**MSC DATA ANALYTICS ENGINEERING**

**DATA ANALYSIS OF THE GLOBAL SUICIDE RATE**

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**Abstract**

This thesis seeks to analyze the global suicide rate. In today’s world, suicide is a very important topic because, it is the fourth leading cause of death in 15 – 19 year old, and also a public health issue.

Multilinear regression was used to predict and determine the relationship between suicide rate and the following independent variables; unemployment, gdp per capita, and depression.

Further analysis was done on six countries from different continents that are part of the top 20 countries with the highest suicide rate for a better analysis of the suicide rate. Linear regression was used to determine the relationship between suicide rate and independent variables (unemployment, gdp per capita, age group, depression). Additionally, linear regression was also used to determine the relationship between suicide rate and divorce.

Result of the study shows that depression, mental health issues, alcohol abuse tend to make people commit suicide. Furthermore, the result shows that alcohol can be both a causative and a facilitator of suicide. Also it was observed that divorced individuals and children from broken marriages may fall into depression which may also make them susceptible to suicide.

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# **1.0 Introduction**

Suicide has many definitions. Schiedam defines suicide as the act of deliberately killing oneself after experiencing some social, economic, or political problems. Many people look at suicide as the only way to run away from social, economic, and political issues forgetting that it causes permanent stress to the family members and close friends. Many scholars have looked at suicide from different angles and dimensions and put a lot of energy into researching factors contributing to suicide. Yet, suicide is increasing at an alarming rate after every 40 seconds (Witt et al., 2017).

According to (Witt et al., 2017), close to 790 000 people lose their lives by committing suicide; this means that after every 40 seconds, one person dies through suicide. Suicide is a global disaster that occurs throughout life. To lower suicide and suicidal attempts, there is a need to stage and implement effective interventions at allowed levels from the population to the individual level (Hedegaard, Curtin, and Warner, 2020). Statistical data conducted by WHO in 2016 shows that 78% of suicides occur in developing nations. In those Third world nations, people strain to improve their living standards and face many social challenges in their lives (Hedegaard, Curtin, and Warner, 2020). At the beginning of the year 2017, it found that suicide accumulated 1.3% of mortality data worldwide, making it the 17th leading cause of death.

Presently, big data has proven to be of great advantage to various industries and organizations. For example, in finance it has helped companies to effectively manage risk and push campaigns or products that suit their customers. In health, big data makes it possible to detect diseases early enough, thereby reducing its effect. Additionally, it also helps to predict a more efficient line of action and advice health practitioners on more effective solutions.

As described by wikipedia, “Data analysis can be defined as the process of inspecting, cleansing, transforming and modelling data with the aim of discovering valuable information, informing conclusions, and supporting decision making”. Through data analysis new insights that unlock new sources of business value can be derived.

## 1.1 Background

Research on suicide and suicidal behavior has increased over the last ten years on many fronts, from the clinical, social, and psychological aspects to the unique environment and population-level influence, such as access to mental health care (Moutier, 2021). Researchers from Canada have been significant contributors to research on suicide and its prevention internationally, with the country’s share of scientific publications increasing from just over 2% in 2005 to more than 6% in 2018 (Moutier, 2021). Researchers are responsible for over a third of international research in specific areas of expertise, including genetics and Indigenous mental health.

The act of committing suicide is associated with health problems and life stress. Due to those risks, there are factors used to assess the patterns (Houtsma, Butterworth, and Anestis, 2018). Depression mood is the current known pattern whereby most people take away their lives after being depressed for an extended period. Depression can be brought about by failing to achieve specific goals or be affected by some psychological issues. Medical problems seem to have contributed to the high rate of suicide. Many people fear diseases like cancer and HIV/AIDS, and when victims are not well-taken care of, they may commit suicide due to fear of isolation in society. The recent coronavirus pandemic that broke out in 2019 in china and spread worldwide may cause people to kill themselves due to challenges associated with the pandemic (Moutier, 2021).

Literature review on the results from the correspondence analysis carried out by Vladeta et al to determine the methods of suicide shows that pesticide suicide and firearm suicide replaced the traditional methods. Furthermore, it shows that suicide pattern depends on the availability of the methods used. From this it can be deduced that restricting access to the means of suicide is more urgent and more technically feasible than ever. (Vladeta et al., 2007). To achieve the above result, data encoded in adherence to the International Classification of Diseases (10th revision) were derived from the WHO mortality database. Suicide methods were differentiated through classification. Afterwards, correspondence analysis was used to identify typical patterns of suicide methods in different countries by providing a cross-tabulated data. (Vladeta et al., 2007).

Findings from research done in China using Poison regression models also shows that the overall suicide rate between 2002 – 2011 decreased significantly except for young males and rural older adults, and an increase in the suicide rate among older adults in both urban and rural areas towards the end of the study period. (Chong et al, 2014). Data on suicide rate ranging from 2002 to 2011 was provided by the Chinese Ministry of Health for this research. Poison regression models were employed to examine the trends of region-specific, age-specific, and gender-specific suicide rates. Hence, the mean national suicide was calculated. (Chong et al, 2014).

The increase in drug abuse and use of firearms in the past two decades has increased the rate of suicide globally. However, it is significant to know that suicide has increased in countries where the use of firearms by ordinary people is low. Social and interpersonal violence may also increase the rate of suicide. Recent studies show that financial strains and a high unemployment rate contribute to suicide because, in many families, violence occurs due to financial difficulties, especially in developing countries.

Furthermore, a literature review on the research carried out on differentiating adolescent suicide attempters and ideators through classification tree analysis of risk behaviors shows that youths characterized by heroin use were at a strikingly high risk of being attempters (78%). While youths who have also experienced rape were also likely to be attempters (58%). The research was done by analyzing data from the 2013, 2015, and 2017 National Youth Risk Behavior Surveys. Classification tree analysis was used to identify combinations of health risk and demographic factors. (Alexis et al., 2020).

The high male-to-female suicide ratio is primarily evident in well-economized countries with limited resources. In developed nations, research shows that men tend to commit suicide than women (Witt et al., 2017). Men in developed countries are involved in nation-building activities, forgetting to look for their welfare. In the third world nations, studies show that women are the one who tends to commit suicide more than men (Witt et al., 2017). In developing nations, women are the ones who play a significant role in upbringing the family; due to this, they face a lot of social problems such as family violence and financial difficulties. The rise of the suicide rate of women in developing nations is contributed by the tendency of men to not providing essential needs to the family. In low-income families, abandoning social responsibility is catalyzed by the behavior of men involving themselves in drug abuse without considering they have a role to play in the family. Furthermore, studies have identified that young women are significantly affected by challenges in being very young at marriage. Early marriages are companied by bearing many children at a young age, financial and social dependence on the man and family relatives, coupled with physical and sexual violence (Moutier, 2021).

The suicidal act thus has specific socio-political and legal implications (Carpenter et al., 2020). For example, when someone caught, committing suicide is taken to court and charged with murder instead of looking for reasons why he or she was committing the act and help him.

## 1.2 Statement of Problem

Over the last ten years, suicide rates have been increasing, drawing attention to researchers, and empirically they have come up with improved methods and based methods for preventing suicidal behavior. People who commit suicide start to show signs or intentions of acting immediately when the idea comes to their mind. According to World Health Organization 2016 analyzes some of the characters, such as talking about suicide, many of their daily stories are full of ideas of committing suicide. They regret to be born or wish that they die. Those who are writers start to write topics on death. Suicidal people, according to (Carpenter et al., 2020), do not have to believe that things will ever change for the better, and suicide is the only way out. It is wise to recognize the warning signs for committing suicide and know how to act on them.

Suicide rates vary from one country to another due to different incomes in terms of gross domestic product. However, the common thread among them in terms of suicide is the little efforts to design and implement programs of reducing or preventing suicide by government, social or educational institutions (Witt et al., 2017). The problem of ignorance to increment of suicide rate is not common to all third world nations with limited availability of national and public resources. In developed countries in Europe, the continent government has given grants to researchers to develop a solution to curb suicide acts. According to (Witt et al., 2017), adequate research on suicide ideation and behaviors can help the government develop policies and implement them to reduce the suicide rate in their boundaries and across the world. There is a need for researchers to seek ways of reducing suicide and preventing suicide activities from taking place.

## 1.3 Aims and Objectives.

### 1.3.1 Aims

The aim of this project is to analyze the global suicide rate, the extent of risk factors, and problems associated with suicide. The suicide rates and solutions pattern will be looked at sincerely, knowing that suicide has become a healthy disaster globally.

Additionally, the project will evaluate and present scalable solutions that will help to reduce suicide rate globally.

### 1.3.2 Objectives

The objectives of this project are as follows:

* Identify key variables responsible for increase in suicide rate through exploratory data analysis.
* Identify and quickly detect people with potential to commit suicide.

## 1.4 Research Question

Hence, it seeks to answer the following research questions:

* Have suicide rates increased over the years?
* Is there an existing pattern behind suicide?
* Male or female, who commits suicide more?
* Which age grade is suicide more prevalent?

## 1.5 Significance of the Study

Strategies and development of preventing and reducing suicide have been put in place globally. Almost all the developed nations are showing interest in financing research on suicide and implementing policies that doctors suggest. In many countries, the ministry of education has implemented a program in their curriculum to solve social problems, which significantly impacts the young generation in reducing the suicide rate in the future (Houtsma, Butterworth, and Anestis, 2018).

The importance of this research work is to identify the underlying issues and patterns behind suicide and to provide solutions that will efficiently reduce global suicide rate or eradicate it entirely.

To prevent and reduce the suicide rate is better for every country to implement a suicidal program in their curriculum. Children start to know that suicide is not the only solution to face challenges. Strategies addressing a specific high-risk group of people within the ecosystem and those who have signs of suicide potential should be exercised (Houtsma, Butterworth, and Anestis, 2018). Programs and policies are formulated and executed to groups to reduce risk factors and increase protective factors. The suicide rate has increased majorly because of social violence, which the primary root of this is financial challenges. Governments and other financial institutions that support the people's social welfare can implement policies for strengthening the economy.

The insights derived from this research is beneficial as it will help to reduce global suicide rate through early detection and help advice government bodies, health organizations on how to prevent suicide or eradicate it entirely.

## 1.6 Proposed Methodology for the Study

Firstly, the method of this research initially involved a systematic literature review and theoretical research to study other existing articles and research related to this study’s topic and formulated research questions to compare several existing suicide prevention methods, and to develop a lasting solution to tackle the issue of suicide.

To accomplish the goals of the proposed method, it is necessary to conduct in depth analysis of various suicide cases, thereby identifying the patterns behind suicide.

From the information gathered from the questions raised and analysis of the systematic literature review, additional pilot study and analysis of data set derived from world bank open data and WHO (world health organization) will be carried out.

Furthermore, data analysis techniques such as trend analysis, comparative analysis and exploratory data analysis will be employed to derive insights from the data derived from both databases mentioned above by comparing variables to determine their effect on the number of suicide.

## 1.7 Justification for the Study and Proposed Methodology

Using the proposed methodology for this project, which is based mainly on carrying out a pilot study aided with the information gathered from the analysis of the systematic literature review of the research topic and formulated questions gives insight to the underlying patterns that causes suicide, thereby making it easy to provide solutions.

Furthermore, this research helps to shed more light on the major causes of suicide, and how it can be prevented or entirely eradicated. It makes earlier detection of suicide triggers possible, thereby helping health professionals and government tackle the problem of suicide.

Knowing factors contributing to suicide will help to understand how to reduce suicide. According to (Houtsma, Butterworth, and Anestis, 2018), doctors seek new ways to identify those at risk, which will assist in addressing the problems affecting those individuals and know how they can help.

Finally, the method proposed in this study poses no known or foreseeable threat to the research participants and follows legal process to ensure that their data is protected and confidential.

# 2**.0 Pilot Study**

Firstly, the following databases were searched to perform a literature review of the research question: Science Direct, ACDM digital library, and Google Scholar.

|  |  |
| --- | --- |
| Database filter | Advanced search criteria |
| Publication | Psychological publications. Journals preferred. Conference papers accepted where applicable. |
| Topics | “Suicide”, “Suicide patterns analysis”, “Suicide and Data analysis” |

Table 2.1: Database search method

A systematic approach has been applied with the aid of journals, peer-reviewed journals, and educational websites to analyze the modern trend in suicide rate. Additionally, a strategy to gather important piece of research has been proposed to efficiently accumulate documents while considering its relevance to standards for justification.

The prisma method was employed to conduct this systematic review. Moher et al. (2009) discovered that there are chances that you can come across biased publications and the search results would not always be suited to the preference of papers. Henceforth, a prisma checklist was introduced to identify the database search to remove unnecessary journals using advanced search and filtering through a qualitative journal justification process.

**Criteria for studying literature for this review**:

1. Inclusion criteria

* There must be some predictive or measurable outcomes so they can be quantified.
* The article must be focused on data analysis and its application to suicide rate.
* The article must be focused on suicide rate.
* The article must be focused on data analysis and its application.

1. Exclusion criteria

* Articles not related to data analysis.
* Articles written in other languages except for English.
* Articles consisting only of abstracts without full text.

**Identification of studies via databases and registers**

Records removed *before screening*:

Duplicate records removed (n = 14600 )

Records identified from:

Science Direct = 273

ACM Digital Learning = 14837

n = 15110

**Identification**

Records screened

(n = 510 )

Records excluded\*\*

(n = 300 )

Reports sought for retrieval

(n = 210 )

Reports not retrieved

(n = 10)

**Screening**

Reports assessed for eligibility

(n = 200 )

Studies included in review

(n = 7)

Reports of included studies

(n = 7)

**Included**

Figure 2.1Prisma program flow chart showing stages of the systematic review.

## 2.1 Results

Results of the Database Search Method

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S/N | Database | Year | Keywords | Filters \*only English Language | Result |
| 1 | Solent university library  (ScienceDirect) | 2017-2021 | Suicide pattern analysis | Research articles | 7,885 research articles |
| 2 | Solent university library  (ScienceDirect) | 2017-2021 | Suicide | Research articles | 17501 research articles |
| 3 | Solent university library  (ACM Digital Library) | 2017-2021 | Suicide pattern analysis | Journals, research articles | 14837 journals, and research articles. |
| 4 | Solent university library  (ACM Digital Library) | 2017-2021 | Suicide | Journals, research articles | 112 journals, and research articles. |
| 5 | Google scholar | 2017-2021 | Suicide pattern analysis | Articles | 164,000 articles |
| 6 | Google scholar | 2017-2021 | Suicide, data analysis | Articles | 120,000 |

**Table 2.2: Database search for literature justification.**

### 2.1.1 Simplified Database Search

The search results shown in table 2.2 above were numerous, consisting also of journals and research articles with little or no substantial information relevant to the research question. Henceforth, the use of Boolean operators “AND” and “OR” to combine keywords help to filter the research and return journals, and articles that closely match the search input. Loong et al. (2016) justified the decision to use truncated words by using a simple asterisk \*.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S/N | Database | Year | Keywords | Filters | Result |
| 1 | Solent university library  (ScienceDirect) | 2017-2021 | Suicide, data analysis | Suicide AND data analysis | 497 |
| 2 | Solent university library  (ScienceDirect) | 2017-2021 | Suicide, data analysis | Suicide OR data analysis | 497 |
| 3 | Solent university library  (ACM Digital Library) | 2017-2021 | Suicide, data analysis | Suicide AND data analysis | 28,277 |
| 4 | Solent university library  (ACM Digital Library) | 2017-2021 | Suicide, data analysis | Suicide OR data analysis | 15,265 |

Table 2.3: Simplified filters and search string used in the academic research.

### 2.1.2 Discussion

Research by Seena et al on prison suicides in 24-high income countries in Europe, Australia and North America shows that there is no association between rates of prison suicide, any other tested prison-related factors, or differing criteria for defining suicide deaths. Meta-regression was used to test the data collected for associations with general population suicide rates, incarceration rates, and prison-related factors (overcrowding, ratio of prisoners to prison officers or health-care staffs or education staff, daily speed, turnover, and imprisonment duration). They concluded that individual level information about prisoner health is required to understand the substantial variations reported and changes over time. (Seena et al, 2017)

Additionally, a multivariate regression analysis done by louis et al on a sample of 1203 males prisoners to determine the suicidal ideation while incarcerated shows that about 23.7% of all prisoners reported past year suicidal ideation during their current incarceration which was significantly associated with both imported vulnerabilities (psychiatric diagnoses and a history of attempted suicide) and variables unique to the prison experience (lack of working activity, exposure to suicidal behavior by peers, and low levels of perceived autonomy, safety and social support). The sample was selected randomly from a flemish prison. (Louis et al, 2017)

Furthermore, a cohort study of the risk of suicide and repeat self-harm after hospital attendance for non-fatal self-harm in Sri Lanka reveals that between July 29, 2011 and May 12, 2016 about 3073 episodes of self-harm (fatal and non-fatal), where 2532(82.3%) were linked back to an individual in the baseline survey. It also shows that men have a higher risk of self-harm than women. And with aid of a survival model the estimated risk of self-harm and suicide appeared to be lower in low- and middle-income countries than in high income countries. (Duleeka et al, 2019)

Prianka et al 2019, identified six randomized controlled trials (RCTs) from four countries (Australia, Iran, United States of America, and United Kingdom) comprising 468 participants in total. The result of their studies shows that there was weak evidence of a small positive effect of interventions on suicide or self-harm outcomes. They conducted a systematic review of randomized controlled trials (RCTs) of interventions for people with substance use disorder that included suicide or self-harm-related primary outcomes. Also, a random effects meta-analysis of standardized mean differences was also conducted. (Prianka et al, 2019).

Another research to determine the changes and educational inequalities on suicide mortality among working-age men (30-64years) in the Baltic countries and Finland with respect to macroeconomics. Changes in overall suicide mortality as well as the educational level between 2000-2003, 2004-2007, 2008-2011, 2012-2015 was analyzed using the census-linked longitudinal mortality data. It was discovered that in Baltic countries, less educated men had a smaller decline in suicide mortality than more educated men. However, in Finland suicide mortality decreased among the highly educated and increased among the less educated men. (Mall et al, 2020)

Ying-Yeh et al carried out a research to illustrate the male to female suicide rate ratio and explore the correlations between female labor force participation rates (FLPR) and suicide rates of both genders. They used R to estimate the Gaussian mixed clustering model with the Bayesian Information Criteria (BIC) to determine the optimal number of clusters. Also, Pearson’s correlation was computed to determine the relationships between FLPR and gender specific suicide rates in each cluster. They discovered that the relationship between egalitarian gender norms varies according to national context. Additionally, the result of the research shows that a greater egalitarian gender norms may benefit both genders, but more for women equipped with better human capabilities. They are concerns that though the beneficial effect may reach a plateau in countries with the highest Human Development Index (HDI)/FLPR, whereas in countries with relatively lower HDI/FLPR, increased FLRP was associated with increased suicide rate. (Ying-Yeh et al, 2017).

Research by Modhurima et al to estimate the risk of suicide associated with mental disorders showed that all disorders were significant predictions of suicide with predicted adjusted relative risk ranging from 4-11 for dysthymia to 7-64 for major depressive disorder. They conducted a systematic review to review studies on mental disorders as risk factors for suicide. Also, a multi-level meta-regression approach was used to obtain pooled relative risks adjusted for covariate and between-study effects. (Modhurima et al, 2021).

### 2.1.3 Summary of sources

Firstly, insights from one of the articles analyzed for this research shows that people with psychiatric diagnosis and a history of attempted suicide are likely to commit suicide. It also shows that men have a higher risk of self-harm than women. However, the estimated risk of self-harm and suicide appears to be lower in low and middle income countries than in high income countries.

Furthermore, there is no evidence of the effectiveness of interventions to prevent suicide and reduce self-harm amongst people with substance use disorder.

Additionally, analysis from this systematic literature review shows that there is an increase suicide rate amongst the less educated.

Finally, in countries with relatively lower Human Development Index/female labour force participation, increased female labour force participation was connected to increase in the suicide rate among females.

Previous studies only considered the psychology behind suicide mortality rate while ignoring other underlying variables (income, life expectancy, etc.) responding for the global suicide rate.

## 2.2 Methodology

The purpose of this study is to determine the feasibility and method of study, efficient to determine the patterns behind suicide rate. Datasets used for this study were gotten from <https://www.kaggle.com/szamil/who-suicide-statistics>. The dataset used for this study contained records from 1979 – 2016, with data of about 141 countries. Quantitative approach was used to analyze the data derived from the dataset. Previous studies focused on the psychology behind suicide rate using meta-regression and clustering.

## 2.2.1 Research Methods

### 2.2.2 Required Data

Data required for this project includes the effect of social media on suicide rate. As previous studies have shown that people who have attempted self-harm or have had suicide ideas are likely to commit suicide. The variables available in this data are as follows:

* Country name
* Sex
* Age
* Suicide number
* Population
* Suicide rate

This age variable is useful as it helps to identify a pattern behind suicide in different age groups.

### 2.2.3 Research Instrument

Previous studies used meta-regression to test data collected for association with general population suicide rates. To carry out a similar study to determine the effects of social media on the suicide rate, data from Kaggle.com or World Health Organization will be important.

This feasibility study will focus on tech-savvy age group (i.e., people aged 15 – 24 years), while employing exploratory data analysis using python programming language in jupyter notebook.

Like previous studies, secondary data gotten from Kaggle or WHO will be used for this analysis. This feasibility study will only include quantitative analysis to ensure that useful insights can be derived from the dataset.

### 2.2.4 Variables & Samples

Like previous studies, independent variables will be country, age, population, income, GDP, education level, while dependent variables will be suicide rate, and number of suicides.

Similar data collection methods to that used in previous studies will be appropriate to acquire relevant data for analysis.

Limitations for this study is that data is only available for about 141 countries which will limit conclusion to available sample data.

## 2.2.5 Results

Chart, bar chart

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Figure 2.2 showing top 10 countries with the highest number of suicide.

We can observe that Russia has the highest number of suicides, followed by United States of America (USA). This may be attributed to the fact that Russia has a higher population than USA.

Chart, line chart

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Figure 2.3 shows the suicide trend from 1985 to 2016.

From this graph, it can be observed that the global suicide rate increased by over 20000 between 1990 and 2000. And the highest number of suicides occurred between 1998 and 2003. It is also important to note that in 2010 which coincides with the rise of social media that the suicide rate started to reduce.

## 2.2.6 Conclusion

Results from fig2.4.2 shows that in 2010, which coincides with the rise of the use of social media (i.e., Facebook, Twitter, Instagram, tiktok etc.) That the suicide rate reduced. Therefore, it can be concluded that social media has a positive impact in reducing suicide due to its ability to network and reach out to people seamlessly. Suicide prevention campaigns can also be easily conveyed to social media users as almost everyone belongs to one social media network or the other.

# **3.0 Pilot Study (connecting section)**

The pilot study was conducted to determine if the research instruments and methods will be suitable to answer the following research questions:

* Have suicide rate increased over the years?
* Which age group is suicide more prevalent?

Firstly, literature review was undertaken during the pilot study using PRISMA to perform a systematic search. Keywords and Boolean operators were used to help narrow down search terms to derive refined literature review result. The table in the pilot study section shows the search results found and reviewed for analysis.

The literature review in the pilot study shows that people who have attempted suicide in the past are likely to commit suicide, as well as those with mental health as they are more prone to self-harm.

The pilot study demonstrated the analytical methods applied on a smaller scale study can also be applied to conduct a large study. The only challenge being that the dataset used only has records for 141 countries. This is probably due to the sensitive nature of suicide as some societies due to belief tend to not disclose suicide deaths. The pilot study used exploratory data analytics techniques to derive insights from the dataset.

Results of the literature review helped refine the research question as it became evident that more studies need to be done to understand the pattern behind suicide rate with more focus on people aged between 15 – 24 years as WHO says, “Suicide is the fourth leading cause of death among 15 – 19-year-old globally in 2019”. (WHO, 2021).

According to Blaxter et al, conducting feasibility study before the main research study helps identity issues (if any) with the research as well as checking to see that the proposed methodology can be applied to carry out the research.

# **4.0 Methodology**

The purpose of this research project is to investigate the following research questions:

* Have suicide rate increased over the years?
* Which age group is suicide more prevalent?

This research project is a continuation of the pilot study (see appendix 1) but on a larger scale as it will combine other datasets.

Quantitative research method will be used for this study, collecting secondary data for statistical analysis to determine patterns behind suicide rate.

Findings from the literature review of previous studies and pilot study conducted suggests that poor mental health contributed to the increase in number of suicides committed. The following hypothesis will be used in this study:

* H1: Alcohol abuse can facilitate or cause people to commit suicides.
* H2: Availability of mental health homes can help to reduce the suicide rate.

To prepare the data for analysis, suicide number column with missing values were replaced with zero, while population column with missing values were replaced with the value of the mean population for all the available population.

This study will examine the suicide trend in 6 countries from different continents for a better understanding of factors that causes suicide on a continent-by-continent level. This approach helps to clarify the factors which may be overlooked when done globally. Another advantage of this approach is that a time series analysis will aid in identifying trends with respect to age, gender, and socioeconomic factors.

## 4.1 Method

Earlier, pilot study was conducted to determine the suitability of the research instruments and method to answer the research question. The study shows that the method and research instruments are appropriate to carry out the research and provide insights to the research question.

## 4.2 Data Collection

Just like the previous study, data collected for this research study was quantitative. One of the benefits of using a quantitative approach is that the data can be tested and checked. Additionally, it can be used for statistical analysis. Quantitative method can help to determine the degree of variation, association between variables, predict and compare differences between groups. (Chris, 2020).

Data used for this study was collected from World Health Organization & Kaggle. Previous studies collected data through survey sampling and from databases as well. Additionally, data on depression was obtained from Our World in Data which focuses on research and data to make progress against the world’s greatest problems.

Furthermore, data that was gathered during this research consists of country, sex, age-group, number of suicides, population, gdp per capita, suicides per 100k population (suicide rate), alcohol consumption, depression, and generation.

The GDP per capita is a universal measure applied to determine the prosperity of nations based on its economic growth. (Thomas, 2020). It shows how wealthy a country is.

Alcohol consumption is the total amount of alcohol consumed per capita. It is a measure of litres of pure alcohol consumed per individual aged 15+ and above.

Though previous studies limited their study to a country or group of countries and sample survey of prisoners, similar data was used to carry out their research.

The unemployment is a measure of the percentage of total labor force that is not employed or without employment. This helps to identify the number of people in a country or region of working age or can work but without work or have no job.

Clinically, depression can be defined as a low mood that lasts for days, weeks or months and affect our daily life. Depression can be caused by factors like, health problems, stress, childbirth, family history, unemployment (NHS.uk, 2019). This helps to determine the number of people in a country or region experiencing depression.

Finally, data on divorce rate was obtained from the Office of National Statistics (ONS) which is largely responsible for producing and checking all information and data produced by individual government departments and also responsible for data collection based on the general public. The data was is important because it helps to identify relationship between single, married, and divorced individual with the suicide rate. The data only contained records from 2002 -2015.

## 4.3 Data Pre-processing

Firstly, a copy of the original dataset was created for reference in case of loss of data. Afterwards, unwanted observations (i.e., duplicate, and irrelevant observations) were removed from the dataset. This was necessary to remove duplicates and irrelevant observations that do not fit the scope of the research question (elitedatascience.com, 2020).

Furthermore, the dataset was checked to determine if it had missing values. And the missing values for each column were replaced with zero.

Finally, data types were converted from strings to numeric where necessary for ease of calculation and statistical analysis.

## 4.4 Statistical Analysis.

Suicide counts and rates by gender, age group, geographic location, gdp per capita, population sizes, alcohol consumption, depression, and unemployment was used. Due to unavailability of data for some countries, which may potentially affect the presentation of the data sample, adjustments were made to only consider countries with available data for the time range of the study.

To calculate the number of suicides, the average suicide across all age group was obtained for each year. The suicide rate was calculated by dividing the number of suicides by the product of dividing one hundred thousand of the population by the total number of the population.

To determine the effect of gdp per capita, age group, alcohol consumption, depression, and unemployment on the suicide rate, statistical analysis was carried out. Bar chart was used to observe the suicide trend over the years. And scatter plot was used to examine the relationship between variables and the suicide rate.

Additionally, the average depression was obtained using a pivot table, then a scatter plot and regression analysis was carried out to determine and predict the relationship between suicide rate and depression on a global level and a country-by-country basis. The bias in this project is the selection of countries from Europe, America, Asia, and United Kingdom except for countries from Africa because data was unavailable for most African countries.

Finally, multilinear regression analysis was carried out to determine the factors that mattered most or may likely influence the suicide rate. This is important due to its ability to predict the suicide rate (dependent variable) based on the relationship with any of the independent variables

# **5.0 Result**

Table

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Table 5. 1 Demography data of the top 5 rows of the data set.

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Figure 5.1 is a bar chart showing suicide trend globally.

Firstly, we try to investigate suicide trend over the years from 1980 to 2016. This bar chart shows suicide trend from 1985 till 2016. As shown in the bar chart, we observe an increase in the number of suicides from 1989 till 2000, but there is also a noticeable decrease in the number of suicides from 2010 till 2015.

## 5.1 Relationship between Suicide Rate and Age Group

Chart, bar chart

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Figure 5.2 bar chart showing the relationship between the suicide rate and age groups.

This bar chart shows the relationship between number of suicides and age. It can be observed that the number of suicide rate is more amongst people aged between 75+ years and is closely followed by people aged 55 – 74 years. People aged between 5 – 14 years, which comprises mainly children have very low suicide rate. Chinese scholars proposed a hypothesis called, “loss theory” where aging is defined as a natural process of life that is accompanied by continuous loss, which includes health, spouse, job, social connections with relatives, friends and organizations, financial independence, and meaning in life. They suggest that “loss events” will accumulate as the elderly age, and at a certain age will trigger a psychological crisis (Li et al., 2009).

Chart, bar chart

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Figure 5.3 shows the relationship between suicide and sex (gender)

The bar chart above is a representation of the distribution of the number of suicides between male and female. From the graph, it can be observed that the ratio of suicide between male and female is 3:1. Hence, the number of men that commits suicide is 3 times more than that of women. Furthermore, it is important to note that gender roles contribute to a higher suicide rate for men. Previous studies by Kim et al suggests that some factors such as economic status or education attainment do not significantly affect female suicide rate but are very significant in male.

## 5.2 GDP per Capita and Suicide Rate on a Global Scale

Chart, scatter chart

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Figure 5.4 Line chart to measure the relationship between GDP per capita and suicide over the years.

The line chart above is a graph plotted to determine or see the effect gdp per capita has on the number of suicides. Over the years the gdp per capital has been in an upward slope as it increases on a global scale, the gdp per capita does seem to have a direct effect on the number of suicides, although some outliers does exist.

Chart

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Figure 5.5 Bar chart of top 10 countries with high suicide rate

This bar chart displays the top 10 countries with the highest suicide rate. From this graph we observe that Hungary is the country with the highest suicide rate. Interestingly, countries from the post-soviet union make up about 70% of the top 10 countries with the highest suicide rate.

## 5.3 Effect of Alcohol Consumption on Suicide Rate

Chart, line chart

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Figure 5.6 Global alcohol consumption trend from 2010 to 2013.

The line graph above shows the trend of alcohol consumption from 2010 to 2013. From the graph we observed that globally, the alcohol consumption also reduced except for 2012. Results from Chitty et al. (2018) research also suggests that 25% of suicide victims were alcohol addicts, and the probability of fatal suicidal behavior increased in people that were intoxicated, regardless of the addiction by nearly 90 times. This study suggests that alcohol can be both a causative factor and a facilitating factor for committing suicide.

## 5.4 Relationship between Unemployment and Suicide Rate

Chart, line chart

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Figure 5.7 Line chart showing trend of suicide rate and unemployment from 1985 – 2016

The line chart above shows the relationship between suicide rate and unemployment over the years from 1985 – 2016. Looking at the graph we can see that as the suicide rate increases as unemployment increases and vice versa.

Chart, scatter chart

Description automatically generated

Figure 5.8 Scatter plot of suicide rate and unemployment.

The figure above is a scatter plot of the suicide rate and unemployment from 1985 – 2016. It shows that there exists a positive correlation between suicide rate and unemployment. The result of this plot suggests that there is a relationship between suicide rate and unemployment. With a p-value of 0.009645, we can conclude that unemployment has a 96 percent chance of causing suicide. This is in accordance with results from previous studies that suggests that an increase in unemployment will lead to an increase in suicide rate especially among working-age men and women (Aaron and David, 2015).

## 5.5 Suicide Trend of the 6 Countries from the Top 20 Countries with Highest Suicide Rate

Chart, bar chart

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Figure 5.9 Bar chart showing suicide trend in Russia from 1989 – 2015.

The above figure is a bar chart showing suicide trend over the years from 1989 – 2015. This graph shows that the number of suicides increased from 1989 to 1994, with the highest number of suicides recorded around 1994. However, there was a decline in the number of suicides from 1995 to 1998 after which it increased and remained steady for 2 years from 1999 to 2001. The years after this shows a steady decline in the number of suicides.

Chart, bar chart

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Figure 5.10 Bar chart of the suicide trend in France from 1985 – 2015.

The above figure is a bar chart of the suicide trend from 1985 to 2016. This graph shows that over the years the number of suicides was declining. However, there was noticeable increase in the number of suicides in the following years: 1993, 2000, 2003, 2004 and 2011. Previous studies suggests that unemployment may be the cause for the increased suicide rate within those years in France. Additionally, Gibbis et al. suggest that the increase in suicide rate was more among the men (Fond et al., 2015).

Chart, bar chart

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Figure 5.11 Bar chart of the suicide trend in United States of America from 1985 – 2015.

The figure above is a bar chart of the suicide trend from 1985 to 2015. The graph shows a continuous increase in the number of suicides from 2000 to 2015.

Chart, bar chart

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Figure 5.12 Bar chart of the suicide trend in Japan from 1985 to 2015.

The above figure is a bar chart of the suicide trend in Japan from 1985 to 2015. The graph shows a decrease in the number of suicides from 1986 to 1991, which was followed by an increase in the number of suicides from 1991 to 1998. However, from 2009 to 2015 the graph shows that the number of suicides is declining.

Chart, bar chart

Description automatically generated

Figure 5.13 Bar chart of suicide trend in Canada from 1985 to 2015.

The above figure is a bar chart of the suicide trend in Canada from 1985 to 2015. This graph shows that the number of suicides fluctuates over the years. Though the number of suicides appear to be high, and a noticeable increase in the number of suicides can be observed from 2006 to 2014.

Chart, bar chart

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Figure 5.14 Bar chart showing the suicide trend in the United Kingdom from 1985 to 2015.

The above chart shows the trend of the number of suicides from 1985 to 2015. Observations from the chart shows that from 1988, the number of suicides declined. However, from 2008 the number of suicides increased with every passing year.

## 5.6 Suicide Rate Vs Age Group of the 6 Countries from the Top 20 Countries with Highest Suicide Rate

Chart, bar chart

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Figure 5. 15 Bar chart of suicide rate vs age group with respect to Russia.

The above chart shows the relationship between suicide rate and age group in Russia. It shows that the suicide rate increases as the age increases, with 75+ years having the highest suicide rate.

Chart, bar chart

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Figure 5.16 Bar chart of suicide rate vs age group with respect to France.

The above chart shows that suicide rate increase with age, with 75+ years accounting for the age group with the highest suicide rate. Recent studies by Observatoire National du Suicide (ONS), 2018 shows that in 2014, the suicide rate in France across all age groups was 14.9 per 100,000, while that of people aged 75 and over was 35.4 per 100,000 (Observatoire National du Suicide [ONS], 2018).

Chart, bar chart

Description automatically generated

Figure 5.17 Bar chart of suicide rate vs age group with respect to United States of America.

The above chart shows the relationship between suicide rate and age group. Like the previously analyzed countries, the suicide rate increases as the age group increases. The evolution of suicide in Europa and USA suggests that suicide prevention policies were effective in youths, but less in the elderly (Fond et al, 2016). This could be why the suicide rate among the elderly appears to be the highest.

Chart, bar chart

Description automatically generated

Figure 5.18 Bar chart of suicide rate vs age group with respect to Canada.

The above chart shows the relationship between suicide rate and age group. From this chart we can see that, unlike other countries, the suicide rate among younger people between the age groups of 35 – 54 years, 25 – 34 years and 15 – 24 years.

Previous studies estimated that in 2009 alone, there was about 100,000 years of potential life lost to Canadians under the age of 75 due to suicide (Tanya, 2012). Data from previous research shows that males committed suicide was 17.9 deaths per 100,000 compared to females 5.3 deaths per 100,000. This shows that the male suicide rate is three times the female suicide rate.

Chart, bar chart

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Figure 5.19 Bar chart of suicide rate vs age group with respect to Japan.

The above chart shows the relationship between suicide rate and age group. It can be observed that the suicide rate increases as the age increases. 75+ years age group has the highest suicide rate. Chinese scholars proposed a hypothesis called, “loss theory” where aging is defined as a natural process of life that is accompanied by continuous loss, which includes health, spouse, job, social connections with relatives, friends and organizations, financial independence, and meaning in life. They suggest that “loss events” will accumulate as the elderly age, and at a certain age will trigger a psychological crisis (Li et al., 2009). This age grade consists of the elderly.

Chart, bar chart

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Figure 5.20 Bar chart of suicide rate vs age group with respect to United Kingdom.

The above chart shows the relationship between suicide rate and age group. It can be observed that the suicide rate among younger people is high. With individuals between the following age groups 35 – 54 years, and 25 – 34 years having highest and second highest suicide rate respectively. Previous research show that depression and health related issues are responsible for the increased suicide rate among the elderly because they consider it a reasonable way to save their families the financial and psychological burdens (Wei et al., 2005).Brian et al., (2013) observed that the personality traits of suicide victims differ with respect to psychiatric disorder and age. The result supports recent report that suggests that middle-aged men, especially those from poorer socioeconomic backgrounds are at risk of suicide due to a combination of economic and social factors.

Chart, scatter chart

Description automatically generated

Figure 5.21 Scatter plot showing the relationship between gdp per capita and suicide rate in Russia

The chart shows that there is a negative correlation between suicide rate and gdp per capita. Therefore, as the gdp per capita increases, the suicide rate decreases and vice versa. The correlation coefficient of gdp per capita and suicide/100k pop is -0.205. This shows that there is a weak negative correlation. Hence, the result suggests that there may be other factors that influence suicide rate.

The dissolution of the Soviet Union engendered economic consequences (e.g., inequalities, unemployment, and privatization), which was previously unknown to the people living under the soviet rule. (Kairi et al, 2013). The result of this study is consistent with Durkheim’s theory, which suggests that unemployment and gdp per capita significantly impacted suicide rate.

Chart, scatter chart

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Figure 5.22 Scatter plot showing the relationship between gdp per capita and suicide rate in France.

The chart above displays the relationship between gdp per capita and suicide rate in France. A negative correlation exists between gdp per capita and suicide rate in France, with several outliers. The result of the correlation coefficient between gdp per capita and suicide rate is approximately -0.152, which suggests that there is a weak negative correlation between suicide rate and gdp per capita.

Previous research of 13 European OECD countries which include France, suggests that per capita real GDP has significant reducing impact on the suicide rate. The study suggests that income has a strong influence on suicide in most countries. Hence, policies aimed at economic development will help to prevent suicide. This shows that besides the gdp per capita, they are other factors that may be responsible for increasing suicide rate for example unemployment, poor health etc.

Chart, scatter chart

Description automatically generated

Figure 5.23 Scatter plot showing the relationship between gdp per capita and suicide rate in United States of America.

The chart above displays the relationship between gdp per capita and suicide rate in United States of America. Weak negative correlation exists between gdp per capita and suicide rate. This result bears similarity with that of countries previously examined within this research. The correlation coefficient between suicide rate and gdp per capita is approximately -0.0611. This suggests that there is no relationship between suicide rate and gdp per capita. Previous study shows that the association of business cycles with suicide among certain age groups may indicate that economic hardships are a precipitating factor for some individuals who likely have other existing risk factors (Feijun et al, 2011).

Chart, scatter chart

Description automatically generated

Figure 5.24 Scatter plot showing the relationship between gdp per capita and suicide rate in Canada.

The chart above displays the relationship between gdp per capita and suicide rate in Canada. There is a weak correlation between suicide rate and gdp per capita as shown in the chart. The correlation coefficient of suicide rate and gdp per capita is approximately -0.128 which suggests that the relationship between suicide rate and gdp per capita is weak. However, previous studies in Canada show that rises in suicide rate among young people have occurred in parallel with other signals of deteriorating youth mental health, including rises in self-reported depression symptoms, suicide attempts and hospital admissions for self-harm (Mitchell et al, 2018)

Lynch et al., 2001 suggests that evidence regarding the association between income inequality and suicide rates is mixed. Further analysis using a multi-country analysis reveals a likely association between lower levels of income inequality and increased suicide rates.

Chart, scatter chart

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Figure 5.25 Scatter plot showing the relationship between gdp per capita and suicide rate in Japan.

The chart above displays the relationship between the gdp per capita and suicide rate in Japan. There is a strong negative correlation between gdp per capita and suicide rate as seen on the chart. Using pearson’s method the correlation coefficient between suicide rate and gdp per capita was obtained as approximately -0.530. This suggests that gdp per capita may likely influence suicide rate.

Chart, scatter chart

Description automatically generated

Figure 5.26 Scatter plot showing the relationship between gdp per capita and suicide rate in United Kingdom.

The above chart displays the relationship between suicide rate and gdp per capita in the United Kingdom. Results from the chart shows that there is a perfect negative correlation between gdp per capita and suicide rate in the United Kingdom with several outliers. Using pearson’s method the correlation coefficient between suicide rate and gdp per capita was obtained as approximately -0.889. This suggests that suicide rate may be influenced by the suicide rate.

## 5.7 Relationship between Depression and Suicide Rate

Chart, scatter chart

Description automatically generated

Figure 5.27 Scatter plot of average depression (%) and average suicide rate from year 2000 – 2016.

The chart above displays the relationship between depression and suicide rate from year 2000 – 2016 using a scatter plot. A 3-order polynomial regression is used to measure the relationship between both variables. The result shows that there is a nonlinear relationship between depression and the average suicide rate. Additionally, previous studies suggest that depression is one the most prevailing causes of suicide, which could be a result of being unemployed, low income, health issues and loneliness. Previous studies on persons with depression shows that among men, there was an interaction between other analgesics and antipyretics (e.g., acetaminophen), hypnotics and sedatives, and previous poisonings associated with a high risk of suicide.

A screenshot of a computer

Description automatically generated with low confidence

Table 5.2: Multiple linear regression of suicide rate using average unemployment, average gdp per capita and average depression (%).

The R Square of 0.84 shows that 84% of the data can be explained by this model. And about 26 observations which is the number of data used to research. Using multiple linear regression shows that there is a 95.7 percent relationship between suicide rate and unemployment, as well as a 97.8 percent relationship suicide rate and depression. Furthermore, depression does appear to be significant because of its relationship with unemployment and low income (especially in countries where the gdp per capita is low). Research by Bostwick and Pankratz, 2000; Ribeiro et al. 2018, suggests that depression has strong association with suicide.

Previous studies suggests that the suicide rate among persons with depression is almost 20 times the suicide rate in the general population (Ferrari et al., 2013). The p-value .479 of gdp per capita suggests that it is not significant or a direct cause of suicide.

Additionally, previous studies suggest that depression is one the most prevailing causes of suicide, which could be a result of being unemployed, low income, health issues and loneliness.

Chart, scatter chart

Description automatically generated

Figure 5.28 Scatter plot showing the relationship between depression and suicide rate in Russia.

The chart above is a 3-order polynomial regression to determine the relationship between depression and suicide rate in Russia. The result of this chart shows that there is a nonlinear relationship between suicide rate and depression. The correlation coefficient of 0.96 suggests that there is a strong positive relationship between depression and the suicide rate.

Chart, scatter chart

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Figure 5.29 Scatter plot showing the relationship between depression and suicide rate.

The chart above shows that there is a nonlinear relationship between depression and suicide rate. A 3-order polynomial regression was used to identify the line of best fit. The outliers suggests that they may be other factors responsible for suicide other than depression. Additionally, the correlation coefficient of 0.80 suggests that there is a strong positive correlation between suicide rate and depression.

Chart, scatter chart

Description automatically generated

Figure 5.30 Scatter plot of suicide rate against depression in the United States of America.

The chart above is a graph of depression against suicide rate to determine the relationship between them. The result suggests that there is no linear relationship between suicide rate and depression in the United States of America. However, the correlation coefficient of -0.69 shows that there is a negative correlation between depression and suicide rate.

Chart, scatter chart

Description automatically generated

Figure 5.31 Scatter plot of depression against suicide rate in Canada.

The chart above is a graph of depression against suicide rate to determine the relationship between suicide rate and depression. The result suggests there is a nonlinear relationship between depression and suicide rate. Hence, a 3-order polynomial regression was used to draw the line of best fit. Additionally, the correlation coefficient of 0.86 shows that there is a strong positive correlation between depression and suicide rate in Canada.

Chart, scatter chart

Description automatically generated

Figure 5.32 Scatter plot showing the relationship between depression and suicide rate in the United Kingdom.

The chart above shows the relationship between depression and suicide rate in the United Kingdom. The result suggests that there is a nonlinear relationship between suicide rate and depression. However, a 2-period moving average is used to derive the line of best fit. Additionally, the correlation coefficient of -0.34 shows that there is a weak correlation between depression and suicide rate in the United Kingdom.

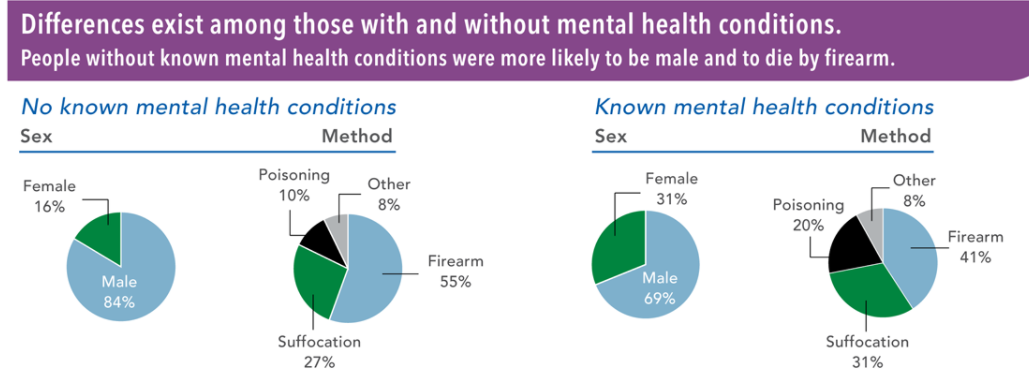


Figure 5.33 Difference in means of suicide by those with mental and no-mental issues in 2015, United States of America. (Source: cdc.gov, 2018:online)

Previous research by CDC, 2018 shows that 84% of male and 16% of female had no known metal health conditions, with firearm (55%) being the most used method of suicide. On the other hand, about 31% and 69% of females and males respectively committed suicide mostly by using firearm

## 5.8 Effect of Divorce on Suicide Rate using cases in United Kingdom as case study

Chart, bar chart

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Figure 5.34 Bar chart showing the trend of suicide rate over the years among single, divorced, and married people.

The chart above is a graphical representation of the trend of suicide rate from 2002 – 2015 among single, divorced, and married people. The result of the chart shows that the divorced individuals have the highest suicide rate, with a suicide rate 2 times that of single people. However, a correlation coefficient of -0.2046 shows that there is a weak negative correlation between suicide rate and divorce, which suggests that other factors like depression for example, may be responsible for divorce. Furthermore, recent study of divorce and depression shows that people with diagnosable depressive episodes after divorce were already experiencing depression before the divorce (David and James, 2016).

Research shows that compared with married individuals, separated or divorced individuals have higher levels of psychological distress and psychiatric symptoms (Mark et al., 2021). Additionally, previous studies have shown that divorce is associated with greater psychological distress.

Chart, bar chart

Description automatically generated

Figure 5.35 Bar chart showing the trend of suicide rate between divorced male and divorced female.

The chart above shows the relationship of the suicide rate between divorced men and divorced women. The suicide rate among divorced male is about 3 times that of divorced female, except for 2015 where the divorced female suicide rate is slightly more than that of the divorced male suicide rate.

# **6.0 Discussion**

The demographic analysis of the survey from the population contained in the data set is shown in table 5.1. The age group of people contained in the data set are as follows: 5 – 14 years, 15 – 24 years, 25 – 34 years, 35 – 54 years, 55 – 74 years, and 75+ years. The data set used for this research consisted of 141 unique countries, with values for years ranging from 1979 till 2016.

Results from figure 5.1 shows that globally the number of suicides increased from 1989 - 2000, followed by a decrease from 2010 to 2015. It is a similar result to the pilot study.

Recent studies shows that the absolute number of suicide deaths increased by 6.7% annually between 1990 and 2016. Additionally, due to the secretive nature of suicide, it may be unrecognized, misclassified or deliberately hidden in official records of death. (en.wikipedia.org, 2021). This supports our findings except that from 2010, the number of suicide deaths reduced by 2.1% the following year.

Figure 5.9 shows the trend of suicide in Russia over the years from 1989 to 2016. The result shows that over the years the number of suicides has been on a steady decline from 2001 to 2015 by an average of 4.4%.

The chart in figure 5.10 shows the suicide trend in France from 1985 to 2016. While the number of suicides increased in some years, the result shows that the number of suicides declined significantly from 1993 to 1999, and 2012 to 2015.

The chart in fig 5.11 shows the trend of suicide in the United States of America. The result shows a 3% increase in the number of suicides over the years from 2001 to 2015.

Figure 5.12 shows the suicide trend in Japan from 1985 to 2015. This chart shows that both 1998 and 2003 had the highest number of suicides. The chart suggests that the number of suicides increased by 20.6% in 1998. However, a significant decline in the number of suicides can be observed from 2010 to 2015.

Figure 5.13 shows the suicide trend in Canada from 1985 to 2015. When compared to the charts in figures 5.9, 5.10, and 5.11 we observe that the number of suicides is lower. However, the number of suicides is relatively high and fluctuates over the years.

Fig 5.14 shows the suicide trend in the United Kingdom from 1985 to 2015. Despite having a lower number of suicide when compared to other countries like Russia and Japan in the top 10 countries with the highest number of suicide rate, it can still be observed that the number of suicides started increasing from 2008.

Figure 5.2 shows the relationship between the number of suicide deaths and age group. From this graph, we observe that the suicide rate increases as the age group increases. The result shows that people aged between 75+ years and 55 – 74 years have the highest suicide rate.

Figure 5.15 shows the relationship between suicide rate and age groups in Russia. The chart shows that individuals within 75+ years and 35 - 54 years have the highest and second highest suicide rate respectively. The male suicide rate for 75+ years is approximately 85 per 100,000 population compared to the female suicide rate of approximately 25.5 per 100,000 population. However, the suicide rate among the age group 25 – 34 years is almost as high as that of individuals within the age group of 55 – 74 years. This result suggests that suicide rate is high among the working-class male and elderly male.

Previous studies show that 43% of all-cause premature mortality among working-age Russian men was attributed to hazardous alcohol consumption. This has contributed to the swing in life expectancy over the last 30 years in Russia (Leon et al, 2007). The result was obtained using a population-based study. Russia’s social, cultural, and political context play a role in its long history of alcohol consumption.

Furthermore, findings from the study shows that working-age Russian men who drank 20+ liters of pure ethanol (i.e., approximately 67 750-ml bottles of vodka or 1000 pints of beer) in the prior year were 12.7 times more likely to die from suicide. Additionally, men who drank non-beverage alcohol at least once a week were 7.3 times more likely to die from suicide than men who rarely or never drank.

Figure 5.16 shows the relationship between suicide rate and age groups in France. The chart shows that the suicide rate increases with age as can be seen by individuals within the 75+ year age group. Additionally, the male suicide rate within this age group is 85 per 100,000 population compared to the female suicide rate of approximately 19.9 per 100,000 population. The male suicide rate is about 4times that of the female suicide rate.

Studies suggest that the cause of the increased suicide rate among the elderly could be related to health issues, depression, and loss of a partner, loneliness, and isolation.

The chart in figure 5.17 shows the relationship between suicide rate and age groups in the United States of America (USA). The result shows that suicide rate increases as the age increases. Hence, individuals within the 75+ years have the highest suicide rate, with the male suicide rate at approximately 44 per 100,000 population, compared to the female suicide rate of 4 per 100,000 population. This shows that male suicide rate among individuals age 75+ is 11 times that of the female suicide rate.

The evolution of suicide in Europa and USA suggests that suicide prevention policies were effective in youths, but less in the elderly (Fond et al, 2016). This could be why the suicide rate among the elderly appears to be the highest.

Firstly, the chart in figure 5.18 shows that the suicide rate in Canada is not as high as that of countries like France, Russia, and the USA. However, we observe that 35 – 54years (working age) male has the highest suicide rate, while 75+ years has the second highest suicide rate. The increase in the suicide rate among working age men could be due to unemployment, depression, loneliness and mental health issues. As young people get older (working age), there is more pressure to deliver results and become independent. Not so many young individuals are prepared for this phase of life. And when they are not able to meet up, they may likely fall into depression which in turn may lead to suicide. The male suicide rate of individuals aged 35 – 54 is 27 per 100,000 population, compared to the female suicide rate of 8 per 100,000 population.

In contrast to the suicide trends in other countries where the rate of suicide tends to increase with age, the persistent trend in Canada shows that persons aged 40 to 59 have the highest suicide rates. Research shows that forty-five percent of all suicides in 2009 (1,769 out of a total of 3,890) were in the age group of 40 to 59, compared to 35% for those aged 15 to 39, and 19% for those 60 and above. (Tanya, 2012)

Previous studies estimated that in 2009 alone, there was about 100,000 years of potential life lost to Canadians under the age of 75 due to suicide (Tanya, 2012). Data from previous research shows that males committed suicide was 17.9 deaths per 100,000 compared to females 5.3 deaths per 100,000. This shows that the male suicide rate is three times the female suicide rate.

The chart in figure 5.19 shows the relationship between the suicide rate and age group with respect to Japan. We observe that the suicide rate increases with age. The result shows that individuals aged 75+ have the highest suicide rate. Within this age group, the male suicide rate 53 per 100,000 population, compared to the female suicide rate of 32 per 100,000 population. The male suicide rate is approximately two times the female suicide rate.

Chinese scholars proposed a hypothesis called, “loss theory” where aging is defined as a natural process of life that is accompanied by continuous loss, which includes health, spouse, job, social connections with relatives, friends and organizations, financial independence, and meaning in life. They suggest that “loss events” will accumulate as the elderly age, and at a certain age will trigger a psychological crisis (Li et al., 2009). This age grade consists of the elderly. Previous studies shows that although there is a decrease in suicide rate in some countries like England and Wales, it tends to increase with age. Additionally, they observed that suicide rates in the old-old (people older than 80 years) was higher than in the young old (people aged between 65 – 79 years) (Kim et-al, 2020). Previous research show that depression and health related issues are responsible for the increased suicide rate among the elderly because they consider it a reasonable way to save their families the financial and psychological burdens (Wei et al., 2005).

The chart in figure 5.20 shows the relationship between suicide rate and age groups in the United Kingdom (UK). This chart shows that individuals aged 35 – 54 have the highest suicide rate (17 per 100,000 population), followed by individuals aged 25 – 34 (15.5 per 100,000 population). Additionally, the male suicide rate is about three times that of the female suicide rate. Brian et al., (2013) observed that the personality traits of suicide victims differ with respect to psychiatric disorder and age. The result supports recent report that suggests that middle-aged men, especially those from poorer socioeconomic backgrounds are at risk of suicide due to a combination of economic and social factors. For example, rising female employment and greater solo living, which have impact on men who are in their mid-life (Bruce and Jie, 2016).

Figure 5.3 shows the relationship between suicide and gender. Firstly, the graph shows that men commit suicide more than women at a ratio of 3:1. Previous studies by Kim et al suggests that some factors such as economic status or education attainment do not significantly affect female suicide rate but are very significant in male. Furthermore, it is important to note that gender roles contribute to a higher suicide rate for men. This is because men participate in war and economic activities, while women focus on domestic chores and activities to earn a living for the family. In coming years, there is a likelihood that suicide rates among women will increase because of their desire for equality (feminism), which encourages women to take up roles and positions well suited to men. This drastic change may likely engender increased suicide rate among women especially due to job loss or unemployment. Previous studies show that in 1991, during the civil war in Sri Lanka, the suicide rates increased (higher than any other country). Additionally, Desjarlais et al. also supports that violence and social upheaval have a direct impact on suicide rate as it tends to increase during conflict and war. Pinguet research also supports the notion that suicide rate increases in times of war and conflict as was observed during the Second World War in Japan (Corey and Gouhua, 2005).

Figure 5.4 shows the relationship between gdp per capita and suicide rate on a global scale. GDP per capita is a measure of a country’s economic output per person, calculated by dividing the country’s GDP by the population (the Investopedia team, 2020). From the scatterplot there exist a negative correlation between gdp per capita and suicide rate. Therefore, a decrease in GDP per capita will result to an increase in suicide rate and vice versa.

Hence a study of some countries from different continents with the highest suicide rate will be needed to further analyze the relationship between suicide rate and GDP per capita.

Figure 5.5 shows the top 10 countries with the highest suicide rate. About 70% of the countries that makeup this list is post-Soviet Union countries. Makinen (2000) suggested that suicides may be hidden under the category of undetermined intention of death.

The scatter plot in figure 5.21 shows the correlation between suicide rate and gdp per capita in Russia. The chart shows that there is a negative correlation between suicide rate and gdp per capita. Therefore, as the gdp per capita increases, the suicide rate decreases and vice versa. Additionally, Varnik et al. (2010) revealed that from 1990 to 1995 male deaths due to undetermined causes in the Baltic and Slavic republic of the former Soviet Union increased with high proportion. It was suggested that the primary cause of this increase was due to the way that deaths were classified before the dissolution of the former Soviet Union. (Varnik et al, 2010).

The dissolution of the Soviet Union engendered economic consequences (e.g., inequalities, unemployment, and privatization), which was previously unknown to the people living under the soviet rule. (Kairi et al, 2013). The result of this study is consistent with Durkheim’s theory, which suggests that unemployment and gdp per capita significantly impacted suicide rate.

Becker (1964) proposed an economic approach to mortality to determine the economic changes that induce individuals to alter their behavior in ways that influence their health. This theory states that an individual’s decision to invest in health is affected by income, the cost of health inputs, the return to investment in human capital, and the time horizon over which one can expect to recoup the investment. Using this framework, Hamermesh and Soss (1974) formulated an economic model of suicide that models the individual as a rational, optimizing agent who takes his own life when the total discounted life utility remaining to him reaches zero. For an individual with permanent income γ, the present value of lifetime expected utility at age a is expressed as:

Z(a,Y) = ꭍꝺwe-r(m-a)UmP(m)dm

Where w is the highest attainable age, r is the individual’s discount rate, and P(m) is the probability of surviving to age m, given that one has reached age a. Utility, Um depends on consumption which in turn is a function of age and income. The theory predicts that suicide rates increase with age and decrease with income (Elizabeth, 2001)

Further research shows that in contrast to high suicide rate in low-and middle-income countries, the suicide rate is lower in high income countries. Due to the negative correlation that exist between gdp per capita and the suicide rate, it can be suggested that suicide rate increases in time of economic meltdown. (Hilario et al)

The scatter plot in figure 5.22 shows the relationship between gdp per capita and suicide rate in France. A negative correlation exists between gdp per capita and suicide rate in France, with several outliers. This shows that besides the gdp per capita, they are other factors that may be responsible for increasing suicide rate for example unemployment, poor health etc.

Previous research of 13 European OECD countries which include France, suggests that per capita real GDP has significant reducing impact on the suicide rate. The study suggests that income has a strong influence on suicide in most countries. Hence, policies aimed at economic development will help to prevent suicide. The results of their findings were achieved using autoregressive distributed lag to cointegration as their estimation methodology.

The chart in figure 5.23 shows the relationship between gdp per capita and the suicide rate in USA. A negative correlation exists between gdp per capita and suicide rate. This result bears similarity with that of countries previously examined within this research.

Previous study shows that the association of business cycles with suicide among certain age groups may indicate that economic hardships are a precipitating factor for some individuals who likely have other existing risk factors (Feijun et al, 2011).

Furthermore, the chart in fig 5.24 show that there is no correlation between suicide rate and the gdp per capita with respect to Canada. However, previous studies in Canada show that rises in suicide rate among young people have occurred in parallel with other signals of deteriorating youth mental health, including rises in self-reported depression symptoms, suicide attempts and hospital admissions for self-harm (Mitchell et al, 2018)

Lynch et al., 2001 suggests that evidence regarding the association between income inequality and suicide rates is mixed. Further analysis using a multi-country analysis reveals a likely association between lower levels of income inequality and increased suicide rates.

Additionally, evidence from previous studies show that countries with higher gdp per capita in 2008 experienced rises in suicide. Therefore, it suggests that high levels of income inequality in rich countries contribute to the rises in suicide rates (Prianka et al., 2020).

Figure 5.25 is a scatter plot that shows the relationship between gdp per capita and suicide rate in Japan. The result from the chart shows that there is a weak negative correlation between gdp per capita and suicide rate. However, previous studies observed that economic crisis was associated with 10,400 more suicides in Japan, Hong Kong, and Korea. It was observed that the economic crisis had a huge impact on the gdp per capita and unemployment in Japan. Additionally, a time series analysis show that some of the crisis’ impact on male suicides is attributable to rise in unemployment. Findings suggest that rises in unemployment may have an impact on the suicide rate (Shu-Sen et al, 2009).

Fig 5.6 shows that alcohol consumption reduced from 2010 to 2013 except for 2012 where the alcohol consumption increased. Comparing this result with that in figure 5.1, we will observe that suicide rate also reduced from 2010 to 2013. From this result we can suggest that a decrease in alcohol consumption leads to a decrease in the suicide rate and vice versa.

Borges (2016) suggested that alcohol consumption increase the risk of suicide attempt by up to 90 times compared to abstinence. Previous research proposed that alcohol involvement ranges from 10% to 69%. (Cherpitel et al, 2004). Using a time series analysis Pridemore and Chamlin (2006) identified a positive association between alcohol related mortality and suicide in Russia between 1956 and 2002. Yury (2011) suggested the existence of close aggregate level association between alcohol consumption and suicide in Russia. Discoveries from his study suggests that a restrictive alcohol policy can be an effective intervention for lowering or preventing suicide in countries where both alcohol consumption and suicide rate is high.

Furthermore, research by Kairi et al. (2006) concluded alcohol abuse and dependence was statistically a significant predictor of completed suicide, while abstinence was a significant predictor for female suicide. They discovered that alcohol abuse and dependence was diagnosed in 68% of male and 29% of female suicides. Their research was carried out by diagnosing alcohol abuse and dependence through interviews with relatives of people who committed suicide. Results from Chitty et al. (2018) research also suggests that 25% of suicide victims were alcohol addicts, and the probability of fatal suicidal behavior increased in people that were intoxicated, regardless of the addiction by nearly 90 times. This study suggests that alcohol can be both a causative factor and a facilitating factor for committing suicide. Also research conducted by Dorota et al. (2020) on alcohol intoxication and suicide by hanging in Poland using a retrospective analysis showed that alcohol is an important suicidal risk factor. Additionally, they discovered that young people mostly (mostly men) were more affected. However, Malone et al., 1994 (cited in Hatice et al., 2003) suggests that people with a history of suicidal act have a higher probability of suicide compared to those without such a history.

Figure 5.7 is a line chart of unemployment and suicide rate. The chart shows that as the unemployment increases the suicide rate also increases and vice versa. This is in accordance with results from previous studies that suggests that an increase in unemployment will lead to an increase in suicide rate especially among working-age men and women (Aaron and David, 2015). An explanation for this is that unemployment increases financial strain which could potentially lead to depression, and finally suicide. However, Durkheim, 1970 suggested that the relationship between economic shocks and suicidality is a status effect. Also, previous research suggests that female labor force participation could create some incongruity between female norms and behavior, which can subsequently increase the suicide rate (Aaron, David, 2015). However, previous research of whether unemployment increases the suicide rates shows that unemployment is not necessarily associated with higher suicide rates because of economic downturns that occur over time and space. Additionally, a detailed study of the relationship between suicide and unemployment in Scotland showed that it was inconsistent. Hence, Platt concluded that the nature of the relationship between unemployment and suicide remains problematic (Platt, 1984). Apparently, this is because research has shown that higher income is associated with higher suicide rates (Yong, 2009). Unlike previous research, Ja et al., (2014) research on the relationship between unemployment and suicide attempt rates in Andalusia shows that unemployment is strongly related to the increase in suicide attempts in men during the first years of economic crisis in southern Spain.

In 2009, research was carried out to determine the effect of economic recession of 2008 on suicide rate. The research shows that there was an increase in suicide rate after the 2008 global economic recession. Results from the analysis of the 2008 global economic recession shows that there were important differences in men and women and the age pattern in different groups of country. (theBMJ.com, 2013).

Previous studies showed that an increased prevalence of depression or anxiety after the economic crisis in Hong Kong, South Australia, Greece, England, and Spain. The mental health of the unemployed people was observed to have deteriorated.

Furthermore, the great depression in the 1930, the Russian crisis in the early 1990s, also support the findings that recession led to and increased in the suicide rate.

Additionally, previous studies of the risks of depression in Spain, and the UK supports the observation that men have greater mental health risks in the context of economic recession (BMJ, 2013)

As shown in the chart in figure 5.27, the scatter plot shows that there is a nonlinear relationship between suicide rate and depression.

The R Square of 0.86 shows that 86% of the data can be explained by this model (i.e. from table 5.2). And about 17 observations which is the number data used to research. Using multiple linear regression shows that there is a 95.7 percent relationship between suicide rate and unemployment, as well as a 97.8 percent relationship between suicide rate and depression. Furthermore, depression does appear to be significant because of its relationship with unemployment and low income (especially in countries where the gdp per capita is low), health issues, childbirth, loneliness etc. The p-value .479 of gdp per capita suggests that it is not significant or a direct cause of suicide.

Additionally, previous studies suggest that depression is one the most prevailing causes of suicide, which could be a result of being unemployed, low income, health issues and loneliness.

Research by Bostwick and Pankratz, 2000; Ribeiro et al. 2018, suggests that depression has strong association with suicide.

Previous studies suggests that the suicide rate among persons with depression is almost 20 times the suicide rate in the general population (Ferrari et al., 2013). Minkoff et al., 1973 proposed that people living with depression may view their situation as hopeless to the extent that suicide becomes the only solution. Previous studies on persons with depression shows that among men, there was an interaction between other analgesics and antipyretics (e.g., acetaminophen), hypnotics and sedatives, and previous poisonings associated with a high risk of suicide. However, in the absence of these psychiatric factors like hypnotics and sedatives and previous poisonings. The anti-inflammatory medications were not associated with high risk of suicide (Tammy et al., 2021). Whereas in women, state pension was identified as the most important predictor, which reflect the social isolation connected with late adulthood (due to widowhood, diminished social ties and obligations, declining health, and ending career) that may bring about suicide risk (Durkheim,1897; Girrad, 1993).

Previous research by Mullakey et al. 2019, suggests a strong connection between loneliness and sadness with depression among adolescents. Steinberg and Morris, 2001 suggested that during adolescence people become more reliant on their self and peers and less reliant on their parent. Using network analysis, loneliness is observed to be a major cause of depression among adolescents. (Mandy et al., 2021)

Research shows that suicide ideation was directly related to symptoms of adolescent depression (i.e., loneliness, sadness, pessimism, family, self-hatred, and self-blame). Further research by Stickley and Koyanagi, 2016 shows that loneliness is directly linked to suicide even when controlling for depression. As shown through observations from research, those who think about suicide often fell very lonely. Hence social connection should be a focus for suicide prevention efforts, as well as depression prevention efforts. Previous research shows that being around people they (adolescents) rate positively can help those who feel lonely (Van Roekel et al., 2014).

The result from the chart in figure 5.34 shows that the suicide rate of divorced people is twice that of married people. However, the weak negative correlation that exist between suicide rate and divorced individual suggests that other factors may be responsible for the increased suicide rate among divorced people. For example, divorce sometimes leave people with a feeling of sadness, loneliness, worthlessness, and depression which are key factors that can lead to suicide ideation and afterwards suicide.

Further analysis shows that the divorced male suicide rate is about three times that of the divorced female suicide rate, except for 2015 where the divorced female suicide rate was slightly more than the divorced male suicide rate. This could be due to the fact that men are less open about their struggles. Hence, have less support than women while undergoing divorce, unlike women that are more open to sharing their struggles and get support from family and friends. Research shows that compared with married individuals, separated or divorced individuals have higher levels of psychological distress and psychiatric symptoms (Mark et al., 2021). Additionally, previous studies have shown that divorce is associated with greater psychological distress. Furthermore, recent study of divorce and depression shows that people with diagnosable depressive episodes after divorce were already experiencing depression before the divorce (David and James, 2016). Therefore, divorce may be considered as a factor that engenders depression which can lead to suicide without proper support.

# **7.0 Conclusion**

The dataset gathered for this research was sufficient to carry out a quantitative analysis. To use the dataset, a copy of the original dataset was first created to avoid loss of data during analysis. The secondary data obtained from the dataset was not as good as expected due to incomplete data, only 141 countries had missing values which was later replaced with zero. This missing values have an effect on the randomness of the data. Additionally, other limitations that could have affected the study is the time frame for which this data was collected.

Therefore, the results of this study should be viewed within the limitation of this study.

This study shows that globally, the suicide rate of young adult of working age has increased over the years. Additionally, this study shows that globally, the male suicide rate is 3 times more than that of the female suicide rate. However, the suicide rate among female also appears to be increasing, which can be attributed to the change brought about by gender roles and women participating in the labor force.

Furthermore, findings from the study of the relationship between divorced individuals, married individuals and suicide rate in the United Kingdom suggests that the suicide rate among divorced individuals is twice that of single and married individuals.

The data suggests that there is a relationship between suicide rate, depression, unemployment, loneliness, and alcohol abuse. Using multiple linear regression, a 95.7 percent relationship was observed between suicide rate and unemployment, while a 97.8 percent relationship was observed between suicide rate and depression.

Hence, the data suggests hypothesis [H1], that alcohol can be both a causative and a facilitator of suicide. The second hypothesis [H2], that the availability of mental homes can help reduce the number of suicides by providing care and support to mentally ill and depressed people.

To advance this study, improvements on the data should be made to include countries from Africa for detailed analysis to gain a better insight on how suicide rate can be reduced. Additional research should be done to determine the difference between the suicide rate for the suicide risk and non-suicide risk individual who visit a mental home.

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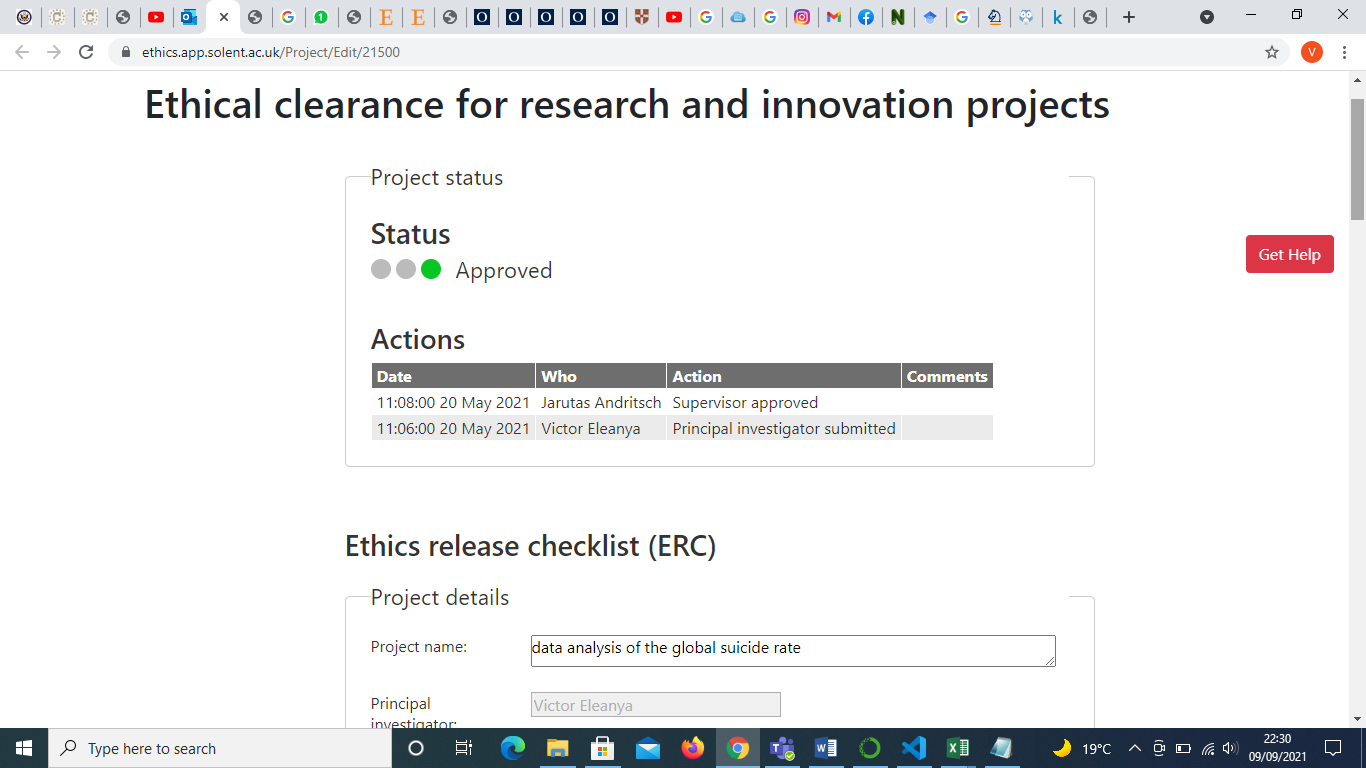
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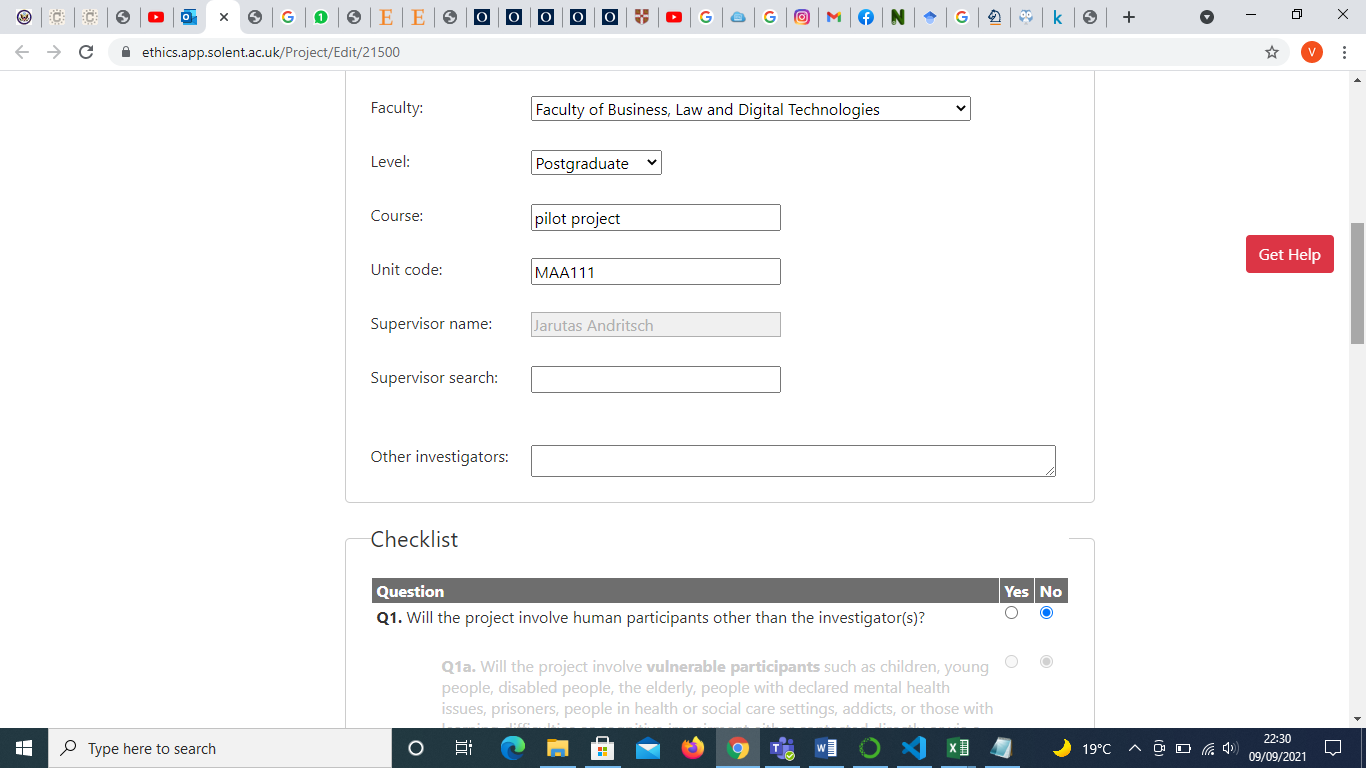
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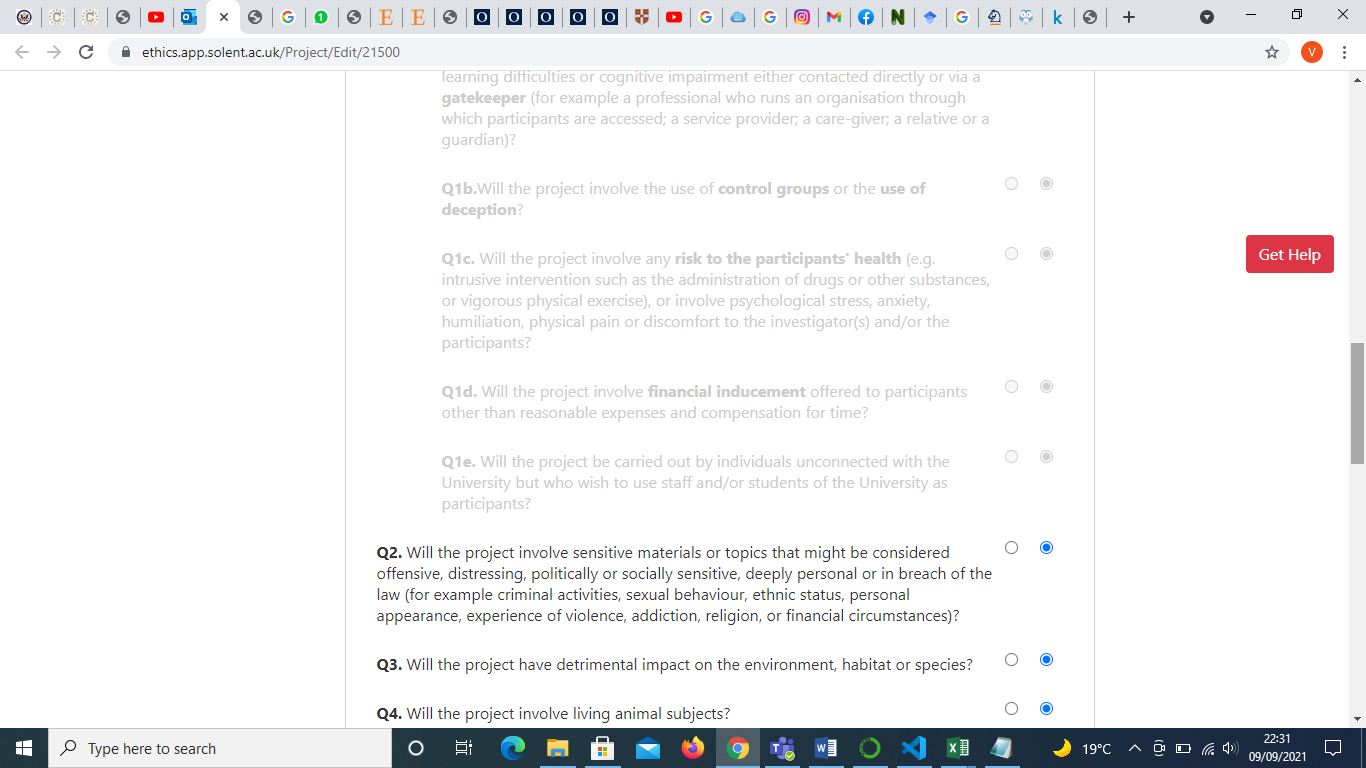
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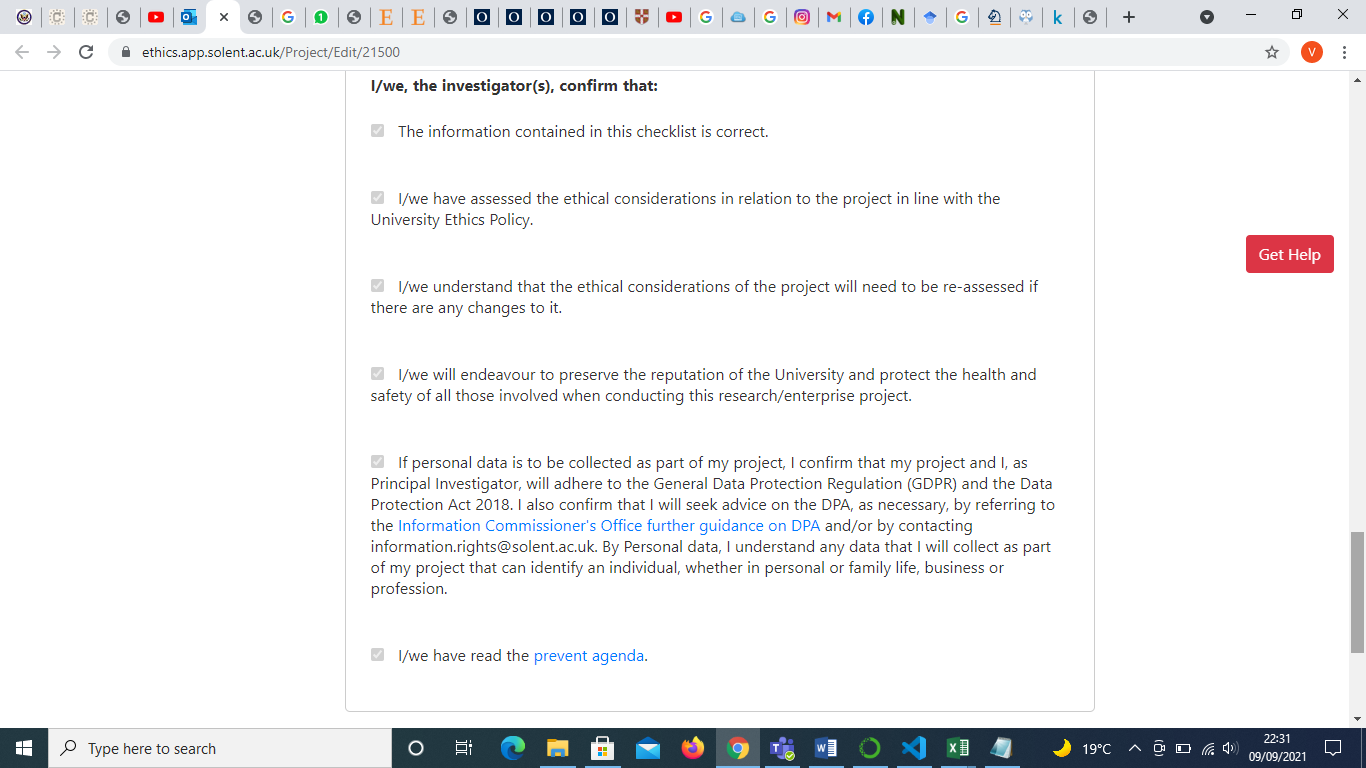
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# **Appendix**

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