CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

(C.A.P.E)

CARIBBEAN STUDIES

Title: The Effects of Waterborne and Vector-borne diseases in Society

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Acknowledgements

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Introduction

Theme

The theme is **Disease**.

Sub Theme

The sub theme is **The Effects of Waterborne and Vector-borne Diseases in Society**.

Problem Statement

Waterborne and vector-borne diseases have caused the most deaths (compared to other diseases) in the neighborhood of Stabroek.

Area of Study

Stabroek is a neighborhood with an area of 0.25 sq mi that is located in the city of Georgetown. Georgetown has an area of 87 miles^2 and is located at the coastline near the mouth of the Demerara River and is the capital of the Co-operative Republic of Guyana; which is a country of the South American continent.

Background Information

The 21st century increased medical cases of infections. Developing countries have the highest deaths by disease, half of their children malnourished. Fifth of these aren't immunized by the time they turn one year old [WHO (2014)][1]. The main causes of diseases are the surrounding landfills, polluted drains, and improper sanitation. The scenario arose from their lack of hygienic practices such as water treatment strategies or cleaning campaigns.

[1] World Health Day 2014. (2014, April 2). Retrieved December 20, 2015, from http://www.who.int/mediacentre/news/releases/2014/small-bite-big-threat/en/

Relevance of Topic

The researcher chose this topic because the information in this paper can assist persons to gain a deeper understanding of diseases in Stabroek. The long term goal of the paper is to develop data that can be used in medical diagnosis and analysis of disease in Guyana. It is hoped that this paper will be used to trigger further development in medical pathology and provide an experimental basis to understand the mechanisms of pathogens and parasites.

Research Question

The purpose of this study is **to compare the effects of water-borne diseases to that of vector-borne diseases in the neighborhood of Stabroek, Georgetown**.

Research Objectives

The following questions are addressed in this study:

1. Are diseases found in the Stabroek?
2. What diseases are found in the Stabroek?
3. What causes these diseases?
4. What effects do those diseases have?
5. What are possible solutions to disease in Stabroek?

Educational Value

This research can be used to inform readers about pathogenic diseases and water-borne diseases and also to understand the current rise in diseases, how pathogens and parasites affect mankind, and evaluate possible solution to these kinds of diseases. This information is most beneficial to educators and pathologists.

Definition of key terms

Disease is defined as a condition of the living animal or plant body or one of its parts that impairs normal functioning and is typically manifested by distinguishing signs and symptoms. A pathogen is defined as a specific causative agent (as a bacterium or virus) of disease. A vector is an organism (like an insect) that transmits a pathogen.

Literature Review

From an article published in Stabroek News by Maya Trotz, *diseases were mentioned prevalent to a degree in Georgetown mainly owing to the fact that the sewer system (Central Georgetown Sewerage System) does not include any water treatment mechanisms and dumps sewage into the Demerara River. The writer also suggested a trend where the population has grown incapable of identifying diseases: the infected masses informing others about their disease [dengue] has reduced overtime*[2]. Trotz (2013) aimed to analyze the knowledge of dengue [disease] present in the Caribbean. The study was conducted in Guyana; sources cited articles from Trinidad and Tobago, Barbados, St. Lucia, and Grenada. This writer held the perspective that diseases are characterized by symptoms, which are easily recognizable. The study is similar to this research which recognizes diseases in Stabroek by symptoms.

Quoting an analysis by the CIA in its World Factbook, "*parasite-carried diseases and water-borne diseases are only two kinds of diseases but they account for more than 80% of casualties of all diseases in Guyana of the twenty first century*"[3]. The CIA highlighted the role played by parasite-carried [vector] and water-borne diseases in the overall deaths of Guyanese over the last decades. Data from death tolls were collected from all over the globe for the analysis. The researcher reckons that this analysis is similar to studying the effects diseases have on a populace.

"Malaria had a mortality rate of consuming 0.1% of Georgetown's population in the late twentieth century but has now increased to a whopping 0.8% by the early twenty first century. Aside from malaria, there is also typhoid – nearly two times greater in casualties

[2] Trotz, M. (2013, December 16). Dengue in our backyard: A Caribbean challenge - Stabroek News. (2013, December 16). Retrieved December 20, 2015, from http://www.stabroeknews.com/2013/features/in-the-diaspora/12/16/dengue-backyard-caribbean-challenge/

[3] The World Factbook. (n.d.). Retrieved from https://cia.gov/library/publications/resources/the-world-factbook/fields/2193.html

than Malaria's casualties."[4]. This book from Ramesh Gampat analyzed disease deaths in Guyana. Gampat (2015) desires citizens to understand the implications of disease, as he believes it is important and critical. *He continues saying disease is very prevalent in our society; resources should be pooled to take measures against them. He also adds that the population of Guyana is becoming more aware about the prevalence of disease as compared to the last decade.* The book compiles various analyses on epidemics and diseases that have infected Guyana since the 1800s.

"*As the world grows more populous, there is also increased risk of extreme crowding, widespread filth in developing countries, and there is the mixing of people, pathogens, parasites, and animals in short periods of time. These are perfect conditions for pathogens and parasites to grow on hosts.*"[5] G. Dimijian (2000) stated that developing countries like Guyana are more likely to catch diseases. Dimijian (2000) has travelled all across the globe from Africa to south-eastern Asia analysing pathogens and parasites. He ascertains that the body responds to diseases through symptoms. Under the same assumption, symptoms can be analyzed to roughly identify diseases. The researcher also analyses symptoms under the same premises.

UNICEF published an article[6] stating that residents generally preferred fighting symptoms of disease rather than cause. *It also stated that the frequent flooding in Guyana produced more water pathogens than parasites. UNICEF concluded that waterborne diseases and food-borne diseases have greater effect than viral infections or vector diseases.* UNICEF based this article in the vicinity of Georgetown to analyze the effects of flooding and disease on public health.

[4] Gampat, R. (2015). [Kindle DX version] Retrieved from http://amzn.to/1QxAf5W
[5] Dimijian, G. (2000, January 13). Pathogens and parasites: Strategies and challenges. Retrieved December 20, 2015, from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1312209/
[6] Children in danger as rainstorms flood Guyana. (2005, January 26). Retrieved December 20, 2015, from http://www.unicef.org/infobycountry/guyana_24950.html

Data Collection Sources

This research was an applied research. It compares water-borne and vector-borne diseases that exist in the real world and suggests possible solutions to them. Quantitative data was collected in this paper. Disease is an area of study subject to bias. Using quantitative data eliminates bias from the research.

The data was collected using questionnaires. A questionnaire is a list of research questions designed to extract quantitative data. A questionnaire was used because large amounts of information can be collected from a large number of people (like a neighborhood) in a short period of time and in a cost-effective way. The questionnaire consists of twenty-one (21) questions. There are eighteen (18) closed-ended questions and three (3) open-ended questions.

The total population of residential Stabroek is ~120 people. The sampling method used was stratified random sampling: the researcher categorized people in the population by their location (stratum) - "proximity to drains", "proximity to landfills", "proximity to main road", and "proximity to businesses" and then randomly selected 5 samples from each stratum. By using this sampling method, the researcher compared and contrasted disease samples by their proximities to pollution – the main underlying cause of disease. Questionnaires were distributed to the 5 random respondents. The questionnaires were handed out on the 1st of February, 2016. They were collected on the 4th of February, 2016. Respondents were given a total of 3 days or 72 hours to complete the questionnaires. However, even after 3 days some respondents skipped questions. Therefore the researcher had to reissue these questionnaires so that the relevant data could be collected. Also, respondents provided very little information in open-ended questions. The responses were sorted into categories and then represented using bar graphs, tables, pie charts, tally charts and photographs.

The researcher also used a book by Ramesh Gampat entitled "*Guyana: From Slavery to the Present – Vol.2 Major Diseases"* as a secondary source to gather background information on vector-borne and water-borne diseases in Guyana.

Presentation of Findings

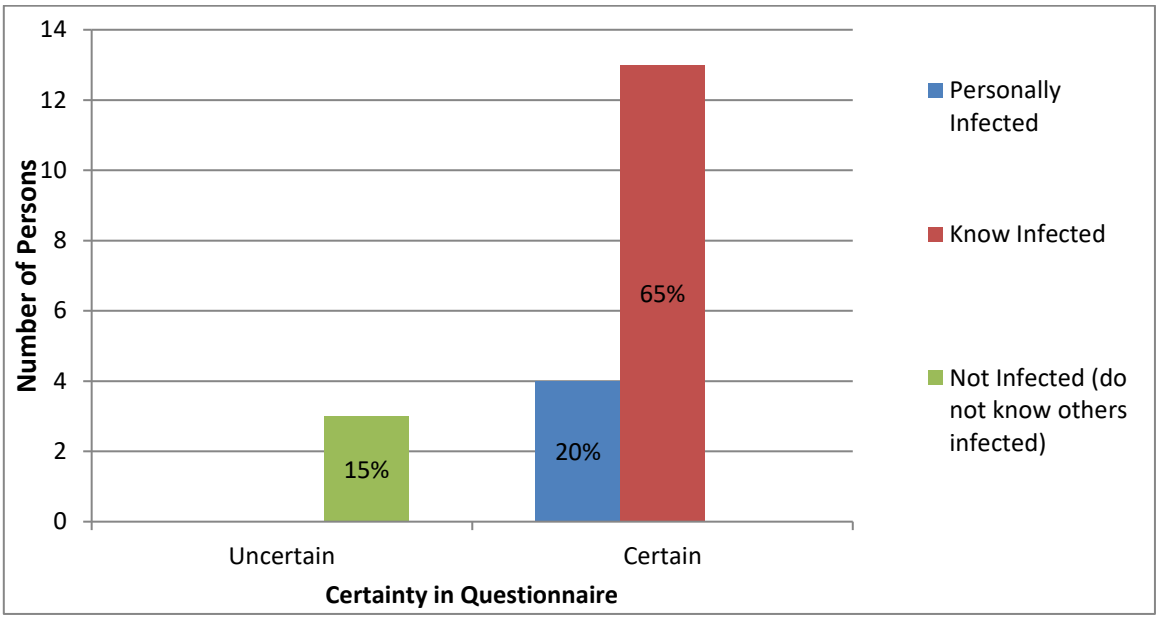

Figure 1: Bar graph showing the numbers of persons infected with disease in Stabroek

Disease	# of Responses	%
Food diseases	3	10.34%
Vector diseases	7	24.14%
Water diseases	7	24.14%
Viral infections	12	41.38%
Total	**29**	**100%**

Figure 2: Table showing the diseases deemed prevalent in Stabroek by respondents

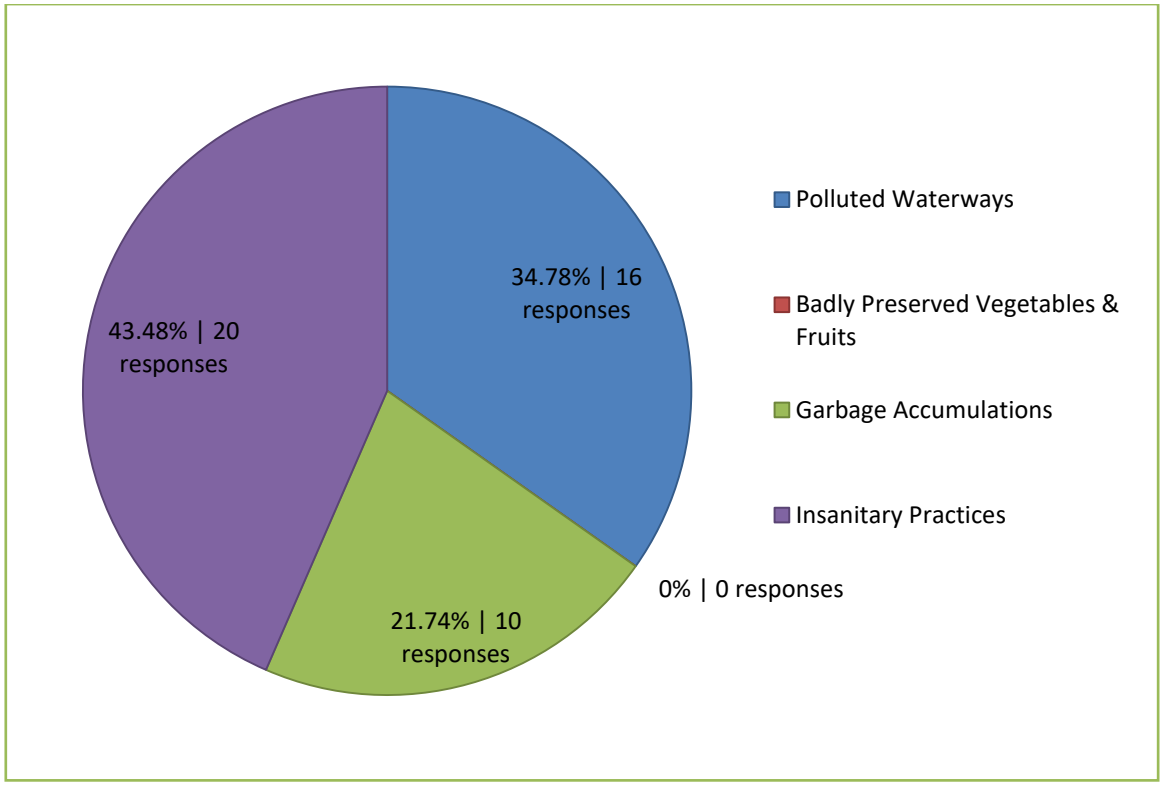

Figure 3: Pie chart showing the main causes of disease as identified by respondents

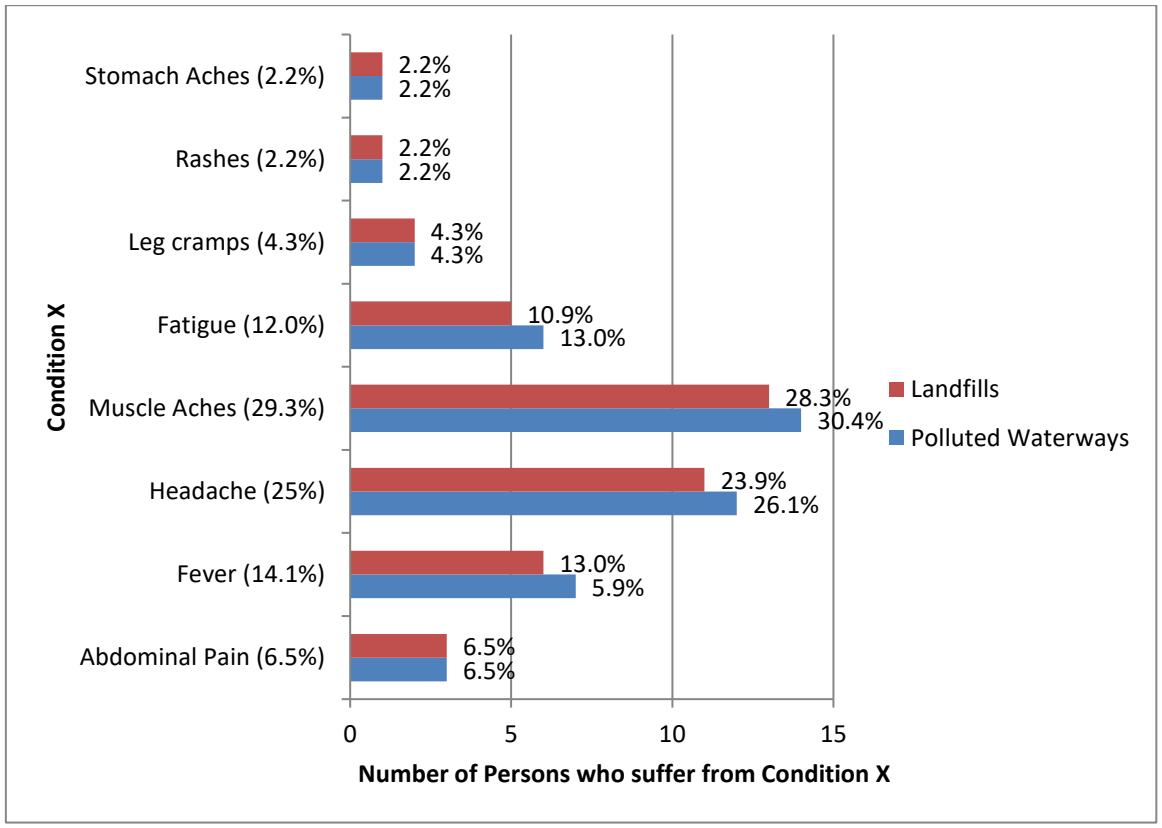

Figure 4: Bar graph showing the effects of disease on residents of Stabroek

	Tally /number of responses for activity			
Activity	**Landfills**	**Polluted Waterways**	**Main Road**	**Businesses**
Avoid uncooked food	|||	||	||||	||||
Avoid unfiltered water	𝍸	||||	||||	||||
Keep fingernails short and clean	|	||||	|||	|
Use sanitary toilets	𝍸	||||	𝍸	||||
Dispose wastes properly	||	|||	|||	|||
Avoid consuming food from vendors	-	-	||	-
Wash hands before eating	𝍸	||||	𝍸	||||
Wear insect repellant	-	-	-	-
Wear long sleeves outdoors	||||	|	|||	||
Do not leave windows and doors open	-	-	-	-
Dump all water-holding containers regularly	𝍸	𝍸	𝍸	𝍸

Figure 5: Tally chart showing the general hygienic activities exercised by residents in Stabroek

Figure 6: Photograph of vector (mosquito) feeding on human blood

Figure 7: Photograph of a human drinking contaminated water

Interpretation of Findings

Figure 1 showed both affirmative (statements that they were infected and/or know of victims who are/were infected with disease) (85% of responses) and dissentive responses (statements that they were not infected with disease) (15% of responses). The results in Figure 1 proved that diseases exist in Stabroek and that the residents have been personally exposed and/or know of victims. The 15% non-infected responses denoted the uncertainty in the responses as those respondents have not been infected with disease.

While Figure 1 establishes that diseases exist, Figure 2 shows the various kinds of diseases in the surroundings for a resident of Stabroek. For the pertaining question asked, each respondent was able to identify one or more kind(s) of disease: taking into consideration that one neighborhood can harbor multiple diseases. However, considering the uncertainty in Figure 1, only 85% of these identifications are valid. The majority of respondents identified viral infections to be the main cause of disease which is true[7]. Waterborne and vector diseases were identified by to be prevalent in the area as well with each having 7 responses (24.14%). Food diseases were the minority occupying 3 responses (10.34%). From this, we can see that both waterborne and vector borne diseases are prevalent in Stabroek and both of them have some exposure to residents.

The diagram/chart in Figure 3 shows the prevailing causes of disease in Stabroek as identified by 46 responses from 20 respondents. Respondents were allowed to give more than one response to the question. All respondents (43.48%) stated that insanitary practices were a cause of disease; none of them (0%) acknowledging badly preserved greens and fruits as a similar cause. 16 responses (34.78%) and 10 responses (21.74%) were given to polluted waterways and garbage accumulations respectively. The researcher infers from the results in

[7] The Epidemiology of Viral Infections. (n.d.). Retrieved February 5, 2016, from http://onlinelibrary.wiley.com/doi/10.1002/9780470688618.taw0224/abstract

Figure 3 that polluted waterways and garbage accumulations are not highly associated with disease as much as insanitary practices, even though most of the diseases today are not directly caused by insanitary practices[8].

Figure 4 shows the effects of disease on residents in Stabroek. The greatest effects were: suffering from muscle aches (29.3%), distressing headaches (25%) and virulent fever (14.1%). Other effects were fatigue (12.0%), abdominal pain (6.5%), and leg cramps (4.3%). Minor effects include rashes (2.2%) and stomach aches (2.2%). From this, we can see that all of these effects are severe. Curing these symptoms is very troublesome for residents as the symptoms usually do not indicate the underlying cause and recur from time to time. Also it can be seen that there are more effects on residents living near polluted waterways compared to residents living near landfills. This is probably due to the fact that Georgetown is frequented by floods leading to frequently polluted waterways.

Figure 5 shows the various hygienic practices practiced by residents in Stabroek. The residents are grouped by their proximity to polluted drains, proximity to landfills, proximity to the main road, and proximity to businesses. The majority of residents: avoid unclean water, use clean toilets, and wash hands before meals. Less popular are: wear insect repellent, wear long sleeves and leave windows/doors closed. These findings highlighted that residents do not emphasize implementing hygienic measures. The activities are only a routine because direct measures like wearing insect repellent and disposing wastes regularly are neglected. Also, it was seen that residents living near landfills exercise more measures than others in Stabroek.

Figures 6 & 7 show the transmission of vector-borne and waterborne diseases through their respective mediums. In Figure 6, the mosquito is the medium containing of a pathogen

[8] Fact sheets on environmental sanitation. (n.d.). Retrieved February 5, 2016, from http://www.who.int/water_sanitation_health/hygiene/emergencies/envsanfactsheets/en/index2.html

and transmits the organism through direct contact with blood. In Figure 7, the pathogens are already within the water and are transmitted through ingestion.

Discussion of Findings

The respondents of the researcher's neighborhood (Stabroek) seemed to be knowledgeable with the topic of Disease even though some respondents were uncertain (15%) about the status of disease in Stabroek. It therefore means that the majority of respondents surveyed were familiar with diseases in the neighborhood. As stated before in Figure 1, there were 17 responses (from a total of 20) where persons affirmed to being victims or know individuals who are victims; this therefore is evident that diseases actually do exist in Stabroek. The uncertainty coincides with the Stabroek News article which stated that there fewer people are telling others about the disease (dengue) and are less aware of the various diseases in the country. R. Gampat however mentioned that we are becoming more aware about the prevalence of disease compared to the last decade: this is contrary to what was observed by the researcher.

While examining the question which assessed the prevalence of various diseases, it was found that vector-borne and water-borne diseases are popular (in Stabroek) but are not the most popular – viral infections are. This is contrary to the analysis on world mortality records by the CIA in the CIA World Fact book which stated that water-borne and vector-borne diseases attribute to more than 80% of all disease casualties in the country. This is probably because the CIA examined the entirety of Guyana which accounts for a wider spectrum of disease whereas the researcher restricted his study to Stabroek. Stabroek is a business hotspot and is less unlikely to catch a wider variety of diseases (owing to the sanitation of popular locations within its vicinity). The study done was also subject to uncertainty as respondents could have given false data. The CIA on the other hand analyzed mortality (100% certainty) of diseases over a greater geographical region being the entirety of Guyana. Doing this allowed them to account for a wider scope of diseases in each category (vector-borne and water-borne).

Waterborne diseases are prevalent in Georgetown mainly due to the sewer system that lacks water treatment processes. Vector diseases also arise from the same condition. The frequent flooding and lack of water treatment provides optimal conditions for parasite and bugs to grow. This was stated in a previous article from UNICEF. However, respondents identified insanitary practices as a major cause of disease which is clearly not the case in Stabroek. Insanitation does cause diseases: but it does not have as many reported cases as waterborne and vector borne diseases have in Stabroek. The transmission of waterborne diseases is highlighted in Figure 7.

The analysis of Figure 4 shows the various effects diseases have on residents. The researcher was able to derive information in comparing residents near polluted waterways to landfills. It was learnt that the former are attacked by a greater number of effects (46 responses) than living near landfills (42 responses). This coincides with the publication by UNICEF which read that living near polluted waterways [source of water borne diseases] have a greater negative effect than living near landfills [source of vector borne diseases]. From this, the researcher can infer that water borne diseases have a greater effect than vector borne disease – because of the fact that waterborne diseases are prevalent near waterways[9] and vector borne diseases are prevalent near garbage accumulations[10]. From Figure 5, it was inferred that residents near landfills exercise more precautionary measures against diseases. This explains why there is less of an effect in landfills compared to waterways.

Figures 6 & 7 show how diseases get into our bodies. From Figure 6, the research realizes that mosquitoes are one of the major causes of vector-borne diseases. This is in conjunction with what was said by R. Gampat when he said that Georgetown is plagued by

[9] Water-related diseases. (n.d.). Retrieved February 5, 2016, from http://www.who.int/water_sanitation_health/diseases/en/

[10] Emergence and Prevalence of Human Vector-Borne Diseases in Sink Vector Populations. (n.d.). Retrieved February 5, 2016, from http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0036858

mosquito diseases such as Malaria. This shows the prevalence of mosquitoes and their cause: landfills in our society. Figure 7 can understood to show the prevalence of water pollution in society. Guyana has been called a land of many waters but it has to be realized that these waters are polluted by human activities. These lead to the growth of pathogens and parasites which cause waterborne diseases.

Conclusions

The researcher concludes that diseases do exist in the neighborhood of Stabroek and are becoming quite prevalent as shown in the analysis of Figure 2. They have impacted the daily lives of residents and impede proper functioning in society. All Guyanese ought to be aware and equipped with the knowledge and means needed to fight disease in the Caribbean. It was found that because the Stabroek neighborhood is more prone to flooding, water-borne diseases have a greater negative effect than vector-borne diseases in the neighborhood of Stabroek. The researcher also concludes therefore that residents in Stabroek should exercise good hygienic practices to combat the issue of disease in the neighbourhood.

Limitations

The researcher met with a couple of drawbacks/issues during data collection. Respondents were not clear in answering questions (they indicated more than one response where it was unnecessary and gave less responses for questions that required more). This resulted in responses that tallied unequally for a few questions. A few respondents skipped vital questions, leading to an increased uncertainty in the questionnaire (other than that identified in Figure 1). Also, the majority of respondents gave vague answers for open-ended questions which made analyzing more difficult than expected.

There were also shortcomings in the midst of this project. In particular, there were issues in choosing the correct sampling method for the questionnaires so that the population is properly represented. These issues included whether to use probability or non-probability sampling methods, and representing most (if not all) characteristics of each unique respondent into their respective strata.

Recommendations

The researcher recommends the following:

1. Water treatment strategies added to the sewer system.

2. Better medical personnel made available.

3. All landfills eliminated and not allowed to accumulate.

4. Citizens made aware of various diseases.

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Appendix

Questionnaire Instructions: Please put a tick (☑) in the box next to the answer of your choice or write in the space provided as the case may be.

1. What is your gender?

    ☐ Male

    ☐ Female

2. In what range does your age fall?

    ☐ 16-25 years

    ☐ 26-35 years

    ☐ 36-45 years

    ☐ 46+ years

3. To which ethnic group do you belong?

    ☐ African

    ☐ Amerindian

    ☐ Chinese

    ☐ East Indian

    ☐ European

    ☐ Portuguese

    ☐ Mixed

    ☐ Other

4. Do you work in or around Stabroek, Georgetown?

    ☐ Yes

    ☐ No

5. Have you (or anyone you know) ever been sick for more than two (2) weeks?

    ☐ Yes (I was sick)

☐ Yes (Someone I know was sick)

☐ No

6. Which type of disease is most prevalent in your area?

☐ Food diseases

☐ Vector diseases (like malaria and dengue)

☐ Viral infections

☐ Water diseases

☐ Other:_____

7. Does it flood a lot in your area?

☐ Yes

☐ No

8. Which of these practices do you perform?

☐ Drink only filtered/bottled water.

☐ Wash hands properly before eating.

☐ Wash the containers daily.

☐ Eat cooked, warm foods.

☐ Keep your fingernails short and clean.

☐ Use of proper toilets for defecation.

☐ Wash food before cooking and cook food at high temperature so as to kill harmful bacteria.

☐ Avoid flies by disposing animal and organic wastes properly.

☐ Ensure to take proper care in disposing of infant and toddler faeces.

☐ Avoid consuming foods, fruit juices, and milkshakes from roadside vendors.

☐ Always keep foods and beverages closed.

☐ Avoid drinking water at parks and other such recreational places.

☐ Avoid swimming in rivers and creeks for prolonged periods of time.

☐ Wash hands before preparing food and before eating.

☐ Avoid ice cubes.

☐ Avoid eating uncooked food.

9. Where do you get your water from?

☐ Well

☐ Pipeline

☐ Reservoirs

☐ Water tank

☐ Other:_____

10. Have you had any of these symptoms for more than a week?

☐ Diarrhea

☐ Dehydration

☐ Weight loss

☐ Watery diarrhea

☐ Leg cramps

☐ Abdominal Pain

☐ Anemia

☐ Excess Gas

☐ Upset Stomach

☐ Chills

☐ Pneumonia

☐ Anorexia

☐ Muscle aches

☐ Headache

- ☐ Tiredness
- ☐ Stomach Pain
- ☐ Stomach Cramps
- ☐ Nausea
- ☐ Vomiting
- ☐ Fever

11. Do you consume any of these items?

- ☐ Water from the pool
- ☐ Chicken
- ☐ Unpasteurized Milk
- ☐ Water from tap
- ☐ River/coastal water
- ☐ Ground beef
- ☐ Imported cheeses
- ☐ Cider
- ☐ Alfalfa sprouts
- ☐ Ready-to-eat foods
- ☐ Fruit and juice
- ☐ Milk products
- ☐ Shellfish
- ☐ Raw Salads
- ☐ Raw vegetables
- ☐ Raw eggs
- ☐ Smoked fish
- ☐ Oysters

12. For what reason do you think water diseases are abundant in your area?

_____

_____

_____

___

13. Does your area have an abundance of pests?

☐ Yes

☐ No

14. Are there any waterways in your area where there is no flow of water?

☐ Yes

☐ No

15. Which of these practices do you exercise?

☐ Wearing insect repellent when outdoors and at all times of day. Be sure to apply it and always apply after sunscreen.

☐ If you choose to open the windows and doors ensure that they have intact screens installed.

☐ Wearing long sleeves and long pants when outdoors at all times a day, when possible.

☐ Always use air conditioning over leaving the windows and doors open.

☐ Keep your yard clean and clear from debris.

☐ Make sure to dump or cover all water holding containers regularly.

☐ Treat standing water that can't be dumped with chemicals.

16. Have you ever been diagnosed with any of these diseases?

☐ Dengue fever

☐ Chikungunya

☐ Yellow fever

☐ Malaria

☐ Other:_____

17. Have you had these symptoms for more than a week after being bit by any insect/bug (like mosquitoes)?

☐ Fever

☐ Body aches

☐ Rashes

☐ Headache

☐ Joint Pain

☐ Joint Swelling

☐ Muscle pain

18. For what reason do you think pest diseases (like mosquito diseases) are prevalent in your area?_____

_____

19. Have you been suffering from any long-term disease (more than 6 months)?

☐ If yes, please state:_____

☐ No

20. What do you think are some main causes for disease in your neighborhood?

☐ Polluted waterways

☐ Badly preserved greens and fruits

☐ Garbage accumulations

☐ Lack of proper sanitary practices

☐ Other:_____

21. What do you think is the major cause for disease in your neighborhood and why?

_____

_____

_____

Dear Respondent,

Thank you for taking part in this questionnaire survey related to diseases in Stabroek, Georgetown. I am Sonny Kothapally, a second year CAPE Caribbean Studies student from Queen's College, Guyana. Today, I will be gaining your thoughts and opinions on diseases to understand the impacts of disease in the future. This questionnaire should only take 4-5 minutes to complete. Be assured that all responses you provide will kept confidential. Please turn over the page to proceed.

Yours faithfully,

Sonny Kothapally

Student