Assessing The Infection Rate of Otitis Externa In Patients Who Swam In Chlorine Treated Waters vs. Natural Lakewater

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Table of Contents

Introduction ……....page 1
Purpose……page 2
Methodology ……..page 3
Results ……....page 4
Discussion ……..page 8
Conclusion ……page 9

List of Figures

Figure 1……Page 4
Figure 2……Page 5
Figure 3……Page 5
Figure 4……Page 6
Figure 5……Page 6
Figure 6……Page 7
Figure 7……Page 7
Figure 8……Page 8

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Abstract

Title: Assessing The Infection Rate of Otitis Externa In Patients Who Swam In Chlorine Treated Waters vs. Natural Lakewater
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Ear infections are the number one reason that children up to five years of age go to the doctor for. It was proven that swimming in natural water heightened the chance of obtaining an ear infection compared to not swimming. It is unknown however how different the rate of obtaining an ear infection, specifically otitis externa (OE). The purpose of this study was to compare the infection rates of participants swimming in natural water compared to chlorine treated water. A survey was created consisting of questions pertaining to demographic information, history of ear infections, rate of swimming, quality/ type of water, and upper respiratory tract infection (URTI) diagnosis. This survey was posted on a website which included a written consent form and other aspects of my research. The data was collected from a public pool and two different swimming teams. 14 participants partook in the study with the majority swimming frequently in chilly pools. These results were not statistically significant, although the data can contribute to a larger study which could have statistical significance. The purpose could not be adequately tested due to the lack of participants. It was found that most of the participants with ear infections swam in chilly water frequently prior to infection. It was also found out that the cases of URTI occurred in swimmers with ear infections.

Introduction

Ear infections such as otitis media and otitis externa are common ailments that can affect people of all ages. By definition, an ear infection is when the ear canal becomes inflamed. Ear infections are caused by a variety of factors, such as water getting trapped in the ear canal which could lead to the bacterial flora infecting this area, causing inflammation. Infection may vary due to the type of water source, its temperature, concentration of bacteria, and the region of the water source. The most common causes of this disease are bacterial infections consisting of Pseudomonas and Staphylococcus bacteria (Wade, 2013).

Ear infections are the most common ailment in children from roughly ages 2-4 (Khamael, 2020) and one of the most common reasons for doctors visits in children (Al-Taie, 2020). This frequency is hypothesized due to children having smaller ear anatomy which heightens the risk of infections. While swimming, water can penetrate the ear canal where there is an imbalance of pressure between the ear canal and eustachian tube and nasal passage (Subtil, 2018). If bacteria are present in the water while the water penetrates the ear canal, then there's a chance for infection to arise. There are earplugs that are 100% effective for keeping water out of the ear canal (Kovoor, 2016). However, it is found that ear protection does not help minimize infection rates in children with tympanic tubes (Subtil, 2019) and this may also hold true in children without tympanic tubes as well.

Different bodies of water contribute to ear infection development in varying ways. One can acquire ear infections from freshwater sources, saltwater sources, and/or chlorinated water sources (Leonard, 2018). Despite the different water sources, the rate of infection in salt water remains consistent with the rate of infection in freshwater (Wade, 2013). The chance of obtaining ear ailments increases when swimming in saltwater rather than not swimming at all (Leonard, 2018). This suggests that there is a correlation of swimming in non-chlorine treated waters and increased ear infection rate. However, studies also show that chlorine is a mucosal irritant (Kavoor 2016), therefore, the chlorine can cause irritation in the ear canal, which could be a precursor to an ear infection.

A systematic review done by Leonard et al. in 2018 compared rates of infections contracted while swimming versus not swimming in ocean water. This review reported a wide variety of ailments that could be contracted such as stomach viruses and ear infections. A model of an ear was constructed digitally and featured the eustachian tube to see how and when water

penetrates the ear. The water goes through due to the imbalance of pressure when the head is submerged underwater (Subtil, 2018). The water remained constant but testing for different variations could help identify which water source affects the ear the most. A randomized control trial (RCT) showed that it does not matter whether you wear ear protection or not while swimming (Subtil, 2019), but did not specify the type of water, which could impact whether or not an infection develops.

As can be seen, there are a few gaps in knowledge regarding the development of ear infections, their rates, and how the type of water impacts these infection rates. For instance, It is not known whether there is a risk factor of seasonal exposure, and tympanostomy tube size may also play a role in ear infection rate (Subtil, 2019). Furthermore, there has not been a true comparison between different bodies of water and rates for ear infections (Leonard, 2018).

Questions have been raised on whether children should avoid swimming post tympanic surgery in order to lessen the chance of infections (Subtil, 2019). Despite infection rates being similar among them, untreated water does have a higher chance of having bacteria when compared to chlorine treated pools (2019), which would suggest infection rates could be higher after swimming in those types of bodies of water. However, there is also the debate that the bacteria that causes infections is already present in the ear prior to an infection developing.

Purpose

To date, there is not a statistically significant study which compares ear infection rates between two unique bodies of water (ie. lake water vs. chlorine treated water). The purpose of this study was to examine if there is a difference between the occurrence of ear infections in individuals who swam in either natural water sources such as oceans, lakes, and rivers or in chlorine treated water sources such as swimming pools. It was hypothesized that individuals who swam in non-chlorinated water (oceans, rivers, or lakes) would have a higher incidence of ear infections than those who swam in chlorinated water (such as swimming pools) due to the higher bacterial levels that are present in non-chlorinated water sources.

Methodology

In order to inform people about this study, a google website was created where the google forms survey, digital consent form, and research paper could be found. The website allowed people to access all of the information provided as well as find the links to the survey. The survey itself was created in google forms and consisted of 23 questions that asked demographic information, water source (chlorinated vs. non-chlorinated) and other characteristics such as temperature of the water, if any types of precaution had been used, and ear infection history.

Fliers were also designed, and these consisted of a brief paragraph describing what kind of participants were needed to complete the survey and a QR code to access the website easily from one's mobile device. These fliers were posted around the Monroe YMCA and sent to 3 local swim teams in order for them to be distributed to swimmers electronically. The teams were from New York Sharks Aquatics (NYSA), and both the Boys and Girls Varsity swim teams of Monroe-Woodbury Central School District.

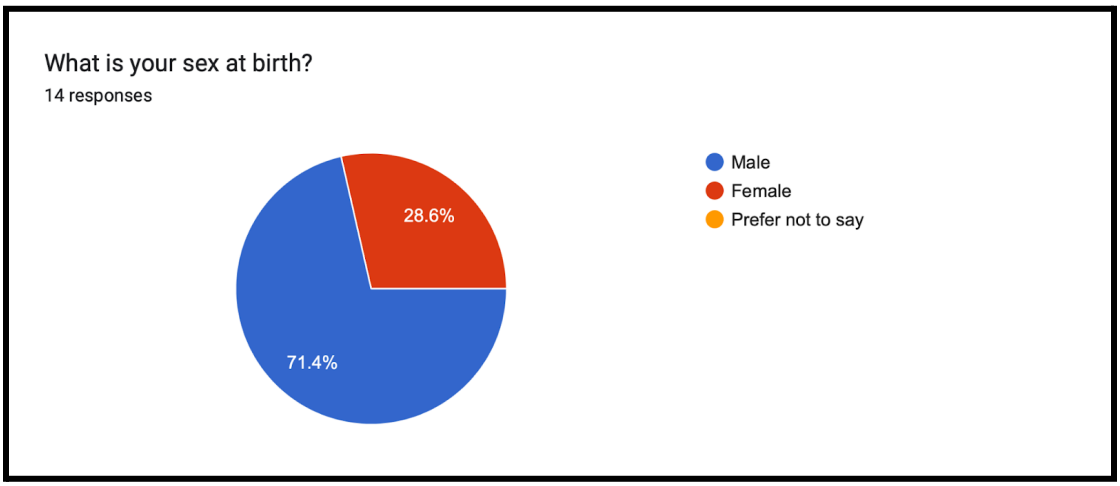
Any participants who agreed to take the survey were provided a synopsis of the research, some background information, as well as a brief biography (located on the aforementioned website). The caregivers and/or participants were informed that the survey was anonymous and that no personal information such as email, name, or phone number would be collected. Due to many participants being minors, a digital consent from (opt out form) was used. Caregivers and/or participants could sign if they did not want to take the survey for any reason. In order to maintain participation, the survey only required a few minutes of time to complete, and consisted of engaging questions that could be answered with minimal effort/difficulty. The survey responses were collected electronically and sorted using google sheets.

The original experimental design was to compare cases of patients with otitis externa to a control group which consisted of children without otitis externa, but too few cases were enrolled. Due to a limited number of participants, this study was analyzed similarly to a case study report. In doing this, some key themes or trends were found that should be investigated further with future research. This study obtained approval from the Monroe-Woodbury Institutional Review Board (IRB) prior to implementation.

Results

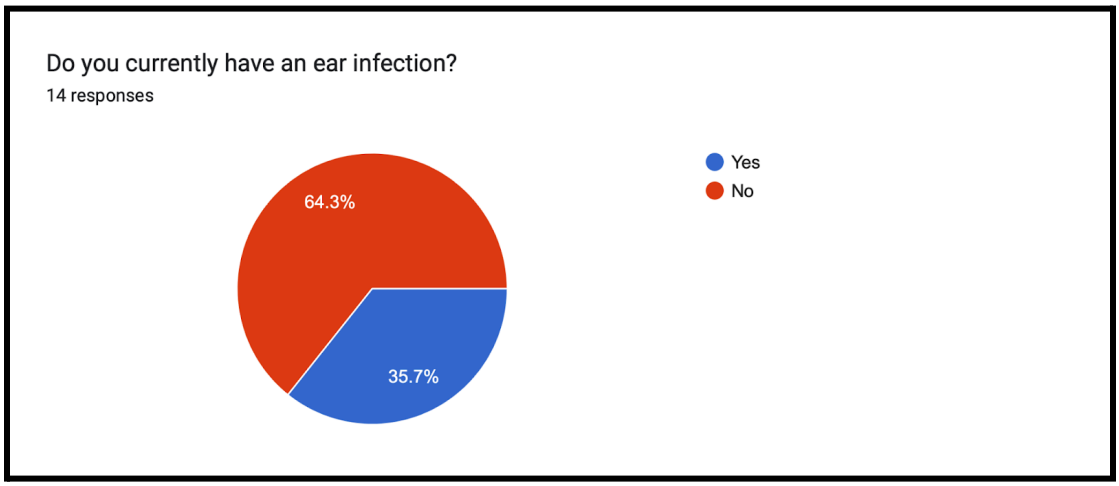
A total of 14 participants completed the survey, with ages ranging from 6-17. The mean age of participants was 15. Some of the survey background questions asked about sex at birth and current ear infection status. The responses to these questions can be seen in Figure 1 and Figure 2. The participants were mainly males, with roughly 71.4% choosing male at birth and 28.6% choosing female at birth (Figure 1).

Figure 1: Sex at Birth



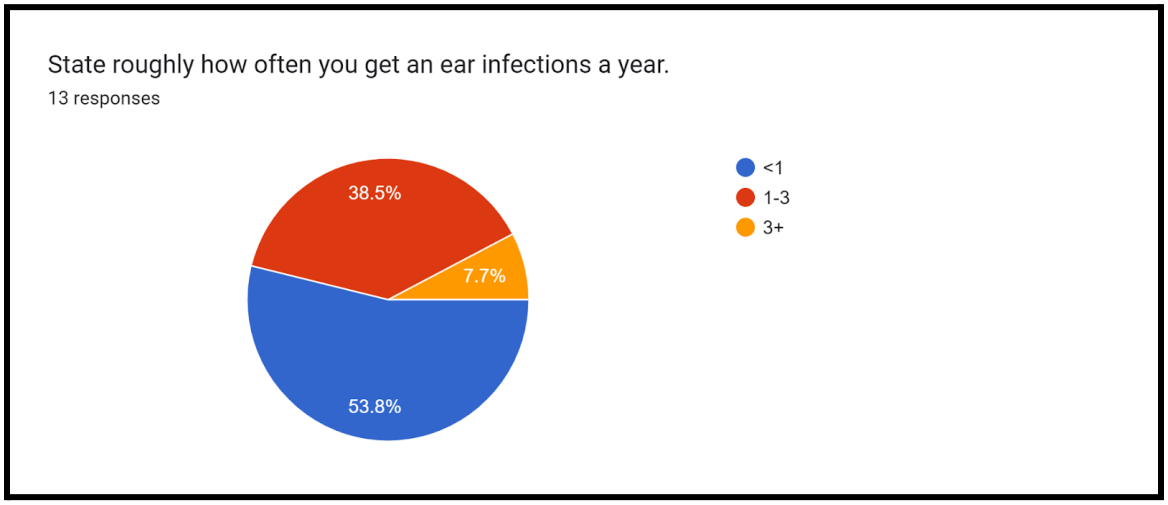
Of the 14 participants, 9 (64.3%) reported not having an ear infection at the time of taking the survey (Figure 2). The other 5 participants did report having an ear infection, with the majority being otitis externa (4 reported yes/1 was not sure). A main symptom reported from obtaining OE was ear pain and each of the 5 ear infection participants reported visiting the doctor due to the ear pain/ear infection with the other reason being a physical check up.

Figure 2: Ear Infection Status



With the yearly infection rates of the patients, 7 participants (53.8%) had less than 1 ear infection a year., 5 people (38.5%) get 1-3 infections on average a year. Only one person had 3 + infections a year, making up 7.7% of this sample (Figure 3). However, most people with more than one ear infection had difficulty recalling past ear infection types (Otitis externa vs. Otitis media). Only two of the participants knew their last infection types which were OE for one & OM for the other.

Figure 3. Yearly Ear Infection Rate



The rates of swimming were high with 8 people swimming up to 14 days prior to diagnosis and only 4 people not swimming (Figure 4). Out of these people, 8 swam in a pool, 2 swam in lakes, and 1 swam in the ocean (Figure 5).The majority of participants swam everyday in chlorinated water with the rest swimming about 1-3 in either a lake, ocean, and/or a pool.

Figure 4. Rate of Swimming

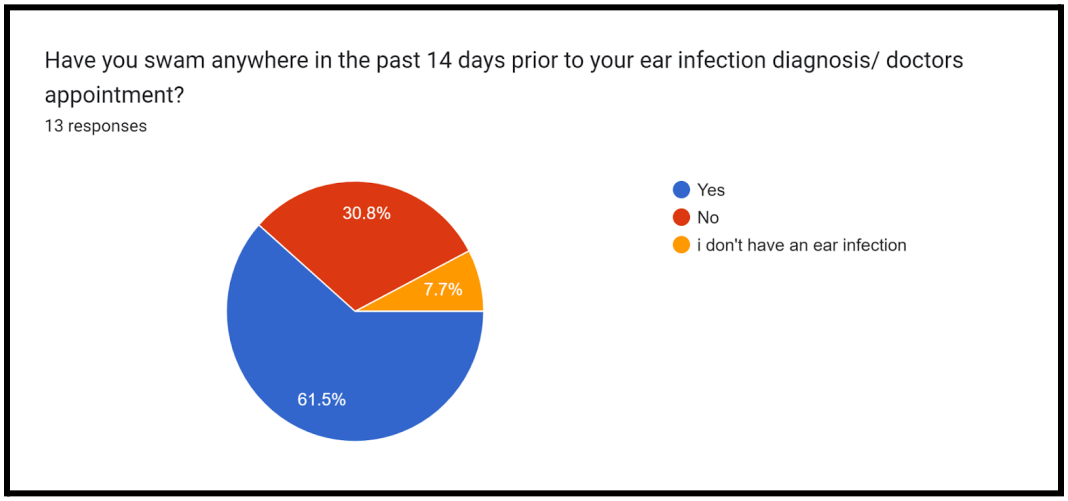
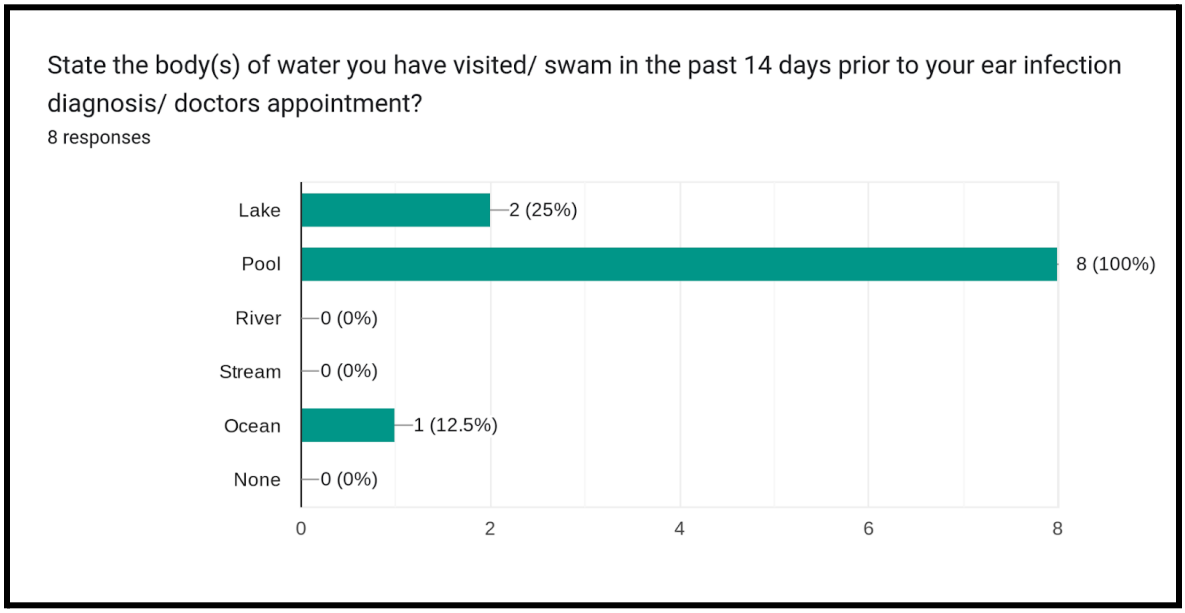


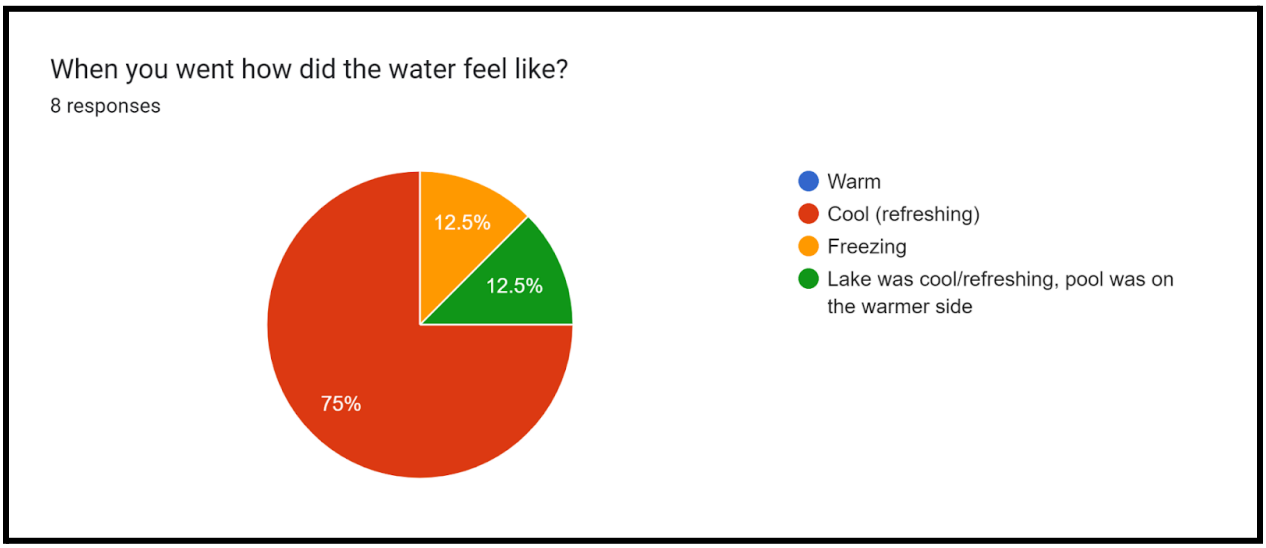
Figure 5. Body of Water



In addition to the location of swimming, participants were asked if they swam with any sort of protection such as earplugs, googles, a silicone and/or latex cap, or no protection. Of the participants, 6 people swam with goggles, 3 people wore a silicone/ latex cap, and 1 person had

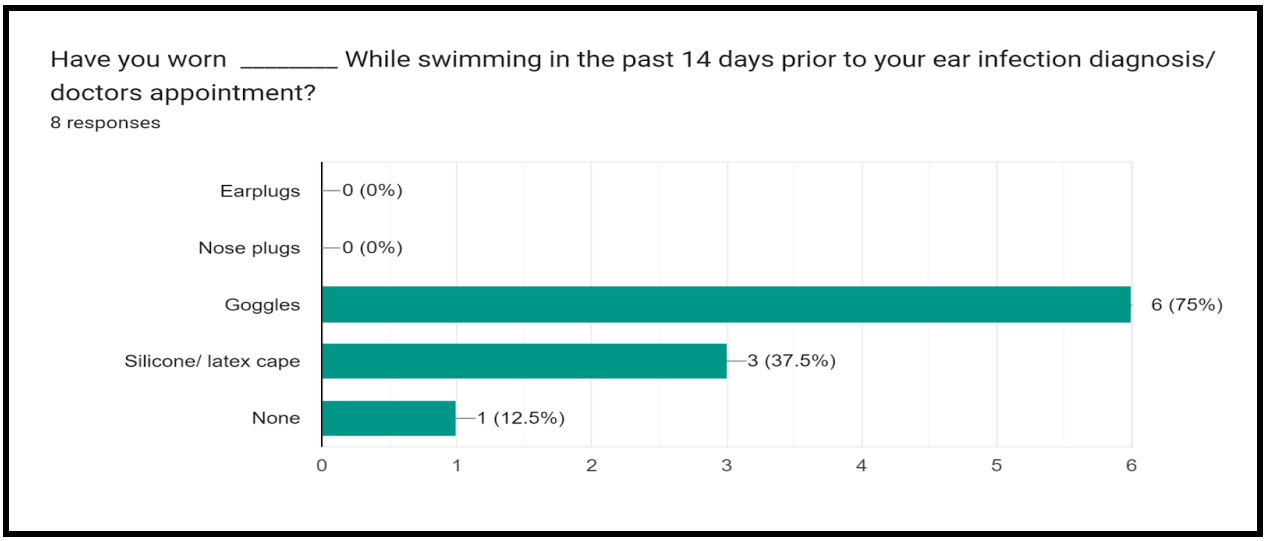
no equipment while swimming (Figure 6). Not all of the participants answered this question. With the rate of swimming specifically, 8 people swam at least 3 times prior to their ear infection diagnosis.

Figure 6. Swimming Protection



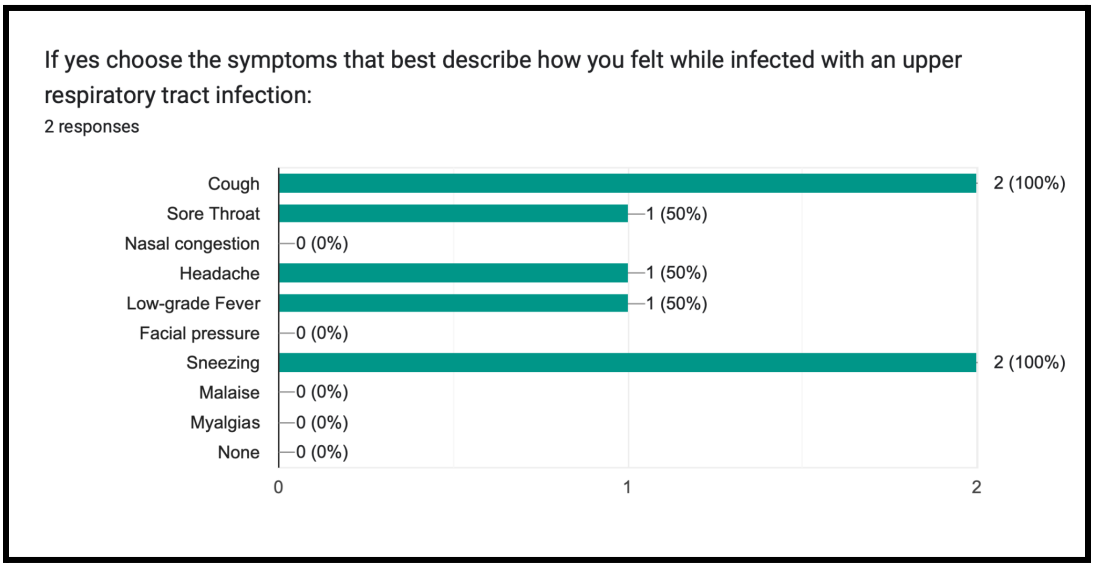
With regard to temperature, of the participants who had swam, 6 people (75%)reported the water temperature as cool, 1 person reported freezing, and 1 person reported cool lake conditions/warmer pool (Figure 7). While swimming, 8 people reported having their face submerged in the water, with 5 swimmers diving 2 feet under the surface and 2 swimmers diving 3 or more feet. A total of 7 people reported swimming strokes such as freestyle.

Figure 7. Relative Feel of the Water



From the survey results, 10 people did not have otitis externa while taking the survey and 4 participants reported having otitis externa. The majority of participants (10) answered no to having an upper respiratory tract infection, however, some did report having an upper respiratory tract infection (2 participants) or either a cold or flu like symptoms (2 participants). The people diagnosed with URTI's reported symptoms of cough, sore throat, headache, low-grade fever, and/or sneezing.

Figure 8. URTI Symptoms



Discussion

This study was analyzed similarly to a case series study. A case series is used more to collect data and describe the characteristics of cases within the study which means that there is no definite answer proving/disproving the hypothesis. However, there were still data values that were useful in analyzing future data from this study. Most of the participants were male. This has little to no effect on the ear infection rate data as it has been found that men and womens rates differ by 0.3% (Wade et. al, 2013). The study obtained information on a multitude of infections derived from swimming in natural water sources that were near sewage treatment facilities. The study focused on ear infection data and found that the overall rate of infection averages out to be 1.67% across all age groups. This study had an infection rate of about 35.7% taking into account that most participants swam multiple times a week with no ear protection such as ear plugs. All 5 of the participants who had an ear infection while filling out the survey visited their primary care physician for a formal diagnosis. This shows that the ear infection data is more significant because none of the participants were self-diagnosed, which at times results in an inaccurate diagnosis. Most of the participants sampled swam in chlorine treated pools which can potentially be a bias of sample due to most of the participants learning about the study in pool locations and through thor swim teams. This can have the potential to affect the results.

As was previously mentioned, there are ways to prevent infection. One way is to dry out your ear canal after you swim. This can be done by simply shaking your head to get the water out of the ear canal (Mayo Clinic, 2019). There were some limitations to this study. Some of the major limitations of this study were that most of the patients only swam in chlorine treated water so there was no true comparison between rates of infection between natural and chlorine treated waters. Only 14 people took part in the survey, therefore, some of the frequency of the data may be off due to this very small population size. There were multiple locations where participants were obtained, which may also have an effect on the results. Additionally, participants filled out the survey themselves, so they could have made an error whale filling out the survey or answer untruthfully. For future research, I would like to use the information derived from this study in order to create a statistically significant case control study with similar parameters.

Conclusion

This original case control study was adapted into a descriptive case series study. The hypothesis was unable to be either supported or refuted. However, this data is a useful contribution to future studies such as a meta analysis. All of the participants with ear infections actively swam more than three times a week, 2 weeks prior to infection. Other authors have had similar studies in the past and their literature contributed to having ear infection data accurate and relevant (Wade, 2013). Further research would need to conduct a case control study using the same variables and have a diversification of swimming locations and a larger number of participants for statistical significance.

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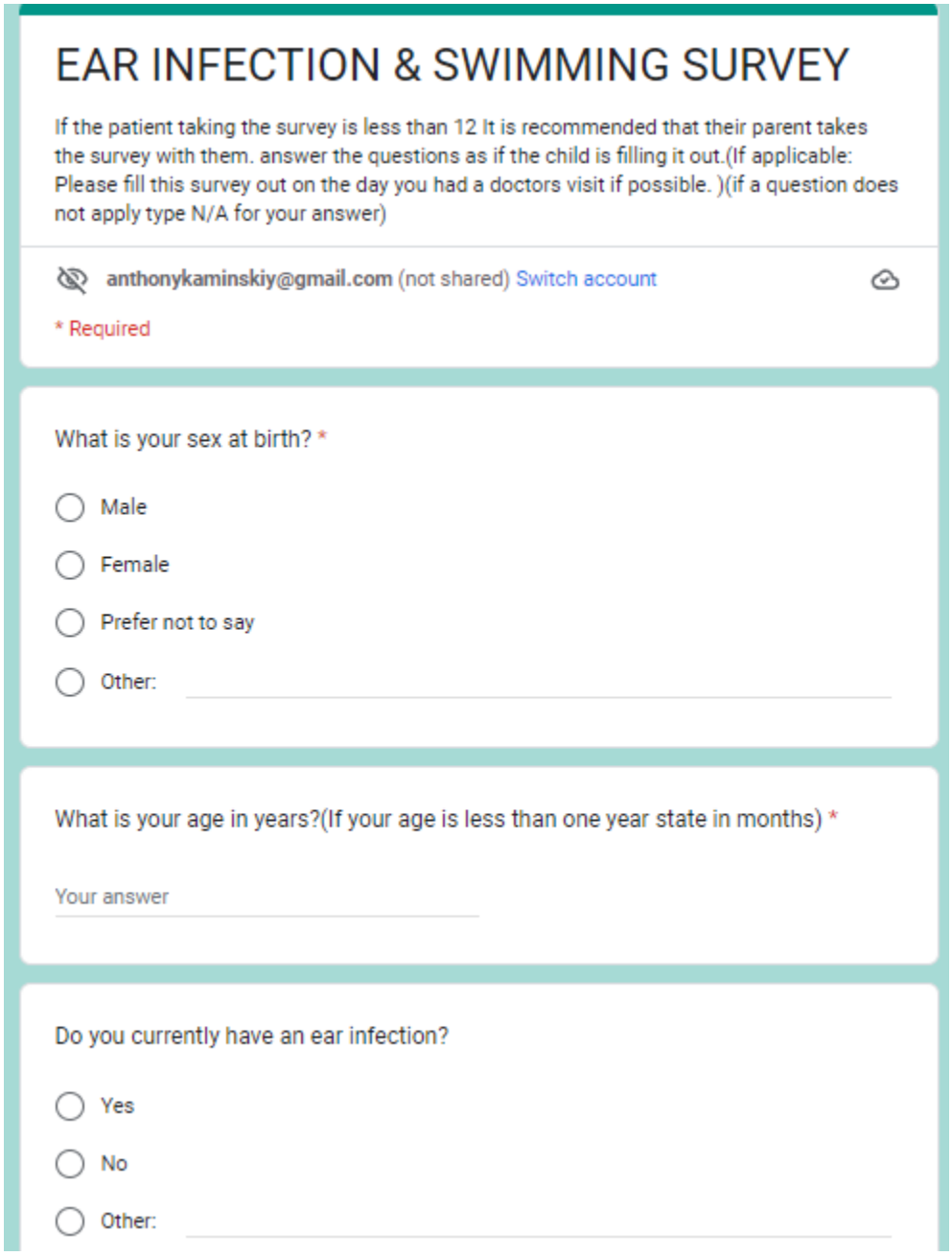
Appendix 1: Survey Questions



EAR INFECTION & SWIMMING SURVEY

If the patient taking the survey is less than 12 It is recommended that their parent takes the survey with them. answer the questions as if the child is filling it out.(If applicable: Please fill this survey out on the day you had a doctors visit if possible.)(if a question does not apply type N/A for your answer)

anthonykaminskiy@gmail.com (not shared) Switch account

* Required

What is your sex at birth? *

- Male
- Female
- Prefer not to say
- Other:

What is your age in years?(If your age is less than one year state in months) *

Your answer

Do you currently have an ear infection?

- Yes
- No
- Other:

If you put Yes to having an Ear infection

Yes to ear inflections

If yes state the date that you were diagnosed:

Date

mm/dd/yyyy

If yes was it otitis externa(outer ear infection)?

- ◯ yes
- ◯ No
- ◯ Other:

If yes: state some prevalent symptoms (This can include: The swelling of the ear canal, your ear hurting, fluid excreting the canal)

Your answer

If yes: was that the reason that you visited your primary care physician?

- ◯ Yes
- ◯ No
- ◯ Other:

If you answered no to having an infection

No to ear infections

If no: what was the primary reason that you visited your primary care physician?

Your answer

if no: state the date of your doctors appointment

Date

mm/dd/yyyy

State roughly how often you get an ear infections a year.

- ◯ <1
- ◯ 1-3
- ◯ 3+

If you answered to having more than one infection

If you have had more than one infection, did you have different types of ear infections in the past?

- ◯ Outer ear (Otitis externa)
- ◯ Middle ear (Otitis media)
- ◯ Cannot recall
- ◯ Other:

Have you swam anywhere in the past 14 days prior to your ear infection diagnosis/ doctors appointment?

- ◯ Yes
- ◯ No
- ◯ Other: _____

If you responded that you swam in the past 14 days prior to your ear infection diagnosis/ doctors appointment

State the body(s) of water you have visited/ swam in the past 14 days prior to your ear infection diagnosis/ doctors appointment?

- ☐ Lake
- ☐ Pool
- ☐ River
- ☐ Stream
- ☐ Ocean
- ☐ None
- ☐ Other: _____

State the dates & location of where you swam in the past 14 days prior to your ear infection diagnosis/ doctors appointment. (state none if this question does not apply)

Your answer

Have you worn _____ While swimming in the past 14 days prior to your ear infection diagnosis/ doctors appointment?

- [ ] Earplugs
- [ ] Nose plugs
- [ ] Goggles
- [ ] Silicone/ latex cape
- [ ] None
- [ ] Other: _____

How many times have you swam in the past 14 days prior to your ear infection diagnosis/ doctors appointment?

- ◯ 0
- ◯ 1
- ◯ 2
- ◯ 3+

When you went how did the water feel like?

- ◯ Warm
- ◯ Cool (refreshing)
- ◯ Freezing
- ◯ Other: _____

While swimming did you submerge your face into the water to the point that your ear canals were submerged as well in the past 14 days prior to your ear infection diagnosis/ doctors appointment?

- ◯ Yes
- ◯ No
- ◯ I cannot recall

State how deep you dive while swimming.

- ◯ Did not dive bellow surface
- ◯ About2 ft
- ◯ Between 5-11 feet
- ◯ 12<
- ◯ Other: _____

State whether you swim strokes such as the front crawl while at the water site.

- ◯ Yes
- ◯ No (treading/ wading)

Are you currently affected with Otitis Externa?

- ◯ Yes
- ◯ No
- ◯ Other: _____

Have you had a cold or Upper respiratory tract infection in the past 2 weeks prior to your visit/ ear infection diagnosis?

- ◯ Yes
- ◯ No
- ◯ A few times
- ◯ Other: _____

If you answered yes to having a Upper Respiratory Tract Infection

If yes choose the symptoms that best describe how you felt while infected with an upper respiratory tract infection:

- ☐ Cough
- ☐ Sore Throat
- ☐ Nasal congestion
- ☐ Headache
- ☐ Low-grade Fever
- ☐ Facial pressure
- ☐ Sneezing
- ☐ Malaise
- ☐ Myalgias
- ☐ None
- ☐ Other: _____