Afropolitan Journals



ISSN: 2617-3072X www.afropolitanjournals.com

# Pathogenic Analysis of the Effects of Solid Waste Dumpsites on Community Health in Gombe Metropolis

**Makka Kwamake Jubli, Bukar Abba Gana and Ahmed Abdullahi Chinade**

*Department of Environmental Management Technology, Abubakar Tafawa Balewa University, Bauchi, Bauchi State, Nigeria.*

*Corresponding author: samirasuleiman451@gmail.com*

## Abstract

Improper disposal of solid waste left unattended to create dumpsites which serve as breeding grounds for pathogenic microorganisms. That becomes pathways for diseases such as malaria, Lassa fever, typhoid etc. Against this background, this study conducted a pathogenic analysis of the effects of solid waste dumpsites on community health within Gombe metropolis. This is to identify pathogenic microorganisms that pose health risks to communities in Gombe Metropolis. Data on pathogens were collected using laboratory techniques using experimental research design. Samples from each of the three (3) selected locations of solid waste dumpsites were withdrawn to determine the total heterotrophic bacteria count. Microorganisms were isolated using the spread plate technique using nutrient agar (Oxoid). Incubation of the plate was done at 35°C for 18–24 hours, and bacteria identification was done by using the key provided in Difco manual (differentiation of Enterobacteriaceae by Biochemical test). Health risks were collected from secondary sources in primary healthcare facilities in the study area. The findings revealed the presence of Escherichia coli (E. coli) and Salmonella spp. in the waste samples from the dumpsites, which were associated with diseases such as malaria, typhoid, urinary tract infections (UTI), and diarrhoea. The priority diseases in the local health facilities, such as typhoid, bacteria, diarrhoea, malaria and UTRI, were found to be those that can be resulted from the presence of Escherichia coli (E. coli) and Salmonella spp. Based on the preceding, the study recommends that health aspects be factored into and considered critical in solid waste management plans, with causative bacterial agents of highlighted health risk factors such as malaria, typhoid, UTRI, and diarrhoea prioritized. Local authorities should strengthen the regulation of solid waste dumpsites to reduce the occurrence of pathogenic microorganisms and the associated health risks. Public education on the importance of practising safe hygiene at solid waste dumpsites is needed to reduce health risks. By implementing these recommendations, the community in Gombe Metropolis can effectively manage the health risks associated with solid waste dumpsites and improve the well-being of its residents.

**Keywords:** Solid Waste, Microorganism, Disposal, Bacteria, Dumpsites.

## Introduction

Improper disposal of solid waste left unattended to create dumpsites which serve as a breeding ground for pathogenic microorganisms that become pathways for diseases such as malaria, Lassa fever, typhoid etc. They can also contaminate ground and surface water and cause greenhouse gas emissions and other air pollutants (United Nations Habitat, 2010). Uncollected wastes often create dumpsites which serve as breeding ground for

mosquitoes and vectors like rodents. In tropical countries, the high temperatures and humid conditions accelerate degradation, increase the amount of leachate and directly affect the surrounding ecosystems by penetrating the soil and contaminating groundwater (United Nations Habitat, 2010). It contaminates water bodies from which surrounding residents normally source water for consumption, cooking and cleaning resulting in uncontrolled dumpsites with consequent environmental and human health impacts, (Yadav et al., 2018).

Waste handlers and waste pickers are especially vulnerable. The affluent lifestyle brought about by modernization and development aggravates the challenges of improper solid waste disposal on community health. Waste dumpsites can wreck the health of humans through diseases mobilised by vectors. This leads to a rise in health problems. People living close to waste dumpsites are vulnerable to contracting typhoid, diarrhoea and dysentery (Krystosik et al., 2020). For example, studies on coliforms such as E.coli and Klebsiella sp. in solid waste clearly indicate that the waste is contaminated with faecal matter. All bacterial isolates recovered from waste samples directly cause water borne infections such as typhoid, diarrhoea and gastroenteritis (Nartey et al., 2012). Human faecal matter presence in all the solid waste dump sites presents a potential health problem not only to waste workers but also to scavengers, other users of the same municipal drop-off point, and even small children who play in or around waste containers. The usual disease pathways include placing contaminated hands in the mouth or eating food through vector insects such as cockroaches or mosquitoes or by directly inhaling airborne dust particles contaminated with pollutants (Krystosik et al., 2020).

The disposal of solid wastes into water bodies may be detrimental to aquatic organisms. This assertion is supported by UN-Habitat (2010), that bacteria like E.coli often lead to depletion of the dissolved oxygen, thereby endangering the survival of aquatic organisms. Release of wastes with high quantities of nitrates and phosphate compounds into rivers could result in obnoxious algae blooms (Singh et al., 2014). Mohammed et al., (2021) asserted that solid waste management is a major issue in Gombe Metropolis which requires proper management to prevent its health and environmental implications. It is therefore worthwhile to study the impact of existing solid waste dumpsites on the health of residents of Gombe Metropolis in order to understand the pathways for spread of diseases associated with solid wastes and propose more efficient waste management framework.

Indiscriminate waste disposal and lack of adequate solid waste collection and treatment lead to the creation of dumpsites which provide breeding ground for pathogens, which greatly have impact on human health. About 80 per cent of all diseases spread within a community in developing countries are believed to be connected to poor waste management in towns and cities (Foray, 2013). Municipal Solid Waste (MSW) management is statutorily the responsibility of Local Governments. However due to inadequate financing and personnel capacity at the Local Government level, state or regional governments have taken over the responsibility, Gombe, the capital of Gombe state in the northeast region of

the country, is not an exception. Solid waste management is a major issue in Gombe Metropolis which requires proper management to prevent its health and environmental implications, (Mohammed et al..,2021).

A walk through the city will reveal the quantity of MSW piled up at the dumpsites. The case is not different when one drives by the city's only landfill site, which is a few kilometres away from the city centre. The stench from accumulated MSW decomposing at the unmanaged landfill site is not a welcoming experience. The city's Solid Waste Management (SWM) process of open dumping is the cause of MSW decomposing at unmanaged dump site (Mshelia & Onuigbo, 2020). Various studies have reported the effects of solid waste dumpsites on human health and the environment: Diarrhoea and acute respiratory infections are significantly higher for children living where solid waste is dumped compared to children living in the same cities that receive a regular waste collection service (UN-Habitat, 2010),

Solid Waste Dumpsites directly cause water borne infections such as typhoid, diarrhoea and gastroenteritis (Nartey et al., 2012). Small children who play in or around waste containers are particularly vulnerable. Vector insects such as cockroaches or mosquitoes or by directly inhaling airborne dust particles contaminated with pollutants (Krystosiket al., 2020). Bacteria like E.coli often lead to depletion of the dissolved oxygen. All bacterial isolates recovered from waste samples directly cause water borne infections such as typhoid, diarrhoea and gastroenteritis (Nartey et al., 2012). Release of wastes with high quantities of nitrates and phosphate compounds into rivers could result in obnoxious algae blooms (Singh et al., 2016).

Thus, Previous studies seem not to have analysed the pathways for spread of diseases among residents living close to solid waste dumpsites. Therefore, this study is undertaken to contribute towards filling the gap by explaining the major health risks associated with the pathogenic microorganisms in solid waste dumpsites in Gombe Metropolis and advise on measures for overcoming the challenges.

## Materials and Methods

### Research Design

This research is experimental by design, as samples were collected using appropriate procedures and analysed in the laboratory.

### Sampling Procedure

Purposive sampling (also known as judgment, selective or subjective sampling) was used for this study. Campbell et al. (2020) corroborate this purposive sampling's validity. In this situation, Pantami Quarters, Adjacent to Pantami Stadium and Adjacent Ecobank, behind Timber Market, were considered commercial areas of Gombe Metropolis. Also, Harwagan Quarters and Kuwait Quarters were considered from residential areas of the metropolis. Lastly, Nassarawa Bogo was considered from the industrial areas. The areas were selected because they suffer from heaped waste dumpsites, serve as breeding grounds for rodents

and disease vectors, and reported common cases of ailments in the communities. In addition, these areas were selected because they are highly populated with dumpsites of different waste compositions. Lastly, these places were chosen because they are commercial, residential and industrial areas. This will give a good representation of large waste streams.

**Sample Collection and Preparation**

The study was conducted to assess the wastes leachate bacteriological composition and potential environmental impacts of the waste dumpsites. The leachate samples were collected at various depths within the waste dumpsites using a systematic approach to capture the variations in leachate composition across different layers. The aim was to understand the leachate's bacteriological characteristics and potential contaminant concentrations at different depths.

To collect the leachate samples, a technique known as "percolation sampling" was employed. This involved the insertion of specialized sampling probes/lysimeters into the waste layers at predetermined depths. These lysimeters were designed to allow the passive collection of leachate as it percolated through the waste materials. The selected sampling depths included the surface layer, intermediate depths, and deeper layers within the dumpsite. This approach provided a representative snapshot of leachate properties and contaminants present at various scientific intervals. Once collected, the samples were properly preserved and transported in sealed sample containers to the laboratory to maintain the viability and integrity of the microorganisms as prescribed by Jibiri et al. (2014).

**Use of Personal Protective Equipment**

Given the potentially hazardous nature of waste dumpsites and the need to ensure the safety of researchers, stringent protective equipment was employed during the sample collection process. Researchers wore full personal protective equipment (PPE), including gloves, coveralls, safety goggles, and respiratory masks. These measures were essential to minimize potential exposure to harmful substances, pathogens, and unpleasant odours associated with waste decomposition. This was done in accordance with Essienubong et al. (2019).

**Reason for Choosing the Rainy Season**

The research was intentionally conducted during the rainy season to capture the highest leachate generation rates. Rainwater infiltrates the waste layers, facilitating leachate percolation and enhancing the release of contaminants. The increased moisture content during the rainy season can lead to higher leachate volumes, providing a more accurate representation of leachate composition and potential pollutant transport. By focusing on the rainy season, the study aimed to generate data that would better inform waste

management strategies and environmental protection measures, contributing to a more comprehensive understanding of the waste dumpsite's impact on surrounding ecosystems and groundwater quality.

**Depths of Samples Collection**

***Surface Layer:*** Samples collected from the surface layer of the waste pile, also known as the "active layer," provide insights into the immediate and recent leachate composition. This layer experiences direct contact with rainwater and is subject to rapid changes in leachate generation and composition. Sampling from the surface layer helps capture the initial effects of rainwater percolation and contamination, which are critical for understanding short-term impacts. This is a depth of approximately 0-20 centimeters.

***Intermediate Layer:*** Collecting samples from intermediate depths within the waste pile allows researchers to study the transition zone between the surface and deeper layers. This layer is important for understanding how contaminants migrate through the waste over time. The leachate collected from this depth provided information about the transformation of pollutants as they move downward and interact with the waste materials. This is a depth ranging from approximately 20-50 centimeters.

***Deeper Layer:*** Samples collected from deeper layers provide insights into the long-term behavior of leachate as it percolates through the waste pile and potentially interacts with underlying soils. This depth helped the researcher understand the potential for leachate to infiltrate and contaminate groundwater resources. Sampling at this depth allows for the assessment of the leaching potential of persistent contaminants. This is a depth of around 50-100 centimeters.

**Identification of Pathogenic Organisms in Solid Waste**

***Determination of total heterotrophic bacteria counts in the samples***

Samples from each of the three (3) selected locations of solid waste dumpsites were withdrawn for the determination of the total heterotrophic bacteria count. Serially diluted samples (0.1ml) of appropriate dilution (10-6, 10-7, 10-8) of the suspension of the contaminated soil in distilled water (prepared by dissolving 1.0 g of soil in 9 ml of distilled water) were spread on nutrient agar plates using the spread plate technique (Odokuma and Okpokwasili, 1993). Bacteria colonies were counted after 24 hours of incubation at 300C, and number of colonies in colony-forming units per gram of soil (cfu/g) was calculated using equation (12) (Stanley et al., 2014).

Information about the bacteria present in the waste samples enabled the determination of the health implications of the dumpsites on the inhabitants of Gombe Metropolis.

***Isolation and identification of bacteria in the solid waste samples***

Microorganisms were isolated using the spread plate technique (American Public Health Association-APHA, 2005) using nutrient agar (Oxoid). The plate was incubated at 35°C for

18–24 hours (Latinwo and Agarry, 2015). Pure cultures of the isolates were obtained by repeated sub-culturing on media used for primary isolation and were maintained on agar slants for further characterization and identification. The bacteria were characterised after studying the colonies' growth characteristics (morphology), Gram reaction and the biochemical test (motility, urea, indole, citrate, catalase oxidase and triple sugar ion). The bacteria identification was made using the key provided in the Difco manual (differentiation of Enterobacteriaceae by Biochemical test).

Lastly, the occurrence of bacterial flora based on percentage frequency was isolated from the waste dump and was analysed in the laboratory.

**Bacteriological Analysis**

Waste samples from the dumpsites were differently analysed in the laboratory for the identification of pathogens, and the occurrence of bacterial flora based on percentage frequency was isolated from the waste dump and analysed in the laboratory. This was done by coliform counting, as adapted from Aliyu, 2010. Attempts were made to characterise the physicochemical properties of these solid waste samples and the biodiversity there off. The predominant microbial floras were studied for their catabolic profile and responsible enzymatic potency of dominant isolates. Figures from the study were used to support the results and to give a visual presentation for clarity.

**Experimental Analysis of Pathogenic Bacteria**

***Total coliform using the Most Probable Number (MPN) technique***

200 mL of buffered water peptone was added to a 20 g sample in a sterile stomacher bag at a 1:10 dilution (10-1), and the mixture was homogenised for 1 minute. There were four 1:10 serial extra dilutions made. Aseptically, 5 mL of Brilliant Green Bile (BGB) 2% and an inverted Durham tube were added to three screw-top culture tubes, each of which held 1 mL of the dilutions 10-2, 10-3, and 10-4 sample homogenate. The tubes were incubated in a 37°C ± 2°C incubator for 24 hours. Each dilution set's number of tubes that formed gas in a positive manner was counted. In a three-tube dilution series, the MPN per g was calculated using the MPN Index.

***Escherichia coli using the viable count method***

200 mL of buffered water peptone was added to a 20 g sample in a sterile stomacher bag at a 1:10 dilution (10-1), and the mixture was homogenised for 1 minute. There were four 1:10 serial extra dilutions made. From dilution tubes, 0.1 mL of samples 10-3 and 10-4 were poured onto the MUG Sorbital Agar surface on Petri plates. The Petri dishes were incubated in a 36°C ± 1°C incubator for 24 hours. The number of CFUs on the plates was counted using the colony counter. The general formula for the viable count on plates is given in Eq (1):

$$N\ (\text{CFUs per mL or g}) = \sum C/[V \times \{n_1 + (0.1 \times n_2)\} \times d \times d] \quad (1)$$

where N: Number of CFUs per mL or g of sample,
Σ C: Sum of CFUs counted on all selected plates of two successive dilutions,
V: Volume of inoculum added to each plate (mL),
n1: Number of plates selected at the 1st dilution,
n2: Number of plates selected at the 2nd dilution,
d: Dilution factor of the first dilution.

***Salmonella spp. using the viable count method***

About 225 mL of buffered water peptone was added to a 25 g sample in a stomacher bag for a 1:10 dilution (10-1), homogenized and incubated. One additional serial dilution (10-2) was prepared in Rappaport Vassiliadis Enrichment Broth (RVEB). The 10-2 dilution was then incubated, and three additional serial dilutions were prepared in RVEB. 0.1 mL of sample from dilutions 10-2, 10-3, 10-4, 10-5 was transferred onto the surface of the petri dishes containing XLD Agar. The general formula which was used for the viable count on plates was the same as described in Eq (1).

**Assessing the Health Risks Associated with the Pathogenic Organisms in Solid Waste**

Assessing the risk of cholera, asthma, diarrhoea, and typhoid in solid waste in the laboratory typically involves analysing the waste samples for specific pathogens, toxins, or indicators of contamination. The levels of faecal indicator bacteria, such as Escherichia coli and faecal coliforms, were measured using standard microbial testing methods. High levels of these indicators can indicate faecal contamination and an increased risk of diarrhoea-related diseases.

While laboratory analysis provides valuable insights into the presence of pathogens or contaminants, the results were interpreted in conjunction with epidemiological data, environmental factors, and local health guidelines to assess the actual health risks posed by solid waste and develop appropriate mitigation measures.

## Results and Discussion

**Experimental Analysis of Pathogenic Bacteria**

The initial (morning) and final (afternoon) bacterial pathogenic loading (Total coliform, E. coli and Salmonella spp.) of waste material in the different locations is summarized in Table 1 below. Two samples were collected from commercial areas and they are labelled S1 (Pantami Quarters, Adjacent Pantami Stadium) and S2 (Adjacent Ecobank, behind Timber Market) of Gombe Metropolis. Two samples were also collected from the metropolis's residential areas, labelled S3 (Kagarawal Quarters) and S4 (Kuwait Quarters). Lastly, two samples were collected from industrial areas and they are labelled S5 (Herwagana) and S6 (Nassarawa Bogo). These samples were collected in the morning and afternoon to establish

differences and comparisons based on thermophilic reactions, as adapted from Soobhany (2018).

The total coliform in the waste leachate is given in Table 1. Among all the final characterization of the different waste streams, total coliform was high in samples of S2 and S5 with a value of 3.57 ± 3.08 log10 MPN $g^{-1}$ and 3.54 ± 3.19 log10 MPN $g^{-1}$, respectively, which might be due to the presence of market wastes and cow dung. These organic materials are the main sources of total coliform (Monroy et al., 2009; Lalander et al., 2013). The log increment (log10 MPN $g^{-1}$) in total coliform as compared to the final level for scenarios S1, S2 and S3 are 2.88, 3.49 and 3.03, respectively. The increment in total coliforms might be due in part to the relatively high temperatures reached during the thermophilic phase of waste degradation during the day. This increase in total coliform during the degradation processes corresponds with earlier findings made by Bustamante et al. (2008).

**Table 1:** Initial and final bacterial pathogens characterization of samples

| | Total coliform (log10 MPN $g^{-1}$)[a] | E. coli (log10 CFU $g^{-1}$)[a] | Salmonella spp. (log10 CFU $g^{-1}$)[a] |
|---|---|---|---|
| **Initial characterization of sample** | | | |
| S1 | 2.77 ± 2.35 b | 4.89 ± 4.62 b | Absent in 25 g |
| S2 | 2.84 ± 1.89 b | 4.96 ± 4.46 b | Absent in 25 g |
| S3 | 2.89 ± 2.31 b | 4.72 ± 4.74 ab | Absent in 25 g |
| S4 | 1.52 ± 0.63 a | n/d* | Absent in 25 g |
| S5 | 1.72 ± 1.49 a | n/d* | Absent in 25 g |
| S6 | 1.52 ± 0.63 a | n/d* | Absent in 25 g |
| **Final characterization of sample** | | | |
| S1 | 3.13 ± 2.33 a | 6.15 ± 4.11 c | 6.24 ± 3.51 b |
| S2 | 3.57 ± 3.08 a | 6.09 ± 4.11 b | 6.50 ± 4.59 c |
| S3 | 3.27 ± 2.55 a | 6.00 ± 4.55 a | 5.44 ± 3.81 a |
| S4 | 3.13 ± 2.33 a | 6.14 ± 3.51 bc | 6.24 ± 4.55 b |
| S5 | 3.54 ± 3.19 a | 6.10 ± 3.81 bc | 6.51 ± 3.51 c |
| S6 | 3.27 ± 2.55 a | 6.01 ± 3.51 a | 5.42 ± 4.29 a |
| **Reduction of bacterial pathogens** | | | |
| S1 | 2.88 log increment | 6.12 log increment | 6.24 log increment |
| S2 | 3.49 log increment | 6.06 log increment | 6.50 log increment |
| S3 | 3.03 log increment | 5.98 log increment | 5.44 log increment |
| S4 | 3.12 log increment | 6.14 log increment | 6.24 log increment |
| S5 | 3.54 log increment | 6.10 log increment | 6.51 log increment |
| S6 | 3.26 log increment | 6.01 log increment | 5.42 log increment |

n/d*: Not detected in 20 g sample; below the detection limit (<1000 CFU $g^{-1}$).

[a] Given in $\log_{10}$ concentration. To get the concentration in general number form, the value displayed in the table (e.g 6.14) is taken to the power of 10 (i.e. $10^{6.14}$ = 1 380 384). Values

designate mean ± standard deviation based on 2 samples. Different letters in the same columns for each sample are statistically different (Tukey's HSD test, $p < 0.05$).

Scenarios S4, S5 and S6 demonstrated a moderately higher increase in total coliform of 3.12 log10 MPN $g^{-1}$, 3.54 log10 MPN $g^{-1}$ and 3.26 log10 MPN $g^{-1}$, respectively. The moderately high increment in total coliform in the afternoon samples might be due to competitive interactions between coliforms and microorganisms specific to the bacterial activity of gut enzymes, similarly justified by Monroy et al. (2009). The differences in total coliforms from each pair of morning and afternoon sample processes indicate the effects of heat on pathogenic reactions and the ability to increase the levels of total coliforms during thermophilic biodegradation of MSW.

*E. coli* is mostly considered an indication of faecal pollution and an indicator of the fate of faecal pathogenic microorganisms (Soobhany, 2018; Singh & Gupta, 2020). At the start of the experiment, *E. coli* was present in the commercial and residential waste mix since *E. coli* is generally found in these streams of waste (Hill and Baldwin, 2012; Lalander et al., 2013). The *E. coli* content for the six sets is shown in Table 1. The increment in *E. coli* in the substrates as compared to the initial level for S1, S2 and S3 were 6.12 $\log_{10}$ CFU $g^{-1}$, 6.06 $\log_{10}$ CFU $g^{-1}$, and 5.98 $\log_{10}$ CFU $g^{-1}$, respectively. The increase in *E. coli* in the sample substrates corresponds with previous studies during the decomposition of other different wastes (Bustamante et al., 2008; Carthy et al., 2011). However, these studies showed that *E. coli* was increased to undetectable levels (<1.77 $\log_{10}$ MPN $g^{-1}$) during composting. On the contrary, waste samples from S4, S5 and S6 did not show the presence of E. coli analysed in the 20 g sample, which was below the detection limit (<1000 CFU/g). Thus, the log increment in *E. coli* from the MSW samples was computed to be 6.14 for S4, 6.10 for S5 and 6.01 for S6.

*Salmonella* spp. is considered the major and specific problem of the hygienic quality of waste dumpsites. At the end of the experiments, *Salmonella* spp. was found in all three pairs of waste sample processes due to cow dung (Letourneau et al., 2010) and food waste (Hassen et al., 2001). At the end of the experiment, *Salmonella* spp. was found to be much higher in the waste mix of S2 and S5, which might be due to the presence of both market wastes and cow dung, whereby they are the main source of these pathogenic bacteria. As presented in Table 1, *Salmonella* spp. was absent in S1, S2 and S3 and S4, S5 and S6 at the beginning of the experiments.

**The Relation between Pathogenic Microorganisms Present in Solid Waste Dumpsites and the Major Health Risks in Gombe Metropolis**

The data obtained were then analyzed to determine the extent to which the residents of dumpsites experience these health problems.

The results of this analysis showed that Malaria, Diarrhea, Typhoid and Urinary Tract infection are among the top priority diseases in the following study area (Pantami, Timber

market, Kagarawal, Kuwait, Herwagana and Nassarawa Bogo). This aligns with findings in the literature. For instance, Ezenyi et al. (2020) report that Nigeria accounts for most of the malaria burden in Sub-saharan Africa and globally. The high burden of typhoid (Buckle et al., 2012) and diarrhoea Oyinloye et al. (2016) in low-income regions like North-eastern Nigeria is also empirically established. This is significant because it highlights the need for interventions targeting these diseases in the study area.

Azzahra & Faradiba (2022) reported that community waste management behaviour, such as the prevalence of dumpsites, influences the spread of malaria. Furthermore, Chengula et al. (2015) found and reported that several diseases, such as malaria, diarrhoea, dysentery, cholera, typhoid, and worm diseases, are caused by poor handling and contact with solid wastes.

Findings in reviewed literature reveal that top-priority diseases found in the study area have a correlative and causative relationship with bacterial pathogens that have been found in solid waste samples in the study area. In the case of Malaria, Nasir et al. (2015) reported that the accumulation of waste dumpsites in proximity to residential areas constitutes a pathway to malaria burden.

It can therefore be deduced from the study findings that Salmonella spp. are pathogenic microorganisms that cause a variety of diseases in the study area. The major diseases caused by Salmonella are diarrhea, fever, and abdominal cramps. These are usually a self-limiting illness that resolves on its own within a few days. However, in some cases, they can lead to more serious complications, such as sepsis, meningitis, and even death. Another disease caused by Salmonella spp. in the study area is Typhoid fever. It is a more serious form of salmonellosis that is caused by the Salmonella Typhi serotype. Typhoid fever is characterized by fever, headache, cough, and gastrointestinal symptoms. If left untreated, typhoid fever can be fatal. Furthermore, Karkey et al. (2013) reported that Salmonella Typhi, identified bacteria in the study area, is the causative agent of cholera, with over 22 million cases and over 200,000 deaths reported annually Salmonella spp. can be found in a variety of foods, including raw meat, poultry, eggs, and unpasteurized milk. Salmonella can also be found in contaminated water and on surfaces that have been in contact with contaminated food or water.

The diseases caused by pathogenic E. coli microorganisms in the study area include Diarrhea. This is the most common symptom of E. coli infection. It can be watery, bloody, or mucusy. Diarrhea caused by E. coli is usually not serious and goes away on its own within a few days. It was confirmed to be among the major causes of Diarrhoea in adults (Ogata et al., 2002) and children (Bouzari et al., 2018). However, in some cases, it can be severe and lead to dehydration. Urinary tract infection (UTRI) is another common infection caused by E. coli. UTIs can affect the bladder, kidneys, or both. Symptoms of a UTI include pain or burning when urinating, frequent urination, and cloudy or bloody urine. Abdalhussin (2022) confirmed that gram-negative bacillus, especially E. coli is a dominant bacterial agent that causes urinary tract infections (UTRI). UTIs are usually treated with antibiotics. The severity

of an E. coli infection depends on the type of E. coli bacteria that is causing the infection and the person's immune system. Most people who are infected with E. coli will recover without any problems. However, some people, especially young children and the elderly, may develop serious complications.

## Conclusion

The research aimed to analyze the effects of solid waste dumpsites on community health in Gombe metropolis towards informing a holistic framework for overcoming the health challenges of solid waste dumpsites in communities in Gombe Metropolis. The suggested study's findings further clarify the pathogenic effects of solid waste dumpsites on community health and the necessity for a health dimension to solid waste management policies. To this end, laboratory quantitative and on-field qualitative techniques were used to collect data on microorganisms and priority diseases in the study area. These were analyzed via statistical tools and an overview of the literature. It was inferred that Ecoli and salmonella typhi are present in solid waste dumpsites within the study area and are causative agents of diseases prevalent in the area, such as Malaria, Typhoid, Diarrhea, and UTI.

## References

Abdalhussin, H. F., Jafar, N. A., & Alrifai, S. B. (2022). Assessment of TLR2 & TLR4 in urine of Iraqi bacter isolated from urinary tract infection of Baghdad hospitals. *HIV Nursing*, *22*(2), 3444-3448.

Azzahra, S. F., &Faradiba, F. (2022). The Influence of Community Behavior in Disposing of Garbage on the Spread of Malaria. *Asian Journal of Research in Infectious Diseases*, *10*, 33-39.

Bouzari, S., Farhang, E., Hosseini, S. M., & Alikhani, M. Y. (2018). Prevalence and antimicrobial resistance of shiga toxin-producing Escherichia coli and enteropathogenic Escherichia coli isolated from patients with acute diarrhea. *Iranian Journal of Microbiology*, *10*(3), 151.

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).

Bustamante, M. A., Moral, R., Paredes, C., Pérez-Espinosa, A., Moreno-Caselles, J., & Pérez-Murcia, M. D. (2008). Agrochemical characterisation of the solid by-products and residues from the winery and distillery industry. Waste management, 28(2), 372-380.

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters & Walker, K. (2020). Purposive sampling: complex or simple? Research case examples. *Journal of research in Nursing*, *25*(8), 652-661.

Chengula, A., Lucas, B. K., &Mzula, A. (2015). Assessing the awareness, knowledge, attitude and practice of the community towards solid waste disposal and identifying the threats and extent of bacteria in the solid waste disposal sites in Morogoro Municipality in Tanzania. *Journal of Biology, Agriculture and Healthcare*, *5*(3).

Essienubong, I. A., Okechukwu, E. P., &Ejuvwedia, S. G. (2019). Effects of waste dumpsites on geotechnical properties of the underlying soils in wet season. *Environmental engineering research*, *24*(2), 289-297.

Ezenyi, I. C., Verma, V., Singh, S., Okhale, S. E., & Adzu, B. (2020). Ethnopharmacology-aided antiplasmodial evaluation of six selected plants used for malaria treatment in Nigeria. Journal of ethnopharmacology, 254, 112694.

Foray, PS; Xiangbin, Y; Quangyen, T (2013). Environmental and Health Impact of Solid Waste Disposal in Developing Cities: A Case Study of Granville Brook Dumpsite, Freetown, Sierra Leone. J. Env'tal Prot., 4: 665-670.

Hassen, A., Belguith, K., Jedidi, N., Cherif, A., Cherif, M., & Boudabous, A. (2001). Microbial characterization during composting of municipal solid waste. Bioresource technology, 80(3), 217-225.

Hill, G. B., & Baldwin, S. A. (2012). Vermicomposting toilets, an alternative to latrine style microbial composting toilets, prove far superior in mass reduction, pathogen destruction, compost quality, and operational cost. Waste Management, 32(10), 1811- 1820.

Jibiri, N. N., Isinkaye, M. O., & Momoh, H. A. (2014). Assessment of radiation exposure levels at Alaba e-waste dumpsite in comparison with municipal waste dumpsites in southwest Nigeria. *Journal of Radiation Research and Applied Sciences*, *7*(4), 536-541.

Krystosik, A., Njoroge, G., Odhiambo, L., Forsyth, J. E., Mutuku, F., & LaBeaud, A. D. (2020). Solid wastes provide breeding sites, burrows, and food for biological disease vectors, and urban zoonotic reservoirs: a call to action for solutions-based research. Frontiers in public health, 7, 405.

Lalander, C. H., Hill, G. B., & Vinnerås, B. (2013). Hygienic quality of faeces treated in urine diverting vermicomposting toilets. Waste Management, 33(11), 2204-2210.

Latinwo, G. K., & Agarry, S. E. (2015). Modelling the kinetics of biogas production from mesophilic anaerobic co-digestion of cow dung with plantain peels. *International Journal of Renewable Energy Development*, *4*(1), 55.

Letourneau, C. (2010). Adaptive management of complex environmental problems – Comparison of national nuclear waste management policies– (Doctoral dissertation, University of Nevada, Las Vegas).

Mohammed, I., Abdullahi, A. C., Istifanus, V., & Jauro, A. S. (2021). An Analysis of Municipal Solid Waste Composition in Gombe-Metropolis.

Monroy, F., Aira, M., Domínguez, J. (2009). Reduction of total coliform numbers during vermicomposting is caused by short-term direct effects of earthworms on microorganisms and depends on the dose of application of pig slurry. Sci. Total Environ. 407, 5411e5416.

MSHELIA, R., & Onuigbo, M. (2020). Simulation of greenhouse gases emission from different solid waste management practices in Gombe, Gombe state, Nigeria. *University of Wah Journal of Science and Technology (UWJST)*, *4*, 9-14.

Nartey, V. K., Hayford, E. K., & Ametsi, S. K. (2012). Analysis of leachates from solid waste dumpsites: A tool for predicting the quality of composts derived from landfills. *Journal of Environment and Earth Science*, *2*(11), 8-20.

Odokuma, L. O., &Okpokwasili, G. C. (1993). Seasonal ecology of hydrocarbon-utilizing microbes in the surface waters of a river. *Environmental Monitoring and Assessment*, *27*(3),175-191.

Ogata, K., Kato, R., Ito, K., & Yamada, S. (2002). Prevalence of Escherichia coli possessing the eaeA gene of enteropathogenic E. coli (EPEC) or the aggR gene of enteroaggregative E. coli (EAggEC) in traveler'sdiarrhea diagnosed in those returning to Tama, Tokyo from other Asian countries. *Japanese Journal of infectious diseases*, *55*(1), 14-18.

Singh, G. K., Gupta, K., & Chaudhary, S. (2014). Solid waste management: its sources, collection, transportation and recycling. *International Journal of Environmental Science and Development*, *5*(4), 347.

Soobhany, N. (2018). Preliminary evaluation of pathogenic bacteria loading on organic Municipal Solid Waste compost and vermicompost. Journal of Environmental Management, 206, 763-767.

Stanley, D., Mason, L. J., Mackin, K. E., Srikhanta, Y. N., Lyras, D., Prakash, M. D., ... & Wong, C. H. (2016). Translocation and dissemination of commensal bacteria in post-stroke infection. *Nature medicine*, *22*(11), 1277-1284.

UN-Habitat (2010) Solid Waste Management in the World's Cities: Water and Sanitation in the World's Cities 2010, Washington DC: Earthscan publications.

Yadav, I. C., Devi, N. L., Li, J., & Zhang, G. (2019). Examining the role of total organic carbon and black carbon in the fate of legacy persistent organic pollutants (POPs) in indoor dust from Nepal: Implication on human health. Ecotoxicology and environmental safety, 175, 225-235.