**Deaths of Despair: A comparison of suicides per 100,000 amongst age groups based on Kaggle suicide data (1985 – 2016)**

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| **Assignment submission for 7COM1079 -** [**Team Research and Development Project**](https://herts.instructure.com/courses/76820) **by GROUP 49** | | |
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**Abstract**

Stories about suicide that appear in the news tend to focus on celebrities who have taken their own lives and on clusters of deaths among students. They miss the bigger picture: that, at a global level, suicides have declined by just 8% since its peak in 2009 (139211 suicides in absolute terms) almost returning to its previous low 127156 suicides of in 2006, for our dataset.

**Objective**

This study aims to assess if there is a difference in the proportion of suicides per 100,000 amongst age groups.

**Method**

Data from Kaggle [1] was examined using R programming language to create visualizations and understand the suicides per 100,000 amongst age groups and genders. Plots were created to further aid in examining the suicides per 100,000 trends over demographics.

We further used chi-square test to further answer our hypothesis.

**Results**

Nearly 129776 people took their own lives in 2015 up 27 percentage points from 1985, and suicide is an important part of the rising number of “deaths of despair” described by Anne Case and Angus Deaton, economists [2]. This cause of death has increased the overall mortality rate amongst males over females. Both absolute levels of suicide per 100,000 people and recent increases are particularly high amongst those aged 75 years and over. The male suicide rate remains almost four times that for women.

**Implications**

On average suicide rate per 100k increases with age (section 4.1.3) and the suicide rate per 100k in men is 3 times higher than those in women (section 4.1.4). We further examined the suicide rate per 100k across both genders and age groups and notice that there is evidence to reject the null hypothesis.

**Research Question**

Is there a difference in proportion of suicide rate per 100k amongst the age groups?

# **PROJECT OVERVIEW**

# Key Insights:

* Suicide rates per 100k are decreasing globally to an average of 11.23 (section 2.1)
* The suicide rate per 100k in men is 3 times higher than women
* Globally suicide rate per 100k increases with age
* Children in 5 -14 age group contribute to about 1% of all suicides across all age groups
* Suicide rate per 100k remains high in 75 and over age group for every year in the record set

# Introduction:

Suicide regularly gets from profound sensations of sadness. Casualties ordinarily have the powerlessness to see answers for issues or to adapt to testing life conditions which at that point drives them to consider suicide to be the lone arrangement. As indicated by the World Health Organization Suicide is a significant medical condition worldwide and is a main source of death. More than 800,000 individuals die consistently from suicides which are assessed to be at the pace of one individual like clockwork. However, suicide is preventable when ideal, powerful intercessions are actualized at public, civil, and individual levels. With regards to a nation's pay level, suicide does not simply happen in major league salary nations, however, it is a worldwide marvel in all locales of the world.

This research will be focused on answer our research question - Is there a difference in the proportion of suicide rate/100k amongst the age groups with supporting hypothesis as:

H0: There is no difference in the proportion of suicide rate/100k amongst age groups.

H1: There is a difference in the proportion of suicide rate/100k amongst age groups.

# Data:

The information to be utilized in this task was gathered by extracting data from an online information base (Kaggle.com).

There are about 27,820 cases where each case represents a nation and the suicide rate for age groups reported by genders for the year between 1985 and 2016 along with the nation's GDP at that point.

As referenced before, the research will be focused on finding any relationship between suicide rate/100k and age group, in this way these are the two factors that will be the fundamental concentration in which suicide rate per 100k is a *dependent variable* and age-group is an *independent variable***.**

Therefore, the objective is to check whether is there any difference in the proportion of suicide rate per 100k amongst age-groups. The number of inhabitants in interest is all people ages 5 and up who ended it all. The socioeconomics from this data comes from nations around the globe so we can sum up our decisions to the population internationally. In any case, since the research is observational the discoveries cannot be utilized to set up causal connections, just a **Comparison of proportions**. For likely inclination, we need to accept that each nation similarly revealed all suicide occasions, in any case, our decisions might be inaccurate.

# Restrictions or Limitations and Assumptions

1. The data in this Research depends on reports up to 2015 excluding 2016
2. The significance level (α) is set to 0.05 and is expected that there is a homogeneity of fluctuation in the data

# **PROJECT MANAGEMENT AND ORGANIZATION PLAN**

# Task Management & Team Meetings:

The team met every alternative day at 20:00 (GMT) with their task status, and which Trello card will they pick next. Any impediments were also brought in the team meetings so that risks of delivering the research can identified and mitigated. *Microsoft Teams* was used as a medium of communication due to ongoing Covid-19 restrictions [3].

Trello Board [4] was used to manage the team tasks and to create visibility of the work involved. As the team is comprised on 5 members we agreed on the Work in Progress (WIP) limit of 5. WIP limit of 4 for all cards being actively worked on – marked as “Doing” on Trello Board and WIP limit of 1 that required peer review – marked as “Review” on Trello Board.

Further labels were added to every card to visualise which stage of the research does it corresponds to, so that goal of the research is kept in mind at all times during the development. The due date was added in every card as outlined in the coursework specification guide [5].

‘R’ programming language is used from sourcing, cleaning, and normalising data, to creating visualization and performing further analysis to test the hypothesis.

# Storage:

We used bitbucket [6] as a version control repository to keep a record of up-to-date work shared between all resources in the team.

Every member has their own branch where they pushed their code to be later reviewed in the team meetings. Peer review was conducted during the team meetings and necessary amends were suggested (if any). Following successful peer review, the code was *merged* into the master branch, Trello card was moved to “Done”. The team members later, *pulled* the most recent change to the repository so that they can work on the latest copy of the code.

# **DATA COLLECTION AND PROCESSING DOCUMENTATION**

# Data Collection Methods:

Every team member brought their own interests and their chosen dataset for team discussions. After much deliberation suicide\_dataset was finalised by the team members downloaded from Kaggle as it fulfils all the criteria [7] we set out in our almost daily meeting using *Microsoft Teams*. We explain these criteria as

1. Dataset should be easy to *understand* i.e. individual/team should not spend a long time (more than 2 days) to investigate terminology/column name/data in a column.
2. It should to *feasible* for the team to implement given limited understanding of the course/R and help in framing a research question and hypothesis.
3. Dataset should help in understanding the *concept* of Correlation, Comparison of means, or comparison of proportion and draw visualisation.
4. The answer to the RQ can be easily *summarised* in a report.

# Data Processing & Cleaning Methods:

Following steps were taken to ensure better data quality.



The above steps are explained in detail below

1. The suicide dataset is in CSV format and we imported the dataset in R. Total of 27820 observations were recorded across 2 genders (male, female), 6 age groups (5-14 years, 15-24 years, 25-34 years, 35-54 years, 55-74 years, 75+ years) and 101 countries. The data can be understood as

* Country: A data set containing 101 of the 195 countries in the world.
* Year: The dataset values are belonging to years between 1985 and 2016
* Sex: Male/Female
* Age: Age is divided in five age intervals. (5-14 / 15-24 / 25-34 / 35-54 / 55-74 / 75+)
* Generation: There are six generations included in this dataset. (Generation X / Silent / Millennials / Boomers / G.I. Generation / Generation Z)
* Population: Number of people
* Number of Suicides: Number of suicides
* Suicides per 100k people: Number of suicides divided by the population number and multiplied by 100.000.
* GDP for year: Gross Domestic Product, a measure of the market value for a country-year combination.
* GDP per capital: Obtained by dividing the GDP by the total population of the country for that year.
* HDI for year: Human Development Index, an index that measures life expectancy, income and education.

1. Next, we visualised the number of records for every year for the period 1985 – 2016 and removed all records for 2016 as suicides were not reported by all countries in the dataset.
2. We expect there are at least 12 records (6 age groups and 2 genders) for every year reported by each country in the dataset.
   1. we noted that there are only 30 countries that have reported suicides for all the years over the 1985 – 2015 period.
   2. we further examined that these countries account ~40% of the total observations reported in the data set (11076 records over 27820 observations).
   3. we, therefore, considered this data as viable enough to further carry our assessment and answer the research question.
3. Finally, we removed any columns that we do not need in our study. This includes

* HDI for year
* gdp\_for\_year ($)
* gdp\_per\_capita ($)
* generation

No further data enrichment was made to the original data set.

1. **VISUALISATION**

# Global Analysis

* + 1. Global Trend

The dashed line is the **global average suicide rate** from 1985 - 2015: **11.5 suicides** (per 100k, per year). There was a spike in suicide rate per 100k in 2009 that is the largest in the dataset. This could be related to the global slowdown of 2009, but we cannot be certain as the dataset does not list the cause of suicides.

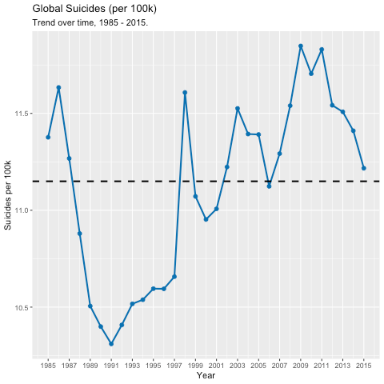


Figure 1. Global suicide rate per 100k over the years

* + 1. Top 20% highest risk between 1985 – 2016

We were interested to understand how the suicide rate per 100k has changed every 5 years. There are 30 country data in our filtered data set (see section 3.2) and we were interested in the top 20% highest risk suicides per 100k and compare the demographics between 1985 and 2015.

We define a demographic as a year in a particular country for some combination of sex and age e.g. UK, 1996, Male, 35-54 age group will form one demography.

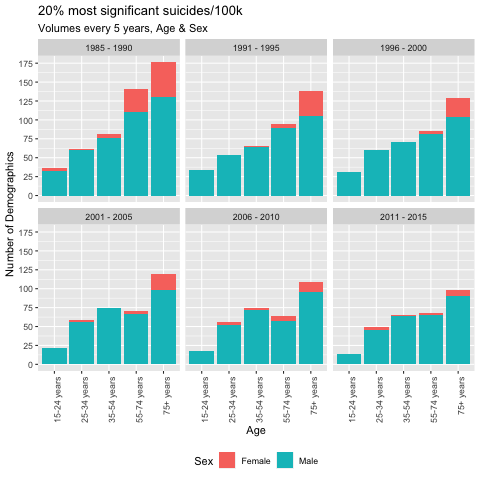
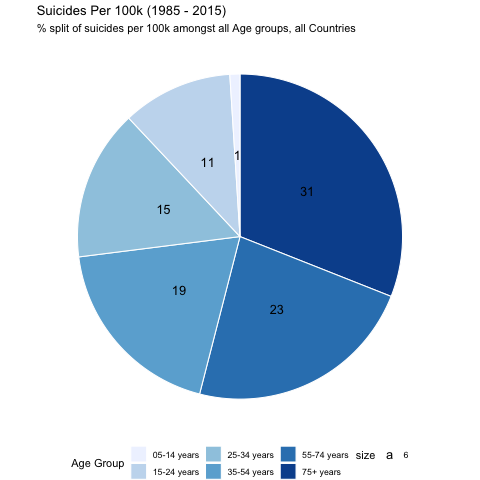
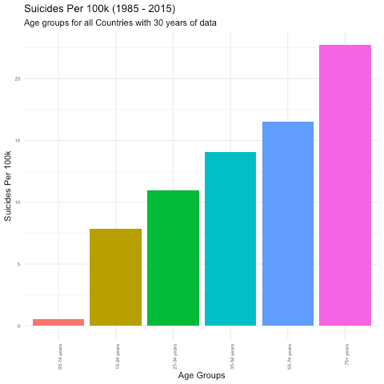


Figure 2. Suicide rate per 100k summarised for every 5 years among all age groups, gender

**We observe suicides per 100k for the 35 – 54 years age group has largely remained flat since 1991 at about 70 suicides per year. Although the suicides per 100k have decreased for 75+ years age group we remain concerned it being high throughout a 30-year period.**

* + 1. By Age Group

Figure . Suicide rate per 100k over all age groups (bar plot and pie chart)



**The above bar plot shows the suicide rate per 100k for all age groups with 30 years of data. The pie chart represents the % share of suicides per 100k amongst age groups.**

**We notice that the suicide rate per 100k increases with a rise in age. We also detect and remain concerned about the high suicide rate per 100k for 75+ age group, which further needs to be examined. Therefore, the ratio indicates suicide rate per 100k is highest in the 75+ age group and minimum in the 5-14 age group.**

**The pie chart, also confirms that the suicides rate per 100k is about 31% for those in 75 years and over age group. We are anxious that the suicide rate per 100k in children (5 – 14 years) is 1% and recommend further studies on what causes children to take of such extreme measures. A study [8] suggests there are broad risk factors that make it difficult for parents and health-workers to spot children at risk of suicide.**

* + 1. By Age Group and Gender

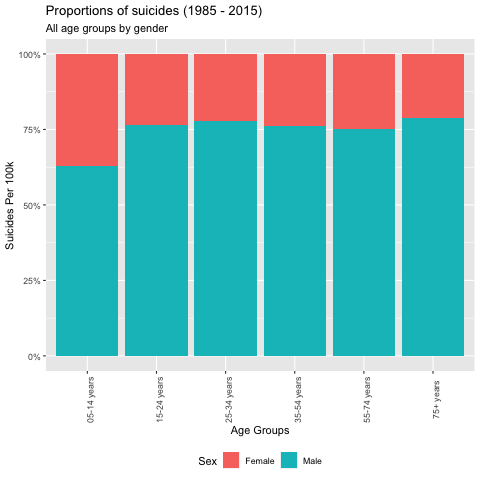
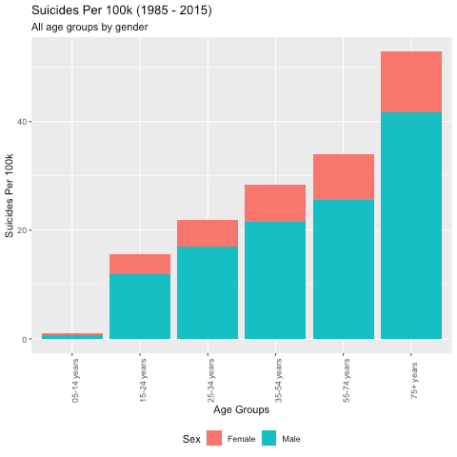


Figure . Suicide rate per 100k over all age groups, gender (Bar plot and Stacked graph)

**The bar plot and stacked bar plot above show the suicide rate per 100k for all age groups and all genders (male and female).**

**We observe that the suicide rate per 100k in males is about 3 times that of females between 1985 and 2015.**

**While the suicide rate per 100k amongst females for all age categories remains the same, we inspect that females in the age group 5 – 14 years have a higher suicide rate per 100k over males compared to all other age groups at about 37%.**

# By Country

* + 1. Per Age Group

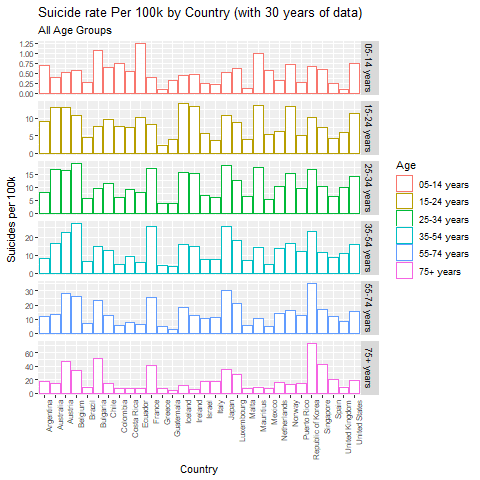


Figure 5. Suicide rate per 100k by Country for all age groups

**The bar plot shows the suicide rate per 100k by the countries with 30 years of data for all age groups.**

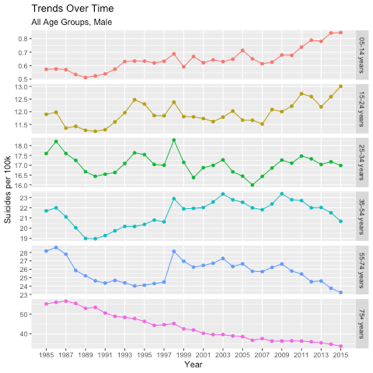
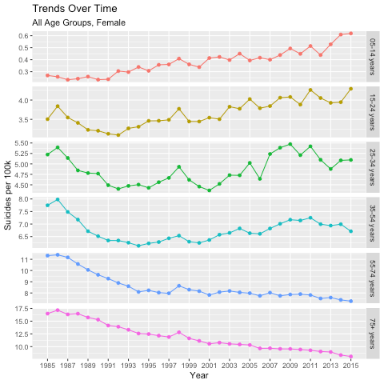
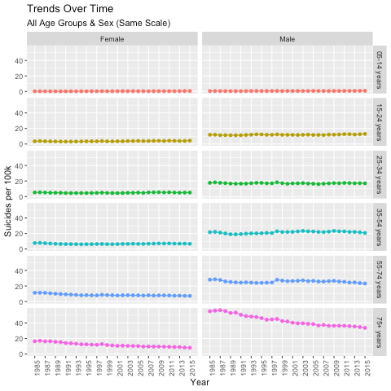
**We observe Ecuador, Iceland, Japan, Belgium has the highest suicide rate per 100k and, UK, Greece and Guatemala have the lowest suicide rate per 100k in the age groups 05-14 years, 15-24 years, 25-34 years and, 35-54 years respectively. Similarly, the Republic of Korea has the highest suicide rate per 100k and, Guatemala have the lowest suicide rate per 100k in the age groups 55-74 years and 75+ years.**

**We also notice that Republic of Korea, the suicide rate per 100k escalates as we move upwards in the age groups however for United States, Argentina, and Guatemala it reduces.**

# Trend Plots

* + 1. By Age Group & Gender

Figure . Suicides rate per 100k trends by all years for all age groups, gender



We share the following insights:

* + - * + Globally the likelihood of suicide increases with age
        + Although the suicide rate in 5 – 14 years remains small and it has doubled in the past 30 years for our filtered dataset for both males and females
        + Suicide rate per 100k for 75+ year age group for both genders is linearly decreasing and has dropped by about 83% since 1988
        + Suicide rate per 100k for 15 – 24 years age group for both genders is highest in 2015 than any time in the 30 years of history

1. **ANALYSIS**

Data Analysis is the cycle of methodically applying statistical and additionally intelligent strategies to portray and outline, consolidate, and assess data which can also help in testing our hypothesis. This statistical analysis will especially focus on the suicide and age-group which is done with the help of proportion test in R. Proportion test is used to check our hypothesis and based on that findings are as follows:

**Table 1.** Total population (in 100k) and suicide rate per 100k (for all age groups)

|  |  |  |
| --- | --- | --- |
| **Age Group** | **Suicides per 100k** | **Total Population**  **(in 100k)** |
| 05-14 years | 0.515137072 | 55148.42857 |
| 15-24 years | 7.869480444 | 55974.8516 |
| 25-34 years | 10.97714016 | 54335.09925 |
| 35-54 years | 14.08981603 | 91890.12811 |
| 55-74 years | 16.51480639 | 56337.14245 |
| 75+ years | 22.70232293 | 17917.72592 |

By looking at Table 1 and figure 3 in visualization, we can say that there is a difference in the proportion of the suicide rate per 100k amongst age groups. The table suggests suicide rate per 100k is reasonably increasing with the age. We need to find whether the difference is significant or not? As we want to check the significance in the proportions of the suicide rate, Pearson's chi-squared test can provide us our answer [11]. To demonstrate the test in R, we are using a prop.test function. After applying prop.test, the results are:

**Table 2.** Results of proportions test on filtered data (all countries with 30 years of data, 1985 - 2015)

|  |  |
| --- | --- |
| X-squared = 105.75 | df = 5 |
| p-value < 0.00000000000000022 (2.2e-16) | alternative hypothesis: two.sided |
| prop 1 | 0.000009340920 (9.340920e-06) |
| prop 2 | 0.0001405896 (1.405896e-04) |
| prop 3 | 0.0002020267 (2.020267e-04) |
| prop 4 | 0.0001533333 (1.533333e-04) |
| prop 5 | 0.0002931424 (2.931424e-04) |
| prop 6 | 0.001267031 (1.267031e-03) |

The degree of freedom(df) is 5 and prop 1 to 6 suggests an estimated probability of success (the proportion of suicide rates amongst the age groups) [11]. The p-value of the test is 2.2e-16, which is less than the significance level alpha 0.05 provides strong evidence against the null hypothesis, accepting that it is giving reasonable evidence to continue our focus to the alternative hypothesis [9]. To verify the above argument from a different perspective, we decided to run the same test (Chi-squared test) with our raw dataset.

**Table 3.** Total population and total number of suicides for the age group (for raw data)

|  |  |  |
| --- | --- | --- |
| **age\_group** | **suicidesper100k** | **total\_population (in 100k)** |
| 5-14 years | 0.622287284 | 83986.93237 |
| 15-24 years | 9.354934257 | 86429.46896 |
| 25-34 years | 13.31948569 | 84381.03587 |
| 35-54 years | 17.05731833 | 143758.8812 |
| 55-74 years | 18.83899557 | 88032.4534 |
| 75+ years | 24.52305776 | 26632.81253 |

**Table 4.** Results of proportions test on raw data (all countries, 1985 - 2016)

|  |  |
| --- | --- |
| X-squared = 110.98 | df = 5 |
| p-value <  0.00000000000000022  (2.2e-16) | alternative hypothesis: two.sided |
| prop 1 | 0.000007409335 (7.409335e-06) |
| prop 2 | 0.0001082378 (1.082378e-04) |
| prop 3 | 0.0001578493 (1.578493e-04) |
| prop 4 | 0.0001186523 (1.186523e-04) |
| prop 5 | 0.0002140006 (2.140006e-04) |
| prop 6 | 0.0009207836 (9.207836e-04) |

After comparing both the tables **Table 2** and **Table 4** we observe similar results. P-value is less than the significance level (0.05) and hence we *reject* the null hypothesis. There is significant difference in the proportion of suicide rate per 100k amongst the age groups.

1. **DISCUSSION AND CONCLUSION**

In this analysis, we compared the suicide rates per 100k amongst age groups, and we found thatsuicides happen globally, impacting people of all age groups and genders. When we compared different rates of suicide, the figures reveal that males are more susceptible to suicide than females. People with the age of more than 75 years are most likely to commit suicide. And people between 05-14 years are least likely to commit suicide. Moreover, the suicide rate per 100k in males is about 3 times that of females.

Thus, we studied and compared the suicide rates between different age groups and conclude that people in 75 years and above are more likely to commit suicide than any other age group. We are distressed with high suicide rate per 100k in 75 years and above age group and very concerned about the suicides in the 5-14 years age group.

Returning to our hypothesis - There is no difference in the proportion of suicide rate/100k amongst age groups – we ran proportion test on both our filtered data set (for which visualizations are created) and the raw dataset. We conclude that the p-value is minuscule and it’s safe to *reject* the null hypothesis.

1. **REFERENCES**

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