Leptospirosis: Do meteorological factors have an impact on incidents within Salvador, Brazil?

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Introduction

Leptospirosis is a zoonotic disease that has become a foremost health concern due to the global development of urban slums (Hacker et.al, 2020). Brazil underwent a noteworthy demographic change amid 1960 and 1996 that created a 350% upsurge within its urban inhabitants (Anuário Estatistico do Bras, 1991). One effect of this consequence was the establishment of urban slums where the deprivation of necessary hygiene encouraged rodent-borne spread of leptospirosis (Ko et.al, 1999). However, meteorological factors robustly impact the spread of leptospires (Mwachui et.al,2015). The disease tends to survive more frequently within warm, and humid surroundings (Zavitsanou and Babatsikou, 2008), and is more predominant within tropical climates (Ratnam, 1994).

Leptospires can survive weeks to months within water as well as moist dirt (Levett, 2001). The virus is usually connected with torrential precipitation along with flooding incidents in Brazil (Centers for Disease and Control Prevention,2019). For instance, hospitalized leptospirosis patients was without doubt linked with severe bouts of rainfall in Salvador, Brazil (Hacker et.al,2020).

The aim of this research was to analyze multiple, previous studies to collect a deeper understanding into leptospirosis, the rise in cases plus meteorological factors in Salvador, Brazil. In addition, data received from a prior investigation will also be analyzed to research deeper to create plots and graphs as a visual representation to note and recognize any possible trends or patterns to determine whether meteorological factors have an impact on leptospirosis cases.

Materials

A combination of articles and journals were read and then analysed to gather an insight into leptospirosis and possible factors in Brazil. Data was also received from an excel document based on findings that were gathered from a previous study on meteorological factors and leptospirosis under the heading “lepto_data” which was then placed into the integrated development environment software “RStudio”. The table represents the list of variables listed within the document as well as a description of what each heading meant.

List of Variables		Description
ID	(V1)	Week numbers from 1-733
SIN and COS	(V2 V3)	A 52week repeating pattern
SIN1 and COS2	(V4 V5)	A 26week repeating pattern
Rt1 and Rt2	(V6 V7)	Rainfall
Ht1 and Ht2	(V8 V9)	Humidity
Tt1 and Tt2	(V10 V11)	Temperature
y	(V12)	Number of cases
ano	(V13)	Years 1996-2010
pop	(V14)	Total population

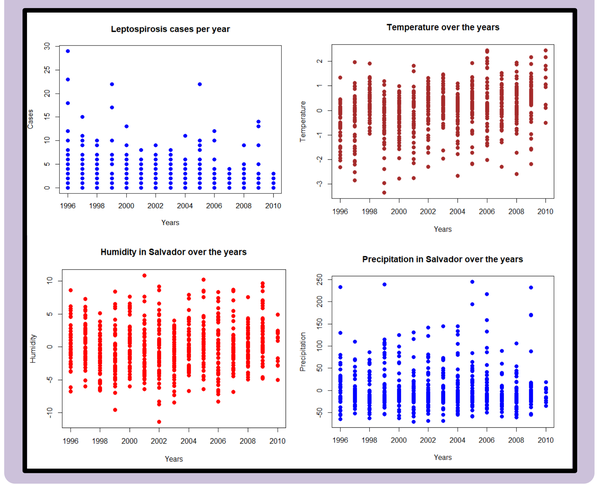
Methodology

To extract data for further analysis, an amendment was first made to the lepto_data file, this helped to change the data into a numeric form which RStudio could understand and to help gain results and analysis. Once edited, various inputs and coding were applied, for example:

```
plot (lepto_data1$V12, lepto_data1$V13)
```

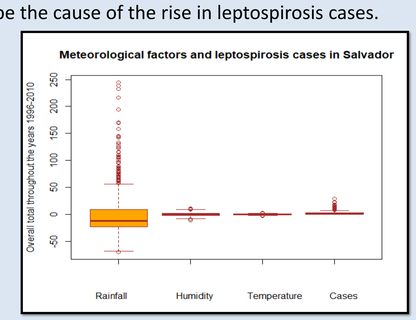
This input created a basic plot, that displayed the amount of leptospirosis cases throughout the years 1996-2010. A repeat of this method for meteorological factors over the years was then inputted to examine for any patterns or structures that may have occurred over the years and to make comparison as displayed below.

```
plot (lepto_data1$V12, lepto_data1$V13), pch
=16,cex=1.3, col="blue",main="Leptospirosis
cases per year",xlab="Years", ylab="Cases")
```



Results

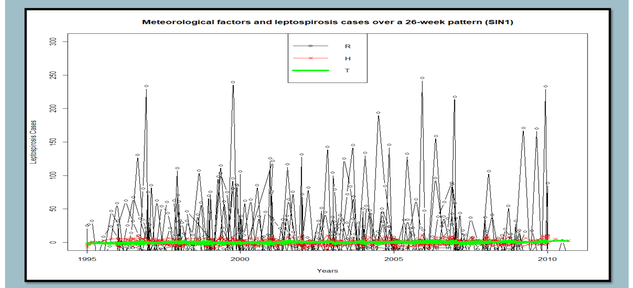
Reflecting on the plots created (see methodology), a box plot was generated to analyse the overall cases as well as meteorological factors to determine what climate conditions may be the cause of the rise in leptospirosis cases.

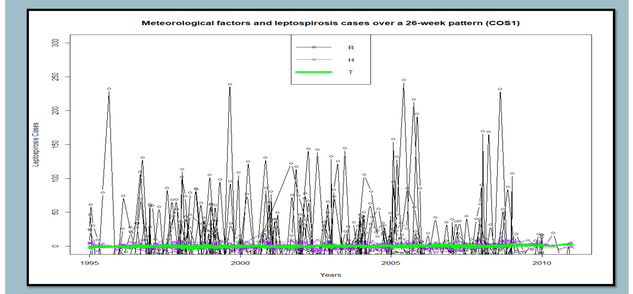


As exhibited, the boxplot demonstrates how the amount of precipitation is more predominant out of all the factors, especially in comparison to humidity and temperature however, along with rainfall, humidity being higher than overall temperature, cases seem to increase.

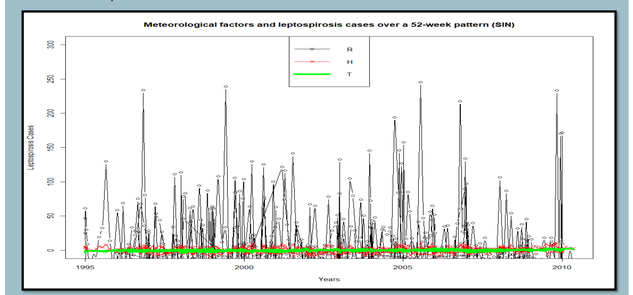
Results Continued

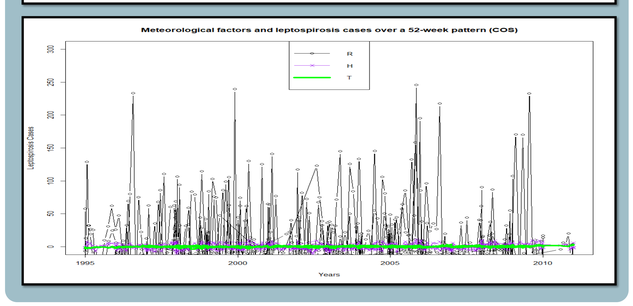
The 2 seasons of Salvador tend to be December to May (dry season) and June to November (wet season) (Ilosvay et.al, 2021). In the plots, R= Rainfall, H=Humidity and T=Temperature. Both the plots represented below are based on 2 separate, 26-week repeating patterns. In the first plot rainfall has a p. value = <2.2e-16, humidity a p. value = 9.441e-16 and temperature a p. value = <2.2e-16 whereas in the second plot, rainfall has a p. value = <2.635e-14, humidity a p. value = 5.124e-05 and temperature a p. value = 7.335e-08.





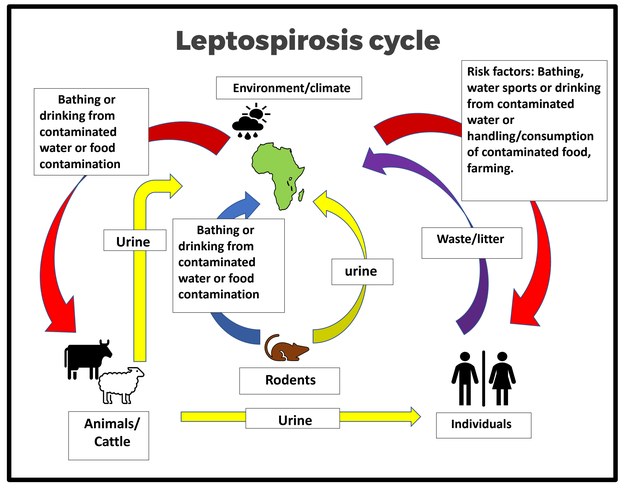
The 52-week period has a very similar pattern and structure to the basic plots, more so than the 26-week patterns. The first plot (SIN) Rainfall, Humidity and Temperature all have a p. value = <2.2e-16, whereas in plot 2 (COS), rainfall = <2.2e-16, humidity = 7.297e-11 and temperature= 1.344e-13.





Discussion

Upon gathering all research, it is apparent the conditions that create an ideal setting for leptospira survival, plus impact the overall cases, is when humidity is higher than the temperature during a period of rainfall however, throughout the research, evidence and results, displayed rainfall to be the more predominant factor towards leptospirosis cases. Combining these outcomes alongside the research from other studies, a cycle can also be acknowledged.



The results displaying the 26-week periods, show inconsistencies compared to the 52-week repeating patterns, however, this will be due to the seasons and how rainfall, humidity and temperature will fluctuate differently throughout the dry season compared to the wet season, yet it is highly understandable that floods occur in Brazil escalating amplified risk of disease transmission, for rainfall appears to be continual over a yearly and seasonal basis.

Conclusion

Overall, evidence plus results show a definite answer regarding the impact meteorological factors can have on leptospirosis cases, however, rainfall is the more predominant factor due to causative flooding which can spread easily across land as well as various water sources in general. Furthermore, it is important to acknowledge that weather factors can not be controlled but the understanding of hygiene and the importance of waste control can help towards rodent infestation that in turn may help the reduction of the spread and rise in leptospirosis cases.

Acknowledgements

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