Country Level Indicators of Suicide Risk: Data Analysis & Decision Support for Policy Makers

Project Report: Georgia Tech ISyE 6414 - Dr. Yajun Mei

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Abstract

Relying on open source data from the World Health Organization and other non-governmental bodies, we highlight trends and related to country-level measures of suicide globally. A descriptive model is formulated that identifies a set of meaningful factors and measures that highlights some intuitive relationships between country-level suicide rates and other indicators such as income, alcohol consumption, and the presence of a country level suicide prevention strategy.

An initial framework for data-driven decision support for policy makers is presented with recommendations including the identification and ongoing monitoring of meaningful factors and measures related to suicide prevention. The hope is that this can provide some introductory guidance for those managing health related planning activities and priorities related to this topic.

An overview of the sources of data, and process of collection, of data related to suicide at the country level is also described briefly, along with a description of some ancillary datasets that were employed to augment and enrich insights. The intention of these descriptions is to make further research and data analysis on this topic more accessible to other interested researchers and data analysts in the future.

1 Research Motivation

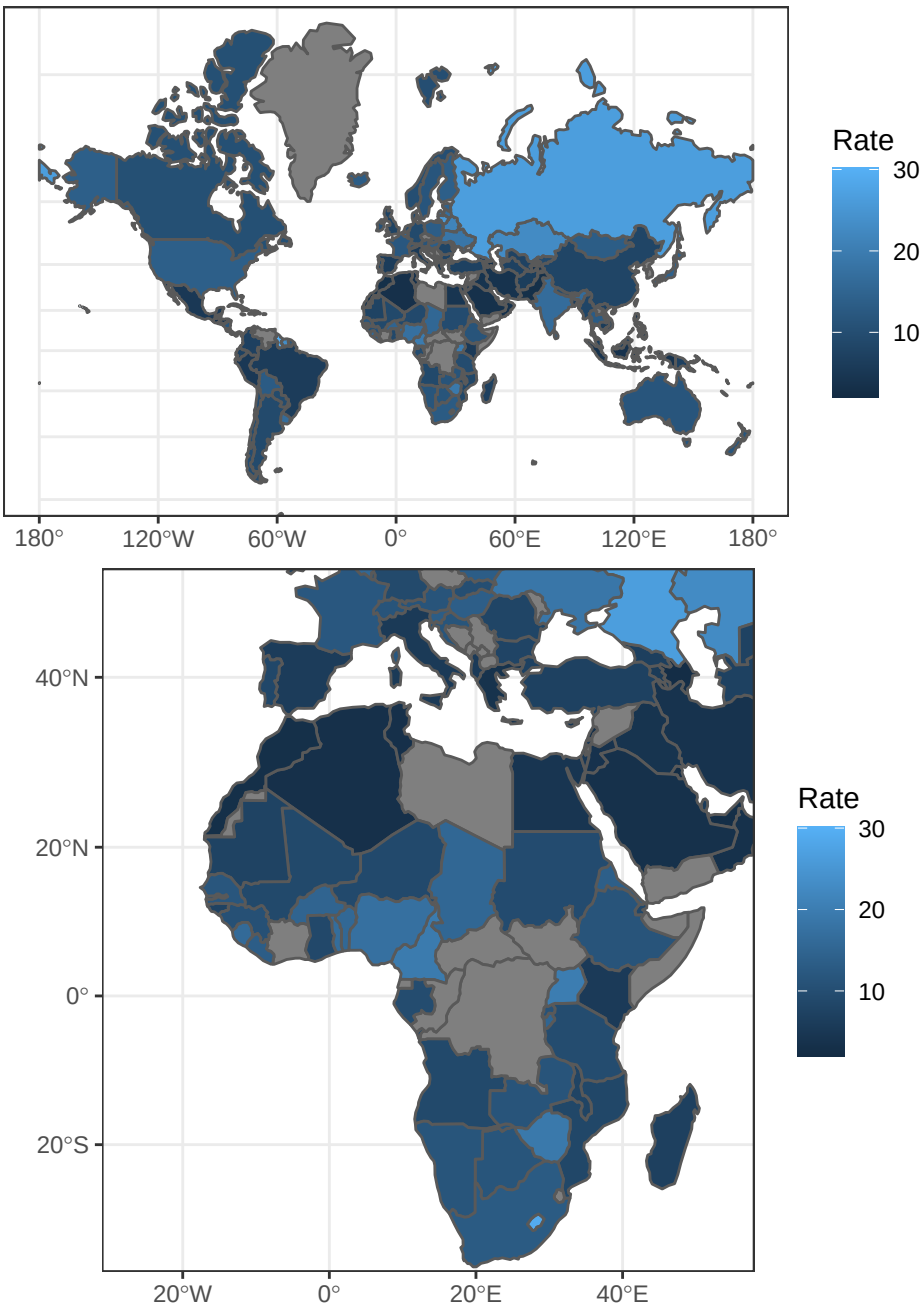
According to the *World Health Organization*, ("Suicide: One Person Dies Every 40 Seconds" 2019) one person dies every 40 seconds from suicide. It is the second leading cause of death among teenagers and adults aged 15-29 years. Despite the staggering number of suicides happening worldwide, just 38 governments worldwide have a national suicide prevention strategy.

Each of these deaths are tragic, and sadly also preventable. For every suicide, there are many more attempts, and previous suicide attempts are the single most important predictor or risk factor for future suicide attempts. ("Suicide: Key Facts" 2019) The possibility of prevention and the scale of the problem highlight the need for policy makers, at the national level, to understand the factors that contribute to suicide not only in their own nations but also globally.

2 Variables & Data Sources

The core dataset we plan to rely on comes directly from the *World Health Organization* and is referenced below. The key measure of interest for our study is the *the age-standardized suicide rate* by country, which is defined as *a weighted average of the age-specific mortality rates per 100,000 persons, where the weights are the proportions of persons in the corresponding age groups of the WHO standard population.* ("Suicide Rate Estimates, Age-Standardized Estimates by Country" 2019) The data consists of country-level measures of suicides rates, as defined above, for 183 nations, broken out by gender, and standardized as describe above. These estimates of age-standardized suicide rates were taken in the year 2000, 2010, 2015, and 2016. This enables the data analyst to observe differences in rate estimates over time, allowing more context and benchmarking for the purposes of this analysis. In addition to relying on the core suicide rate statistics provided above, we also intend to append country-level data, for corresponding time periods, from ancillary data sources. Currently, we are considering the following data:

1. GDP per capita, as a high level measure of wealth, sourced from the *World Bank* (https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?view=map)
2. Adult education level, as made available from the *OECD*, the *Organization for Economic Co-operation and Development* (https://data.oecd.org/eduatt/adult-education-level.htm)
3. The female labor force participation rate, from the *United Nations Development Programme* (http://hdr.undp.org/en/content/labour-force-participation-rate-female-male-ratio)
4. Whether or not the government of a country has a suicide prevention strategy, according to the *World Health Organization* (https://apps.who.int/iris/rest/bitstreams/1174021/retrieve)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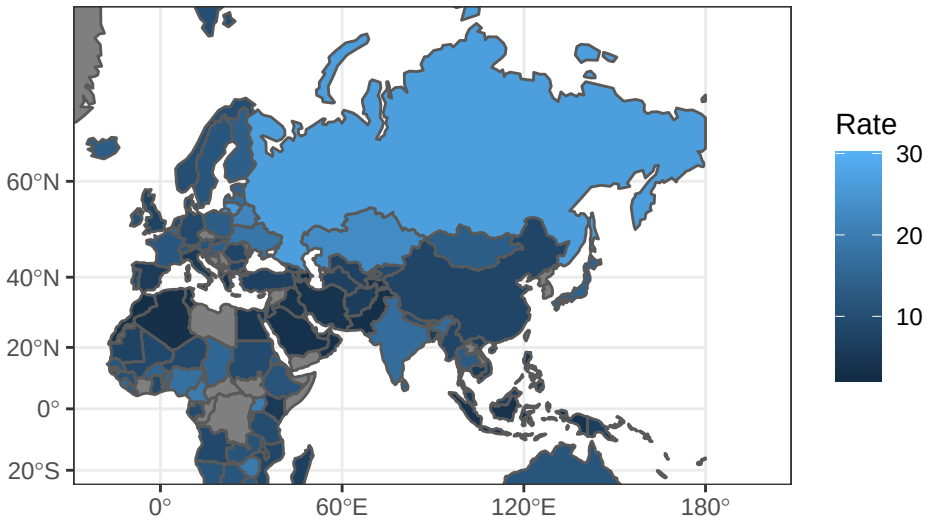


3 Modeling & Assumptions

explain (and justify) your proposed methods or models.

4 Quantifying Impact of Measures on Suicide

present key findings when executing the proposed methods or models. For the benefit of readability, detailed results should be placed in the Appendix. Reference of computer softwares to implement your proposed methods or models (even it is a web page) should be given.

4.1 Identifying, Describing and Monitoring Country Level Indicators Is Critical for Effective Decision-Making Support

Table 1: Decision Support Framework for Policy Makers

Area of Focus	Decision Support
Identifying & Quantifying Measures and Indicators of Country Level Suicide Rates	Using a model to describe the relationships between country-level indicators and suicide rates to help policy makers identify what variables are important and putting context around how to monitor them
Incorporating Domain Knowledge and Expertise of Subject Matter Experts	Allows policy makers to correlate indicators with country-level suicide related outcomes in context of qualitative insights from experts in the field
Insight Gathering, Analysis and Support Policy Maker Decisions	Integrating data and insights and providing inital context to help policy makers to frame longer term health planning activities and policies

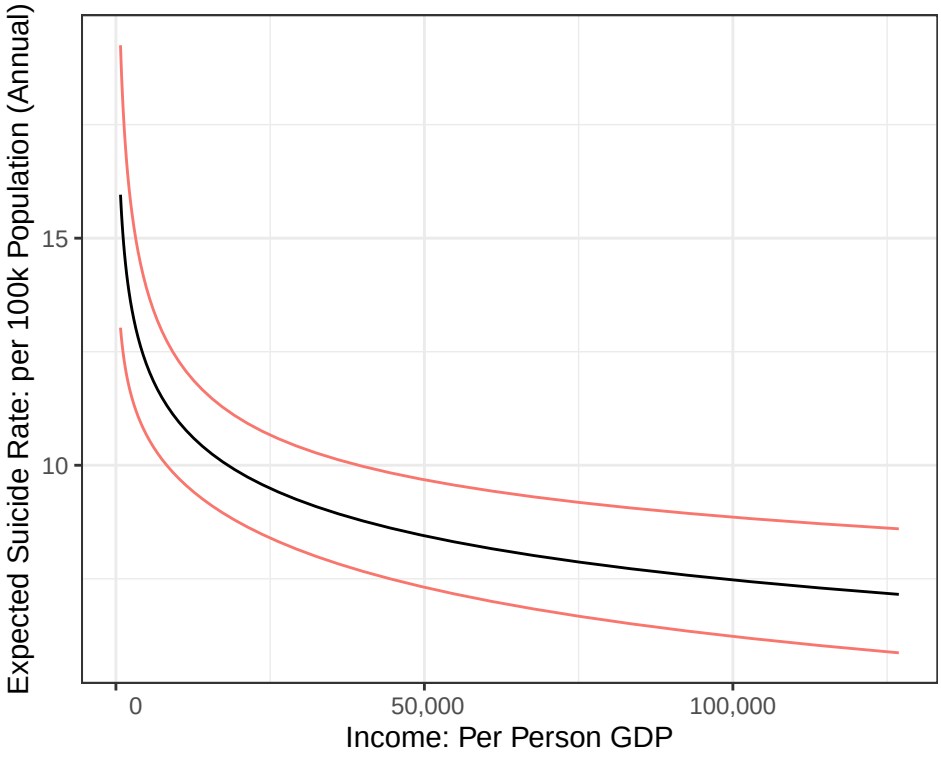
4.1.1 Quantifying Impact: Income, GDP per person

Insights

Our model indicates the presence of a significant relationship between a measure of income (country-level GDP per person) and suicide

Countries with lower per person income, tend to have higher incidence of suicide when controlling for other variables in our model*

Based on our estimates, an approximate 10% increase in income corresponds to a 2% decrease in suicide rate at the country level for the typical country



4.1.2 Quantifying Impact: Alcohol Consumption:

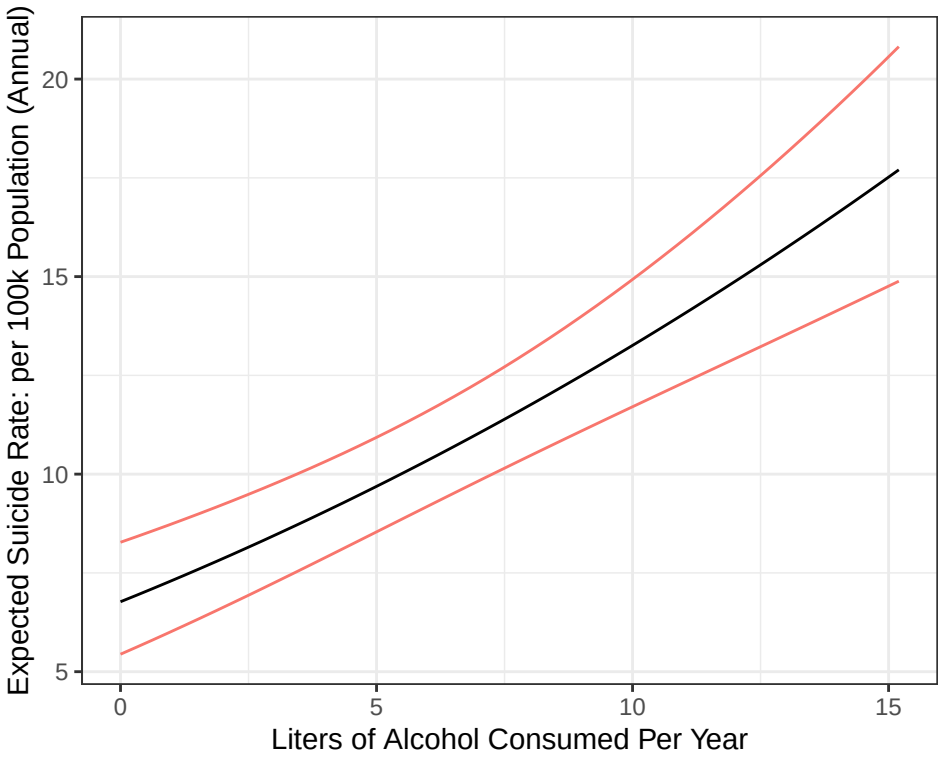
Insights

Our model indicates the presence of a significant relationship between a measure of alcohol consumption (liters per year)

Countries with higher levels of alcohol consumption income, tend to have higher incidence of suicide when controlling for other variables in our model*

Based on our estimates, an approximate 4% increase in alcohol consumption corresponds to a 2% increase in suicide rate at the country level for the typical country (>4 liters per year)

Alcohol consumption was the most impactful and significant indicator of country-level suicide rate in our analysis



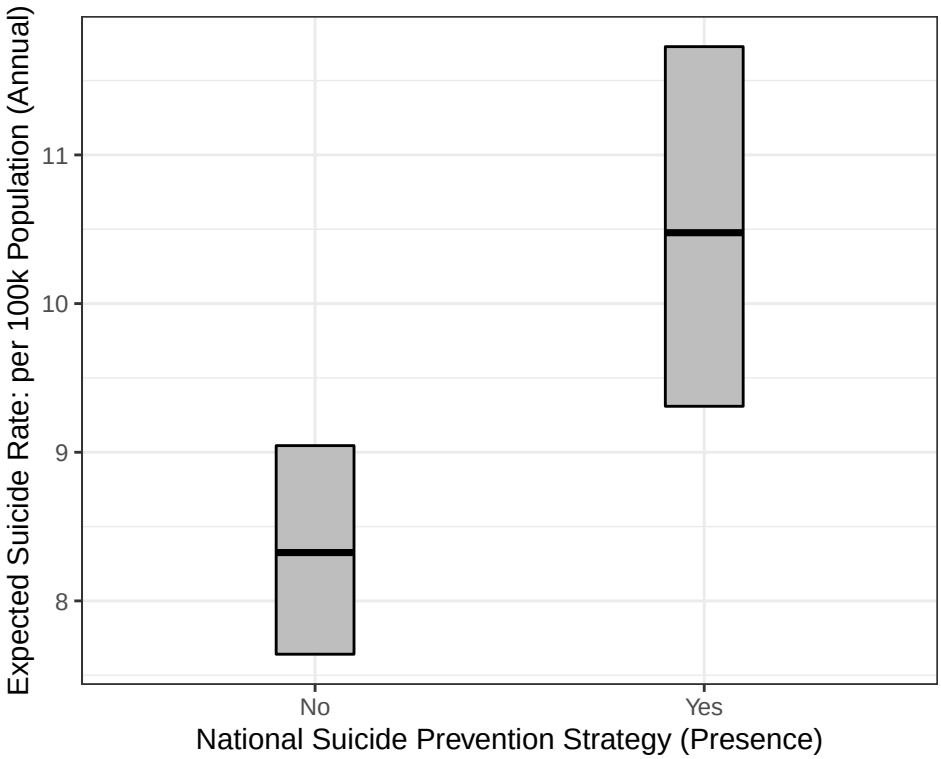
4.1.3 Quantifying Impact: The Presence of A National Suicide Strategy

Insights

Our model indicates that countries that have put a national suicide prevention strategy in place, tend to have higher incidence of suicide rates overall

Based on our estimates, countries that have implemented a suicide prevention strategy have a 26% higher incidence of suicide nationally

However, to put this in context, it appears that the institution of a suicide prevention strategy by countries struggling with suicide prevention overall, including Guyana, Lithuania, Suriname, Belarus and South Korea are driving this estimate



5 Research Limitations

6 Appendix & References

This section only includes needed documents to support the presentation in the report. Feel free to divide it into several subsections if necessary. Do NOT dump all computer outputs unor-ganized here

6.1 Model Final Specification

$Y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_4 x_{4i} + \epsilon_i,$ where we assumed, $\epsilon_i \sim \mathbb{N}(0, \sigma_Y^2)$

for $i = 1, ..., n$ country level measures, where

Y_i : The estimated national suicide rate (per 100k population) for thei^{th} country.(Box-cox transformed $\lambda = 0.4$)
x_{1i} : The estimated national labor participation rate (percentage) for the i^{th} country.
x_{2i} : The log-transformed estimated per-person gross domestic product (GDP) (income) for the i^{th} country.
x_{3i} : An estimate of the national per-person average of liters of alcohol consumed annually for the i^{th} country.
x_{4i} : A binary indicator of the 'presence of a national suicide prevention strategy' in 2019 for the i^{th} country.

This yields fitted regression model:

$\hat{Y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_{1i} + \hat{\beta}_2 x_{2i} + \hat{\beta}_3 x_{3i} + \hat{\beta}_4 x_{4i}$

where,

$\hat{\beta}_0,\ \hat{\beta}_1,\ \hat{\beta}_2,\ \hat{\beta}_3,$ and $\hat{\beta}_4$ were estimated by the method of iterative re-weighted least squares.

6.2 Model Summary Statistics

Table 2: Regression Model Summary

	Dependent variable:
	Suicide Rate (Box-Cox Transformed $\lambda = 0.4$)
Income (pp GDP) - Log Transformed	-0.404^{***}
	(0.080)
Liters of Alcohol Consumed	0.166^{***}
	(0.026)
Suicide Prevention Strategy (Binary)	0.562^{***}
	(0.185)
Labor Participation Rate	1.031^{**}
	(0.472)
Constant	5.420^{***}
	(0.828)
Observations	162
R^2	0.412
Adjusted R^2	0.397
Residual Std. Error	1.272 (df = 157)
F Statistic	27.475^{***} (df = 4; 157)
Note:	*p<0.1; **p<0.05; ***p<0.01

References

"Suicide Rate Estimates, Age-Standardized Estimates by Country." 2019. http://apps.who.int/gho/data/node.main.MHSUICIDEASDR?lang=en.

"Suicide: Key Facts." 2019. https://www.who.int/news-room/fact-sheets/detail/suicide.

"Suicide: One Person Dies Every 40 Seconds." 2019. https://www.who.int/news-room/detail/09-09-2019-suicide-one-person-dies-every-40-seconds.