Accelerated case rates led to herd immunity in Amazonas during the COVID-19 pandemic

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Background and Overview

What happened in the Amazon and São Paulo during COVID-19?

This exploratory analysis of tabular and genetic data shows that the city of Manaus, and its state, Amazonas, were hit harder per capita than São Paulo during the summer of 2020 TODO: additional citations. Deaths especially affected adult male patients, and elderly patients. From summer into fall, this intense period of infection correlated with the emergence of an antibody prevalence among Manaus blood donors that was approximately threefold greater than antibody prevalence among São Paulo blood donors (Buss *et al.*, 2020). This is an indication of good news and herd immunity for Manaus, heading into winter.

Additionally, a genetic analysis of 33 SARS-CoV-2 samples showed that TODO: sequencing and bash findings.

Methods

Tabular data analysis

\textcolor{red}{TODO: tabular parsing walkthrough: trace piping especially. pkg citations; See methods section of https://elifesciences.org/articles/61981 Describe what I did in prose form Data were downloaded from the NCBI SRA archive from project numbers _ on date. Then processed with trimmomatic and run through a bwa variant calling pipeline (CITATION from bwa paper). ... That data was then brought into RStudio to analyze in combination Include steps of modifying datatables, e.g. age ranges }.

Genetic data analysis

TODO: sequencing and bash walkthrough: trace scripts as sets by format; citations

- vcfR package website.
- https://kjhealy.github.io/covdata/
- https://github.com/como-ph/oxcovid19
- https://ropensci.org/blog/2020/10/20/searching-medrxivr-and-biorxiv-preprint-data/
- https://covidtracking.com/data/api
    - `readr::read_csv("https://api.covidtracking.com/v1/states/daily.csv")`
- https://rt.live/
    - `readr::read_csv("https://d14wlfuexuxgcm.cloudfront.net/covid/rt.csv")`

Results and Discussion

Tabular data analysis

This analysis indicates that living in Manaus, being elderly, and being male were risk factors for COVID-19 in Brazil in the spring and summer of 2020. It surprised me to see that male patients in Manaus were at such markedly higher risk of death than female patients, to the order of TODO: insert ratio.

TODO: tabular parsing; refer to figures; 66Fix fill for col.

Genetic data analysis

TODO: fastqc screenshot: evidence that it's reasonable Quality, length, WATCH a few weeks ago on fastqc examples with one goofy one , citations.
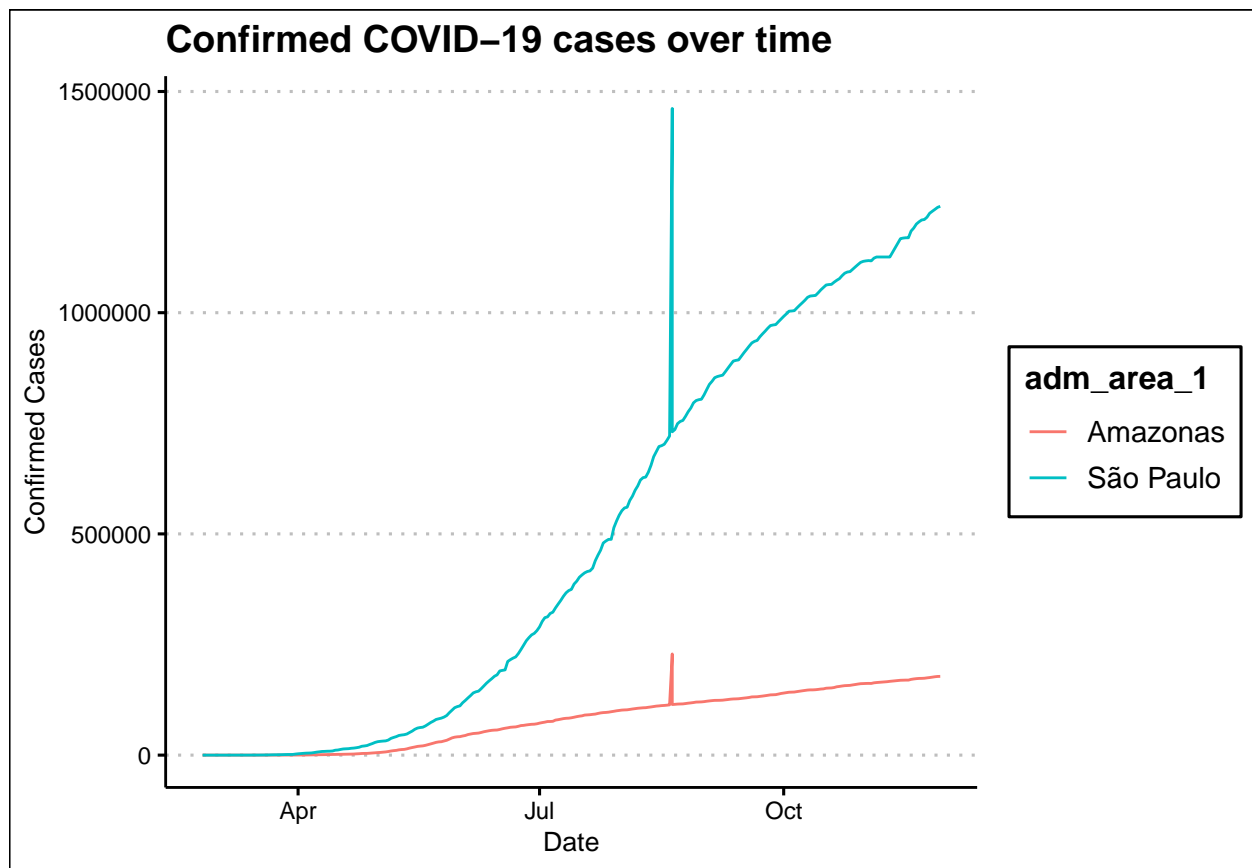
Figures

Figure : The state of São Paulo saw more total confirmed cases than the state of Amazonas.
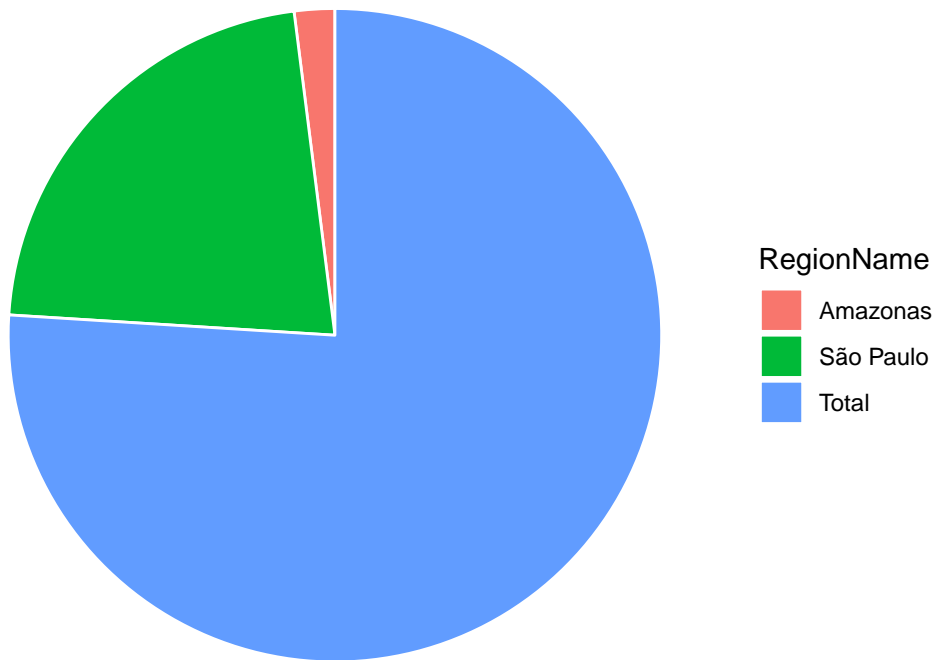
Population of Brazil

Figure: The state of São Paulo is much larger than Amazonas by population at 46 million versus 4 million.
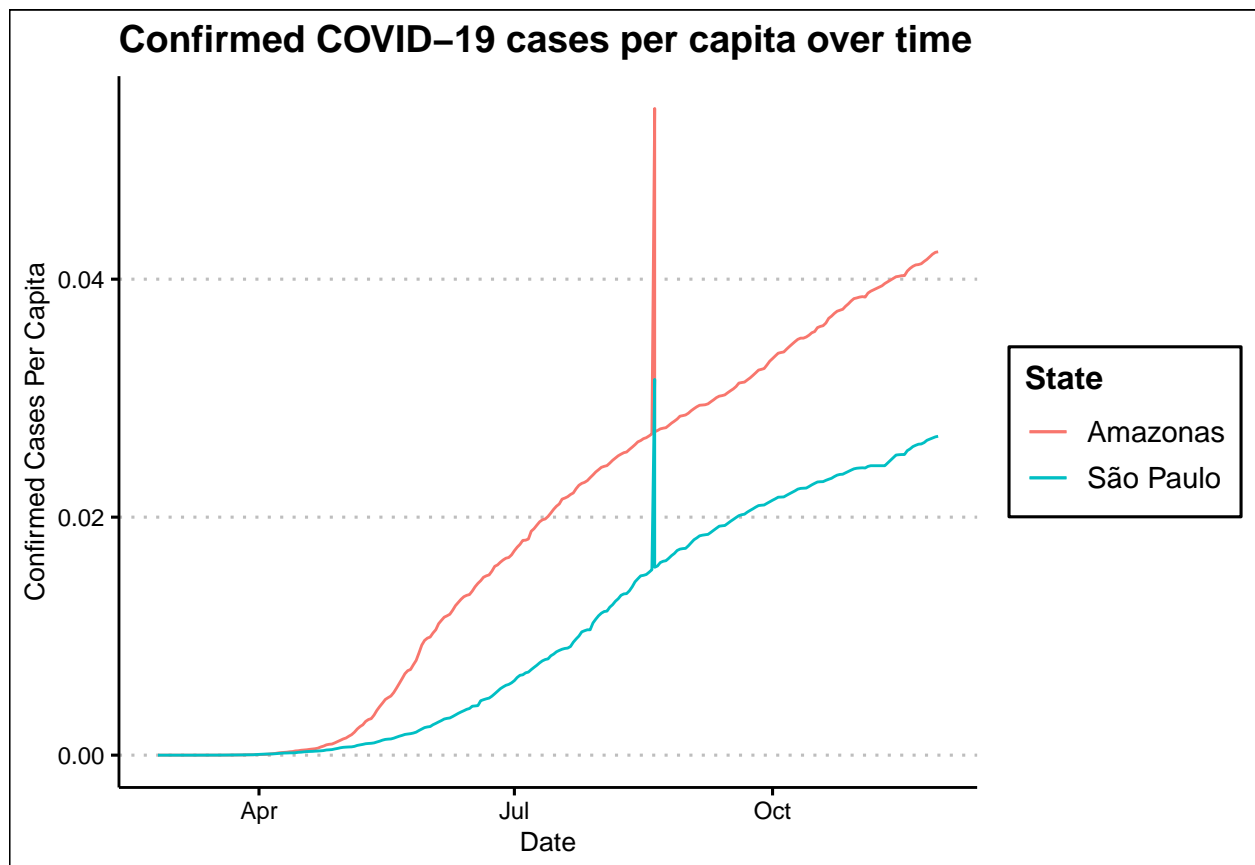
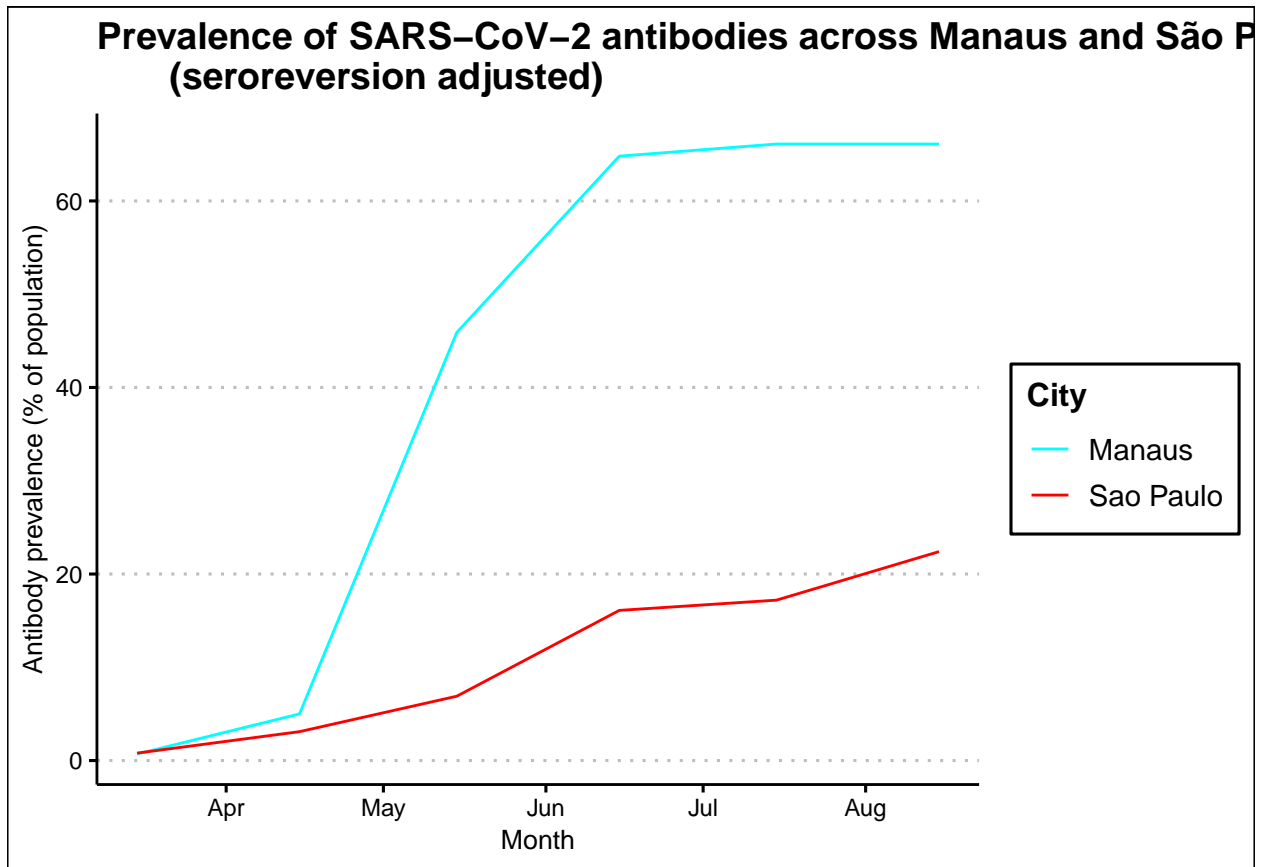**Figure**: Amazonas saw greater confirmed cases per capita than São Paulo.

**Prevalence of SARS–CoV–2 antibodies across Manaus and São P
(seroreversion adjusted)**

Figure: Manaus saw more widespread prevalence of SARS-CoV-2 antibodies vs. São Paulo, up to 66% vs. 22% of the population respectively.

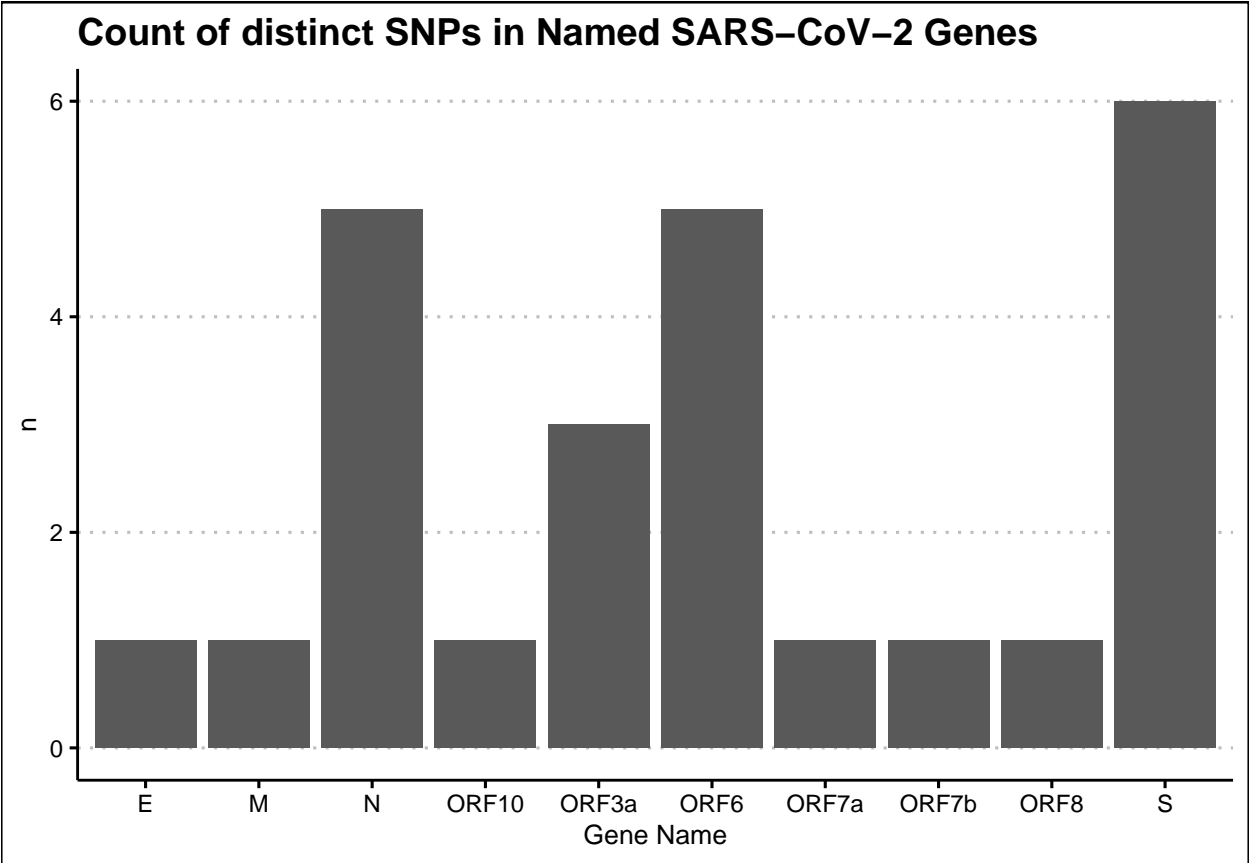**Figure**: N and S genes have more unique SNPs in the set of samples analyzed.
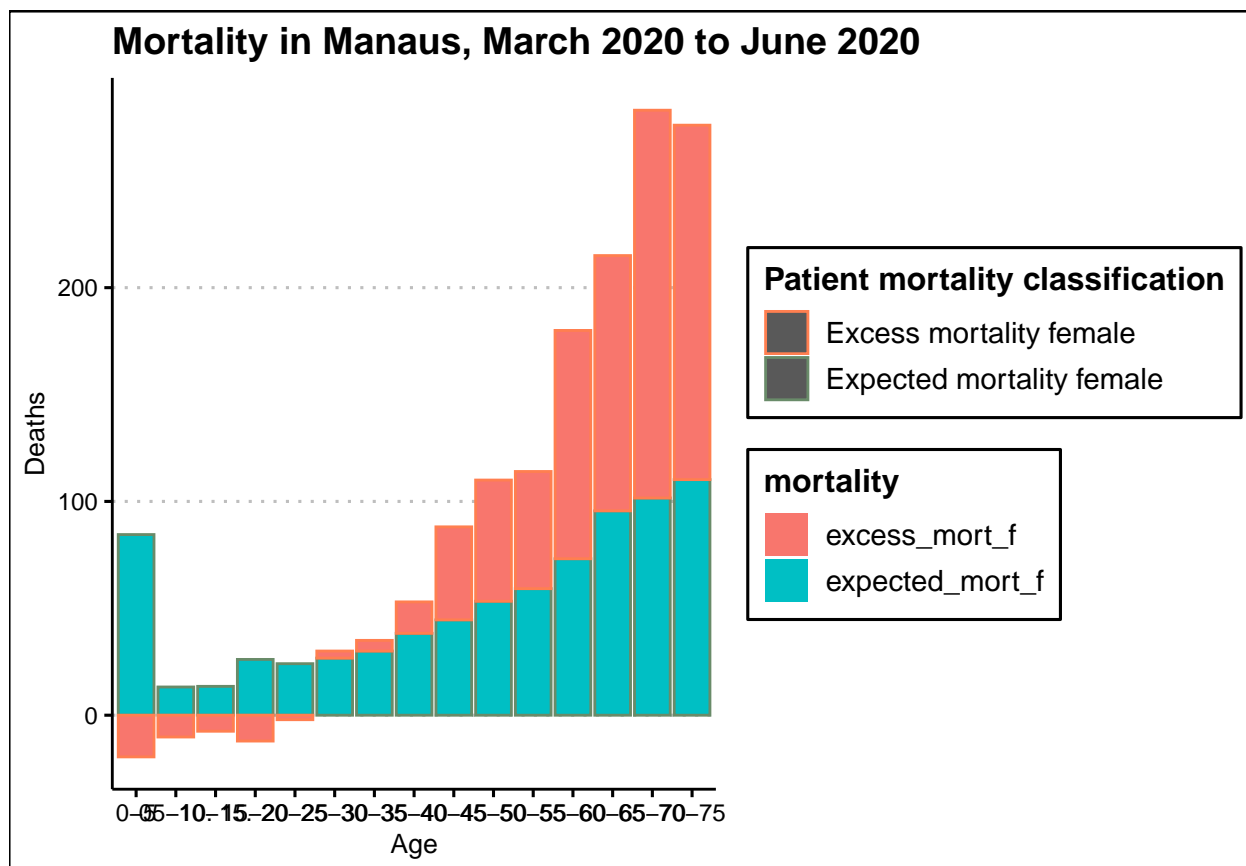
Figure: Excess mortality, unexpected deaths of any cause, reached a maximum of about 2.5 times the expected mortality in female patients.
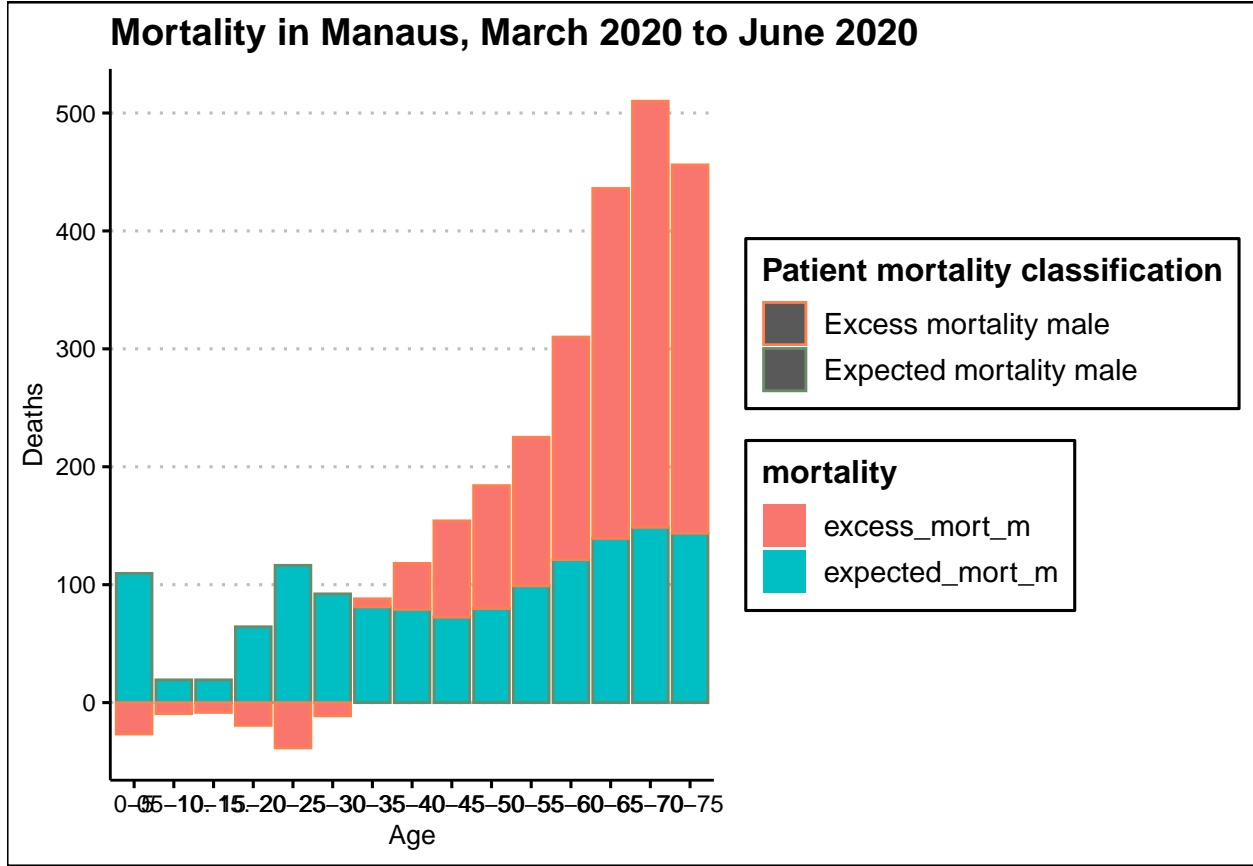
Figure: Excess mortality in male patients reached a maximum of about 2.5 times the expected mortality in male patients, and 4.5 times that of female patients.

Tables

Gene Name	Start	End	Length
S	21563	25384	3821
ORF3a	25393	26220	827
E	26245	26472	227
M	26523	27191	668
ORF6	27202	27387	185
ORF7a	27394	27759	365
ORF7b	27756	27887	131
ORF8	27894	28259	365
N	28274	29533	1259
ORF10	29558	29674	116

Table 1: Gene names, locations, and lengths in the SARS-CoV-2 genome. Higher SNP counts in the S and N genes may be related to the larger size of these genes.

Sources Cited

TODO: say scripts provided by Naupaka Zimmerman "and based on an approach from data carpentry CC" sentence in methods section. In template README steps of this were based on data carpentry, include this in methods Webpage URLs should be in code, not cited. If complicated. "Figured it out based on approach here" Packages in bibtex? Diff schools of thought. Objection that it pollutes biblio Dr. Z leans toward code side Definitely cite oxford19 but not base r packages Can use this for wiggle room. Prefers at least a few peer reviewed articles Adding bibtex and citing Demonstrate skills to use both in Rmd. If you want to mention a webpage or article, how formal: peer reviewed yes, r pkg, have citation function that will give it to you; markdown link is ok for webpage; or create BibTex for website

Buss,L.F. *et al.* (2020) COVID-19 herd immunity in the brazilian amazon. *medRxiv.*