conservation, Population Structure, and Comparative Genomics of Rare Sequence Types. *Frontiers in Microbiology*, *7*, 270.

Yousafzai, M. T., Karim, S., Qureshi, S., Kazi, M., Memon, H., Junejo, A., Khawaja, Z., Rehman, N. U., Ansari, M. S., Ali, R., Ujjan, I. U., Lohana, H. M., Memon, N. M., Hussain, M., Nigar, R., Bar-Zeev, N., & Qamar, F. N. (2021). Effectiveness of typhoid conjugate vaccine against culture-confirmed Salmonella enterica serotype Typhi in an extensively drug-resistant outbreak setting of Hyderabad, Pakistan: a cohort study. *The Lancet Global Health*, *9*(8), e1154–e1162.

Yusuff, A. S., Wasiu, J., & Akintayo, C. O. (2014). Review on Prevalence of Waterborne Diseases in Nigeria. *Journal of Advancement in Medical and Life Sciences*, *1*, 5–7.

Zerfu, B., Medhin, G., Mamo, G., Getahun, G., Tschopp, R., & Legesse, M. (2018). Community-based prevalence of typhoid fever, typhus, brucellosis and malaria among symptomatic individuals in Afar Region, Ethiopia. *PLOS Neglected Tropical Diseases*, *12*(10), e0006749.

Zhe, W., Yonghong, L., Bike, Z., Jinghuan, R., & Fanxiao, J. (2019). Application of Public Health Risk Assessment Methodology for Typhoon Disaster in China. *European Journal of Preventive Medicine*, *7*(1), 11–16.

Zolnikov, T. R., da Silva, R. C., Tuesta, A. A., Marques, C. P., & Cruvinel, V. R. N. (2018). Ineffective waste site closures in Brazil: A systematic review on continuing health conditions and occupational hazards of waste collectors. *Waste Management*, *80*, 26–39.