Comparing Coronavirus Incidence Under Different Air Travel Restrictions in 2021

STAT 3901 Statistical Communication

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Introduction

Project Description

COVID-19 situations and regulations vary by country. This analysis looks at three neighboring countries with different air travel statuses within the date range Jan. 1st, 2021 to March 1st, 2021:

- Brazil (Open)
- Colombia (Partially Open)
- Venezuela (Closed)

The Data

- Data were collected by John Hopkins University starting from January of 2020
- The variables include:
  - country_region
  - province
  - incident_cases
  - cumulative_cases
  - Date

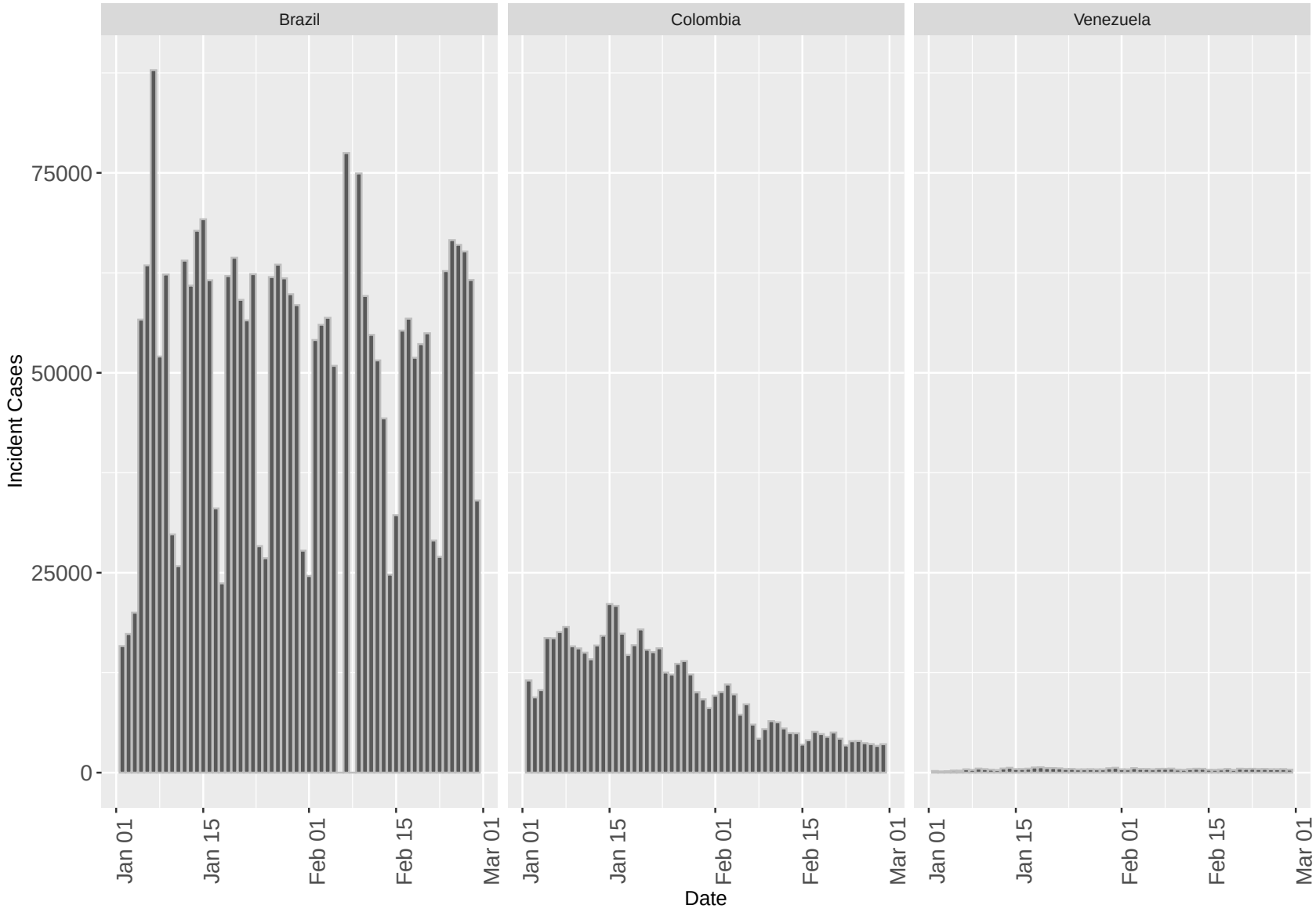
Exploratory Analysis

Numeric Descriptions

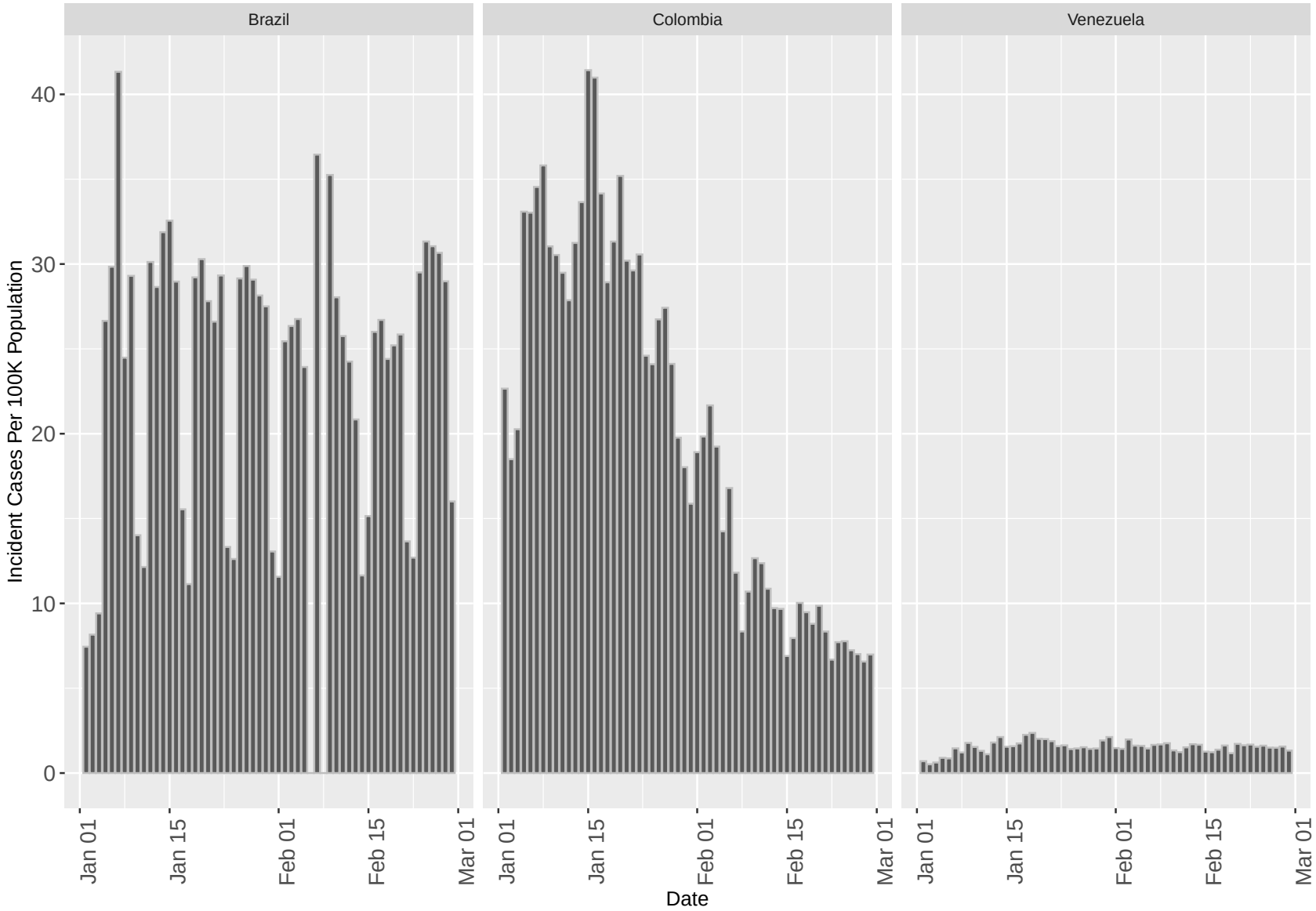
country_region	Average Number of Cases Per Day	SD of Daily Cases	Cumulative Cases
Brazil	49149.6724	19376.5808	2850681
Colombia	10289.8276	5359.9176	596810
Venezuela	435.0345	103.5601	25232

country_region	Total Incident Cases	ndays	Total Person Years
Brazil	2850681	58	33776565
Colombia	596810	58	8085500
Venezuela	25232	58	4518588

Incidence Graph



Incidence Graph with Respect to Population



Methods

Incidence Rates and Ratios

- Incidence rates are calculated using the equation:

$$IR = \frac{Number\ of\ new\ cases\ of\ disease\ during\ specified\ period}{Time\ each\ person\ was\ observed,\ totaled\ for\ all\ persons}$$

- Often the denominator is in person-years
- Incidence rate ratios are a ratio of two incidence rates

$$\frac{IR_1}{IR_2}$$

CDC. Principles of Epidemiology | Lesson 3 - Section 2 https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section2.html (accessed Apr 30, 2021).

Calculating Indcidence Rates and Ratios with R

```
BC <- as.table(matrix(c(2850681, 33776565, 596810, 8085500),
      nrow = 2, byrow = TRUE))
BCval <- epiR::epi.2by2(dat = BC, method = "cohort.time",
         conf.level = 0.95, units = 1000, outcome = "as.columns")
print(BCval)
```

```
##              Outcome +    Time at risk        Inc rate *
## Exposed +      2850681        33776565             84.4
## Exposed -       596810         8085500             73.8
## Total          3447491        41862065             82.4
##
## Point estimates and 95% CIs:
## -------------------------------------------------------------------
## Inc rate ratio                                 1.14 (1.14, 1.15)
## Attrib rate *                                  10.59 (10.37, 10.80)
## Attrib rate in population *                    8.54 (8.33, 8.75)
## Attrib fraction in exposed (%)                 12.54 (12.32, 12.76)
## Attrib fraction in population (%)              10.37 (10.24, 10.50)
## -------------------------------------------------------------------
##  Wald confidence limits
##  CI: confidence interval
##  * Outcomes per 1000 units of population time at risk
```

Results/Discussion

Results

- Estimated incidence rates (per 1000 person-years):

Country	Estimate
Brazil	84.40
Colombia	73.81
Venezuela	5.58

- Estimated incidence rate ratios:

	Estimate	Lower	Upper
Brazil vs Venezuela	15.114	14.929	15.302
Colombia vs Venezuela	13.218	13.056	13.383
Brazil vs Colombia	1.1434	1.1405	1.1463

Discussion

- For all incidence rate ratios, the confidence intervals were entirely above one
- Evidence suggests the incidence rate for:
  - Brazil was 15.11 times higher than that of Venezuela
  - Brazil was 1.14 times higher than that of Colombia
  - Colombia was 13.22 times higher than that of Venezuela
- Brazil $>$ Colombia $>$ Venezuela

Conclusions

- In the case of Brazil, Venezuela, and Colombia, there is evidence air travel restrictions may have an impact on incidence of coronavirus
- Further analysis is needed to determine whether this pattern is prevalent in all countries in similar situations