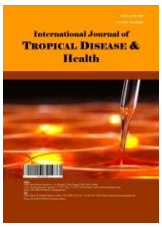

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Prevalence of Typhoid Fever in Franceville (Gabon): Case of the Sino-Gabonese Friendship Hospital; Retrospective Analysis of Clinical Data Over Three Years

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Authors' contributions

This work was carried out in collaboration among all authors. The data reported in the study were available to the authors and contributed equally to the preparation and writing of this manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Typhoid fever is an infectious disease that is fatal if left untreated. The most recent global data show more than 20 million cases annually, with more than 200,000 deaths. In Gabon, a study has shown that young adults are increasingly affected. Nevertheless, national data on this scourge are rare. The aim is to determine the prevalence of typhoid fever at the Sino-Gabonese Friendship Hospital in Franceville. The data are confirmed cases of typhoid fever at the Sino-Gabonese Friendship Hospital in Franceville, entered into a database of the health information management system of the South-East Franceville Gabon Regional Health Directorate between January 2018 and December 2020. A trend analysis was conducted over time to establish correlations between the prevalence of typhoid fever and factors such as age, gender and time of year. To statistically analyze these data, measure incidence rates, and establish relationships between these values and their significance, we used R version 3.6.1 software. 2175 people suffered from typhoid fever during the three years of the study. Of these, 960 (44.07%) were men and 1215 (55.93%) were women. A 95% confidence interval was estimated and a value $p \leq 0.05$ was considered statistically significant. The age group 15-49 years was the most affected. Although cases occurred throughout the year, there were increasing cases of typhoid from 2018 to 2020 and a high prevalence during quarters 1 and 4. The prevalence over the years was 454 cases or 20.87% in 2018, 750 cases or 34.48% in 2019, and 971 cases or 44.65% in 2020. In Gabon, particularly in Franceville, typhoid fever is a real public health problem. To protect themselves against this disease and avoid possible epidemics, the health authorities and decision-makers must educate the population about the disease.

Keywords: Typhoid fever; franceville sino-gabonese friendship fospital; gabon; public heath.

1. INTRODUCTION

Typhoid fever is an infectious disease that can be transmitted primarily through direct contact with an infected person, or indirectly through consumption of contaminated food prepared by a sick person (or a healthy carrier), or even through consumption of water contaminated with fecal matter, or through consumption of contaminated drinking water [1-4]. The bacterium responsible for this disease is of the genus *Salmonella*. There are two main groups, invasive and non-invasive. The invasive form, also known as *Salmonella* typhoid, causes enteric fevers [5]. Typhoid *Salmonella* includes *Salmonella typhi* and *Salmonella paratyphi*. Non-typhoid *Salmonella*, non-invasive forms, are made up of *Salmonella* species that generally cause gastroenteritis. Enteric fever (typhoid fever) is a real burden for about 5.5 billion people living in less developed countries [6]. Without prompt treatment, typhoid fever can be fatal. It is said that without effective treatment, typhoid fever has a case-fatality rate of 10% to 30% [7]. Despite their differences, estimates of global typhoid fever data agree on a worrying and dramatic increase in cases in Sub-Saharan Africa [8-9]. To this end, some studies have estimated that typhoid fever causes between 9.9 and 24.2 million cases and 75,000 to 208,000 deaths per year [10-13]. Lack of access to safe drinking water is a major risk factor for typhoid fever [14]. This is most often found in poor and overcrowded populations with poor and inadequate sanitation [6]. Although important and valuable, data on the prevalence of typhoid fever are scarce in underdeveloped countries [10]. This often results in highly variable estimates of annual prevalence of typhoid fever. For example, WHO has estimated the incidence of typhoid fever at about 17 million cases worldwide [15]. Meanwhile, in a systematic review published in 2019, researchers estimated that 14.3 million cases of typhoid and paratyphoid fever occurred in 2017, of which *Salmonella enterica* serotype typhi caused 76.3% of the enteric fever cases with about 135.9 thousand deaths [16-17]. A good estimate of prevalence would therefore be a major asset with implications for a possible reduction in the incidence of this disease in the population. This difficulty in estimating prevalence is partly due to the considerable overlap in the symptoms of typhoid and paratyphoid, although typhoid is more severe and lasts longer [18-19]. About 2-5% of the population infected with *S. typhi* become chronic carriers, which is generally higher in women and in people with biliary abnormalities such as gallstones [20]. In Sub-Saharan Africa, including Gabon, there are little data to describe typhoid or paratyphoid case-fatality rates. In a study Crump assumed a 1% case-fatality rate for typhoid fever based on hospital data [21]. The true magnitude of typhoid fever is difficult to quantify because the

clinical picture is often confused with many other febrile diseases, and most typhoid-endemic areas lack facilities to confirm the diagnosis [19]. The prevalence of *Salmonella* infection in many parts of sub-Saharan Africa is largely unknown. This is attributed to the lack of laboratories for diagnosing the deadly *Salmonella* often attributed to malaria [22]. In Gabon, although the latest reported cases of typhoid fever in Libreville showed a worrying trend of typhoid fever [23], there are no statistical data available. Reliable national data on its prevalence. It is in this context that this study was conducted to determine over three years, the prevalence of typhoid fever from health records data of people who presented at the Sino-Gabonese Friendship Hospital between January 2018 and December 2020, to establish the different correlations that could exist between this prevalence, age, gender at different specific times of each year and finally, to determine the period of the prevalence of typhoid fever from January 2018 to December 2020.

2. MATERIALS AND METHODS

2.1 Study Design

It is a retrospective and cross-sectional study based on the data and files of patients who presented themselves at the Sino-Gabonese Friendship Hospital in Franceville between January 2018 and December 2020. This study collects data at a given time to allow a description of the typhoid fever prevalence model in Franceville. Aimed to obtain a structured data set allowing systematic comparisons of incidence over three years was done over five years in Ghana [19].

2.2 Framework for the Study

The study was carried out based on the results of the analysis of samples obtained by the Sino-Gabonese Friendship Hospital in Franceville, capital of the second largest province of Gabon in terms of population. Located in the 2nd arrondissement, the Sino-Gabonese Friendship Hospital of Franceville is a support hospital for the regional hospital Amissa Bongo de Franceville. As in all Gabonese towns, Franceville has four seasons: A big dry season, a big rainy season, a small rainy season, and finally a small dry season. The sometimes disorderly alternation of these different seasons during the year favors the advent and spread of many infectious and parasitic and even non-infectious diseases that persist in tropical regions. The unfavorable rainy seasons allow the spread of many parasites. Factors such as sanitation and drinking water supply are not adequate in Franceville, which borders urban shantytowns and under-integrated based on, which do not often have access to drinking water. Contaminated river water or "Mpassa" river water is used either for drinking or washing. This makes the population increasingly vulnerable to food and water-borne diseases.

2.3 Study Population

It consisted of all the people who went to the Sino-Gabonese Friendship Hospital in Franceville for treatment and were diagnosed with *Salmonella* between January 2018 and December 2020. The basis of the study was therefore the number of cases of typhoid fever that had been recorded during this study period.

2.4 Exclusion and Inclusion Criteria

We have included anyone who had *Salmonella* isolated from their blood or stool sample at the Sino-Gabonese Friendship Hospital in Franceville from January 2018 to December 2020. Persons suspected of typhoid but without laboratory confirmation were excluded.

2.5 Sampling Method

Reasoned sampling was used to target and focus only on bacteriologically confirmed cases of typhoid fever during the study period. To ensure the representativeness of the study, the sample size depended on the number of cases recorded in the database of the South-East Franceville Regional Health Department.

2.6 Procedure for Obtaining Data

The data used for the study came from the database of the South-East Regional Health Directorate in Franceville. Access to these data was facilitated by the University of Science and Technology of Masuku, after a request for collaboration and autorization to access the statistical data of the different health care structures present in the Haut-Ogooué province was sent to the South-East Regional Health Directorate in Franceville for the period from January 2018 to December 2020. After agreement from the said department, the extracted data was made available to us in digital form. All cases of typhoid fever from January 2018 to December 2020 were extracted and used for the study.

2.7 Statistical Analysis of the Data

The data were entered in a Microsoft Excel 2016 format and then analyzed using R software version 3.6.1, including the measurement of rates and associations. An accurate binomial test of samples was used to determine the factors associated with the prevalence of typhoid fever. A 95% confidence interval was estimated and a value of $p \leq 0.05$ was considered statistically significant.

3. RESULTS

3.1 Socio-demographic Characteristics of Patients with Typhoid Fever

During study (January 2018 to December 2020), 2175 people received at the Sino-Gabonese Friendship Hospital from the different districts of Franceville suffered from typhoid fever out of a total of 9008 patients who consulted for infectious and parasitic diseases, i.e. a prevalence of 24.15%. Of the 2175 patients, 960 (44.14%) were men and 1215 (55.86%) were women. The highest number of cases of typhoid fever was recorded among women compared to men in all age groups except for those aged 0-11 years and 50 years and over in which 8 cases were recorded compared to 12 cases and 134 cases compared to 144 cases among men respectively. The age group of 15 to 49 years with 851 or 39.13% of typhoid fever cases was the most affected, followed by the age group of 5 to 14 years with 607 cases or 27.91%, then the age group of 1 to 4 years with 419 cases or (19.26%), the age group of 50 years and over with 278 cases or 12.78% and finally the age group of 0 to 11 months with 20 cases or (0.92%). While the lowest percentage of cases among men was recorded in the 0-11 months age group with 12 cases or 0.55%, the highest rate among women was in the 15-49 years age group with 502 cases or 23.08%. The age group of 0-11 months with 8 cases or (0.37%) recorded the lowest number of cases among women (Table 1).

The analysis of the significance level of the observed differences in the percentage of typhoid fever infection in men compared to women according to age group was carried out using the exact binomial test with a 95% confidence interval. The test was considered to be significant when p-value ≤ at 0.05.

3.2 Distribution of Typhoid Fever Cases from 1st Quarter 2018 to 4th Quarter 2020

It can be seen that the evolution of typhoid from 2018 onwards is increasing from year to year, whatever the quarter considered. When comparing the typhoid fever cases of the different years of our study, the year 2018 recorded the lowest number of 454 cases (Fig. 1). They began to increase in 2019 (750 cases) and especially in 2020 (971 cases).

Observation of the incidence of fever by quarter shows us that in 2018, Quarter 1 = 236 cases for 293 cases in 2019 and 315 cases in 2020; in Quarter 2 = 40 cases (2018), 103 cases (2019), and 110 cases in 2020. In Quarter 3= 47 cases are recorded in 2018, 172 cases in 2019, and 260 cases in 2020. Finally, 131 cases are recorded in quarter 4 in 2018, 182 and 286 cases respectively recorded in 2019 and 2020.

In 2018, the Sino-Gabonese Friendship Hospital in Franceville recorded the highest number of cases of typhoid fever in the first quarter (January, February, March) with 236 cases or 75 men and 161 women. The lowest rate was recorded in the second quarter (April, May, June) with 40 cases (20 men and 20 women). Contrary to the year 2018, there is a strong increase in typhoid fever cases during the years 2019 and 2020. The first quarter of each year will record the highest number of typhoid fever cases with 293 cases in 2019 (139 men and 154 women), followed by the fourth quarter with 182 cases (85 men and 97 women), the third quarter with 172 cases (78 men and 94 women) and the second quarter with 103 cases (44 men and 59 women). And in 2020, 315 cases or 132 men and 183 women, followed by the fourth quarter which recorded 286 cases or 141 men and 145 women, the third quarter with 260 cases or 123 men and 137 women, and finally the second quarter (April, May, and June), with 110 cases or 52 men and 58 women.

In sum, the first quarters (January, February, March) with 844 cases and the fourth quarters (October, November, and December) with 599 cases from each year of the study recorded the highest number of cases of typhoid fever. The lowest numbers of cases were recorded in the second quarters of these years with only 253 cases in total. The average number of cases recorded was in the different third quarters (Fig. 2).

3.3 Correlations between Typhoid Fever Prevalence Rates, Age, Sex, and Period of Prevalence

Fig. 3 shows the distribution of typhoid fever cases by gender (among men and women) during the study period.

Higher rates of typhoid fever have been recorded among women compared to men. This was studied and confirmed by a binomial test using a 95% confidence interval and the p-value ≤0.05. This meant that there was a 50/50 difference between the presence of typhoid in men and women, which was statistically significant (Table 2).

The main annual difference in typhoid fever cases between males and females was in the 0-11 months and 50 years and older age groups, where the typhoid fever rate was lower, while the highest cases were recorded in the 15-49 years age group for females, followed by the 5-14 years age group and the 1-4 years age group.

3.4 Typhoid Fever Prevalence Period between January 2018 and December 2020

Comparing typhoid fever cases from the different years of our study, the year 2018 recorded the lowest number of 454 cases (Figure 1). They started to increase in 2019 (750 cases) and especially in 2020 (971 cases). The first quarters (January-February, March) with 844 cases and the fourth quarters (October-November and December) with 599 cases in each year of the study recorded the highest numbers of typhoid fever cases. The lowest numbers of cases were recorded in the second quarters of these years with only 253 cases in total. The average number of cases recorded was in the different third quarters.

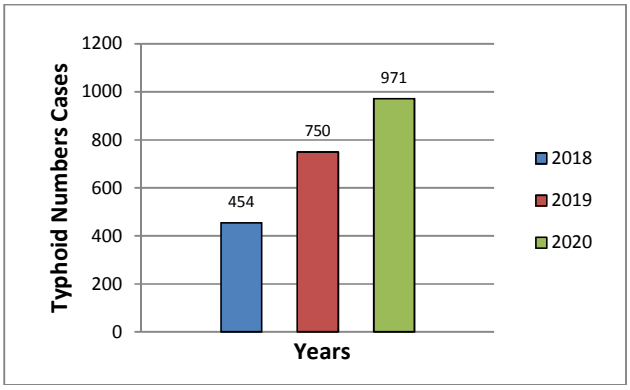

Fig. 1. Distribution of typhoid fever cases by year during the study period

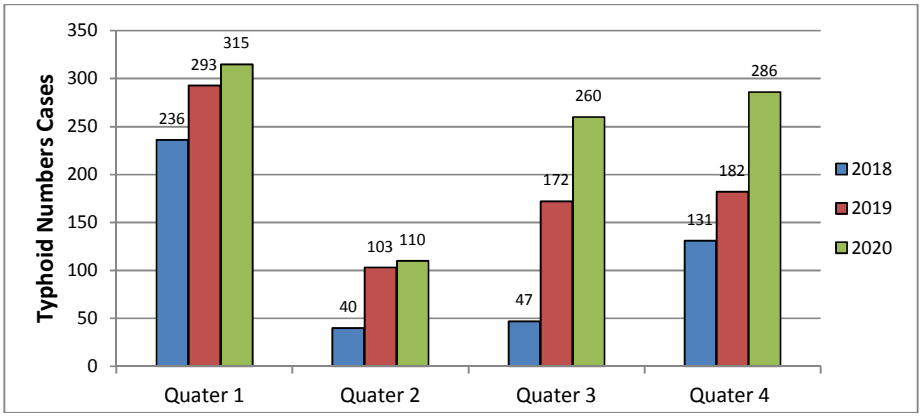

Fig. 2. Distribution of typhoid fever cases from 1st quarter 2018 to 4th quarter 2020

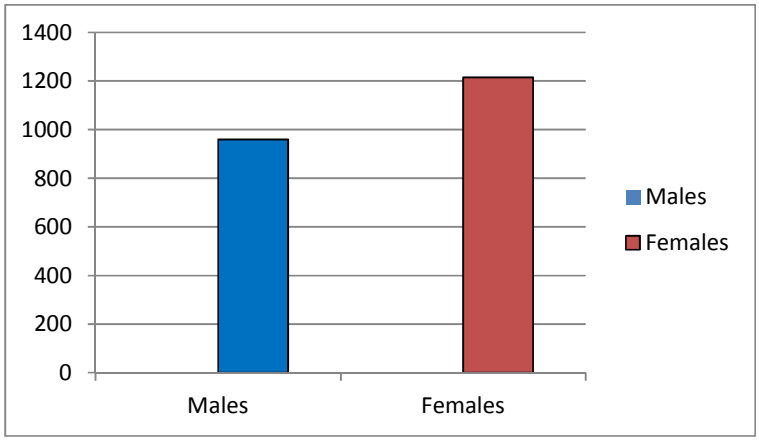

Fig. 3. Distribution of typhoid fever cases by gender

4. DISCUSSION

Over the three years of our study, the prevalence of typhoid fever is increasing from 2018 to 2020. This increasing rate of typhoid fever in Franceville and its environs is consistent with numerous studies that have shown a similar increase in *Salmonella* cases from year to year [24-25]. These same fluctuations and increasing incidence have been shown in work in Tanzania [5]. Mweu and English estimate of the global burden of enteric fever suggests a moderate incidence of typhoid fever of 10 to 100 cases/100,000 people per year in most African countries [26]. In Gabon, a study carried out from January 1992 to December 1996 in Libreville, involving 150 bacteriologically confirmed cases of typhoid and paratyphoid fevers, showed that young adults were the most affected [24]. As in all Gabonese cities, in Franceville, people who want to live in the West are increasingly eating out of their homes. So, with the resurgence of food shops on the public highway (grills, fruit, and vegetables, fermented drinks, cakes...) and even the drinking water that is served there is of dubious quality and hygiene, it could be predicted that the rate of typhoid fever cases in 2021 and the following years in Franceville could be higher if measures were not put in place to deal with it. Perhaps this is why the Gabonese food security agency (AGASA) undertook to launch a campaign with the slogan "Eat out, eat clean" to raise awareness of good hygiene practices among street food workers [27-28].

Numerous studies indicate different age groups typhoid fever susceptibility. Thus, it is very difficult to confirm exactly which age groups are highly susceptible to this disease. In contrast to Crump who reported that the 5-9-year-old age group was the most affected and the 20-24-year-old age group the least affected [14]. Reported that the most affected age group was the 5-19-year-old age group [27]. Our study shows that the

highest number of cases of typhoid fever was recorded in the 15-49 age group with 851 cases, followed by the 5-14 age group with 607 cases. Similarly, there are differences in consideration of which sex is most susceptible to typhoid fever. This is the case of a study carried out in Libreville, Gabon, indicating that the male sex was the most affected by typhoid fever [24]. In 2012, another study showed a higher prevalence of typhoid fever among men (59.0%) from 2008 to 2009 [27], but other studies have revealed high prevalence rates of *Salmonella* among women. This is the case of the results noted in a study on common *Salmonella* infections which showed that women accounted for 55.6% of those infected [25]. In our study, it was established that women with 1215 cases or (55.93%) were more diagnosed with typhoid fever. This high prevalence of typhoid fever among women in the 15 and 49 age group can be explained by the fact that women are more sensitive than men and are more likely to visit health care centers. On the one hand, in rural areas, women take care of household chores such as cleaning rubbish bins, fetching water from the well or the river, washing or cooking with it, and on the other hand, in urban centers, the Gabonese population, which is dominated by the increasingly young female gender, is not adept at cooking and is increasingly eating in the streets, thus exposing itself to the consumption of sometimes soiled

food. It can be assumed that the water used and consumed by women in this age group could be infested with *Salmonella* bacteria. The prevalence could be attributed to water cuts, which often force people to resort to well water or to buy water from street vendors. To this can be added either a lack or either a lack or even absence of public toilets, and the fact that most households lack latrines and defecate in the open air. There are also many links between the outbreak of disease and places where hygiene and sanitary conditions are precarious and poor [20].

In this study, the results for the quarters are consistent because according to the data presented, the prevalence rate of typhoid fever cases was most often high in the first quarter with 844 cases or 38.8%, and in the fourth quarters 599 cases or 27.54% of each year of the study. Then came the number of cases recorded in the third quarter with 479 cases or 22.02% and the lowest number in the second quarters with 253 cases or 11.64%. As Mefane et *al*. [29] and Okome-Nkoumou [24] show that the high annual rates of typhoid fever cases at the Sino-Gabonese Friendship Hospital in Franceville were recorded during the rainy seasons corresponding to the first quarters (January, February, March) and fourth quarter (October, November, and December). Numerous cases of typhoid fever have been recorded throughout each year. These higher prevalence rates of typhoid fever during the rainy seasons, also observed in a study conducted in Ouagadougou and Libreville, correlate well with the rainfall of each year, confirming the role played by water in the spread of salmonella and the resulting contamination [23,30].

As with any study, this work has limitations. From the data collected, we were not able to specify which cases were caused by paratyphoid serovars, since all recorded cases were labeled as typhoid. Indeed, the data from the regional health department of South East Franceville did not specify whether *Salmonella typhi* or *paratyphi* was the cause of the typhoid cases. However, since both species and their subtypes and strains can be classified as suffering from typhoid fever, this does not affect the quality of our study. Another limitation is that in Gabon, as soon as the first symptoms of a disease appear, people tend to first resort to traditional medicine that uses so-called medicinal plants. And so, what is certain is that not all people infected with typhoid fever went to the Sino-Gabonese friendship hospital in Franceville between January 2018 and December 2020, to be treated. This could affect the actual values of the prevalence of the disease in Franceville. It is in this spirit that the results of our study can therefore be interpreted.

Table 1. Demographic characteristics of typhoid fever patients in the years 2018, 2019, 2020

Age groups	Males	Females	Total	Binomial test		
				p(H)	IC95%	p-value
0-11months	12	8	20	0.6	[0.4 – 0.8]	0.5034
1-4 years	186	233	419	0.44	[0.4 – 0.5]	0.0245*
5-14years	269	338	607	0.44	[0.4 – 0.48]	0.0057*
15-49years	349	502	851	0.41	[0.37 – 0.44]	< 0.001*
50years - +	144	134	278	0.5	[0.45 – 0.57]	0.5
Total	960	1215	2175	0 .44	[0.42 – 0.46]	< 0.001*

* significant test.

Table 2. Annual distribution of typhoid fever cases by age group in males and females

Years Age groups	2018		2019		2020		Total	
	Males	Females	Males	Females	Males	Females	Males	Females
0- 11 months	0	2	3	1	9	5	12	8
1 – 4 years	39	38	75	95	72	100	186	233
5 – 14 years	28	76	92	100	149	162	269	338
15 – 49 years	88	162	125	157	136	183	349	502
50 - +	11	10	51	51	82	73	144	134

5. CONCLUSION

In Gabon, typhoid fever continues to be a real public health problem of concern, particularly in the Haut Ogooué region, of which Franceville is the capital. Data from the South-East Regional Health Department in Franceville, indicate an upward trend and, the 15 to 49-year-old age group is the most at risk because it is more active. Given this high prevalence, the health authorities and health decision-makers in our country have a heavy responsibility to educate the population on food and fecal hygiene, regular health checks by street food operators, and finally on the symptoms and consequences of typhoid in this province. This is crucial because the first symptoms of the disease, similar to those of malaria, are often confused with the latter by the population, as is the case in Gabon. Therefore, failure to present the first symptoms at health facilities could lead to serious problems such as intestinal perforation, anemia and hepatomegaly, among others, which are fatal.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Fusheini A, Gyawu SK. Prevalence of typhoid and paratyphoid fever in the Hohoe municipality of the Volta region Ghana. A five-year retrospective trend analysis. Annals of Global Health. 2020;86(1):1-10.
2. Egoz N, Shihab S, Leitner L, Lucian M. An outbreak of typhoid fever due to contamination of the municipal water supply in northern. Israel Journal of Medicinal Sciences. 1988;24(11):640-3.
3. Ceylan A, Acemoglu H, Hosoglu S. Typhoid fever epidemic in Ahmetli village, Diyarbakir-Ergani. Mikrobiyoloji Bulteni. 2003;37(1):41–7.
4. Harrison L. CDC warns of drug-resistant typhoid fever outbreak. Medscape Medical. 2021;17.
5. Malisa A, Nyaki H. Prevalence and constraints of typhoid fever and its control in an endemic area of Singida region in Tanzania: Lessons for effective control of the disease. Journal of Public Health and Epidemiology. 2010;2(5):93–99.
6. Whitaker JA, Franco-Paredes C. Rethinking typhoid fever vaccines: Implications for travelers and people living in highly endemic areas. Journal of travel medicine. 2009;16(1):46–52.
7. Von Kalckreuth V, Konings F, Aaby P. The Typhoid Fever Surveillance in Africa Program (TSAP): Clinical, diagnostic, and epidemiological methodologies. Clinical Infectious Diseases. 2016;62(1):9–16.
8. Awol RN, Reda DY, Gidebo DD. Prevalence of *Salmonella enterica* serovar thyphi infection, its associated factors and, antimicrobial susceptibility patterns among febrile patients at Adare General Hospital, Hawassa, southern Ethiopia. BMC Infectious Diseases. 2021;21:30.
9. Buckle GC, Walker CLF. Typhoid fever and paratyphoid fever: Systematic review to estimate global morbidity and mortality for 2010. Journal of Global Health. 2012; 2(1).
10. Antillón M, Warren JL, Crawford FW. The burden of typhoid fever in low-and middle income countries: A meta-regression approach. PLoS neglected tropical diseases. 2017;11(2).
11. Mogasale V, Maskery B, Ochiai RL. Burden of typhoid fever in low-income and middle-income countries: A systematic, literature-based update with risk-factor adjustment. The Lancet Global health. 2014;2(10).
12. Lee JS, Mogasale VV. Geographical distribution of typhoid risk factors in low and middle income countries. BMC Infectious Diseases. 2016;16(1):732.
13. Marks F, von Kalckreuth V, Aaby P. Incidence of invasive salmonella disease in sub-Saharan Africa: A multicentre population-based surveillance study. The Lancet Global Health. 2017;5(3):310–323.

14. Mogasale V, Maskery B, Ochiai RL. Burden of typhoid fever in low-income and middle-income countries: A systematic, literature-based update with risk-factor adjustment. The Lancet Global Health. 2014;2(10):570–580.
15. Crump JA, Luby SP. The global burden of typhoid fever. Bulletin of the World Health Organization. 2004;82:346–353.
16. Ao TT, Feasey NA. Global burden of invasive nontyphoidal Salmonella disease, 2010. Emerging Infectious Diseases. 2015;21(6):941.
17. Stanaway JD, Reiner RC, Blacker BF. The global burden of typhoid and paratyphoid fevers: A systematic analysis for the Global Burden of Disease Study 2017. The Lancet Infectious Diseases. 2019;19(4):369–381.
18. Kim J-H, Mogasale V. Updated estimates of typhoid fever burden in sub-Saharan Africa. The Lancet Global Health. 2017;5(10):969.
19. Fusheini A, Gyawu SK. Prevalence of typhoid and paratyphoid fever in the Hohoe municipality of the Volta region, Ghana: A five-year retrospective trend analysis. Annals of Global Health. 2020;86(1):111,1–10.
20. Ericsson CD, Hatz C, Basnyat B, Maskey AP,Zimmerman MD, Murdoch DR. Enteric typhoid fever in travelers. Clinical Infectious Diseases. 2005;41(10):1467–1472.
21. Crump JA. Updating and refining estimates of typhoid fever burden for public health action. The Lancet Global health. 2014;2(10):551–553.
22. Evans J, Adusei A, Timmann C, May J, Mack D, Agbenyega T, Horstmann RD, Frimpong E. High mortality of infant bacteremia clinically indistinguishable from severe malaria. Qjm. 2004;97(9):591–597.
23. Okome-Nkoumou M, Ayo Nkana E, Békalé J, Kombila M. Fièvres typhoïdes de l'adulte dans un service de médecine interne à Libreville (Gabon). Département de parasitologie-mycologie-médecine tropicale; 2018.
24. Dakorah MP. Prevalence of salmonella infections in patients attending St. Dominic hospital, (Akwatia)- Eastern Region. Thesis, University of Science and Technology, Ghana; 2014.
25. Neil KP, Sodha SV, Lukwago L. A large outbreak of typhoid fever associated with a high rate of intestinal perforation in Kasese District, Uganda, 2008–2009. Clinical infectious diseases. 2012;54(8):1091–1099.
26. Mweu E, English M. Typhoid fever in children in Africa. Tropical Medicine & International Health. 2008;13(4):532–540.
27. Ntoutoum L. Hygiène alimentaire: AGASA se penche sur « l'alimentation de la rue »; 2020.
28. Umeh E, Agbulu C. Distribution pattern of salmonella typhoidal serotypes in Benue State Central, Nigeria. International Journal of Epidemiology. 2010;8:1–23.
29. Mefane C, Omwanga D. Sérologie, sensibilité aux antibiotiques et lysotypie de quelques souches de *Salmonella* isolées chez des enfants hospitalisés au CHL. Bulletin de la Société des pathologies exotiques. 1986;79:165-71.
30. Gendron Y, Thevenieau D, Touze JE, Mailloux C, Barabe P. Fièvre typhoïde de l'adulte à Ouagadougou. Étude analytique de 124 observations. Medécine Tropicale. 1981;41: 625-30.

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