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Creating Evidence:

Methods of suicide, by age group and gender

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Abstract:

This study aimed to identify patterns in the dataset "Methods of suicides, by age group and gender" and validate the findings to provide evidence-based insights. The primary motivation behind this study was to raise awareness so that it can improve mental health policies for the Swiss population in future. To achieve these objectives, various data analysis techniques, including exploratory data analysis, predictive analysis, and statistical analysis, were employed. Notable findings from this study include: 1) a higher incidence of suicide among men compared to women, 2) a higher prevalence of suicide in the 20-29 age group compared to other age groups, and 3) predicted that in year 2024, hanging will be predominant for both genders to commit suicide compared to any other methods. These findings contribute to the understanding of suicide trends and can inform proactive measures to address mental health concerns.

Introduction:

Mental Health is equally important as Physical Health. It impacts overall well being and quality of life. Openly discussing suicides helps break down stigmas surrounding mental health, promoting understanding, empathy, and acceptance. The primary motivation behind this study was to raise awareness so that it can improve mental health policies for the Swiss population in future. The goal was to find meaningful information and evidences from dataset "Methods of suicides, by age group and gender". This dataset covers the Swiss population from the year 2000 to 2021 and is publicly available on opendata.swiss in the health category.

In our study, we employed three distinct analysis techniques: Exploratory data analysis, Predictive Analysis, and Statistical Analysis. To ensure the validity of our findings, we utilised various data visualisation methods, assessed the goodness of fit with r^2 values for regression models, and examined the statistical significance using p values obtained from T-tests.

Based on our analysis of the data through Exploratory Data Analysis, several key findings have emerged. Firstly, there is a downward trend in the percentage of deaths resulting from suicide over the years for male demographic. Secondly, men have a higher percentage of deaths from suicide compared to women. Thirdly, we found that hanging is the primary method by men to end their lives however, poisoning is the primary method among known methods for women to end their lives.

Young adults in the age group of 20-29 often face numerous challenges as they transition into adulthood. This period is marked by a multitude of responsibilities, including managing university studies, part-time jobs, financial constraints, social interactions, peer competition, and romantic relationships. In addition, these years play a crucial role in establishing the groundwork for their future. Given these circumstances, we hypothesize that the incidence of suicide deaths is higher among individuals in their young adulthood (age 20-29). Using data visualisation, box plots, and T-test we proved that young adults commit more suicides than any other age group. We additionally found that for age 20-29, men commit more suicides than women, and men use weaponry and women use hanging as predominant method to commit suicides.

We hypothesize that in the future, the method of hanging is expected to become the predominant choice among both male and female individuals for committing suicide. We used predictive analysis to predict deaths from suicide using year, gender, method of suicide as independent variable. We found that in year 2024, 35.9% of male individuals who died of suicide will use hanging method to commit suicide which is more than any other method in the dataset. This percentage proved the hypothesis for male population. However, for female population, we found that in year 2024, 49.9% of female individual who died of suicide will use some other methods to commit suicide (other than hanging, poisoning, weaponry). This disproves our hypothesis for the female population.

Background and Related Work:

Suicide is a serious public health issue worldwide. According to Omigdobun [1], suicide is among the 5 major causes of death in young people. According to WHO [2,3], suicide is the third cause of death among young people. Men commits more suicides than women [5,6,7]. However, more women attempt suicides as compared to men [5,6,7]. According to studies, the factors contributing to suicide attempts are feelings of helplessness and hopelessness [8]. Research [4] on methods of committing/ attempting suicides has found that Hanging was the most prevalent suicide method among both males and females. In Switzerland hanging rank as second for males after weapons [4]. However, these researches are relatively old. In order to find evidences on recent data, we study methods and trends of suicide in Swiss population. Using predictive analysis approach, we will predict methods of suicide in year 2024 i.e. next year. This could help policy makers make better decisions regarding public mental health.

Data Characterisation:

Dataset: Methods of suicides, by age group and gender
Coverage: Switzerland
Years: 2000-2021
Language: German

Data preprocessing: Downloaded the dataset for all the years and combined them into one csv file. Added year information as column of the data. German translated to English.

Final preprocessed data column description:

- gender: Men / Women/ People (both combined)
- 0-19: Number of deaths for age group 0-19
- 20-29: Number of deaths for age group 20-29
- 30-39: Number of deaths for age group 30-39
- 40-49: Number of deaths for age group 40-49
- 50-59: Number of deaths for age group 50-59
- 60-69: Number of deaths for age group 60-69
- 70-79: Number of deaths for age group 70-79
- 80-89: Number of deaths for age group 80-89
- 90+: Number of deaths for age group 90+
- Total: Total deaths for all age groups combined
- year: year of deaths from 2000 to 2021
- Method: poisoning, weapons, hang, others, total suicides, all causes of death

Total features: 13
Total no. of rows: 396
Known methods: Poison, Hang, Weapons
All methods: Poison, Hang, Weapons, Others
Missing data points: In the raw dataset, some cells had no value. We replaced them to 0.

Since this dataset provide detailed information about methods of suicide, by age and gender, and includes data from year 2000 to 2021, it appear to be good choice to perform this study on Switzerland population.

Methods:

We performed experiments using exploratory data analysis and hypothesis-driven confirmatory data analysis.

Exploratory Data Analysis:

1. Percentage of Deaths from Suicide over years Men vs Women:
   Calculated percentage of deaths from suicides using *total suicides* and *all causes of death* methods across years and genders. Plotted them in a line plot. Plotted a box plot to see variability of data for men and women. Performed a T-test to check if men and women data differs significantly.
2. Percentage of Suicides from different methods Men vs Women:
   Calculated percentage of suicides from different methods using methods (*poisoning, hang, weapons, other methods*) and *total suicides* for men and women. Then plotted a line plot to visualise patterns over the years. Plotted pie charts of suicide methods for men and women from year 2000 to 2021.

Confirmatory Data Analysis:

Following are the generated hypotheses:

1. Hypothesis A:
   The incidence of suicide deaths is higher among individuals in their young adulthood (age 20-29).
2. Hypothesis B1:
   In the future, the method of hanging is expected to become the predominant choice among **male** individuals for committing suicide.
3. Hypothesis B2:
   In the future, the method of hanging is expected to become the predominant choice among **female** individuals for committing suicide.

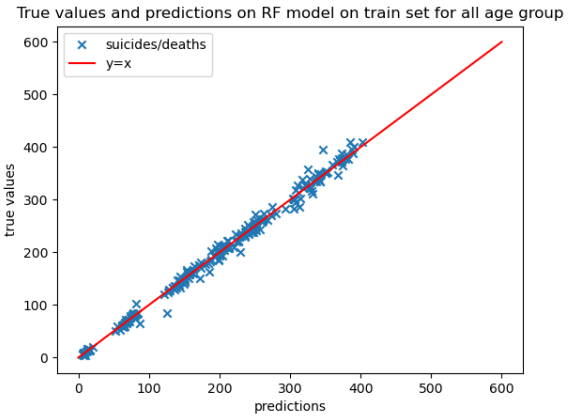
Methodology for Hypothesis A:
Plotted a grouped bar chart of percentage of deaths from suicide for different age groups for both genders combined from 2011 to 2021. In addition, plotted box plots of percentage of deaths from suicide for different age groups for men and women separately. To compare percentage of deaths from suicide between men and women, plotted box plot for men and women. Performed T-test to check significance.

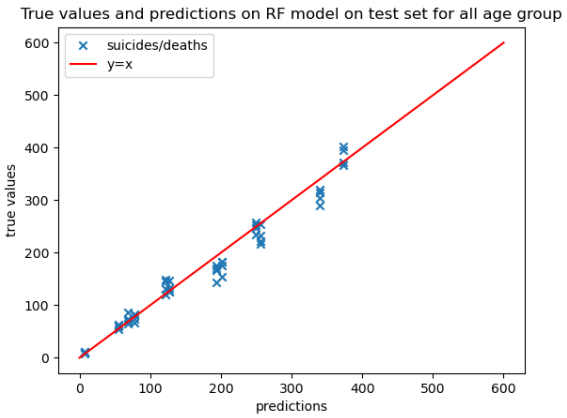
Methodology for Hypothesis B1 and B2:
Performed predictive analysis to predict deaths from suicide.

Dependent variable	*total* (Total deaths for all age groups combined)

Independent variable	*gender, year, method*
Models	Random Forest regression and XgBoost regression
Train data	From year 2000 to 2017
Test data	From year 2018 to 2021
Methods	*poisoning, hang, weapons, others, total suicides*
Gender	*Men, Women*
Encoding on categorical data	One hot encoding
Evaluation metrics	r^2 values
Performance visualisation	Scatter plot with prediction on x axis and ground truth on y axis
Future prediction	Prediction for all methods for both genders for year 2024 (10 predictions in total)

Table 1: Predictive analysis for Hypothesis B1 and B2



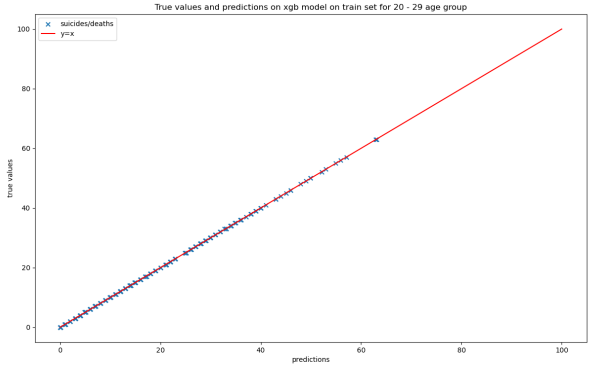


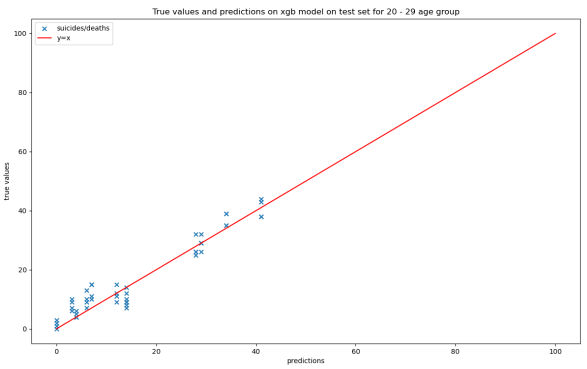
R^2 value on train set Random Forest: 0.992	R^2 value on test set Random Forest: 0.963
R^2 value on train set XgBoost: 0.999	R^2 value on test set XgBoost: 0.95

Selected random forest model to predict future because R^2 value on test set is higher than of XgBoost model.

<u>Methodology for Additional Analysis</u>:

As an additional analysis, we performed a predictive analysis for the age group 20-29. Everything is the same as Table 1, except the dependent variable. Here, the dependent variable is the number of deaths for age-group *20 - 29*.





R^2 value on train set Random Forest: 0.974	R^2 value on test set Random Forest: 0.901
R^2 value on train set XgBoost: 0.999	R^2 value on test set XgBoost: 0.911

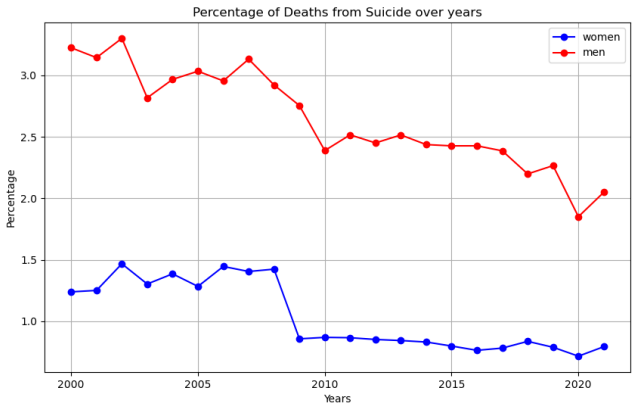
Selected XgBoost regression model to predict future because R^2 values on train set and test set are higher than of Random Forest model.

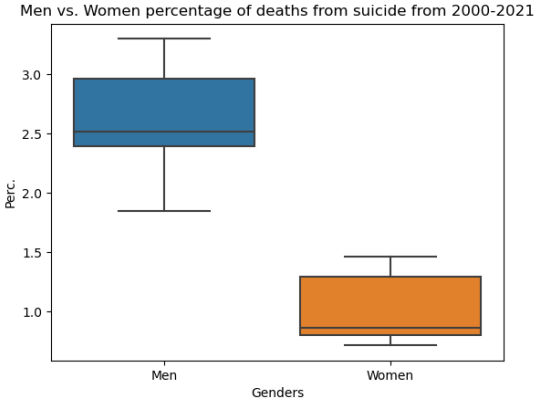
Implementation and Software use:

This study is performed using python programming language. Following are python packages used to conduct the data analysis: pandas, numpy, seaborn, matplotlib, sklearn, xgboost, and scipy. For predictive analysis, Random Forest and Xgboost regression is used. Full implementation in the github repo: code

Results:

Percentage of Deaths from Suicide over years Men vs Women





p-value from T-test on men vs women = 7.1124863718914395e-19

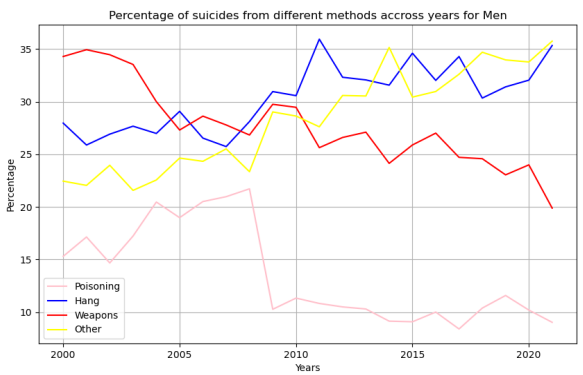
Observations:

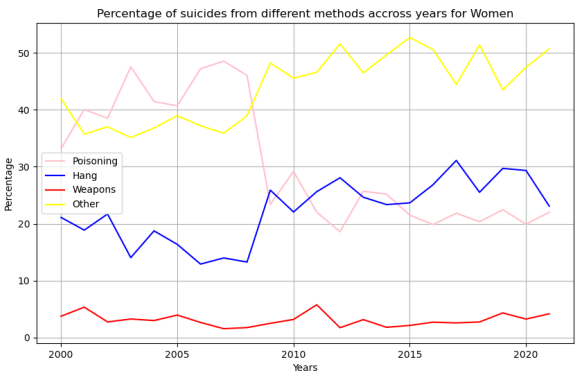
1. A downward trend is observed in percentage of deaths from suicide for men (from left plot).
2. From year 2009 to 2021, percentage of deaths from suicide for women remained constant.
3. Percentage of deaths from suicide are higher for men than for women (both plots).
4. P-value < 0.05, meaning significance in difference between percentage of suicide for men vs women (based on T-test).

EVIDENCES:

1. Percentage of deaths from suicide are decreasing over time for men.
2. Percentage of deaths from suicide remained constant over time for women.
3. Men commits significantly more suicides than women.

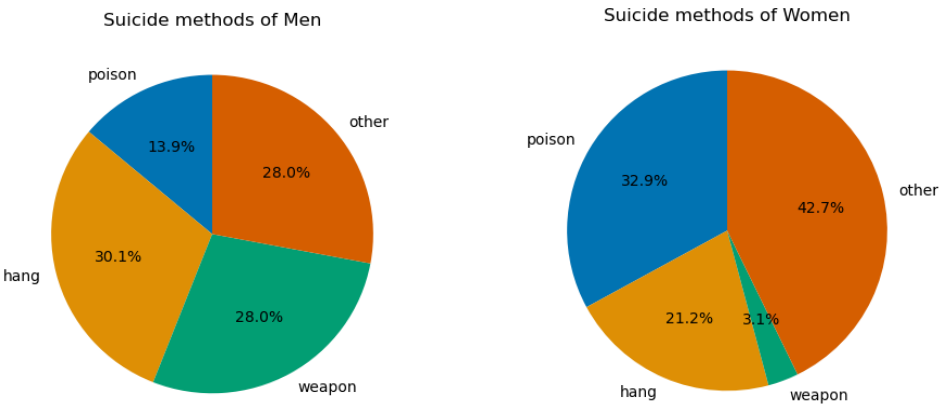
Percentage of Suicides from different methods Men vs Women





Observations:

1. Percentage of suicides with hanging and *other* methods has increased over years for men. However, percentage of suicides with weapons and poisoning has decreased over years for men (from left plot).
2. Percentage of suicides with *other* methods has increased over years for women. From year 2009 to 2021, percentage of suicides using weapons, hanging, and poison almost remained constant (from right plot).
3. Sudden drop in consumption of poison for commiting suicide from year 2008 to 2009 (from both plots).



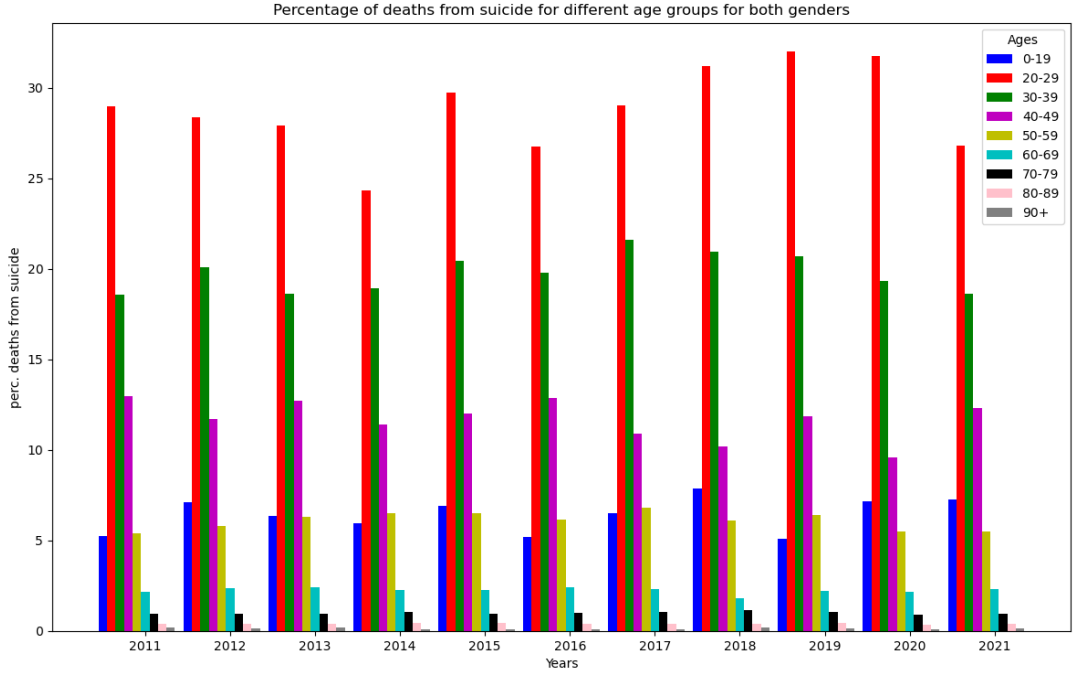
Observations:

1. Men commit more suicides using 1) hanging 2) weapons and *other* methods
2. Women commit more suicides using 1) *other* methods 1) poison

<u>EVIDENCES:</u>

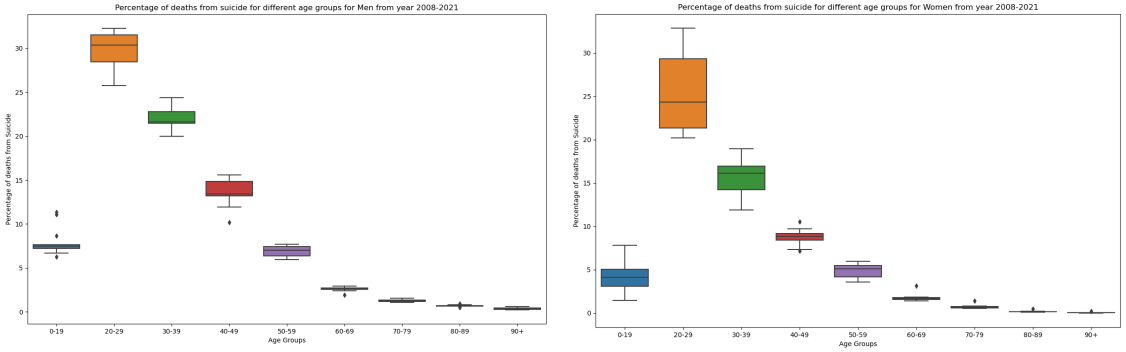
1. Hanging is the predominant method chosen by men to commit suicide, and a rising trend is being observed over the years within the Swiss population.
2. Women uses *other* methods to commit suicide and an increase in usage has been observed over the years for Swiss population. Among the known methods, poison emerges as the primary choice for women, and its percentage has remained relatively stable from 2009 to 2021.

<u>Hypothesis A</u>: The incidence of suicide deaths is higher among individuals in their young adulthood (age 20-29).



Observations:

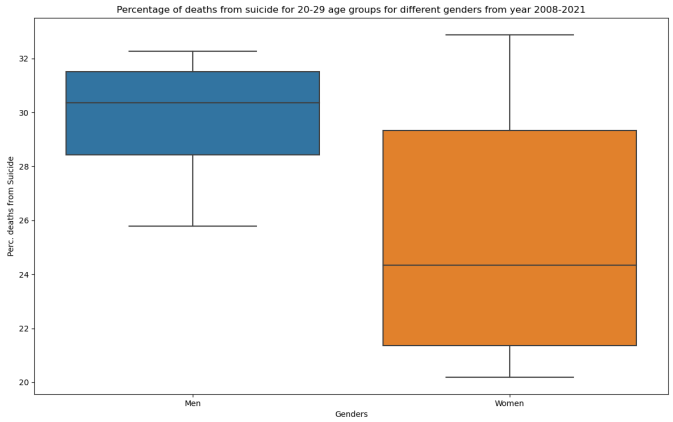
1. The age group 20-29 demonstrates the highest percentage of suicide deaths, followed by the 30-39 and 40-49 age groups.



Observations:

1. **30%** (median of data) of deaths are from suicide in **men** of age group 20-29 from year 2008-2021 and is highest as compared to all other age groups (from left plot).
2. **24%** (median of data) of deaths are from suicide in **women** of age group 20-29 from year 2008-2021 and is highest as compared to all other age groups (from right plot).

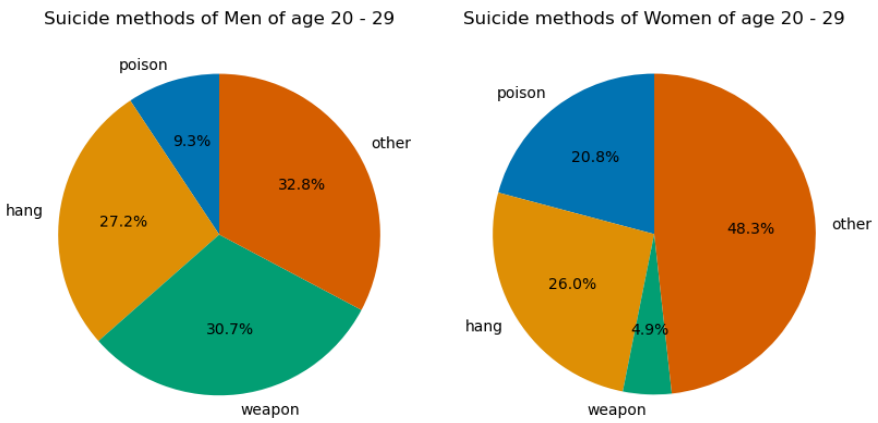
NOTE: **Based on all the above observations, we proved the hypothesis that the incidence of suicide deaths is higher among individuals in their young adulthood (age 20-29).** However, we further analysed this age group to find more information from the data.



P-value from T-test for men vs women percentage of suicide deaths for age group 20-29: 0.0055094589134642895

Observations:

1. Since p-value is less than 0.05, men of age 20-29 significantly commits more suicide as compared to women of same age group.



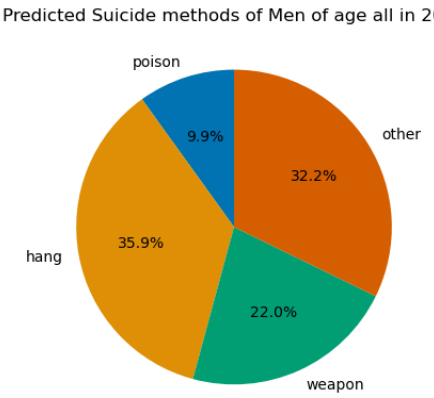
Observations:

1. Among known methods, weapons are the predominant methods of commiting suicide in male population of age group 20-29 (from left plot).
2. Among known methods, hanging is the leading method to commit suicide in female population of age group 20-29 (from right plot).

EVIDENCES:

1. The incidence of suicide deaths is highest in young adults (20-29 age) with 30% in men and 24% in women.
2. Suicide deaths are significantly higher in men as compared to women for age group 20-29.
3. Weapons leading method to commit suicide in Swiss male demographic and Hanging leading method in female demographic for age group 20-29.

<u>Hypothesis B1</u>: In the future, the method of hanging is expected to become the predominant choice among male individuals for committing suicide.



Observations:

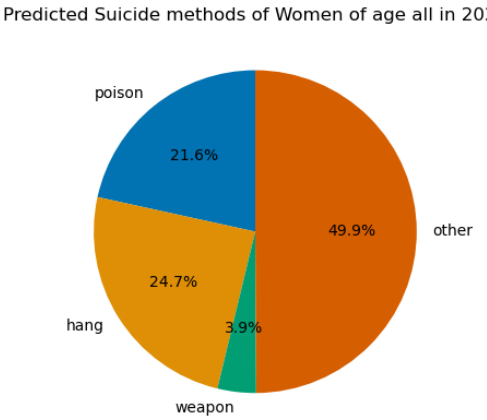
1. In 2024, hanging will be predominant method to commit suicide in male population.

Above observation **proves** hypothesis B1 that in the future, the method of hanging is expected to become the predominant choice among male individuals for committing suicide.

<u>EVIDENCES</u>:

1. In 2024, the method of hanging is expected to become the predominant choice among male individuals for committing suicide.

<u>Hypothesis B2</u>: In the future, the method of hanging is expected to become the predominant choice among female individuals for committing suicide.



Observations:

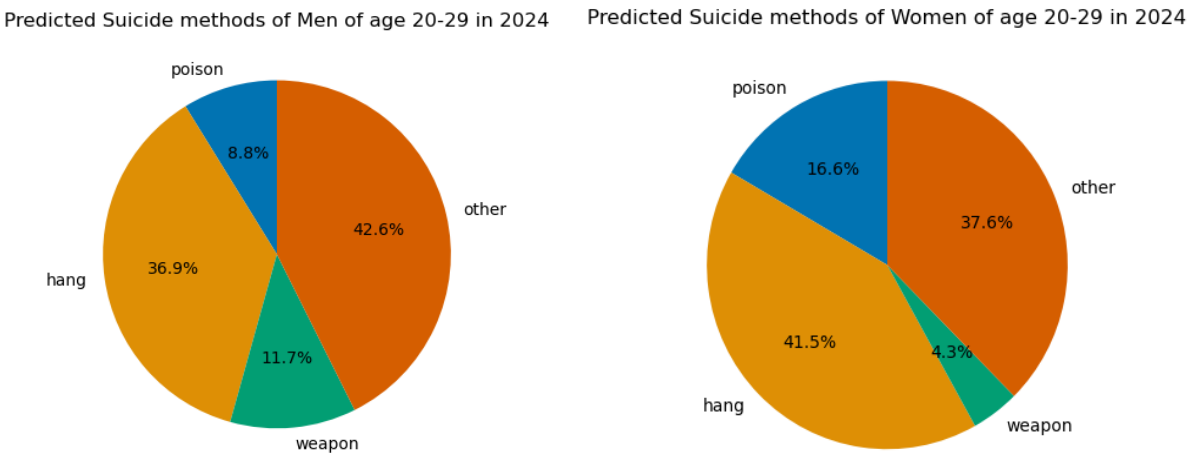
1. In 2024, *other* methods will be predominant choice to commit suicide in female population.

Above observation **disproves** hypothesis B2 that in the future, the method of hanging is expected to become the predominant choice among **female** individuals for committing suicide. However, hanging is still leading method to commit suicide among known methods therefore, for known methods, above observation **proved** hypothesis B2.

EVIDENCES:

1. *Other* methods are leading choice among females to commit suicide in year 2024.
2. Hanging is the second leading method overall but top known method to commit suicide among females in year 2024.

Additional Analysis Results for age group 20-29



This additional analysis is being performed on the age group 20-29 because it became an interesting age group after proving hypothesis A.

Observations:

1. In 2024, men of age group 20-29 will commit more suicides using *other* methods. Among known methods, hanging will remain a leading method to commit suicide (from left plot).
2. In 2024, women of age group 20-29 will commit more suicides using hanging method (from right plot).

EVIDENCES:

1. In 2024, women and men of age group 20-29 will commit more suicides using hanging along with *other* methods.

Overview results:

1. Men commit more suicide than women
2. 20-29 age group commit more suicide than any other age group

3. Summary of analysis of suicide methods are as follows:

Gender	**Age group**	**Known methods**	**All methods**
Men	all ages	Hanging	Hanging
Women	all ages	Poison	Other methods
Men	20-29	Weapons	Other methods
Women	20-29	Hanging	Other methods

4. Summary of 2024 predictions for suicide methods are as follows:

Gender	**Age group**	**Known methods**	**All methods**
Men	all ages	Hanging	Hanging
Women	all ages	Hanging	Other methods
Men	20-29	Hanging	Other methods
Women	20-29	Hanging	Hanging

Discussions:

This study suggests that men commit more suicide than women in Switzerland which aligns with results from studies on several countries by WHO [5,6] and Pietro D [7]. According to our results on Swiss demographic, the incidence of suicide deaths is highest in young adults (20-29 age) with 30% in men and 24% in women.

According to Värnik A [4], in Switzerland, hanging is second common method to commit suicide after weapons in male population, however our study has found that hanging is most common method to commit suicide for male population. Among female demographic of Switzerland, Värnik A [4] concluded that hanging is the leading method to commit suicide, however, from this study, we concluded that poison is a predominant method to commit suicide for female population. The observed discrepancy in results is due to the time duration used to perform the studies. Värnik A [4] performed their analysis on a dataset which covered suicide information from year 2000 to 2005, whereas this study is conducted on relatively bigger and more recent dataset i.e. from year 2000 to 2021. Since our results are concluded from recent data, they are more reliable.

Limitations:

The study has following limitations:

1. The dataset used in this study has a relatively small sample size, consisting of only three suicide methods: poisoning, hanging, and weapons. To gain a more comprehensive understanding of suicide methods, it would be beneficial to have information about additional methods. In some results, *other* method have a higher percentage, but drawing conclusive insights from such limited information is challenging.

2. During the study, the dataset contained certain missing values, which were substituted with zeros. This replacement strategy could potentially impact the accuracy and integrity of our data analysis.

3. Due to the limited size of the dataset, the predictive models exhibited overfitting issues on the training data. As a consequence, the reliability of future predictions for the year 2024 may be compromised.

Conclusions:

The study conclude that men commit more suicides than women in Switzerland. The incidence of suicide deaths is highest in young adults (20-29 age). Hanging is the most common method to commit suicide in male population, whereas Poison is the leading method to commit suicide in women. In 2024 in Switzerland, hanging will become leading method to commit suicide for both men and women.

References:

[1] Omigdobun OO, Adejumo OA, Babalola OO. Suicide attempts by hanging in preadolescent children: a case series. West Afr J Med. 2008;27(4):259–62

[2] WHO. Figures and facts about suicide. Geneve: World Health Organisation; 1999

[3] WHO. Mental health and development Targeting people with mental health condition as a vulnerable group. Geneve: World Health Organisation; 2010

[4] Värnik A, Kõlves K, van der Feltz-Cornelis CM, et alSuicide methods in Europe: a gender-specific analysis of countries participating in the "European Alliance Against
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[5] WHO. Figures and facts about suicide. Geneve: World Health Organisation; 1999

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[7] Pietro D, Tavares M. Risk factors for suicide and suicide attempt: incidence, stressful events and mental disorders. J Bras Psiquitr. 2005;54(2):146–54.

[8] Polewka A, Chrostek-Maj J, Kroch S, et al. Sense of coherence and risk of suicide attempt. Przeg Lek. 2001;4:335–39. [in Polish]