Analysing HDI, Homicide, and Suicide Correlations

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Summary

This research investigates the correlations between Human Development Index (HDI), suicide rates, and homicide rates across diverse countries. Publicly available databases from reputable sources like World Health Organisation and United Nations Office on Drugs and Crime are used. Conducted analysis revealed that while a higher HDI typically aligns with lower violence, the situation is nuanced. Notably, the United States, despite its high HDI, contends with significant violence challenges.

A detailed examination of distinct age groups uncovered a common vulnerability among middle-aged individuals to suicide. However, Brazil and the United States defy this pattern due to their distinct cultural and economic factors.

An interesting pattern is observed where males are disproportionately affected by both suicide and homicide. In fact, analysis of data from five countries—Germany, the United States, Japan, Australia, and Brazil—revealed that, on average, 76.4% of suicides and 68% of homicide victims are male.

In conclusion, while economic progress and a robust HDI contribute to favourable outcomes, they do not exclusively dictate mental health and violence levels. The report emphasizes the necessity for tailored strategies that account for specific challenges and cultural nuances in each country. This multi-dimensional issue necessitates an integrated approach that acknowledges the complexities of human behaviour. The report underscores the need for a comprehensive framework that comprehends the intricate factors at play, offering valuable insights for policymakers, researchers, and advocates seeking to address mental health and violence challenges effectively.

To support the research web-based interactive Dashboard is created. Utilizing the dynamic capabilities of Plotly's Dash framework, a user-focused platform was crafted that facilitates in-depth analysis of datasets related to suicide rates, HDI, and homicide rates. This dashboard allows users to discover trends and insights by combining user-friendly interfaces with a diverse range of visualizations.

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Introduction

According to Turecki and Brent (2015), Suicide is defined as a fatal self-injurious act with some evidence of intent to die and still remains a pressing global concern. Based on the World Health Organization (2019), nearly 703,000 lives are lost to suicide each year, making it a top-15 cause of death worldwide. They also state that, while the link between suicide and mental disorders (in particular, depression and alcohol use disorders) is well established in high-income countries, many suicides happen impulsively in moments of crisis with a breakdown in the ability to deal with life stresses, such as financial problems, relationship break-up or chronic pain and illness. Additionally, very little research has been done recently investigating possible correlations between HDI reports and crime rates with the suicide rates. The emotional and psychological distress experienced by individuals at risk of suicide is often aggravated by societal factors such as stigma, limited access to mental health services, and social isolation. Additionally, suicide rates can vary significantly across countries and demographic groups, highlighting the need for further investigation into the underlying factors contributing to this problem.

Understanding and addressing the issue of suicides is incredibly significant due to its profound impact on individuals, families, and societies. Suicide is a complex public health problem that not only represents a significant loss of human life but also carries far-reaching consequences for mental health, social well-being, and community stability. Researching suicides can help identify risk factors, develop effective preventive measures, and provide support for individuals and communities affected by this tragedy.

While achieving a consensus on the factors influencing mental stability remains challenging, research suggests that these factors can be broadly categorized into three main dimensions: individual, societal, and environmental.

- Individual factors: These factors pertain to characteristics and experiences unique to individuals. They may include mental health disorders, substance abuse, a history of previous suicide attempts, and a lack of effective coping mechanisms.
- Societal factors: These factors encompass broader social dynamics and norms within a given society. They can include socio-economic disparities, limited social support networks, cultural or religious beliefs, and stigma surrounding mental health issues.
- Environmental factors: These factors refer to the contextual and environmental influences on mental well-being. They may encompass access to lethal means, media reporting practices, the quality of mental health services, and the overall safety and security of an individual's surroundings.

By studying these influential factors, researchers can better understand the multifaceted nature of suicide and design targeted interventions.

Moreover, as part of environmental factor, suicide rates can be interconnected with other social indicators, such as crime rates and HDI reports. Research has suggested potential relationships between these variables, indicating the need for a comprehensive examination of their interplay. For example, socio-economic factors, such as poverty and inequality, can contribute to both higher suicide and crime rates. Additionally, the perception of safety and social cohesion, as reflected in HDI reports, may influence individual well-being and, consequently, suicide risk. Understanding these connections can inform holistic approaches to promoting well-being and reducing vulnerabilities within communities.

Project Aim

The aim of this project is to investigate the correlation between HDI, homicide, and suicide rates in different countries. By examining the relationships between these variables, the goal is to contribute to the understanding of the factors that influence suicide rates, and to identify potential implications for public policy and social interventions.

To provide clarity on the terminology used, The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. "Homicide rates" refer to the frequency or incidence of homicide within a given population, while "suicide rates" indicate the occurrence of self-inflicted deaths.

Understanding the correlation between these variables is crucial for addressing social challenges and improving the overall well-being of communities. By identifying patterns and potential causal relationships, this research can contribute to evidence-based decision-making and the development of targeted interventions.

Objectives

The objectives of this project include:

- Analysing and comparing HDI scores, homicide rates, and suicide rates across different countries.
- Investigating the potential correlation between HDI and homicide rates, as well as HDI and suicide rates.
- Assessing any mediating or moderating factors that may influence the observed correlations.
- Examining the potential impact of socio-economic, cultural, and environmental factors on the relationship between HDI, homicide rates, and suicide rates.
- Identifying potential implications for public policy and social interventions aimed at promoting well-being, reducing crime, and preventing suicides.

Deliverables

The deliverables of this project include:

- A comprehensive and correlation analysis of HDI scores, homicide rates, and suicide rates in selected countries.
- Source code for the website with Interactive dashboards
- Visualizations and data representations to illustrate the findings.
- The MSc project report

Ethical, Legal, and Social Issues

Privacy and data protection are of utmost importance when handling sensitive information related to crime rates and suicide rates. Ethical guidelines and legal frameworks are followed when accessing and analysing data from various sources. All of the data is used for research purposes only and accessed through open sources credited in Appendix A.

Furthermore, it is crucial to ensure that the findings and interpretations are presented responsibly, considering the potential stigmatization of certain communities or perpetuation of stereotypes. The research aims to contribute to a comprehensive understanding of the factors at play without unfairly targeting specific groups or individuals.

Structure of the report

The report is structured into six chapters. Chapter 1, the Introduction, provides a thorough background on the significance of researching suicides, highlighting its impact on individuals and societies. It discusses the importance of understanding influential factors and their potential connections to homicide rates and HDI reports. Relevant studies and research papers in the field are referenced to contextualize the project.

Chapter 2, Background Research, presents a comprehensive review of existing literature, theories, and empirical studies related to HDI, homicide rates, and suicides. This chapter seeks to build a foundation of knowledge, identifying key concepts, theories, and models that contribute to understanding the interrelationships between these variables.

Chapter 3, Research Methodology, focuses on the research methodology employed in the project. It provides a detailed description of the chosen approach, including the data collection methods, variables, and statistical techniques used for analysis. This chapter ensures transparency and replicability of the study, allowing readers to understand the research design and make informed judgments about the validity of the findings.

Chapter 4, Implementation, presents the empirical findings and results obtained from the analysis of HDI scores, homicide rates, and suicide rates across different countries. This chapter includes data visualizations, tables, and figures to illustrate the patterns, correlations, and trends identified in the research. The empirical results provide insights into the relationships between these variables and support the overall objective of the project.

Chapter 5, Evaluation of Results, focuses on the evaluation and validation of the research findings. It discusses the methodologies employed to test the reliability and robustness of the data, as well as the evaluation of the statistical analyses performed. This chapter also explores the limitations and potential biases of the research, aiming for transparency and ensuring the credibility of the results.

Chapter 6, Conclusions and Future Work, serves as the final chapter of the report. It summarizes the main findings and conclusions drawn from the research. This chapter discusses the implications of the findings, their significance in the context of well-being, crime prevention, and suicide prevention, and potential applications in policy and interventions. Additionally, it outlines avenues for future research, highlighting areas that require further exploration to deepen our understanding of the complex relationships between HDI, homicide rates, and suicide rates in different countries.

Background Research

Literature Survey

Suicide problem overview

As highlighted in the Introduction, suicide remains a prevalent global issue and one of the leading causes of death. Ritchie et al. (2019) have consistently recorded suicide in the top-15 causes of mortality over the past two decades. The significance of investigating suicide arises from its unique nature as the only cause of death resulting from conscious self-injuries. The irreversible nature of suicide emphasizes the importance of understanding its underlying factors, whether they are individual, societal, or environmental in origin.

Suicide has multiple underlying causes, often involving a complex interplay of various factors rather than a singular cause. Post-incident investigations often rely on data provided by family members, friends, and colleagues, as communication with the victim is no longer possible. According to Simms et al. (2019), in the case of young individuals, suicidal tendencies are frequently associated with a combination of adverse childhood experiences, stressors in early life, and recent events. Notable risk factors among young people include bereavement, abuse, neglect, self-harm, mental or physical health issues, and academic pressures. It is essential to recognize that while many young people experience these stressors, only a minority will develop suicidal tendencies. Nonetheless, these factors play a crucial role in shaping young individuals' mental health and necessitate targeted approaches in mental health support and intervention.

According to Franklin et al. (2017), there are additional factors besides those mentioned earlier that significantly influence mental health in adults. These factors include experiences such as being arrested or imprisoned, facing financial problems, dealing with the end of a close friendship or romantic relationship, and encountering retirement or job loss.

Chronic pain and illness also play a crucial role in mental well-being. As mentioned previously, individuals suffering from physical and/or mental illnesses have a higher risk of developing depression and suicidal tendencies. For those experiencing chronic pain or illness with no prospect of a cure or relief, suicide may be perceived as a means to regain dignity or control over their lives. Lerman et al. (2015) found that among adult patients with chronic pain treated at specialty pain clinics, high levels of depression and anxiety can exacerbate pain and pain-related disability. Furthermore, individuals with chronic pain or terminal illnesses may feel like a burden to their loved ones. The constant need for assistance with medical appointments, household chores, or financial matters can lead to thoughts such as "the world would be better without me." These feelings of burden and the belief that they are causing hardships for their loved ones combined with chronic pain and illness contribute to suicidal thoughts. All discussed factors do not necessarily lead to suicide attempts. However, they all are main reasons for suicidal ideation and social isolation.

According to Purse (2022), suicidal ideation means wanting to take your own life or thinking about suicide. The author also states that there are 2 kinds of ideation. Passive suicidal ideation involves desiring death or wishing to die without developing a specific plan for suicide. In contrast, active suicidal ideation goes beyond mere thoughts and entails a genuine intent to die by suicide, often involving detailed plans on how to carry it out. While it may appear that passive suicidal ideation is less dangerous than active ideation, the author emphasizes that both are of equal importance. Symptoms that someone is thinking about, or contemplating suicide include:

- Isolating yourself from your loved ones
- Feeling hopeless or trapped

- Talking about death or suicide
- Giving away possessions
- An increase in substance use or misuse (ex. drugs and alcohol)
- Increased mood swings, anger, rage, and/or irritability
- Accessing the means to kill yourself, such as medication, drugs, or a firearm
- Acting as if you're saying goodbye to people
- Feeling extremely anxious

Social Isolation is frequently mistaken for loneliness. Even though they are related, the meanings are different. Loneliness is the distressing feeling of being alone or separated. Social isolation is the lack of social contacts and having few people to interact with regularly. You can live alone and not feel lonely or socially isolated, and you can feel lonely while being with other people. In fact, Calati et al. (2019) state that social isolation usually leads to loneliness as well as other additional suicide risk factors, such as depression and misuse of drugs and alcohol.

At times, individuals may attempt suicide not necessarily because they genuinely desire death, but rather due to their struggle in seeking help. According to Schimelpfening (2023), this phenomenon is called parasuicide and involves mimicking the act of suicide without the intent to take one's own life, serving as a way to demonstrate to the world their deep emotional pain.

Unfortunately, sometimes these cries for help can be lethal if the individual underestimates the lethality of their chosen method. Additionally, author states that people who make failed attempts are much more likely to try again if no measures are taken. Their next attempts are also more likely to be fatal.

Sometimes, situations that appear to be suicide may actually be an accidental death. As mentioned earlier parasuicidal behaviours can contribute to accidental suicide. Other examples are unintentional overdoses, firearm discharges, and poisonings. For this research accidental suicides are not considered as it focuses on intentional self-harm.

Mental Health and The Internet

In the last two decades, technological advancements have dramatically transformed the landscape of communication and connectivity. The rise of the internet and the rapid spread of mobile phones, becoming increasingly affordable and powerful, have revolutionized how people interact with each other and access information. With the exponential growth of internet technologies, staying online has become easier and more accessible than ever before. Consequently, the popularity of various social media platforms has soared, with an increasing number of people joining these virtual communities every year.

Together with the technology, the internet has evolved into a virtual playground, offering people a diverse array of platforms to engage with each other and the digital world. Additionally, the increasing affordability and power of mobile phones have contributed significantly to the accessibility of the internet, making it feasible for large number of people to remain connected 24/7. However, according to the Ritchie et al. (2023), by 2020 only 60% of the whole population were online.

With the ease of internet access, social media has emerged as a cultural phenomenon, capturing the attention of billions of individuals worldwide. The appeal of platforms like

Facebook, Instagram, Twitter, and TikTok lies in their ability to create virtual communities, allowing users to share experiences, opinions, and emotions instantly.

Amidst the incredible benefits of social media in fostering global connections and facilitating communication, it is essential to recognize its potential negative impact, particularly on mental health. While social media has undoubtedly opened doors to enhanced socialization, creative expression, and information sharing, it also brings an array of challenges, including cyberbullying, information overload, and detrimental comparisons.

Social media platforms, despite their potential for fostering positive interactions, have also become breeding grounds for cyberbullying and online harassment. The anonymity afforded by virtual interactions emboldens individuals to engage in hurtful behaviors without facing direct consequences. Cyberbullying encompasses a range of harmful actions, such as spreading rumors, posting offensive comments, sharing private or embarrassing information, or sending threatening messages. These acts can lead to severe emotional distress and psychological trauma for victims, particularly among vulnerable populations, such as adolescents and young adults.

Social media platforms serve as vast repositories of information, presenting users with an overwhelming influx of content on a daily basis. The relentless stream of news, opinions, updates, and entertainment can lead to information overload. According to the Edmunds et al. (2000), information overload happens when a person is flooded with too much data, making them feel overwhelmed and unable to process or focus on all the information given. The term is used to refer not only to situations involving too much data for a given decision but also the constant inundation of data from many sources.

Information overload can trigger anxiety, stress, and cognitive strain as individuals struggle to process and prioritize the constant flow of content. The pressure to keep up with the latest trends, news stories, and social updates can be emotionally taxing, contributing to a sense of inadequacy or a fear of missing out (FOMO). For those already dealing with mental health issues, such as anxiety or depression, the continuous barrage of information on social media can exacerbate their condition, potentially increasing the risk of suicidal thoughts.

Social media often presents an idealized version of people's lives, leading to unrealistic comparisons and feelings of inadequacy. The prevalence of edited images and curated content can foster feelings of dissatisfaction with one's own life, contributing to a decline in self-esteem and an increased susceptibility to mental health issues.

Other dangerous outcome of social medias are trends. Sweet (2021) states that humans possess an innate need for connection. The Internet and social media platforms have become sanctuaries for those who encounter social difficulties, offering them a sense of belonging. Online popularity serves to boost our self-esteem and provides a feeling of being appreciated. She also states that this is the reason why trends can become very popular very fast. They provide a feeling of community and connection to the participants very quickly. Sweet (2021) also states that these social media challenges are more popular in kids, teens, and young adults demographics. The reason is that while older adults usually have established social status and experience young people can struggle from the need of belonging. According to the author, during our early teens and adolescent years, we yearn for acceptance and strive to discover where we fit in. Besides the natural tendencies of

impulsivity, curiosity, and a belief in our invincibility, this age group seeks validation from others, particularly from their peers.

There are positive sides to social media trends and challenges. For example, the Ice Bucket Challenge, that was popular around 2014, helped raise awareness for amyotrophic lateral sclerosis (ALS) and money in donations to ALS Association. A lot of people were involved in this challenge knowing that it is for the good cause. In contrast, there are trends that are on the opposite side of spectre. For example, The Blackout Challenge that was popular on Tik Tok around 2022 and was responsible for death of several children. The entire premise of the “challenge” is to choke themself until the blackout. Obviously, there are no good intentions behind this trend. However, as mentioned earlier, children do not fully understand the dangerous part of these types of challenges and care about being seen and accepted online more. This type of trends not only could develop physical and mental health issues but also lead to accidental suicides.

So, while social media has revolutionized modern communication, allow anybody with the access to the internet to find themselves or seek help if needed, it also poses unique challenges to mental well-being.

Suicides are avoidable, and there are various measures that can be implemented at population, sub-population, and individual levels to prevent suicide and suicide attempts. Such as:

- limit access to the means of suicide (e.g. pesticides, firearms, certain medications).
- interact with the media for responsible reporting of suicide.
- foster socio-emotional life skills in adolescents.
- early identify, assess, manage, and follow up anyone who is affected by suicidal behaviours.

However, these measures should also be supported by foundational pillars like situation analysis, multisectoral collaboration, awareness raising, capacity building, financing, monitoring and evaluation. To effectively prevent suicide, efforts must be coordinated and collaborative across various sectors of society, including health, education, labour, agriculture, business, justice, law, defence, politics, and the media. The approach should be comprehensive and integrated since no single strategy alone can sufficiently address the complexity of suicide as an issue.

While suicide and mental health issues are gaining increased recognition in modern times, there are still significant challenges and barriers that must be addressed to enhance prevention efforts. One major obstacle lies in cultural and societal issues. Stigmatization, particularly concerning mental disorders and suicide, dissuades many individuals contemplating suicide or those who have attempted it from seeking the necessary support and assistance they require. Moreover, the prevention of suicide has not received sufficient attention due to a lack of awareness regarding its magnitude as a critical public health concern and the prevailing taboo in numerous societies, preventing open discussions on the topic. According to World Health Organisation (2019), by 2019 only 38 countries report having a national suicide prevention strategy and only a few countries have included suicide prevention among their health priorities. Moreover, even in 2023 there are still countries where attempting suicide is illegal. According to Muiruri (2021), section 226 of Kenya’s penal code says, “any person who attempts to kill himself is guilty of a misdemeanour”. It can be speculated that in country where this kind of laws exist the government does not want to resolve the root of the suicide problem. Therefore, options to prevent mental health issues discussed earlier like limiting ways of attempting suicides or organising special medical treatment for people struggling with their mental. Additionally, the media probably do not

cover suicide cases properly. One more negative side of not taking this issue seriously is poor data quality.

Globally, there is a significant lack of availability and accuracy in data related to suicide and suicide attempts. WHO (2019) states that only about 80 Member States possess reliable vital registration data that can directly be used to estimate suicide rates. While the issue of poor-quality mortality data is not exclusive to suicide, the sensitivity of this topic and the illegal status of suicidal behaviour in some countries likely lead to under-reporting and misclassification, making it a more substantial concern for suicide compared to most other causes of death.

For the development of effective suicide prevention strategies, there is an urgent need for improved surveillance and monitoring of suicide and suicide attempts. Cross-national variations in suicide patterns and changes in suicide rates, characteristics, and methods underscore the necessity for each country to enhance the comprehensiveness, quality, and timeliness of their suicide-related data. This entails implementing vital registration systems for suicide, establishing hospital-based registries for suicide attempts, and conducting nationally-representative surveys to gather information on self-reported suicide attempts. The establishment of these robust data collection methods is vital for crafting well-informed and targeted suicide prevention initiatives.

Correlation Between Suicide Rates and HDI

Human Development Index (HDI) reports are created and maintained by United Nation Development Programme. Their mandate is to end poverty, build democratic governance, rule of law, and inclusive institutions. Their mission is to support transformative change and foster global connections, providing countries with valuable knowledge, experience, and resources to empower individuals in building a better quality of life. HDI is one of the factors that is measured and monitored to achieve this mission.

Human Development Index is a summary measure of average achievement in key dimensions of human development: longevity, education, and living standards. It is computed as the geometric mean of normalized indices for each of these three dimensions. The health dimension is determined by life expectancy at birth, while the education dimension considers the mean years of schooling for adults aged 25 years and older, along with the expected years of schooling for children entering school age. The standard of living dimension is measured by the gross national income (GNI) per capita. To ensure a comprehensive representation, the HDI logarithmically transforms income to account for its diminishing significance as GNI increases. Subsequently, the scores for the three HDI dimension indices are combined into a composite index using the geometric mean, providing a holistic view of human development achievements. Figure 1 provides a better visual understanding of how HDI is calculated.

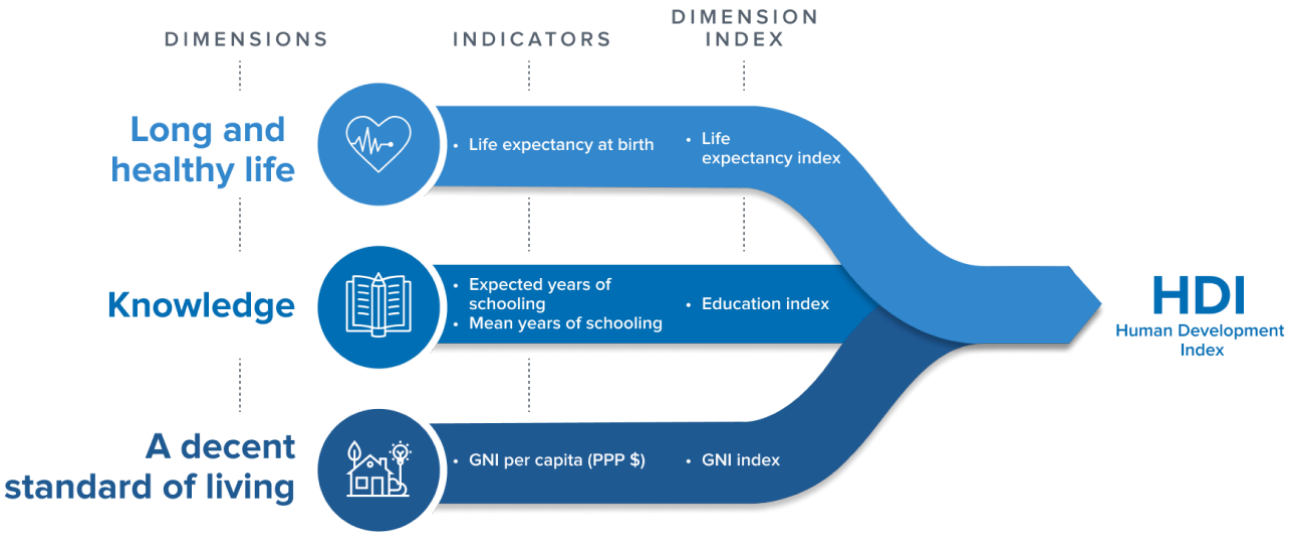


Figure 1. HDI Dimensions and Indicators. (UNDP 2021)

However, UNDP also state that HDI simplifies and captures only part of what human development entails. Nevertheless, intuitively Human Development Index should have some general representation of overall mental health situation within the country. It is reasonable to assume that higher levels of HDI should be indicative of a better mental state within the country and subsequently lower suicide rates. This belief is founded on the common perception that increased longevity and wealth often lead to a sense of "peace of mind" and improved overall well-being. However, while this assumption may hold true to some extent, the relationship between HDI and mental health, as well as suicide rates, is a complex interplay of multiple factors. In the research literature there is no consensus on whether this Index has correlation with the suicide rates or not. In paper written by Khazaei et al. (2017) they did research on 91 countries and found significant positive correlation between HDI and suicide rates. It means that suicide rates increased with increasing levels of human Development Index. Whereas Lendo et al. (2006) in their study focused on United States data and did similar analysis. They state that with higher HDI in the region, the suicide rates are lower. However, both papers conclude that suicide and mental health are more complex issues and there must be other factor that influence people.

Correlation Between Suicide Rates and Crime Rates

This study proposes that Crime Rates may be a contributing factor influencing the mental health and suicide rate. It is crucial to note that in this context, the correlations between suicide rates and crime rates do not necessarily imply that the victims or criminals themselves commit suicide. Instead, the focus is on exploring the overall relationship between crimes and suicides. The underlying assumptions behind this notion are that the occurrence of crimes might elevate anxiety and apprehension within the community as a whole.

Interestingly, similar pattern can be found in different studies covering different scales. Kennedy et al. (1999) did an analysis of violence, homicide, and suicide in 32 London boroughs. They concluded that as all three factors are closely related, they are likely to be valid indices of the difference between adjacent boroughs. Implying that their data can be used for the delivery of preventing and mental health services. Additionally, Machado et al. (2020) conducted a study investigating association between homicide rates and suicide

rates in Brazilian municipalities. They also concluded that in general changes in homicide rates lead to changes in suicide rates. However, authors also stated that due to the many different sociodemographic and socioeconomic factors in municipalities it is not casual association. Suicide and homicide rates have increased in Brazil despite increased community mental health support. Therefore, calling for extra measures. Finally, Fountoulakis and Gonda (2017) did study about correlation of suicide and homicide rates according to geographical areas. They conducted a research of mortality data of 82 countries. Authors suggest that at least in some human populations, suicides and homicides share common etiopathogenetic substrates and could be triggered by the same internal or external events or might develop based on common genetic background.

So, it can be seen that city based, 1 country based, and many countries based studies all made the same conclusion that most likely there is a correlation between crime and suicide rates.

Overall, it can be seen that suicide and mental health is a serious and complex problem that has been around for a long time. There are numerous potential factors that can influence a particular group of people. However, to the best of my knowledge there are no research done investigating the influence of both HDI and crime rates on suicides.

Methods and Techniques

There are numerous different ways of conducting similar research. Some of the examples include:

- **Quantitative Analysis**: Employing statistical methods, such as regression analysis, to analyze extensive datasets containing suicide rates, HDI values, and crime rates. This approach allows for the identification of potential correlations and associations among these variables.

- **Cross-National Studies**: Conducting cross-national comparative studies to investigate variations in suicide rates, HDI, and crime rates across different countries. This method facilitates a comprehensive understanding of the interplay between these factors on an international scale.

- **Longitudinal Studies**: Employing longitudinal research designs to track changes in suicide rates, HDI, and crime rates over an extended period. Longitudinal studies reveal trends and patterns that may not be apparent in short-term analyses.

- **Case Studies**: Conducting in-depth investigations of specific countries or regions to gain nuanced insights into the dynamics between HDI, crime rates, and suicide rates in localized contexts.

- **Mixed-Methods Approach**: Combining quantitative and qualitative methods to achieve a comprehensive perspective. Utilizing both statistical data and qualitative insights from interviews and surveys to enrich the understanding of individuals affected by suicide and crime.

- **Literature Review**: Conducting a comprehensive review of existing academic literature, research papers, and reports to build upon prior knowledge and identify

gaps in the understanding of the relationship between HDI, crime rates, and suicide rates.

- **Data Mining and Big Data Analysis**: Utilizing data mining techniques and big data analysis to extract meaningful patterns and insights from extensive and diverse datasets.

- **Geospatial Analysis**: Incorporating geospatial analysis to visualize the distribution of suicide rates, HDI, and crime rates across geographic regions, potentially identifying spatial patterns or clusters.

- **Causal Inference Techniques**: Applying causal inference methods, such as propensity score matching or instrumental variable analysis, to explore potential causal relationships between HDI, crime rates, and suicide rates.

- **Public Health Surveys**: Administering public health surveys to collect self-reported data on mental health, suicide ideation, and perceptions of safety and crime within communities.

- **Social Media Analysis**: Analyzing social media data to gain insights into how discussions and sentiments surrounding HDI, crime, and suicide may be reflected in online conversations.

This project is not only about conducting research but also to raise awareness of this problem. To achieve this web-based interactive dashboard is created. This type of interaction can help users to understand current situation with suicide rates and mental health and to increase the recognition of this problem.

There are also different methods in creating interactive web-based dashboards. The backend can be JavaScript, Python or other programming languages. The design and front end can be created from zero of use already existing templates. The website can be deployed in platform like AWS, Azure or in GitHub Pages.

Choice of methods

To conduct the research several techniques are utilized. Mainly, cross-national studies are done. Using both quantitative and qualitative methods analysis of specifically chosen countries is done. This approach helps to visualize the situation and have statistical confidence in the results.

To create the interactive dashboard, it was decided to use Python and CSS. Python was chosen as it has a huge variety of different libraries that can be easily installed. For this project newest Pandas library was used for data management. Dash library was used for front and back end. The full code can be found in the public GitHub repository linked in Appendix 1. While the research part focuses on specific countries, interactive dashboards allow users to choose any country that is present in a database to see the statistics or to interact with a world map to overview the data around the globe. Instructions on how to use the website locally can be found in the readme file on the GitHub.

Datasets and Experimental Design

Data Sources

Using data within the range of 1999-2019 offers a substantial advantage in the context of various datasets, including the WHO dataset. This period encapsulates two decades of information, which enables a comprehensive analysis of trends, patterns, and shifts over a substantial timeframe. Data from this range provides a balanced perspective, allowing for the identification of both short-term fluctuations and long-term developments. Additionally, the 1999-2019 interval covers a period marked by significant socio-economic and technological changes, which can have profound implications on the variables being studied. This prolonged time span helps capture the effects of various interventions, policies, and societal shifts, allowing for more accurate assessments of their impact. Additionally, the quality of the data became much more inclusive and accurate supporting the reliability of findings.

WHO Mortality Data

The WHO mortality datasets are extensive collections of well-organized data that cover mortality statistics and related information from various countries and regions worldwide. These datasets serve as valuable repositories of critical insights into global mortality patterns, including causes of death, age groups, and demographics. The WHO mortality datasets are meticulously compiled and updated by pooling data from authoritative sources such as national vital registration systems, health ministries, and statistical agencies, ensuring their accuracy, reliability, and relevance for global health analyses and policymaking.

These datasets offer a wide range of information, including overall mortality rates, specific causes of death, age-specific and sex-specific mortality rates, and comparative mortality assessments. The comprehensive nature of the WHO mortality datasets facilitates the examination of temporal trends, geographical variations, and disparities in mortality patterns among different populations and regions. Researchers, public health professionals, policymakers, and other stakeholders benefit from these datasets as they contribute to evidence-based decision-making, identifying health priorities, and devising targeted interventions to improve global health outcomes.

In the context of this project, the scope of data analysis is narrowed down to focus solely on suicide-related data from the provided datasets. The original dataset comprises a variety of columns, namely Region Code, Region Name, Country Code, Country Name, Year, Cause, Sex, Age group code, Age Group, Number, Percentage of cause-specific deaths out of total deaths, and Death rate per 100,000 population.

To facilitate data manipulation and analysis, the Jupyter Notebook environment and the Pandas library were employed. The dataset was transformed into a Pandas dataframe, a versatile data structure that allows for efficient handling and processing. Subsequently, a filtering process was applied to retain data specifically falling within the 1999-2019 Year range. To streamline the analysis towards the project's objectives, certain columns: Region Code, Region Name, Age group code, and Percentage of cause-specific deaths out of total deaths were eliminated from the dataframe. Additionally, the data related to the age group between 0-4 years was excluded. This decision may evoke a certain level of controversy, as arguments can be made for the significance of retaining such data due to rare occurrences of such incidents. However, it's worth noting that suicide is fundamentally a conscious decision, raising questions about the self-awareness of individuals in this age group. While opinions diverge on the age at which self-awareness truly develops, with some associating it with the earliest memory around this age and others asserting that it emerges later, typically around 8-9 years old, the broader context is multifaceted. This consciousness could be

influenced by diverse factors such as familial socioeconomic status, environmental surroundings, and even genetics. It's essential to acknowledge that this decision isn't without debate. Nevertheless, for the purposes of this project, the assumption is made that children under the age of 5 lack the intentional and cognitive capacity to make a deliberate choice to commit suicide.

This transformation and filtering process aligns the dataset with the specific goals of the project, ensuring that the subsequent analysis is centred on the relevant suicide-related data within the designated timeframe.

Additionally, it's important to highlight that while data quality has significantly improved over time, there remains a notable number of countries that opt not to partake in this data collection initiative, resulting in the absence of accessible open-source databases concerning suicide statistics. Particularly challenging regions in this aspect are Africa and Asia. In countries such as India, China, and North Korea, despite the presence of resources earmarked for data collection and upkeep, these efforts are either not undertaken or the data isn't made publicly accessible. In Africa, the situation is multifaceted – aside from the limited availability of resources for data collection and maintenance, certain countries contend with the additional complexity that attempting suicide is regarded as a criminal offense, thereby adding another layer to the challenges in obtaining comprehensive and accurate suicide-related data.

Links to the WHO mortality datasets and their documentation are available in Appendix 1.

HDI Data

The Human Development Index (HDI) datasets stand as comprehensive compilations of systematically organized information that encapsulate multidimensional facets of human development across diverse countries and regions worldwide. These datasets serve as invaluable repositories of insights into the overall well-being and progress of societies, assessing factors such as life expectancy, education, and standard of living. The HDI datasets are meticulously curated and updated, drawing data from reputable sources including national statistics agencies, international organizations, and research institutions, thereby ensuring their accuracy, credibility, and suitability for informing analyses and policymaking on global human development trends.

Within these datasets, an array of indicators is present, encompassing not only HDI scores but also its constituent dimensions: life expectancy, education, and income. The datasets facilitate dynamic exploration of temporal trends, geographical disparities, and societal progress in human development metrics. Researchers, policymakers, and professionals in various fields benefit from these datasets, as they offer valuable insights into societal advancements, enabling evidence-based decision-making and the formulation of strategies to foster human development. However, for the scope of this project, the focus is directed specifically towards the basic HDI scores. This emphasis is predicated on the understanding that the data encompassed in the calculation of this index reflects the contextual factors surrounding individuals, which wield a notably substantial influence on their mental well-being.

The original dataset encompasses data ranging from 1990 to 2021. Moreover, its structure is designed such that distinct indicators for each year are segregated into separate columns. For instance, columns such as "hdi_1990," "hdi_1991," and so on are indicative of this structure. Notably, the dataset encompasses more than 300 such columns, which, for the purpose of conciseness, will not be exhaustively listed within this report.

The process of converting the dataset into a more manageable format involved using the Jupyter Notebook environment and the Pandas library. Through this, the dataset was

transformed into a Pandas dataframe and further refined to retain only the relevant information aligned with the report's objectives.

Thankfully, it appears that the United Nations, responsible for curating the Human Development Index data, have been able to effectively manage this dataset for a majority of countries. References and links to the HDI database are provided in Appendix 1 for further exploration.

Homicide Data

The selection of the UNODC Intentional Homicide database for this analysis was underpinned by several compelling reasons. Firstly, homicides, as tragic events involving the loss of lives, have far-reaching implications beyond the immediate victims, affecting not only friends and families but also generating a broader impact on the mental well-being of individuals residing in the locality where the incident occurred. The occurrence of such events can lead to elevated levels of anxiety within the community. Furthermore, homicides are often indicative of underlying societal challenges such as inequality, crime prevalence, and law enforcement effectiveness. By using intentional homicide data, valuable insights can be gleaned into these multifaceted issues, which can indirectly influence mental health at various levels. Additionally, the choice of this dataset was influenced by its reputation as one of the most consistent and reliable open-source data repositories available.

The UNODC Intentional Homicide database represents an extensive compilation of systematically organized information, capturing data related to intentional homicides across diverse countries and regions. This database serves as an invaluable resource for understanding the prevalence and dynamics of violent deaths, offering insights into the societal factors influencing such occurrences. The United Nations Office on Drugs and Crime, being a recognized authority in criminal justice and crime prevention, meticulously curates and updates this dataset, ensuring its accuracy, credibility, and relevance for analyses pertaining to global homicide trends. After filtering and refining datasets columns left are: Iso3_code, Country, Sex, Year, Counts, "Rate per 100,000 population". Where Iso3_code represent Country code by ISO3 standard that is also present in all other datasets and used as a primary key for merging and data formatting.

While these datasets serve as suitable foundations for this project's objectives, it's worth noting that there exists significant possibilities to enhance accuracy and extract further insights. For instance, as previously highlighted, substance abuse, notably drug and alcohol misuse, stands as a prominent contributor to poor mental health and suicide. Yet, the challenges in pre-emptively recording such data are evident. Despite the legality of alcohol in the majority of countries, the data pertaining to alcohol sales volume remains insufficient, and insights from those undergoing alcoholism treatment offer only a partial view of the issue. When it comes to illicit drugs, data collection is even more intricate, primarily relying on illegal drug seizures or information regarding individuals in drug rehabilitation programs to provide limited insights into drug abuse patterns.

Another crucial aspect that remains elusive from reputable online sources is data concerning prior suicide attempts and various mental health disorders. These elements stand as pivotal determinants in the prevention of suicides, yet their sensitive nature often deters their open sharing on digital platforms. These deeply personal data points are integral for crafting effective suicide prevention strategies, given their pronounced impact on individuals' mental states. However, due to privacy concerns and ethical considerations surrounding such information, their availability remains restricted in online databases.

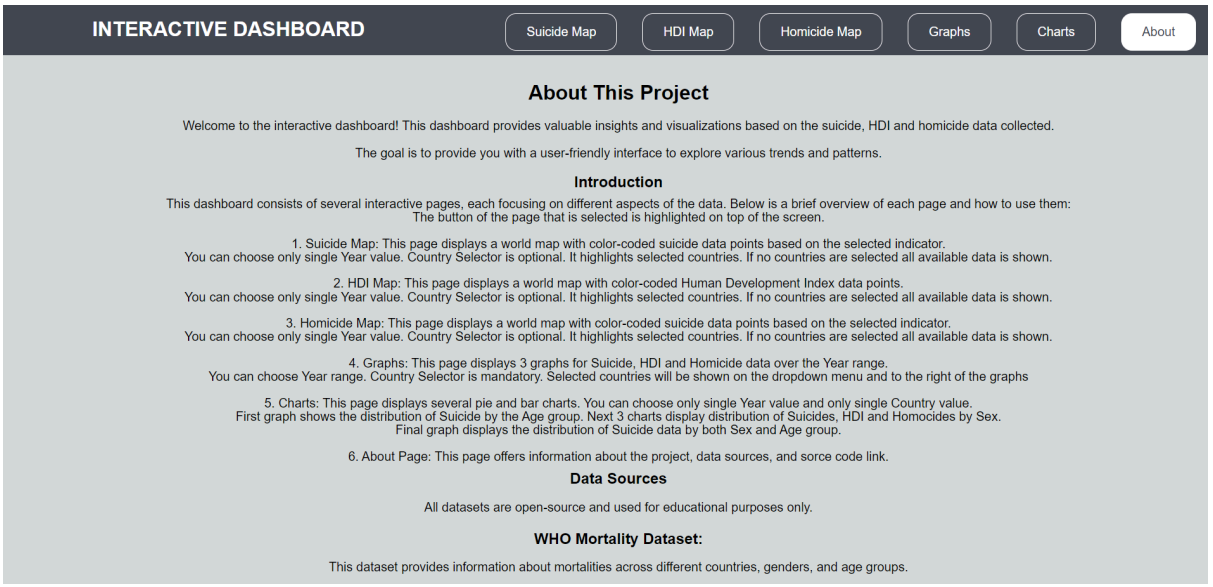
So, besides these limitations there are also countries that are not able or are not willing to collect and share these types of data. Improving the quality of data and making it more

available could be an important step towards better understanding and analysing of suicide problem.

Interactive Dashboard Design

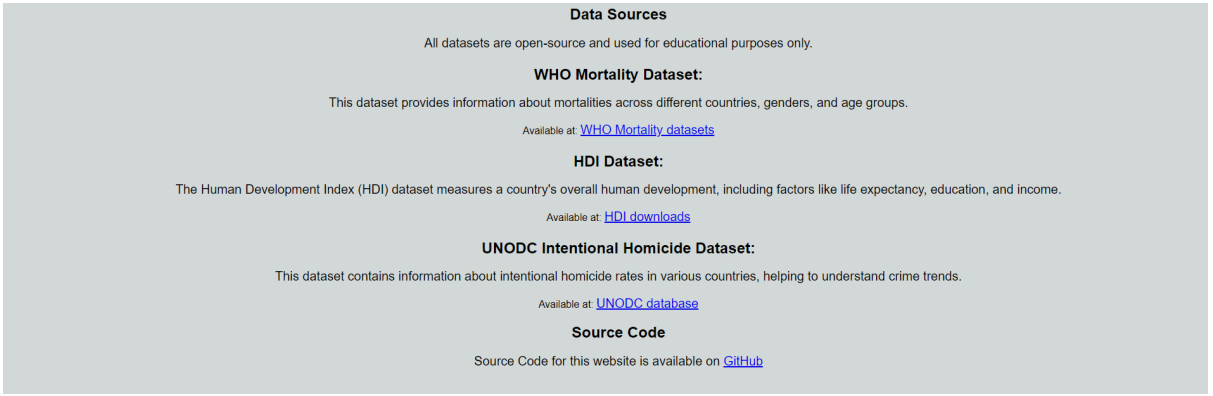
Layout overview

As mentioned earlier to support this report website with interactive dashboards was created. It consists of 6 pages in total and the initial page is “About” that can be seen in Screenshot 1.



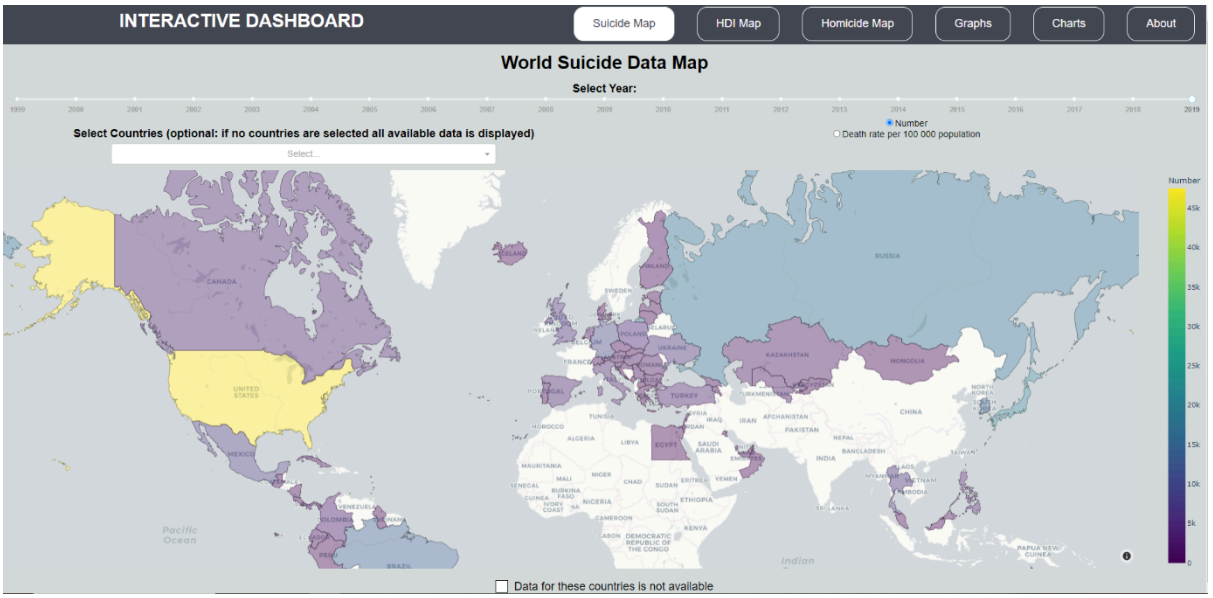
Screenshot 1. “About” page part 1.

First of all, the top line shows the title of the website on the left and 6 buttons on the right. The button of the page that the user is currently on is highlighted by different colours than the rest of them. The line stays the same on all pages allowing user to easily navigate through them. The part 1 of “About” page shown on the Screenshot 1 describes the purpose of the website and general introduction to the website explaining how to operate on every page and what each of them represent.



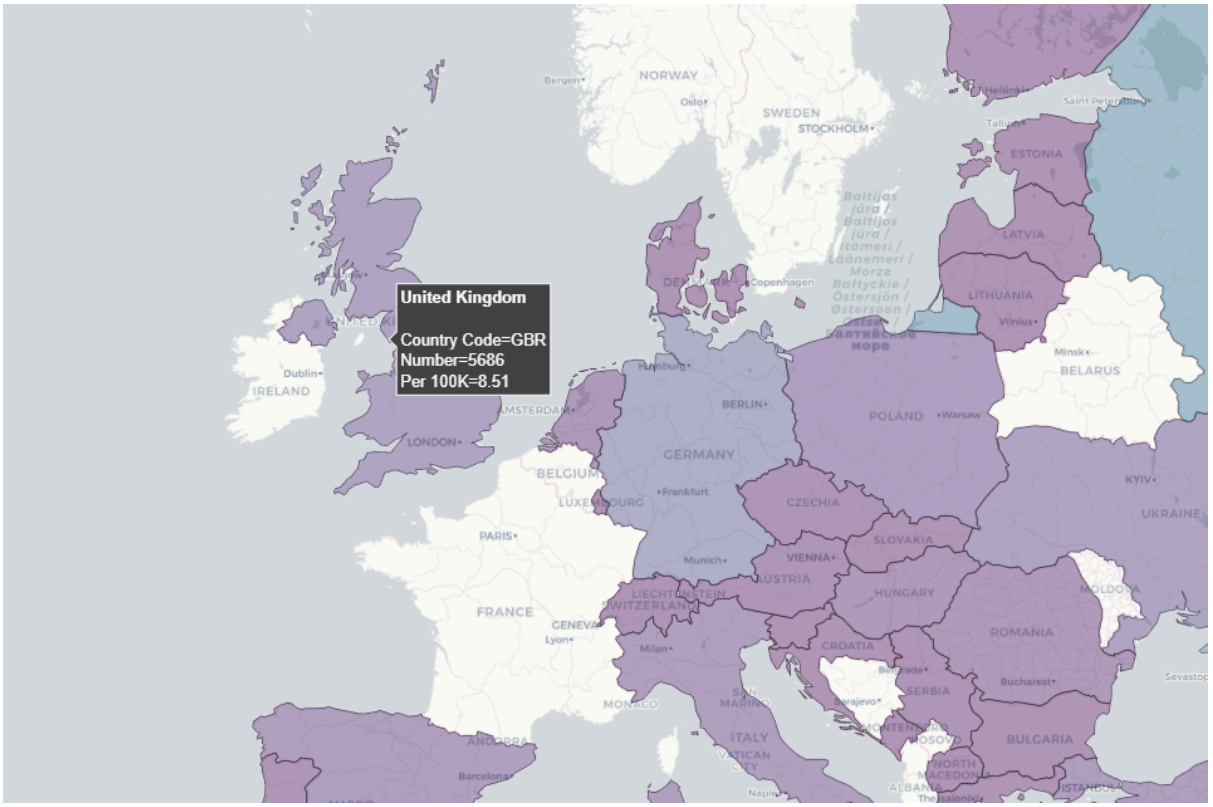
Screenshot 2. “About” page part 2.

Screenshot 2 shows the second and final part of “About” page. In this part it is mentioned that all the data is used for educational purposes only. Then there are brief description and links to the original datasets used in this project. Finally, as this is an open source website, there is link to the public GitHub repository containing source code.



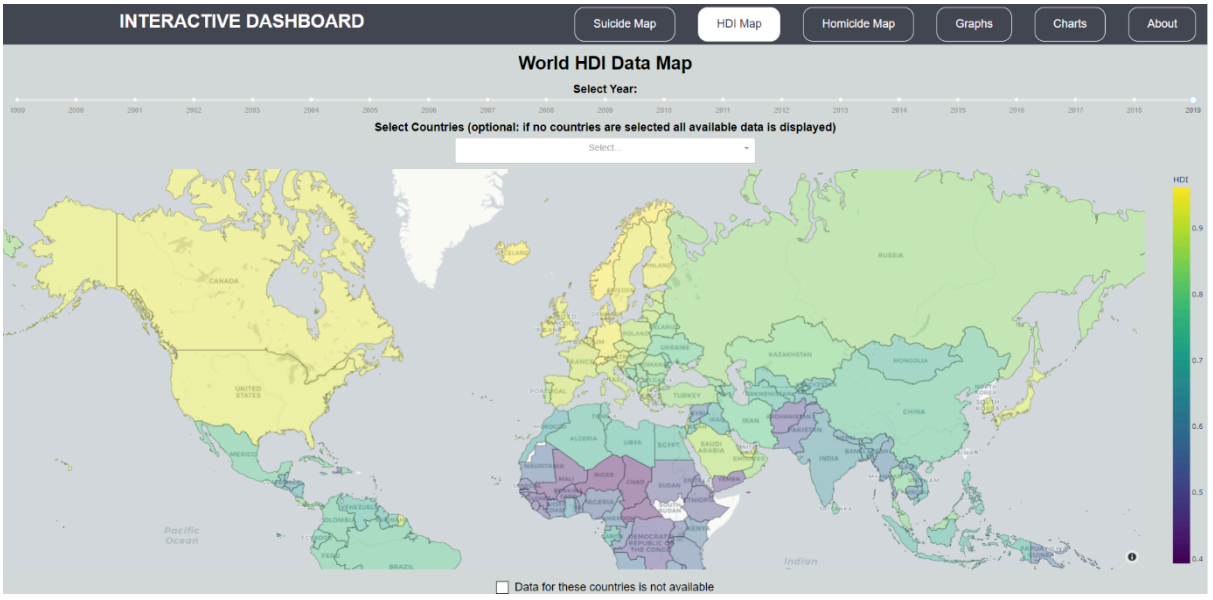
Screenshot 3. “Suicide Map” page (90% Zoom)

Screenshot 3 shows slightly zoomed out version of “Suicide map” page. The screenshot was taken with a 90% zoom in order to include all parts of the page. At the top of the page below the header there is title of the page, “World Suicide Data Map”, informing user of the content on the page. Below that there is Year slider that can be chosen to only 1 value. Below that there are other menus. Country selector on the left allows user to select any number of countries. If no countries are selected all suicide data is shown. On the right there is the selector for representation of the data. The map can show either total count of suicides or rate per 100.000 of population. Finally, there is interactive map that shows the data according to the settings user choses and dynamically changing colour scale. At the bottom of the page there is statement that for countries painted white no data available for selected parameters. By default, map shows number of suicides for all countries for 2019. Besides changing the parameters user can zoom in, zoom out, move around the map and hover over the countries.



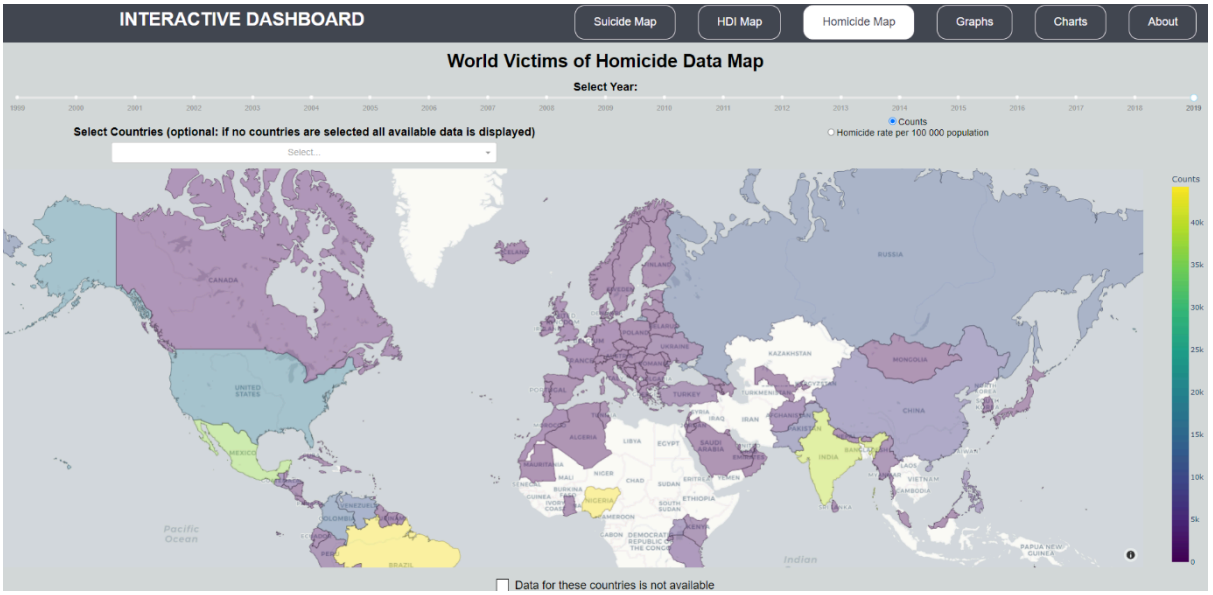
Screenshot 4. “Suicide Map” page. Hover response

Screenshot 4 shows the response of the user hovering over the UK territory. The hover box shows the name of the country, It’s ISO-3 code, number of suicides for selected year and the rate of them per 100.000 of population.



Screenshot 5. “HDI Map” page (90% Zoom)

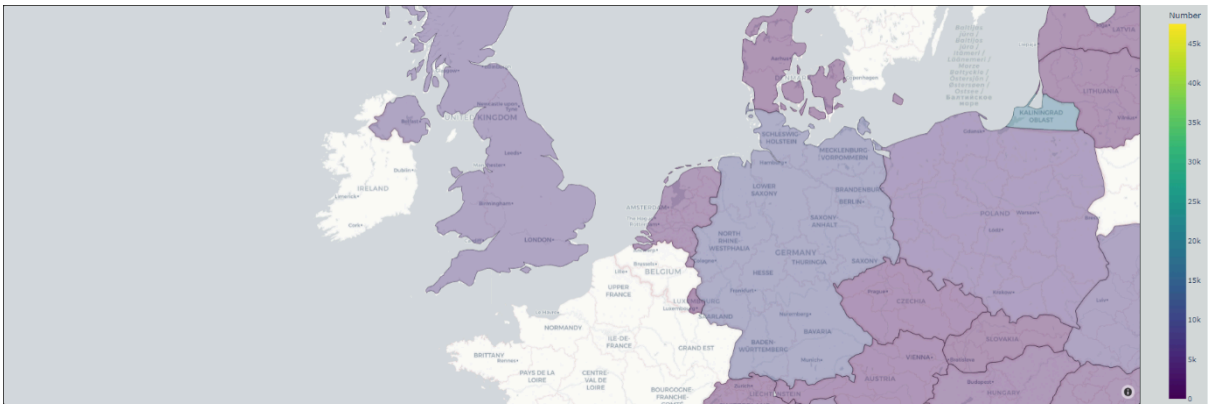
Screenshot 5 “HDI Map" page. This page has similar interactive map but for Human Development Index data. Most of the layout is the same as for Suicide Map except “Number” or “rate per 100.000 population” options. As HDI index do not have any of these parameters these options are not needed. On hover this map also shows country name, code, and HDI data for selected year. By default, map shows HDI data for every available country for 2019.



Screenshot 5. “Homicide Map” page (90% Zoom)

On Screenshot 5 there is “Homicide Map” page. It has the same layout as “Suicide Map” but shows the homicide data. Here user also can choose only single Year value, countries, and the way to represent the data. On this map if the user hovers over the country it will also show the country name, code, homicide count and the rate per 100.000 population.

For all of these 3 maps it was decided to use viridis colour scale as it is one of the best for showing differences for small values.



Screenshot 6. Map colours differences.

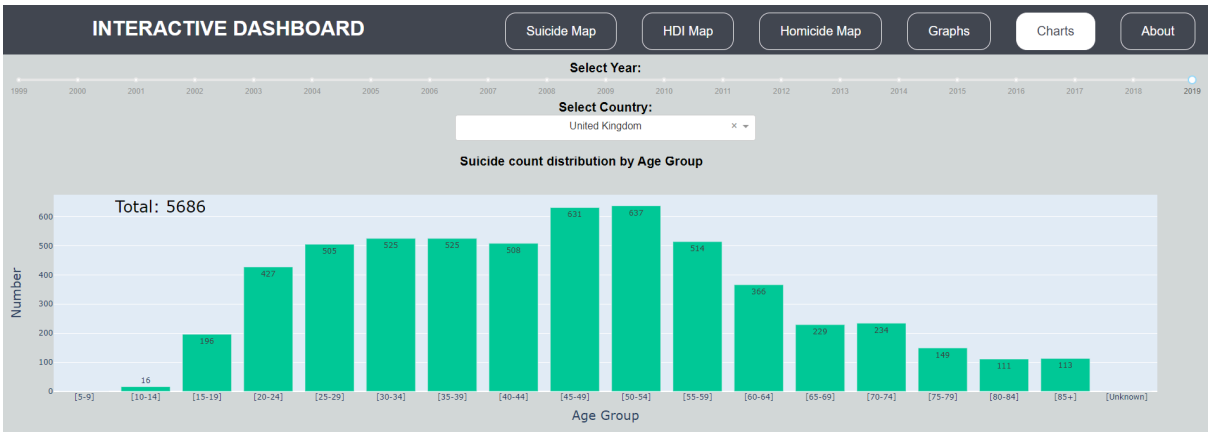
For example, Screenshot 6 shows number of suicides data for some European countries for 2019. It can be seen that due to the high variability of data most of the are located in low 20% of the colour scale. However, the difference between the UK, Netherlands and Germany can be visually seen.

Screenshot 7. “Graphs” page.

Screenshot 7 shows the “Graphs” page layout. At the top of the page below the Header there is a Country selector. User can choose any number of countries to show. Below that there is Year slider. However, for this page the slider represents the range of years and not singular value. User can select any year range or even singular year by placing both marks at the same value. Below that there are 2 menus, both for selecting either number or rate per 100.000. However, the menu on the left is for the Suicide data whereas on the right for homicide graph. Finally, there are 3 graphs showing data for selected parameters. The first graph from the left shows the Suicide data over time. Selected Year range is represented on the x-axis. Y-axis changes from number to rate according to selected parameter. Middle graph represents the HDI over time. Year range is on the x-axis and HDI is on the y-axis. Final graph shows homicide data over time, and it has the same layout as suicide graph. On the right from this graph there is legend that shows corresponding colours for selected countries. This layout helps to easily compare values between countries for any year range. By default, the selected country is United Kingdom, the year range is 1999-2019 and the menus are set to show count.

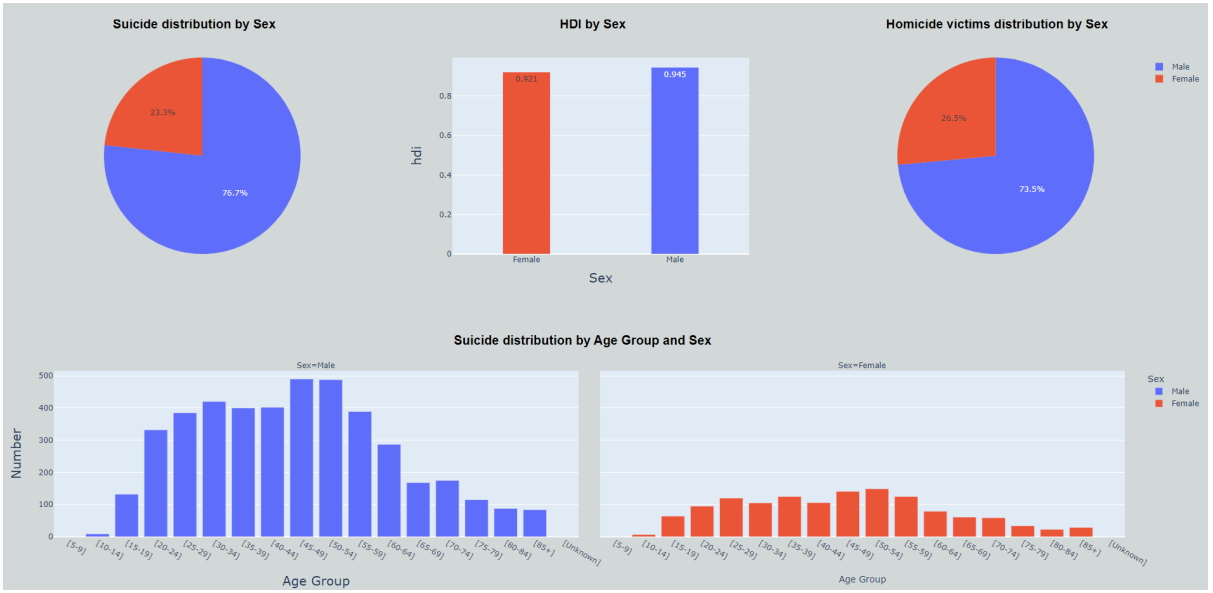
Screenshot 8. "Graphs" page. Non-default parameters.

Screenshot 8 shows the "Graphs" page with non-default parameters. The UK, Netherlands and Germany are selected. Year range is 2005-2018, showing count for suicide and rate for homicide data are selected. It can be seen that the colour scheme is consistent in all 3 graphs. Moreover, it can be noticed that the colour for the UK in Screenshot 7 is blue, same as in Screenshot 8. This function is not initially supported in Dash, and it was this way on the website, so it does not confuse users after adding new countries to the graphs.



Screenshot 9. "Charts" page. Part 1.

Screenshot 9 shows the first part of the "Charts" page. Below the Header there is Year selector, where only single value can be selected. Below that there is Country selector. However, on this page only one country can be selected. First bar chart show suicide count distribution by age group. Age group variable is on the x-axis and number of suicides is on the y-axis. There is also total count of suicides printed on the top left of the bar chart.



Screenshot 10. “Charts” page. Part 2.

Screenshot 10 represents second part of “Charts” page. First pie chart shows the distribution of suicides by Sex. Bar chart to the right shows the HDI index for Male and Female. Final pie chart on the right shows the distribution of homicide victims by Sex. Bottom bar graphs represent the distribution of Suicides by age group for Males on the left and Females on the right. All these charts help to visualise the difference in data between Males and Females for specific country and year.

Implementation

Correlation Analysis

Correlation analysis is a method used to examine the potential relationships between two or more variables in a dataset. In our case, we explored the relationships between Human Development Index (HDI), Suicide Rate, and Homicide Rate. Correlation analysis helps to understand whether changes in one variable tend to coincide with changes in another variable, and to what extent. It serves as a starting point for further investigations and analyses. The correlation coefficient is a numerical value that quantifies the strength and direction of a relationship between two variables. It can range from -1 to +1:

A positive correlation coefficient (between 0 and +1) indicates that as one variable increases, the other tends to increase as well. This suggests a positive relationship.

A negative correlation coefficient (between -1 and 0) indicates that as one variable increases, the other tends to decrease. This suggests a negative relationship.

A correlation coefficient close to 0 suggests a weak or negligible relationship.

The calculated Pearson correlation coefficients for used datasets are as follows:

Correlation between HDI and Suicide Rate: 0.27

Correlation between HDI and Homicide Rate: -0.53

Correlation between Suicide Rate and Homicide Rate: -0.20

HDI and Suicide Rate

The positive correlation coefficient of 0.27 between HDI and Suicide Rate suggests a weak positive relationship between these two variables. This implies that, on average, as the Human Development Index increases, there is a tendency for the Suicide Rate to increase slightly as well.

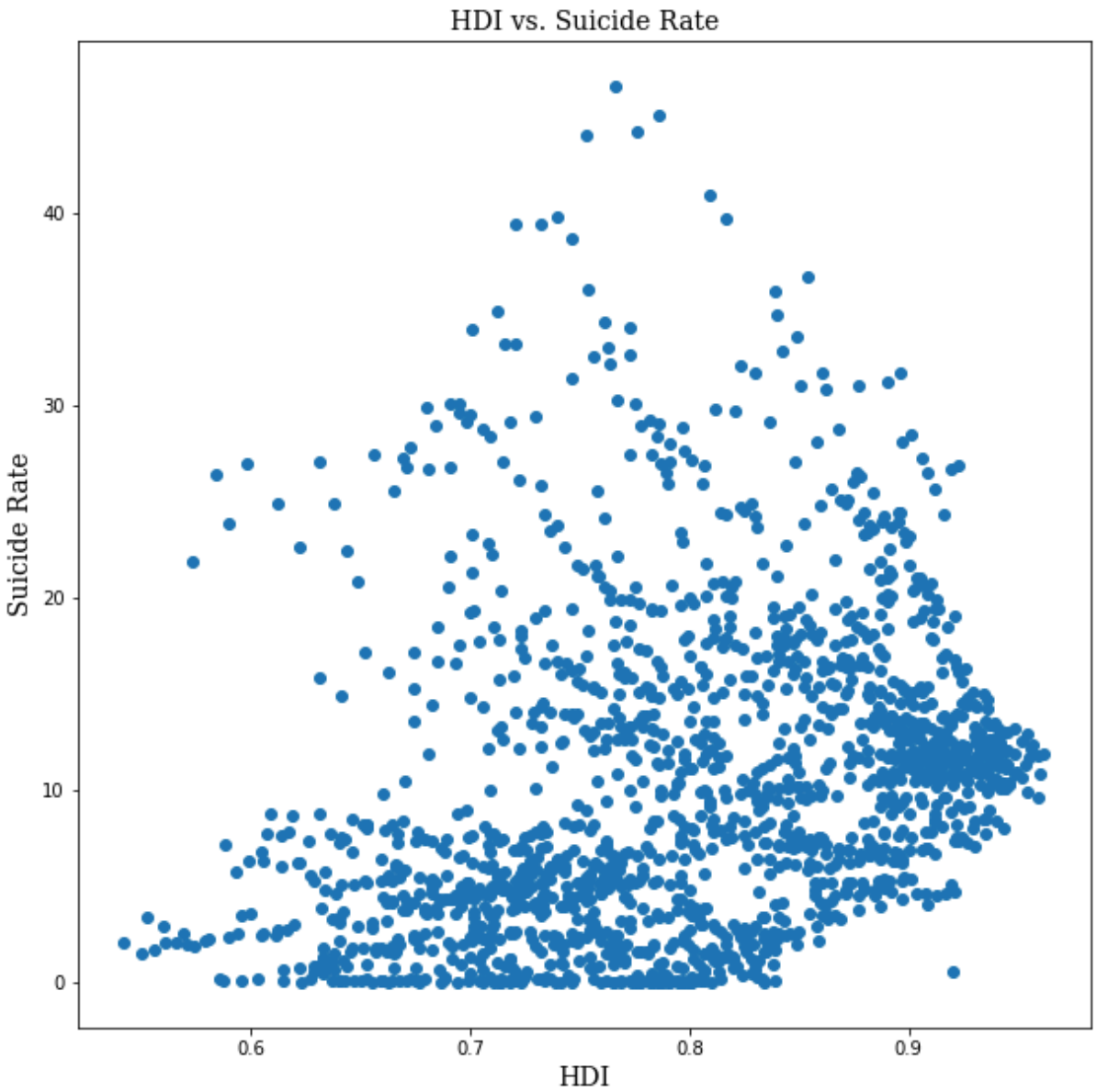


Figure 2. HDI vs Suicide Scatter plot.

Figure 2 represent the scatter plot of HDI and suicide rates. It can be seen that the datapoints do not have clear pattern. So, as the strength of this correlation is also relatively low, it indicates that other factors might contribute more significantly to variations in Suicide Rate.

HDI and Homicide Rate

The negative correlation coefficient of -0.53 between HDI and Homicide Rate indicates a moderate negative relationship between these two variables. This suggests that, on average, as the Human Development Index increases, there is a tendency for the Homicide Rate to decrease. This correlation suggests that higher levels of human development are associated with lower incidences of homicide.

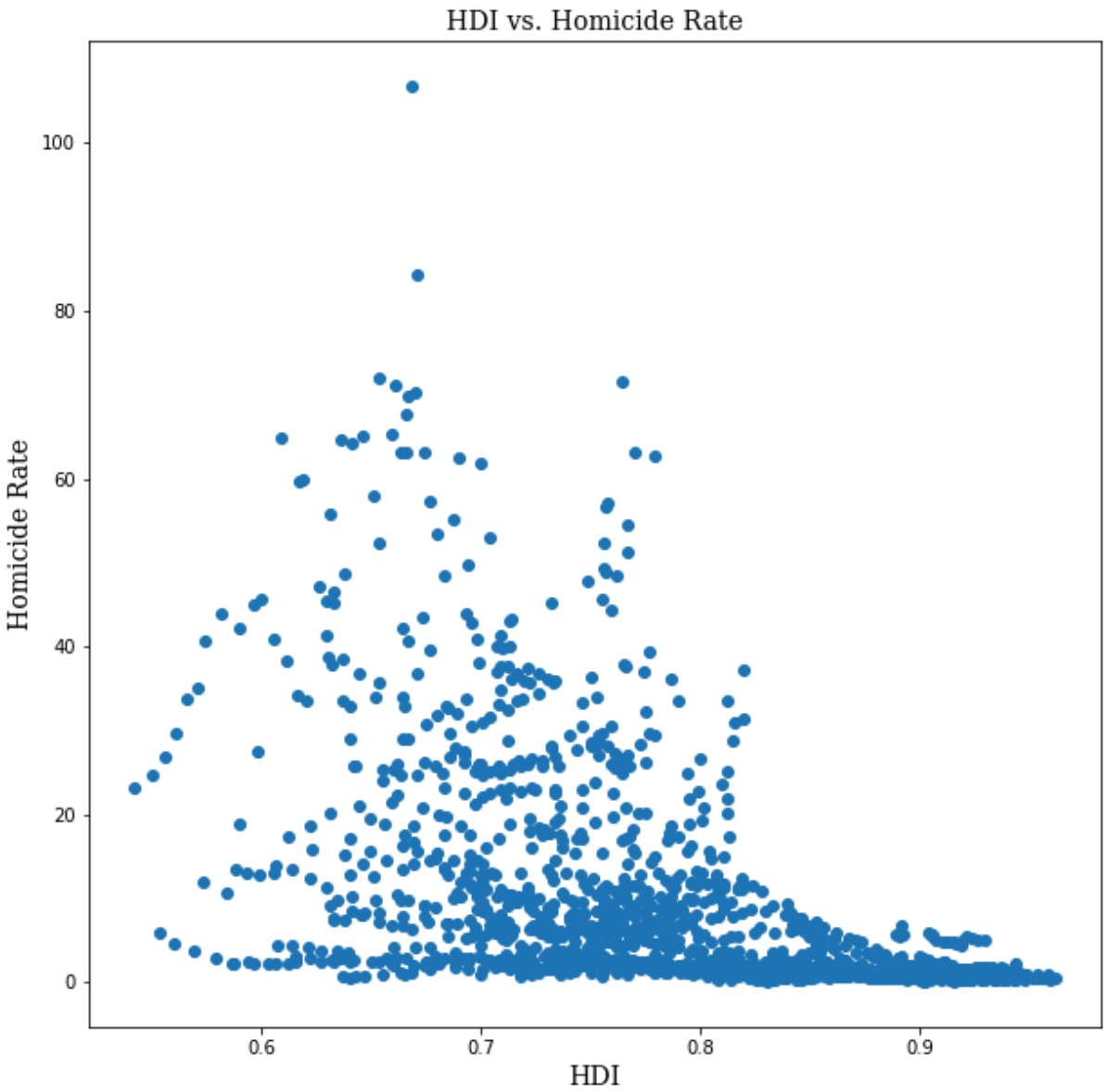


Figure 3. Homicide vs HDI Scatter plot.

Figure 3 show the scatter plot of homicide rates and Human Development Index. It can be seen that there is pattern when HDI is higher the Homicide tends to be lower. This visually confirms the correlation coefficient that was calculated for these parameters.

Suicide Rate and Homicide Rate

The negative correlation coefficient of -0.20 between Suicide Rate and Homicide Rate implies a weak negative relationship between these two variables. This suggests that, to some extent, as the Suicide Rate increases, there is a tendency for the Homicide Rate to decrease slightly.

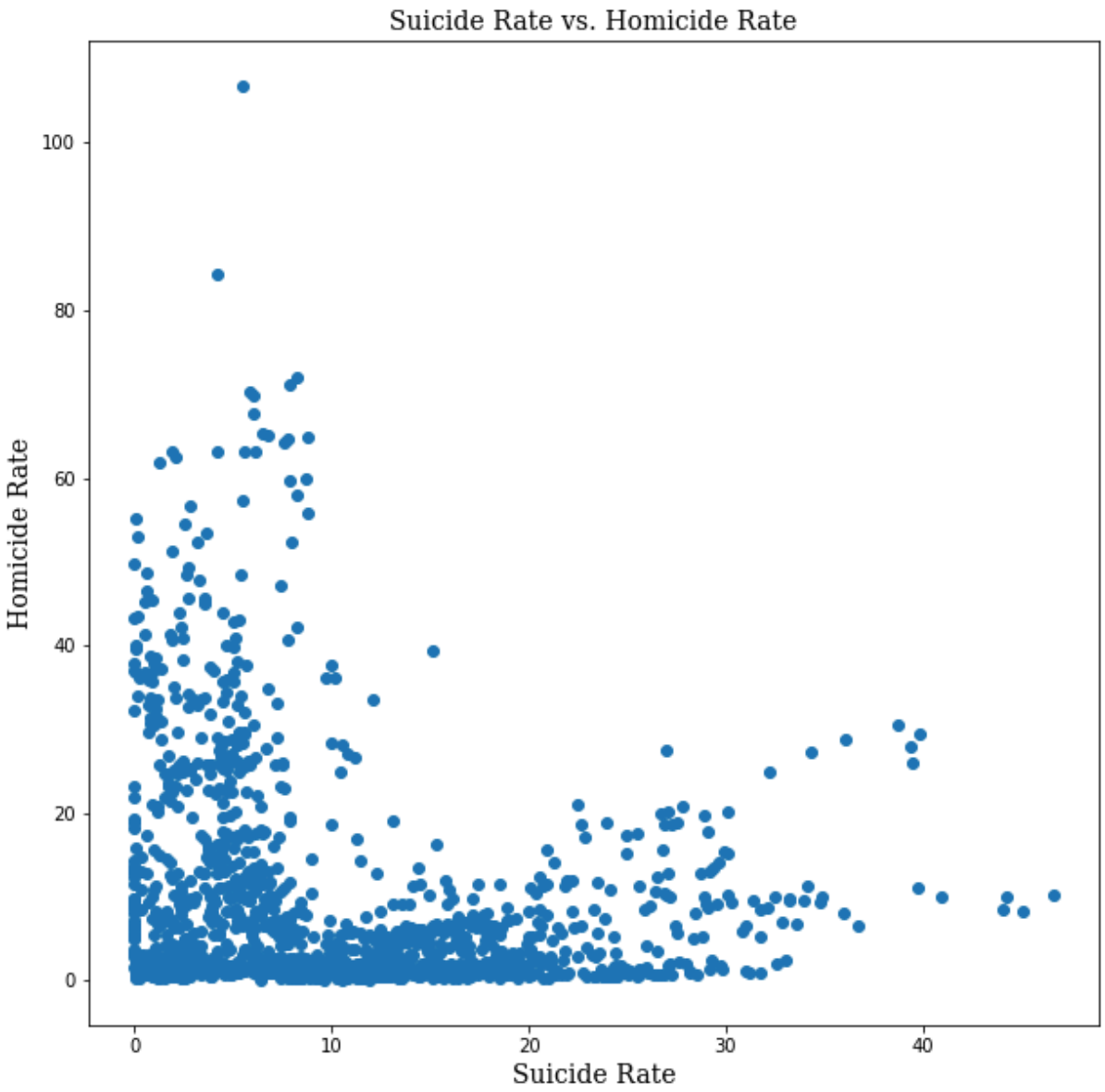


Figure 4. Homicide vs Suicide Scatter plot.

Figure 4 represent the scatter plot of homicide and suicide rates. It can be seen that there is no clear visual pattern of how these variables are connected. So, as the strength of this correlation is also relatively low, it indicates that other factors might contribute more significantly to variations in Suicide Rate.

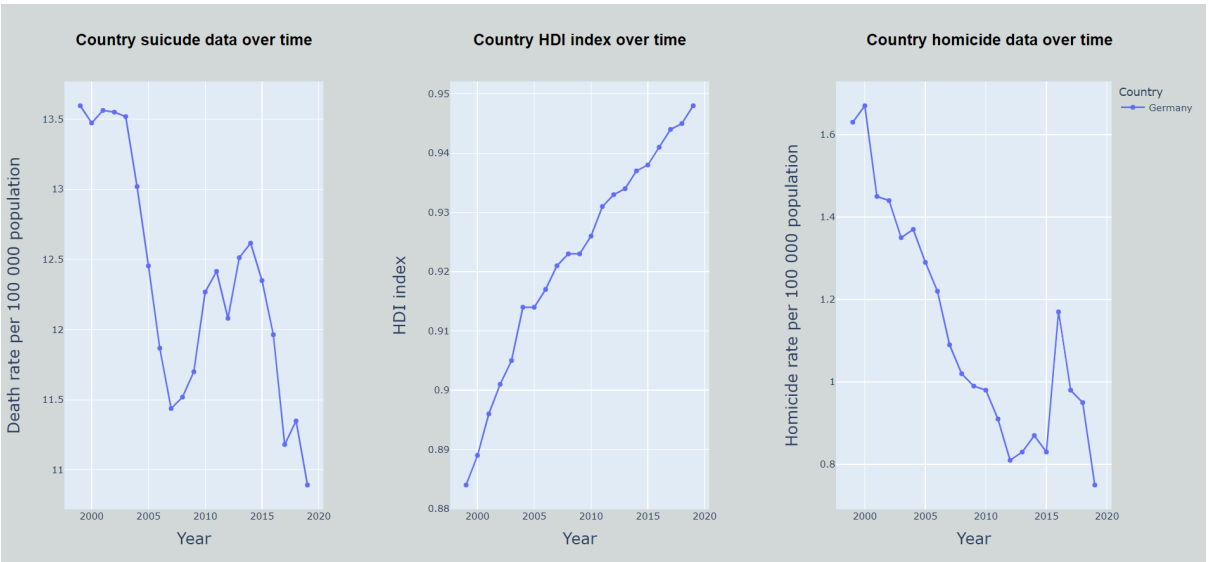
These correlation coefficients provide insights into the potential relationships between HDI, Suicide Rate, and Homicide Rate. However, it's important to keep in mind that correlation does not imply causation; while these correlations suggest associations, further in-depth analyses are required to uncover the underlying factors and potential causal mechanisms driving these relationships.

Country Level Analysis

For country level analysis it was decided to investigate Germany, USA, Brazil, Japan, and Australia. These countries represent a broad spectrum of human development levels, cultural contexts, geographical locations, and socioeconomic conditions. Germany and the USA, as high-HDI nations in Europe and North America respectively, provide valuable insights into how well-developed economies and robust healthcare systems may influence mental health outcomes. Brazil, a medium-HDI country in South America, offers an opportunity to explore the effects of socioeconomic disparities on mental health within a rapidly developing region. Japan, as a high-HDI East Asian country, presents intriguing contrasts between societal pressures and advanced healthcare systems. Australia, a high-HDI nation in Oceania, offers insights into the impact of geographical isolation and indigenous cultural factors on mental health patterns. Analysing this diverse set of countries enriches the study's findings by uncovering both universal trends and region-specific dynamics, contributing to a more comprehensive understanding of the intricate interplay between human development, mental health, and violence. Vast majority of countries with low Human Development Index are located in Africa. Unfortunately, as mentioned earlier, Africa has a serious issue with collecting and maintaining data about suicides. Therefore, it is impossible to do any analysis using public. databases from reputable sources.

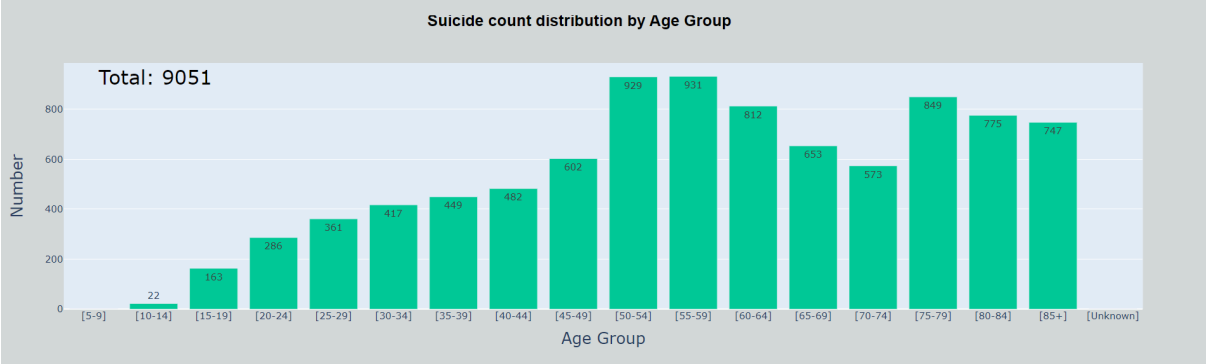
Germany

Germany, known for its rich history, technological advancements, and vibrant cultural heritage, presents an intriguing subject of analysis in the context of the interplay between HDI, suicide rates, and homicide rates. As a high-HDI nation and one of the world's largest economies, Germany has achieved remarkable milestones in terms of quality of life, education, and healthcare accessibility. Its robust social support systems, efficient healthcare infrastructure, and emphasis on mental well-being suggest a favourable environment for positive mental health outcomes. However, beneath its prosperous surface lies a complex tapestry of factors that contribute to mental health challenges. By analysing this nation's experiences, it is possible to gain insights into how a well-developed European nation manages the intricate balance between progress, societal pressures, and mental well-being.



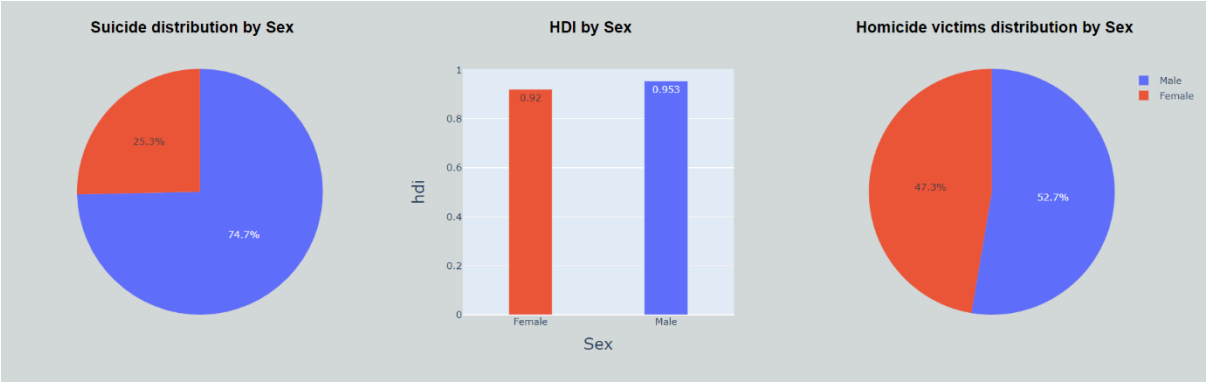
Screenshot 11. Germany data over time

Screenshot 11 represents the Germany suicide, homicide and HDI data for 1999-2019 period. Suicide and Homicide values are represented by the rate per 100.000 population. The most left graph shows the suicide rate changes over time. It can be seen that from 1999 to 2006 there was a 14.8% decrease. However, after that from 2006 to 2011 there was 8.7%. There is no specific reason for that rapid growth. One of the most likely reasons is the worldwide crisis in 2008. Some research like done by Hegeri et al. (2013) suggest that there also was influence of “anniversary effect” following the suicide of German celebrity and goalkeeper Robert Enke. The anniversary effect is a collection of disturbing feelings, thoughts, and/or memories that can occur on or around the anniversary of a traumatic event. Nevertheless, despite instability in suicide rates HDI was consistently increasing with the exception in 2004 and 2008, where it stagnated. On the other hand, homicide rates were consistently decreasing until 2015 where Germany experienced rapid growth in the homicide rates. According to Boers et al. (2017), this growth is solely due to offences committed by newly arrived refugees. In 2015 there were a lot of protest from German people who did not want to accept refuges from Middle East unlike the government. The increase of violent crimes could be the result of this immediate reaction as from 2016 to 2019 the homicide rates dropped by 36%. The small increase in suicide rates in 2016 could be explained by these violent actions however there are not enough evidence to support this theory. Therefore, it can be seen that in Germany there is no clear correlation between suicide rates, HDI and homicide rates.



Screenshot 12. Suicide count distribution by Age Group in Germany in 2019

Screenshot 12 shows the distribution of number of suicides in Germany in 2019. It can be seen that the most vulnerable groups are people aged 50-59 and 75-79. It can also be seen that there is a pattern of increasing suicide counts until the age of 59. After that there is a decrease until the age of 75, where there is rapid increase. Even though this data is for year 2019 very similar patter can be found for previous years as well. After investigating the data for 1999-2019 range it can be concluded that the most vulnerable age groups are 45-54 and 65-74.

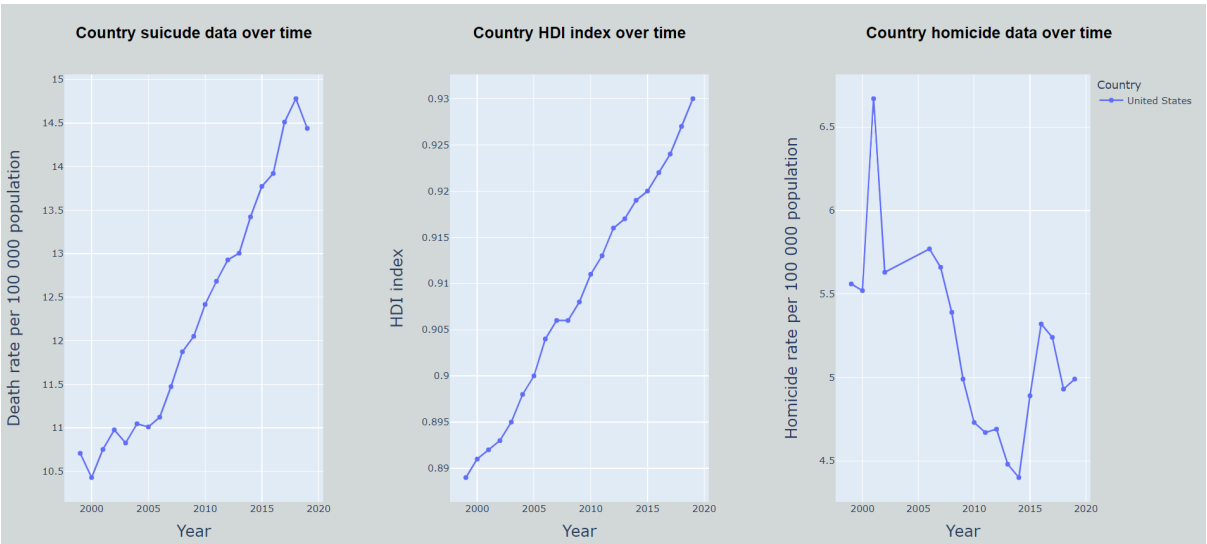


Screenshot 13. Data by Sex distribution in Germany in 2019

Screenshot 13 represents Suicide (left), HDI (middle) and Homicide (right) distributions by Sex in Germany in 2019. It can be seen that despite the slightly better HDI score of Male population the suicide distribution is highly skewed towards them. Additionally, Males are more likely to be victims of homicide. Even though this screenshot shows the information for 2019 the distribution is similar throughout the whole 1999-2019 period. After calculation, for this 20 years period in Germany 74,7% of people who committed suicide and 53,4% of victims of homicide were Males.

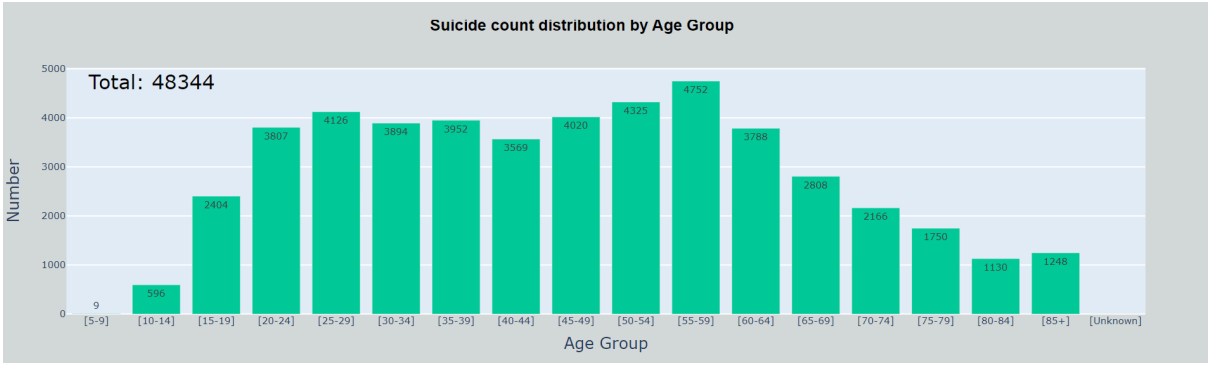
United States

The United States, a nation renowned for its cultural diversity, economic prowess, and global influence, stands as an intriguing focal point for our analysis of the intricate connections between HDI, suicide rates, and homicide rates. With its high-HDI status and vast resources, the U.S. presents a unique blend of opportunities and challenges in the realm of mental health. The country's advanced healthcare infrastructure, technological advancements, and research initiatives offer a promising foundation for promoting mental well-being. Yet, the U.S. also grapples with complex societal issues, including economic disparities, varying access to healthcare, and cultural nuances that shape individual experiences. Also, the US is one of the few countries where guns are legalized (not in all states).



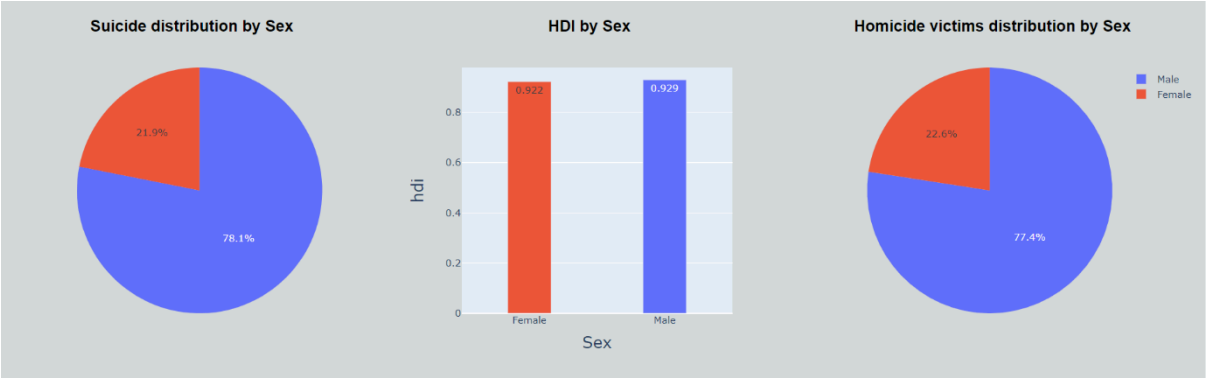
Screenshot 14. US data over time

Screenshot 14 shows the Suicide rates (left), HDI (middle), and homicide rates (right) data over time for United States. It can be seen that throughout the 20 years period the suicide rates were steadily increasing with a slight decrease in 2019. From 1999 to 2019 there is 34% increase in suicide rate. According to Steelesmith et al. (2019), there are multiple reasons for this consistent incline. They show that suicide rates were increasing most rapidly in rural areas, although all county types saw increases during the 1999-2016 period. Several contextual factors were associated with suicide rates simultaneously, with social capital being associated with decreased suicide rates. An increase in suicide rates was associated with rural residence, higher deprivation, higher social fragmentation, higher density of gun shops, and a higher percentage of county residents who were veterans and who were uninsured. Despite the unfortunate raise of suicides United States were scored with higher Human Development Index almost every year except 2008 where it stayed the same. On the right graph it can be seen that homicide rates had a big jump in 2001. It is possible due to the terrorist attack that happened on the 9th of September 2001 as the difference between number of predicted Homicides and actual data is roughly the same as the victims of the attack. However, it could not be determined whether that is true or not for the UNODC database. After steady decline the homicide rates rapidly increased in 2015 and 2016. According to Gaston et al. (2019), there are two most likely historic social phenomena that caused it: a police legitimacy crisis related to an alleged “Ferguson effect” and the opioid epidemic. The Ferguson effect is an increase in violent crime rates in a community caused by reduced proactive policing due to the community's distrust and hostility towards police. The Ferguson effect was first proposed after police saw an increase in violence following the 2014 shooting of Michael Brown in Ferguson, Missouri. Opioid epidemic refers to the situation in the US in 2016 when there have been several reports from the government that the number of overdose death doubled since 2010 and tripled since 2000. As drug addiction can cause hostile and violent behaviour it could be one of the reasons for the “jump” in Homicide rates data.



Screenshot 15. Suicide count distribution by Age Group in US in 2019

Screenshot 15 represents the suicide count distribution graph in the US in 2019. It can be seen that similar to graph for Germany the most vulnerable age group is 50-59. However, in the United States young adults are also inclined to commit suicide. After investigating the 1999-2019 range it can be concluded that this trend is somewhat consistent. In earlier dates less people aged 25-34 committed suicides and the highest age group was 50-54. However, it seems that later more young adults started to suffer from this issue.

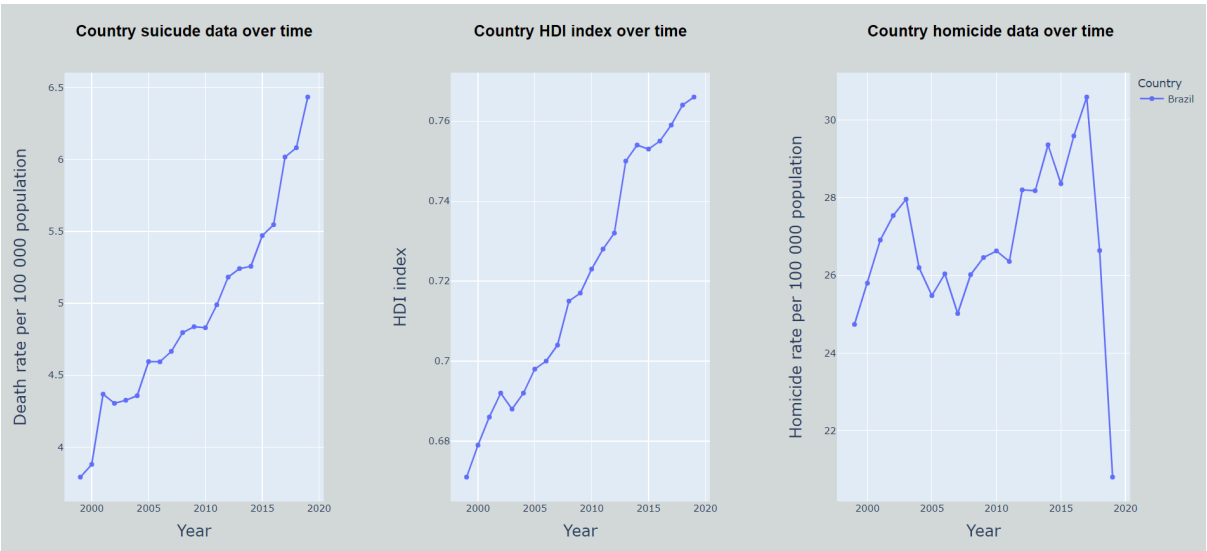


Screenshot 16. Data by Sex distribution in US in 2019

Screenshot 16 represents Suicide (left), HDI (middle) and Homicide (right) distributions by Sex in the US in 2019. It can be seen that the pattern in this Screenshot is the same as for Germany. The HDI score is slightly better for Males. However, the suicide and homicide distributions are skewed to Male population as well. After analysing these data for 1999-2019 range it was calculated that on average in the United States 78,5% of people who committed suicide and 77,1% of victims of homicide were Males.

Brazil

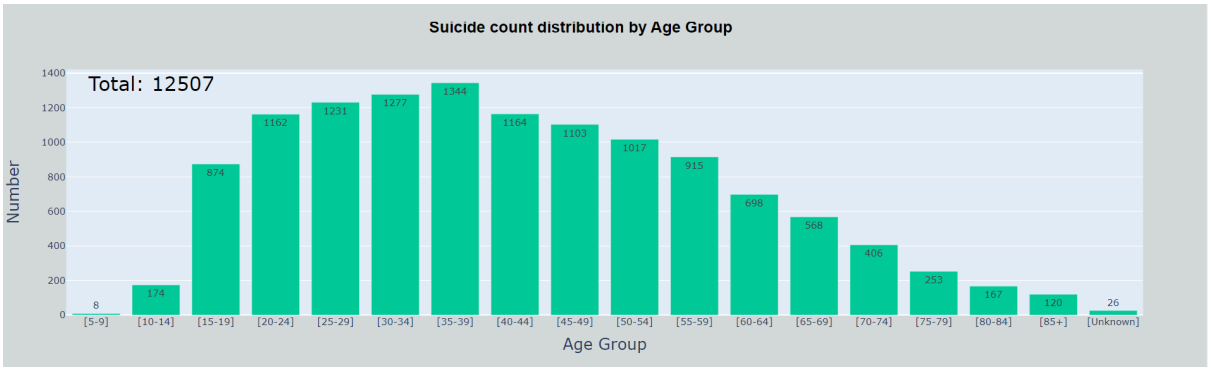
Brazil, a nation characterized by its vast landscapes, rich cultural heritage, and diverse population. As a medium-HDI country and a prominent player in the South American region, Brazil offers a unique vantage point to explore how socioeconomic factors intersect with mental health outcomes. The nation's rapid economic development and efforts to address inequality hold the promise of improved well-being. However, Brazil also faces complex societal challenges, including disparities in access to education, healthcare, and social services. These challenges, in turn, can influence mental health patterns and violence dynamics.



Screenshot 17. Brazil data over time

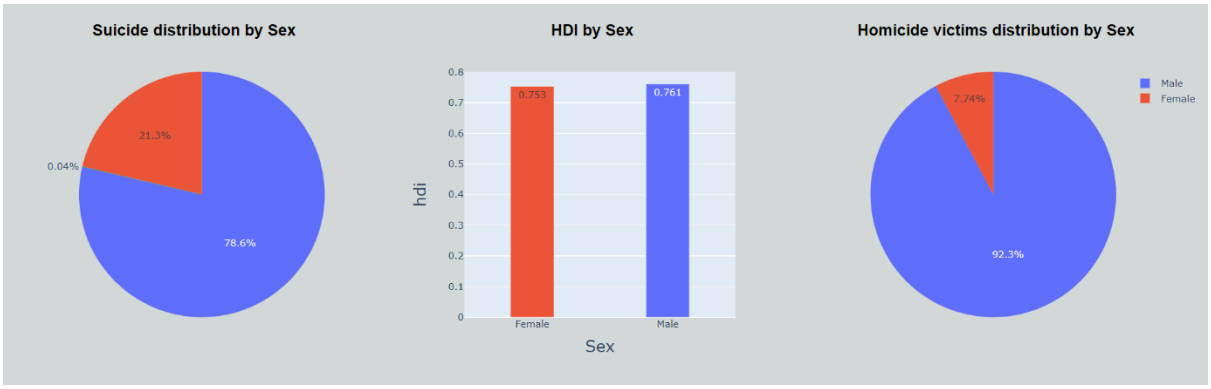
Screenshot 16 shows the Suicide rates (left), HDI (middle), and homicide rates (right) data over time for Brazil. It can be seen that in Brazil for 1999-2019 period HDI was on the rise. Meaning higher quality of life and better economy. However, despite that suicide and homicide rates were also increasing. From 1999 to 2019 suicide rates increased by 69.9%. Homicide rates on the other hand significantly dropped in 2017. On the surface it seems like a good thing. However, usually these anomalies do not indicate valid data. According to

University of Brazilia research, in some states, the quality of information is poor, the cause of the homicide is unknown, the police do not investigate, or there is not even a computer to record it correctly. There is great precariousness in this area, and at the same time that violence is migrating there. Additionally, Brazilian land often used for drug trafficking which also brings a lot of problems whether it is increased drug abuse or gang wars.



Screenshot 18. Suicide count distribution by Age Group in Brazil in 2017

Screenshot 18 represents the suicide count distribution graph in Brazil in 2017. It was decided to use 2017 because as mentioned earlier the data for 2018 and 2019 years has anomaly values and there are no official or public about this issue in English. Therefore, it was decided to analyse data from 1999-2017. It can be seen that contrary to the US and Germany there is suicide data is skewed towards young people. After investigating the data for the whole range, it was concluded that the most influenced age group is 25-34. After that age the number of suicides steadily decline. Possible explanations can be that crimes and drug abuse are high in the whole region. Therefore, young people are more likely to engage in mentally dangerous activities. Moreover, it is very likely that there are stigmatization of suicides and bad media portrayal of the problem in the region. As mentioned earlier these are influential to the overall mental state of people suffering from suicidal thoughts. This can be one of the explanations for this distribution of data because young people are usually more influenced by public opinion.



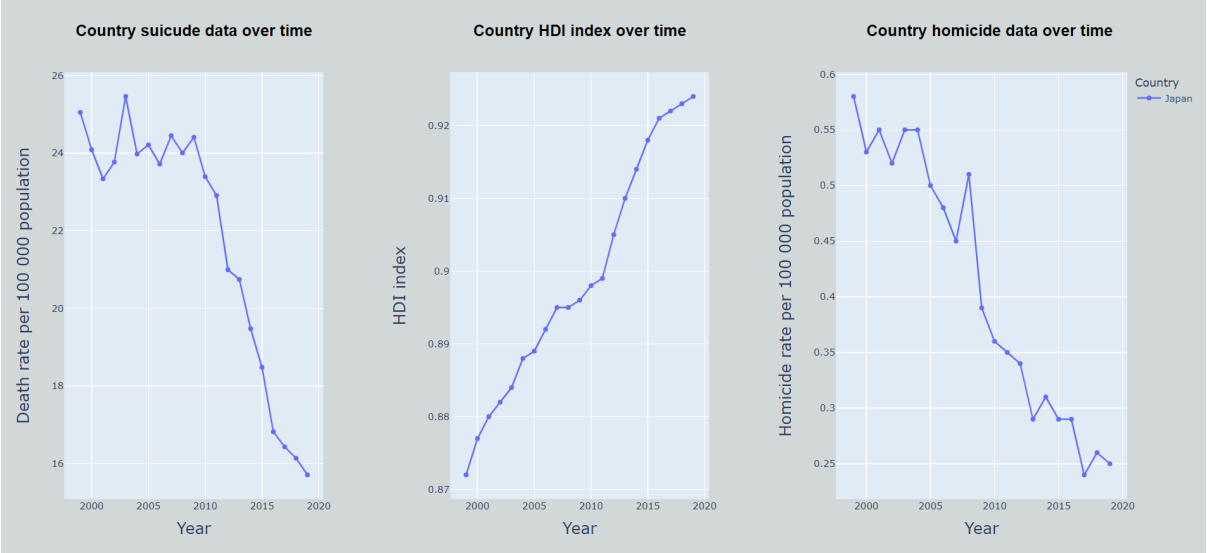
Screenshot 19. Data by Sex distribution in Brazil in 2017

Screenshot 19 represents Suicide (left), HDI (middle) and Homicide (right) distributions by Sex in Brazil in 2017. It can be seen that even if the Human Development Index is lower in general it is still slightly higher for Male than Female. However, it can be noticed that there is 0.04% of suicide victims with unidentified Sex. As mentioned earlier the potential reason for that could be poor data quality. Interestingly, this pattern can be noticed in almost every year in 1999-2017 range. Nevertheless, the same “dominance” of Male suicide victims also

present. Calculated suicide count average for the whole range is 79,2% for Male population. However, it can be seen that vast majority of homicide victims are Males for 2017. This trend is the same throughout the 20 years range with the average of 91,6% of homicide victims being Males.

Japan

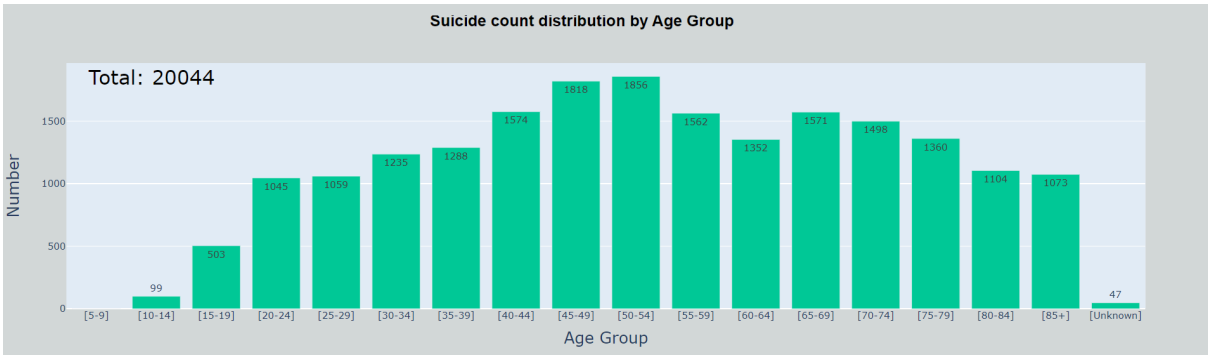
Japan, a nation renowned for its technological innovations, rich cultural heritage, and unique societal norms, offers a captivating lens through which to examine the intricate interplay between HDI, suicide rates, and homicide rates. As a high-HDI country in the East Asian region, Japan presents a dynamic landscape where economic prosperity, educational excellence, and healthcare advancements coexist with distinct cultural pressures. It is one of the few countries in Asia region that collect, maintain, and share their data about suicide cases. The nation's emphasis on achievement and social harmony shapes mental health patterns in complex ways. While Japan boasts one of the world's most advanced healthcare systems, it also grapples with challenges related to societal expectations, especially among its youth.



Screenshot 20. Japan data over time

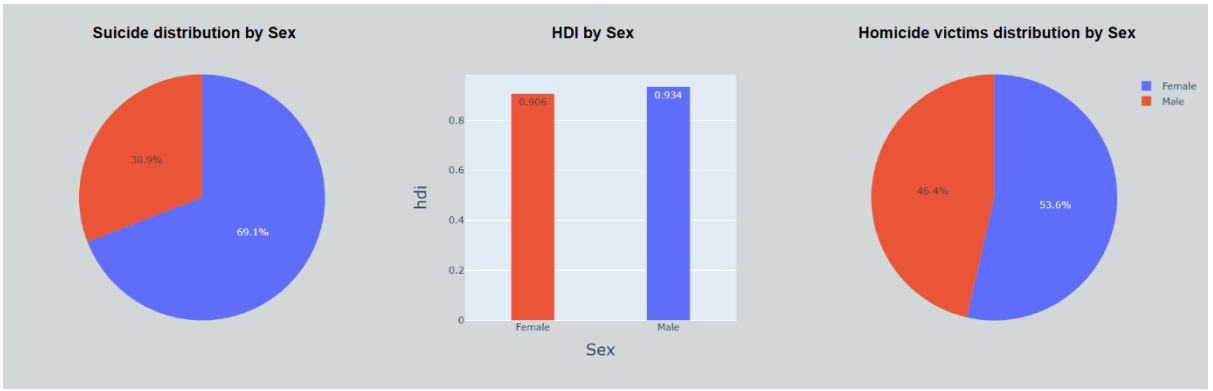
Screenshot 20 shows the Suicide rates (left), HDI (middle), and homicide rates (right) data over time for Japan. It can be seen that suicide rates rapidly decreased after 2009. According to Onishi (2015), during that period overwork, problems with human relations, physical/mental disease, and poverty could form a chain that leads to suicide, regardless of gender. From 2009 to 2015 the suicide rate dropped by 24.2%. Author states that as the main causes of suicide in Japan are mental health issues, the Basic Act on Suicide Prevention passed in 2006 took effect in 2009 and led to outstanding decrease in suicides. According to the data, it is expected to drop even further. However, even after significant drop it is still relatively high compared to other developed countries with high HDI. HDI have been steadily increasing in 1999-2019 range. Which is expected due to the technological and economical achievements in Japan. Homicide on the other are extremely low. In 2019 Japan had the lowest homicide rate in the world. There are several possible reasons for that. According to Bui (2021), one of them is culture. The author states that explaining low crime with culture is to say that collectivist traits like group-orientation, inclination towards harmony, and high self-control are why the Japanese do not murder, assault, and steal from each other as much as others in different countries. Another reason for low crime is strict weapon laws and strong police forces. As Japan is an island it is extremely hard to smuggle guns or drugs. However, on the other hand, the author also claims that domestic violence, sexual

assault, and white-collar crimes are likely to be underreported, and their prevalence are actually thought to be high. Moreover, during Yakuza times their gangs had more power than police forces and therefore, had more control over crime world and information about it.



Screenshot 21. Suicide count distribution by Age Group in Japan in 2019

Screenshot 21 shows the number of suicides distribution by Age group in Japan in 2019. It can be seen that the most vulnerable groups are 45-54. It can also be seen that there is “bump” on the graph for groups of age 65-74. However, upon further investigation of the data it was concluded that this pattern was only for the range 2009-2019 range. For the 1999-2009 period there was steady incline until 45-54 and then steady decline after that. Therefore, it can be concluded that the most common group vulnerable to suicide are middle aged people between 45-54. This data potentially confirms the claims made by Onishi (2015) that most of suicides in Japan happen due to the overwork and human relationship issues. People at that age usually have been working for 20 years in strict and demanding conditions. So, it is possible that because of it they could develop some mental health problems that could also influence their relationships with other people.

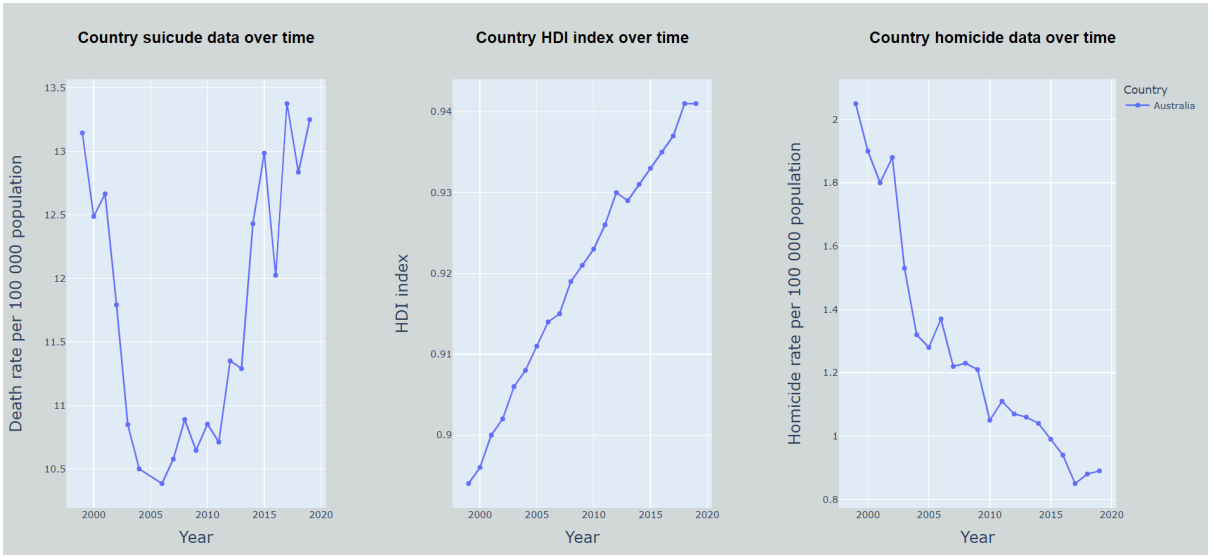


Screenshot 22. Data by Sex distribution in Japan in 2019

Screenshot 22 represents Suicide (left), HDI (middle) and Homicide (right) distributions by Sex in Japan in 2019. It can be seen that despite being one of the highest HDI in the world the gap between Male and Female is quite substantial. Similarly, the homicide victims distribution is not as skewed to the Male side as other countries. On average for the 1999-2019 period 53,3% of homicide and 72,4% of suicide victims are Males.

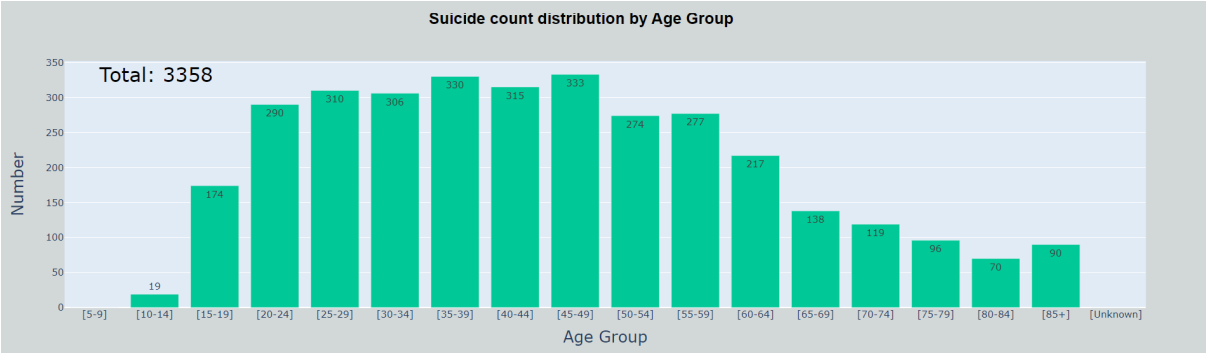
Australia

Australia, a country known for its stunning landscapes, diverse indigenous cultures, and thriving urban centres, offers a captivating backdrop to explore the intricate connections between HDI, suicide rates, and homicide rates. As a high-HDI nation in the Southern Hemisphere, Australia represents a unique blend of advanced development and nature. The nation's commitment to education, healthcare, and social welfare forms a foundation for positive well-being. However, Australia also faces challenges tied to geographical isolation, indigenous disparities, and the complexities of multiculturalism.



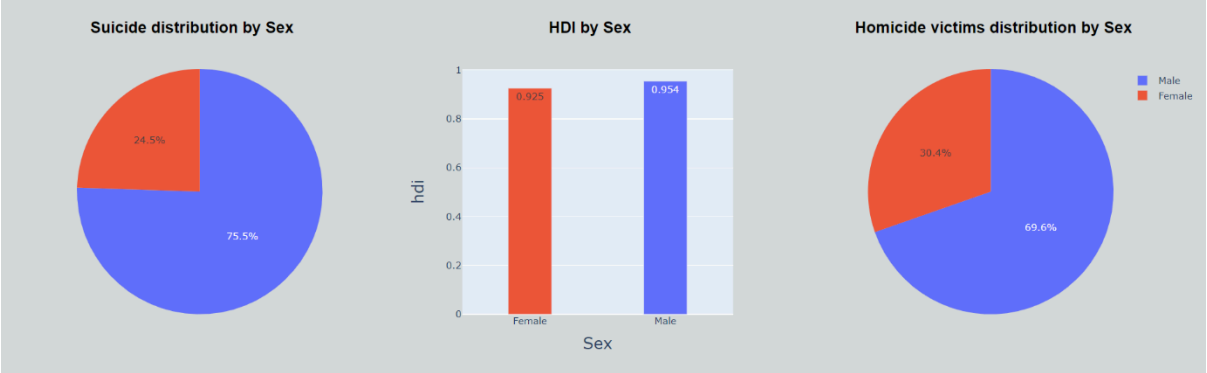
Screenshot 23. Australia data over time

Screenshot 23 shows the Suicide rates (left), HDI (middle), and homicide rates (right) data over time for Australia. It can be noticed that after 2006 suicide rates started to rapidly grow. At first some hypothesis can be made as similar pattern were noticed in the graphs for Germany and United States. However, according to Australian Institute of Health and Welfare (2022), it is important to note that deaths by suicide were underestimated in the collection of routine deaths data, particularly in the years before 2006. Since then, the Australian Bureau of Statistics has introduced a revisions process to improve data quality by enabling the revision of cause of death for open coroner's cases over time. Therefore, rapid increase of the rate of suicides caused not by some actions or event but rather by improving the quality of the data to better reflect the reality. HDI score has also been raising during 1999-2019 range due to developing economy and export of the country. Additionally, it can be seen that homicide rates are much lower than in Brazil and the US and closer to Germany and Japan. Goldsworthy (2019) states that one of the key factors for low homicide rates is strict gun laws. After the gun laws were reformed in 1996 homicide rates started to decline as well.



Screenshot 24. Suicide count distribution by Age Group in Australia in 2019

Screenshot 21 shows the number of suicides distribution by Age group in Australia in 2019. It can be noticed that the most endangered age group are people between 35-49. Throughout the 1999-2019 the high counts slightly shifted from 30-39 age groups to 35-49. However, as mentioned earlier that shift can be explained by poor quality of data before 2006.

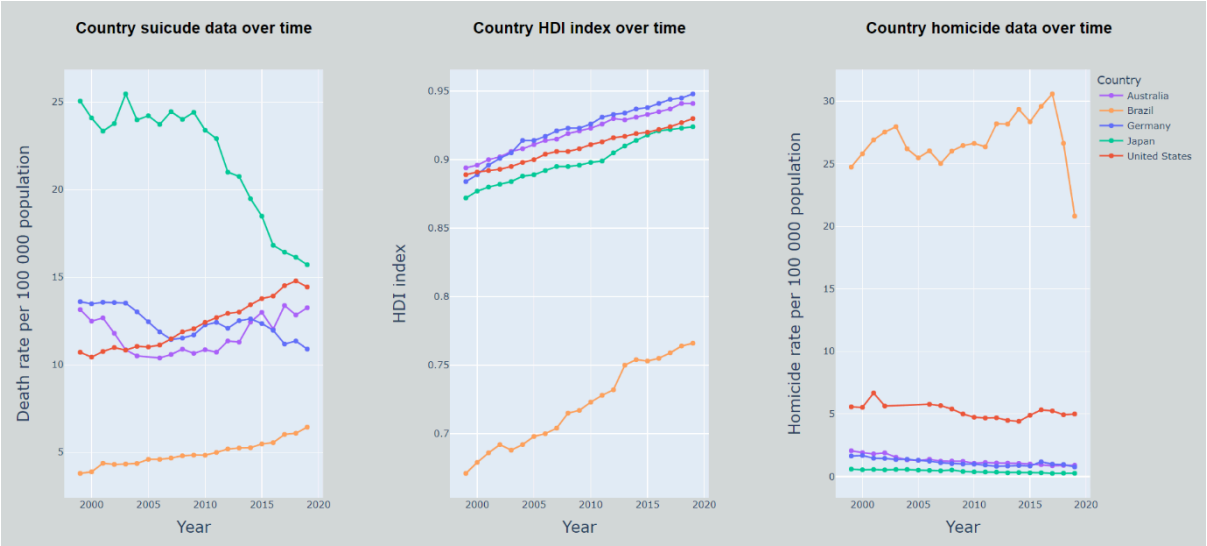


Screenshot 25. Data by Sex distribution in Australia in 2019

Screenshot 22 represents Suicide (left), HDI (middle) and Homicide (right) distributions by Sex in Australia in 2019. It can be seen that similarly to Japan even with high Human Development Index score for Male population is generally higher than for Female. However, the same can be said for both homicide and suicide rates. For the 1999-2019 period on average 77,1% of all suicides and 64,7% of all homicide victims are Male.

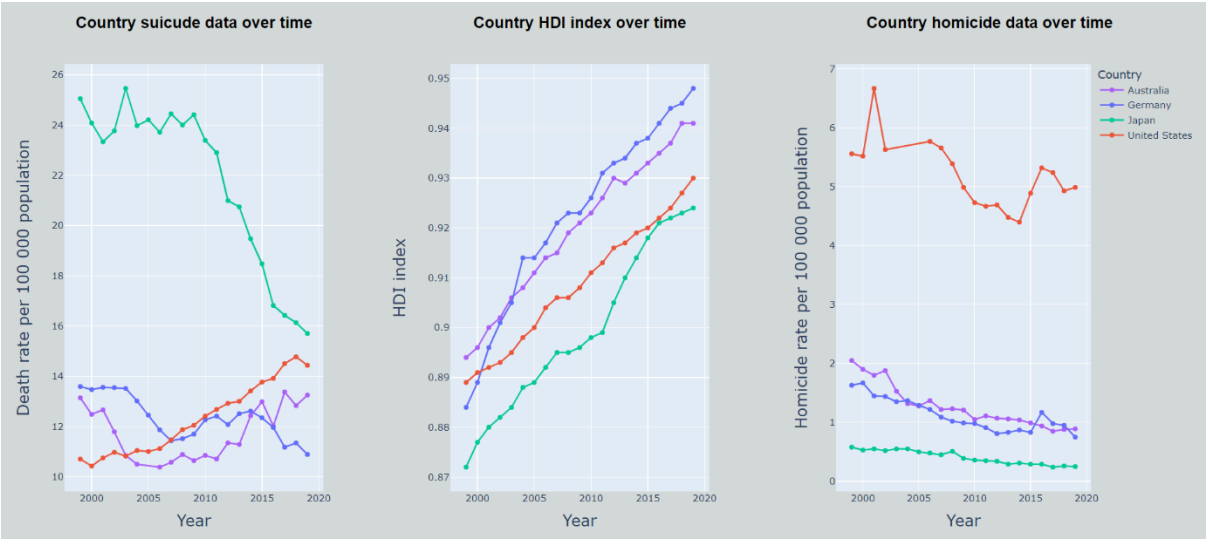
Cross Country Comparison

To better understand the correlation between suicide rates, Human Development Index, and Homicide rates cross country analysis can be done. For this part it was decided to use 5 countries analysed in the previous section as some investigation about their data has already been done. Therefore, for this part data from Germany, United States, Japan, Australia, and Brazil are used.



Screenshot 26. Suicide, HDI and Homicide data for Australia, Brazil, Germany, Japan, and United States for 1999-2019 period.

Screenshot 26 shows the Suicide rates (left), HDI (middle), and Homicide rates (right) for Australia (purple), Brazil (orange), Germany (blue), Japan (green), and Unite States (red) for 1999-2019 period. It can be noticed that despite having the lowest Human Development Index and highest Homicide rates Brazil have the lowest rate of suicides. Even though this rate is continuously growing throughout the whole period by 2019 it is still twice as low as the second lowest country, Germany. However, it does not mean that there is definite correlation between these values. As mentioned earlier it can be caused by poor data quality. On the other hand, Japan having the lowest Homicide rates and relatively high HDI has the highest suicide rates by 2019. Due to the big differences between Brazil and other countries in all graphs it can be seen that on some graphs, like homicide rates, the data for these countries is clustered together and the changes in them can be hardly noticed. Therefore, to further investigate these countries Brazil is removed from the next screenshot.



Screenshot 27. Suicide, HDI and Homicide data for Australia, Germany, Japan, and United States for 1999-2019 period.

Screenshot 27 represents the Suicide rates (left), HDI (middle), and Homicide rates (right) for Australia (purple), Germany (blue), Japan (green), and Unite States (red) for 1999-2019

period. It can be seen that Homicide rates for Germany, Japan and Australia are in steady decline and by the 2019 they all are below “1” value. Alternatively, for United States these rates are not as stable and have much higher unpredictability to it. On the other hand, all Human development Indexes are rising including the Index for Brazil represented in Screenshot 26. Even though it seems like a good trend it seems that there is no correlation between it and Suicide rates. Looking at the Suicide rates graph in both Screenshot 26 and 27 it can be seen that despite improving quality of suicide rates for some countries are raising. Which can be considered contradictory to the nature of suicides.

Evaluation of Results

Looking at the Screenshot 27 and Figure 3 it can be assumed that there is some correlation between HDI and Homicide rates. Calculated Pearson correlation (-0.53) also indicated moderate negative relationship. However, while it stands for countries like Germany, Australia and Japan, this rule cannot be applied to Unite States and Brazil. One of the possible reasons for United States can be gun laws, which in some states allows to buy weapons without any licence. For Brazil illegal drug smuggling and poor data quality could be the reason for inconsistent Homicide data.

Another conclusion that can be made from Screenshots 26 and 27 is that for selected countries Suicide rates do not have correlations with neither HDI nor Homicide. For example, as mentioned earlier, Human Development Index for all countries is raising. However, while Homicide rates for both Germany and Australia are consistently in decline, Suicide rates for Australia are raising whereas in Germany they are falling. So, these countries while having the same trends in both HDI and Homicides have different results in Suicide values. Therefore, there must be other factors influencing the results. Same patterns can be seen while analysing the data for Japan. While looking at the Screenshot 20 it can be seen that HDI is raising and both Homocide and Suicide are falling. So, it can be falsely assumed that better quality of life (HDI) and safer environment (homicide rates) have an influence on the Suicide rates. However, as mentioned earlier in the analysis of Japan, suicides in this country are usually caused by other factors. It can be supported by the Screenshots 26 and 27. While having high Human Development Index and lowest Homicide rates not only among selected countries but also around the world, it has the highest Suicide rates. This insight not only confirms that there are more influential factors than HDI and Homicide rates but also shows the importance of conducting cross country analysis, because this would be hard to catch if only Country based analysis was done.

The analysis of age-related graphs across the five selected countries reveals intriguing patterns that provide valuable insights into the intersection of human development, violence rates, and mental health outcomes. In nations characterized by high HDI and low homicide rates, such as Germany, Japan, and Australia, the data underscores the vulnerability of adults aged 44-59 and, at times, the elderly population.

However, the narrative shifts in the context of Brazil, a middle-HDI nation. Here, individuals aged 25-39 emerge as a particularly vulnerable demographic in terms of suicide rates. This finding emphasize the influence of socioeconomic dynamics and the unique challenges faced by young adults in a mid-range development setting.

Interestingly, the United States, marked by both high HDI and relatively high homicide rates, presents a complex picture. In this nation, suicide counts are observed to peak among both young adults and individuals in the middle-aged category. This dual pattern suggests that while advanced development may mitigate mental health concerns to some extent, the coexistence of higher homicide rates may lead to distinct challenges for a broader age spectrum.

Other data that was analysed is distributions of Suicide rates, HDI, and homicide rates by Sex. Germany, United States, Brazil, Japan, and Australia are all located in different continents with different cultures and histories. That is why it is very interesting that all have the same pattern when it comes to data distribution by sex.

First of all, looking at HDI charts for all analysed countries it can be seen that on all of them Male scores are higher than Female. In some countries the difference is negligible, for example 0.007 difference in United States for 2019 on Screenshot 16. In others the difference can be considered substantial, like the 0.03 difference in Germany in 2019. However, according to these data it can be falsely assumed that it could be applied to other countries as well. In reality it is more complicated than this. For example, in Finland which has high HDI, the difference between Male and Female is really small and during 1999-2019

period half of the time Female had higher index. In Russia and Ukraine, countries with mid-HDI, during the same time period Female population always had higher Human Development Index. One of the possible reasons are that vast majority of worker in dangerous environments, like miner, firefighter, electric and other, are Males. Other reason could be that due to more traditional lifestyle and culture Male population is under a lot of stress as they are seen as providers and defenders. In low-HDI countries, like Namibia for example, Female index is also higher throughout the 1999-2019 period. Possible reasons could be the same as for middle-HDI countries, that Males are usually seen as providers. Additionally, due to the low quality of life for the same reason it is likely that Male population is more likely to be involved in criminal activities.

However, it can also be noticed that Male population is dominant in Suicide and victims of Homicide rates. Unlike HDI, this trend occurs in all other countries. According to the WHO mortality dataset used for this research in 1999-2019 period there are only 8 instances where Female suicide numbers are higher than Male. All of them are in low-HDI and small population countries where total number of suicides was lower than 3. Therefore, it can be concluded that Male population is much more likely to commit suicide in every country covered by World health organization. Homicide rates have similar patterns. After analyzing the UNODC homicide victims dataset for 1999-2019 it was found that in approximately 6% of all countries and years there are instances when there were more Female homicide victims than Male. Moreover, the difference between these rates is usually quite big. Looking at the statistics for 5 chosen countries it can be seen that between them for 1999-2019 period on average 76,4% of suicides and 68% of homicide victims are Male. However, this trend can also be seen in countries where Female HDI is usually higher. Investigating previous examples in Russia for this time period 82,9% of suicides and 75,4% of homicide victims are Male. For Ukraine these numbers are 81,6% and 68,2%. For Finland 74,5% and 69,3%. For Namibia this data is not available. Therefore, these parameters confirm not only that there is Male dominance in Suicide and Homicide rates but also that there is likely more factors influencing these rates than HDI.

Overall, these findings underscore the need for tailored interventions that acknowledge the unique dynamics within each country and demographic group.

Conclusion and future work

Research

Conclusion

In conclusion, the analysis of the correlation between HDI, suicide rates, and homicide rates across different countries has revealed complex and nuanced relationships. While some patterns can be observed, such as the moderate negative correlation between HDI and homicide rates, and the prevalence of certain vulnerable age groups, it's important to recognize that these relationships are influenced by a multitude of factors beyond just HDI or violence rates.

The cross-country comparison highlighted that while HDI improvements and lower homicide rates can be associated with better mental health outcomes, this correlation is not straightforward. The moderately negative correlation observed between HDI, and homicide rates points to a potential influence of socio-economic development on reducing violent tendencies within societies. This aligns with the hypothesis that as countries progress economically and socially, they often witness a decline in violent crime rates. However, this correlation cannot be simplistically applied across the board, as nations like the United States demonstrate complex scenarios where high HDI coexists with significant violence issues.

Moreover, the analysis of age-specific trends in suicide rates underscores the importance of considering the unique vulnerabilities of distinct age groups. While a common thread of vulnerability emerges among middle-aged individuals in several countries, such as Germany, Japan, and Australia, the situation in Brazil and the United States diverges. Young adults in Brazil face an elevated risk of suicide, pointing to the potential influence of socio-economic disparities and cultural pressures in a mid-range development context. In the United States, a mix of factors, including HDI, access to mental health resources, and the coexistence of high violence rates, underscores the complexity of mental health challenges spanning multiple age groups.

Gender disparities in suicide and homicide rates, observed consistently across countries, highlight the crucial intersection of cultural norms, societal expectations, and mental health issues. The prevalent trend of males being more susceptible to suicide and violence reflects not only potential psychological factors but also the influence of traditional gender roles and societal pressures. This reality calls for a deeper exploration of the societal constructs shaping the mental well-being of different genders.

In light of these intricate dynamics, the approach to addressing mental health issues and violence prevention necessitates a comprehensive understanding of cultural, socio-economic, and psychological factors. The findings underscore that while economic development and improved HDI scores can contribute positively to mental health outcomes and crime reduction, they are not the sole determinants. Tailored interventions are essential, accounting for the unique challenges faced by different countries, age groups, and genders.

As societies aim to promote mental well-being and curb violence, the findings emphasize the need for collaborative efforts that span disciplines and transcend national borders. Policies and initiatives focused solely on economic development might not yield the desired outcomes if they neglect to consider the cultural and social contexts that shape mental health challenges and violence patterns. While correlations offer valuable insights, they should serve as starting points for more in-depth investigations and nuanced strategies that address the myriad factors influencing these complex phenomena.

In conclusion, the correlation between HDI, suicide rates, and homicide rates is both fascinating and intricate. While patterns and trends can provide us with insights, they can

also be misleading if not examined within the broader context of culture, society, and individual experiences. The journey toward better mental health and reduced violence requires a holistic approach that respects the complexity of human behaviour and recognizes the importance of collaborative, multidisciplinary solutions tailored to the specific needs of diverse populations.

Limitations and Future work

One of the main limitations for this project is lack of high quality and reliable data. Even though World Health Organisation and United Nations are huge and reputable agencies they still do not have data for all countries. As mentioned earlier for low-HDI countries the problem is that they usually do not posses enough funds to collect and maintain these data. Meanwhile other countries like China and North Korea do not have public databases containing these types of data. So, more proactive steps towards improving World databank should be taken. Whether it is providing funding or making agreements with other countries. This would allow many other researchers to conduct different types of analysis and statistical testing while being confident in the quality of the data.

Other important limitation is lack of data for other factors. As mentioned earlier Mental Health issues and previous suicide attempts are one of the most important factors when dealing with suicides. However, this type of data is very sensitive and not available publicly for privacy matter. Therefore, for future projects it would be highly beneficial to collaborate with governments or hospitals to both conduct insightful research and not break any privacy of the patients.

Other future work proposal is more complicated. It is an established fact that alcohol and drug abuse can be the reason for suicide. However, it is very hard to quantify this data. It could measure the number of crimes that involve drug or alcohol. However, it will not tell full picture of consumption of these substances. It could also be based on sales of these substances. However, it is impossible to keep track of all sales as there could be large number of them that are illegally acquired. Gun control have the same issue. Even when they are banned in most countries there are still black markets and illegally obtained weapons. Therefore, for future research it can be also beneficial to collaborate with the police forces of governments to at least obtain some of the data.

Overall, it is clear that due to the cultural, societal, and economical factors it is impossible to analyse the world as a whole. Moreover, in countries like the US where in some states guns are allowed and in some are not, or in regions like Europe where drugs are banned in most of them but allowed in Netherlands and Portugal analysing them together can output false results that do not consider these features. To better understand suicide problem, it is suggested to conduct deeper analysis for countries considering other factors than HDI and homicide rates.

Interactive Dashboard

The development of the interactive dashboard using Dash has introduced a dynamic and engaging platform for visualizing complex datasets related to suicide rates, HDI, and homicide rates. However, there are certain limitations to consider and areas for potential enhancement in future iterations.

Data Visualization Capabilities

Dash has enabled the creation of a diverse set of data visualizations, yet it's essential to recognize the limitations of the chosen visualization types. While the dashboard offers an impressive array of charts and graphs, some datasets may benefit from more specialized

visualization techniques. Exploring additional chart libraries and custom visualization components could enhance the dashboard's capacity to reveal intricate insights.

Performance Optimization

As the dashboard's complexity grows, it's crucial to optimize its performance to ensure a smooth and responsive user experience. The loading times of interactive elements and data visualizations can be influenced by the volume of data and the intricacy of computations. Delving into Dash's callback mechanisms, optimizing data preprocessing, and incorporating caching strategies can mitigate performance bottlenecks.

Mobile Responsiveness

For this project only Desktop browsers were tested. Dash inherently supports responsive design, but refining the layout and interactions for mobile users requires careful attention. Adapting visualizations, scaling down complex interactions, and optimizing space utilization for smaller screens are strategies to prioritize for mobile friendliness.

User-Friendly Interactivity

The interactive nature of Dash is a double-edged sword. While it promotes exploration, excessive interactivity can lead to cognitive overload and confusion. Balancing the depth of interactivity with simplicity is essential. Intuitive tooltips, guided interactions, and streamlined workflows can guide users effectively through the dataset exploration process.

Customization and User Preferences

Dash's flexibility enables customization, but it's crucial to strike a balance between flexibility and complexity. Empowering users to customize visualizations, save preferences, and manipulate parameters can enhance their experience. Developing user-friendly interfaces for customization and allowing users to save their configurations are avenues for improvement.

Accessibility and Inclusivity

Creating an inclusive experience for users with disabilities is a responsibility. While Dash is a powerful tool for dynamic visualizations, ensuring compliance with accessibility standards (e.g., WCAG) is crucial. Incorporating features that facilitate screen reader compatibility, keyboard navigation, and high contrast modes can ensure a broader user base.

In conclusion, Dash has played a pivotal role in transforming complex datasets into intuitive visualizations and interactive experiences. Recognizing Dash's strengths and limitations, as well as prioritizing continuous improvement and adaptation, will ensure that the dashboard remains a powerful tool for data exploration and insight generation.

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Appendix A

World Health Organisation Mortality database:
https://www.who.int/data/data-collection-tools/who-mortality-database

Human Development Index (HDI) database:
https://hdr.undp.org/data-center/documentation-and-downloads

United Nations Office on Drugs and Crimes Homicide database:
https://dataunodc.un.org/dp-intentional-homicide-victims

Interactive Dashboard GitHub link:
https://github.com/mv686/dashboard