Comparative Analysis of Mortality in the United States in 1980 and 2019

Adedeji Okikiade (AO) [a++*], Chidinma Kanu (CK) [b#], Oluwadamilare Iyapo (OI) [c†], Ololade Omitogun (OO) [d‡] and Richard Adetoye (RA) [e^]

[a] *Department of Pathology, Clinical Sciences, California Northstate University, Elk-Groove, CA, USA.*
[b] *Ejyde International Education and Research Consultancy, MD, USA.*
[c] *Department of Pathology, Eko University of Medicine and Health Sciences, Lagos, Nigeria.*
[d] *Alluring Healthcare Solutions, LLC, MD, USA.*
[e] *Ekiti State University Teaching Hospital, Ado, Ekiti, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Objectives: The study aims to compare and analyze the mortality patterns of two different years (1980 and 2019) with unique peculiarities in the United States by applying basic (Inferential and descriptive) statistical tools to elucidate the findings in simple terms.

[++] *Assistant Professor;*
[#] *Medical Editor and Research Trainee;*
[†] *Senior Lecturer;*
[‡] *Director;*
[^] *Resident Physician;*
Corresponding author: Email: okikis@yahoo.com;

Methods: We conducted a retrospective, comparative, and observational data analysis on leading causes of death in the United States by age, race, and gender in 1980 and 2019. The data in this report are based on information from all death certificates filed in the 50 states and the District of Columbia. The causes of death are ranked by age and number of deaths, and classified by the International Classification of Diseases, 10th Revision (ICD–10). (Cause-of-death statistics are based on the underlying cause of death).

SPSS (statistical package for social sciences) version 29 Software in Excel sheet was used to analyze the datasets. Descriptive and inferential (parametric and non-parametric) analyses were used. The statistically significant relationships and assumptions were made using chi-square/t-test, variance, Pearson's correlation, and Fischer's exact tests with the significance level set at $p ≤ 0.05$. The analysis and determination of the level of agreement between the initial diagnosis and findings from the new analysis were done.

Results: The total number of deaths recorded in the United States in 2019 was about 2,854,838, with a mortality rate of 869.7 per 100,000 population, while the total number of deaths in 1980 was 1,989,841. In the adult population, the five major causes of death were heart disease, cancer, accidents, respiratory diseases, and cerebrovascular diseases. There were more deaths in 2019 than in 1980, and the mean age was 15-24 for both years. The common cause of death in 1980 from birth till the age of 24 remains higher. The highest mortality rates for age 45-65 remained cardiovascular disease in both 1980 and 2019. The Pearson correlation has a positive linear trend ($r = 0.947$, $p < 0.01$). There is a strong positive correlation between the number of deaths attributed to all causes for males and females, indicated by the coefficient is significant ($p < 0.001$). The variability in the number of deaths is higher among males (74.4855) than females. Male deaths are higher, with female is barely over 40% of total deaths. The analysis reveals an upward trend in mortality rates from 1980 to 2019, with a substantial increase observed in 2019. The model's high R^2 value of 0.897 indicates that the model explains a significant portion of the variability in the data.

Conclusions: There is higher Mortality in 2019 than in 1980, and this cuts across the most common cause of death despite a lower rate of death. The decrease in mortality rate over two decades is likely associated with advancement in health care provision despite the increase in population growth. There was a significant reduction in deaths due to unintentional injuries among individuals aged 15-24 in 2019, with an increase in deaths from mental illness and suicides and a strong positive trend and correlation between the number of deaths in 1980 and 2019.

Keywords: Mortality; racial and ethnic differences; sex differences; vital statistics.

1. INTRODUCTION

Global life expectancy at birth varies based on several variables, particularly gender, race, and genetic factors. Data from 1980 to 2015 shows that life expectancy at birth (years) is 59.6(male)and 63.7(female), and total death in millions is 45.2[23.5 (male) and 21.6(Female)] [1].

Global gains in life expectancy were generally gradual but steady, although catastrophic events, including the genocides in Rwanda and the Democratic Republic of Congo, terrorism and political crises in the Middle East and Africa, famines in North Koreans, and escalating Mortality due to HIV/AIDS, had worldwide effects on longevity. Slower gains were achieved for life expectancy at 50 years, or the average number of additional years of life a 50-year-old can anticipate at a given point in time [1,2].

The mortality rate is essential in determining any population's public health and wellbeing. It portrays the number of deaths in a population over a specific period, so understanding mortality patterns is essential because they provide incredible insights into the overall health status and healthcare systems of different populations. This research aims to conduct a comparative analysis of Mortality in the United States in 1980 and 2019. The study of mortality trends is essential for several reasons. Firstly, it is often used as a metric to assess how effective the healthcare system has been and to determine whether there has been an improvement or decline in the healthcare system. Secondly, it helps to unveil disparities in health outcomes across different populations; hence, it can help guide healthcare providers and researchers on possible solutions to public health challenges [3,4]. Thirdly, it helps to identify areas where the United States excels or lags behind global

averages, thereby providing opportunities for learning from international best practices and addressing global health challenges collaboratively.

"The research is expected to provide valuable insights into the pattern of mortality trends and associations with various variables while comparing two years that are two decades apart with similar and overlapping peculiarities and different interventions despite population growth and variations. The key factors and differences in the years and mortality changes are identified, and their implications are discussed using statistical tools" [5,6]. The study aims to provide substantial information to assist with evidence-based policymaking and strategies to improve population health outcomes. In addition, the comparative nature of the study could provide a basis for highlighting strengths and weaknesses in public healthcare policies and strategies across many nations, facilitating the cross-exchange of knowledge and best practices across different healthcare systems nationwide and internationally.

2. MATERIALS AND METHODS

2.1 Research Design

This study adopts a quantitative research design to investigate the relationship between various factors. To achieve the research objectives, it employs both descriptive and inferential statistical analyses.

Data visualization of the statistical tool used for the analysis in Excel. Excel offers various chart types and formatting options for visually appealing graphs and charts. It makes it easy to generate histograms, scatter plots, bar charts, line graphs, and pivot tables to visualize data trends, patterns, and relationships. Descriptive statistics will be computed to summarize the characteristics of the variables under study, including measures of central tendency, dispersion, and frequency distributions. The statistical tools used for the descriptive statistics are SPSS, Excel, and Python programming language (NumPy and Pandas library).

Inferential Statistics that would be adopted are:

I.   Regression analysis using SPSS to examine the relationship between the dependent variable and independent variables. This analysis will help identify significant predictors and their impact.

II. Parametric tests, such as t-tests or ANOVA, will be employed to compare means across different groups or conditions, assuming normal distribution and homogeneity of variances.

III. non-parametric tests, such as the Mann-Whitney U test or the Kruskal-Wallis test, will be used when data do not meet the assumptions of parametric tests.

IV. regression analysis assumptions, including normality, linearity, homoscedasticity, and independence of residuals, will be assessed using graphical methods and statistical tests.

V.   A chi-square test analyzes the association between categorical variables and assesses the goodness-of-fit of observed data to expected frequencies.

This comprehensive methodology ensures that the data collected is analyzed using appropriate statistical techniques to draw meaningful conclusions in line with the research objectives.

2.2 Data Strategy, Collection and Analysis

Starting with 1980 data, the rules changed for selecting Chronic lower respiratory diseases (CLRD) and Pneumonia as the underlying cause of death, increasing the number of deaths for CLRD and decreasing the number of deaths for Pneumonia [3]. Therefore, trend data for these two causes of death should be interpreted with caution. For more information, see Sources and Definitions, Comparability ratio. From 1998 to 1999, the cause-of-death title for Chronic obstructive pulmonary diseases (COPD) in the International Classification of Diseases, Ninth Revision (ICD–9) was renamed Chronic lower respiratory diseases (CLRD) in ICD–10 [3].

Starting with 2011 data, the rules changed for selecting Renal failure as the underlying cause of death, affecting the number of deaths in the Nephritis, nephrotic syndrome, and nephrosis and Diabetes categories. These changes directly affect deaths with mention of Renal failure and other associated conditions, such as Diabetes mellitus with renal complications [3]. The result is

a decrease in the number of deaths for Nephritis, nephrotic syndrome, and nephrosis and an increase in the number of deaths for Diabetes mellitus. Therefore, trend data for these two causes of death should be interpreted with caution. SPSS, which stands for Statistical Package for the Social Sciences, is a powerful software tool used for statistical analysis and data management. Originally developed by IBM, SPSS provides a user-friendly interface that allows researchers and analysts to perform a wide range of statistical analyses, from basic descriptive statistics to advanced modeling techniques. After defining the variable view, the data is then inputted into the data view. The next step is to perform a descriptive statistic using our SPSS. This statistical tool was used to perform these analytics in the variable view of each column.

3. RESULTS AND INTERPRETATION

The Mortality in 1980 and 2019 shares a similar pattern in variable statistical variation in terms of outcome, and the increased population growth from 1980 as compared to 2019 should be a factor to be considered in the interpretation of the results. The ten most common causes of death vary in relation to age categorization. Stratifications (categorization) based on age are >1,1-4, 5-14, 15-24, 25-44, 45-65, and above 65. The graphical distributions based on these age categorizations further match the most common causes of death. Then, "year (1980) versus year (2019)" comparisons were made, and data was analyzed appropriately with annotations [see Figs. 1-9 and Tables 1-4]. Descriptive analysis revealed a mode i.e. the most frequent age rank is 1 which corresponds to the age rank" Under 1 year" group, this indicates that the most frequent age group to which mortality takes place is infants under 1 year of age.

In infancy, the most common cause of death is congenital anomaly for both years, followed by sudden infant death syndrome (SIDs), but unintentional injuries are the most common by age 1-4. Then, congenital anomaly, malignancy, and suicide are next to congenital anomaly and SIDs in both years [Figs. 1-2]. There were generally more deaths in 2019 than in 1980, but in 1980, the common cause of death from birth till the age of 24 remained higher, with unintentional injuries, malignancy, congenital anomaly, homicide, and suicide taking the lead [Figs. 1-4]. Death from unintentional injuries is significantly high from the age of 1 to 44 and

distantly followed by malignancy [Figs 2-7]. In contrast to many age categories,15 -24 showed a higher rate of homicide and suicide than malignancy as the second most common cause of death, and the pattern is the same for both years [Fig. 4].

Heart disease and malignant are the most common cause of death after the age of 44 [Figs 6-9]. The highest mortality rates for ages 45-65 are cardiovascular disease and were nearly the same in 1980 and 2019. Most other causes, including cerebrovascular diseases (stroke), Pneumonia, influenza, chronic obstructive pulmonary diseases, diabetes mellitus, unintentional injuries, nephritis/nephrotic syndrome/and nephrosis, and chronic liver disease and cirrhosis, have seen an increase in the number of deaths in 2019 in the group older than 65 [Fig. 9].

The Pearson correlation analysis indicates a strong positive linear trend (r = 0.947, p < 0.01) between the number of fatalities in 1980 and 2019(Table 2). There is a strong positive correlation between the number of deaths attributed to all causes for males and females, indicated by the Pearson correlation coefficient of 0.996. The p-value for the correlation coefficient is significant (p < 0.001) (Table 3). The variability in the number of deaths is higher among males (74.4855) than females. Male deaths are higher, and female is barely over 40% of total deaths (Table 4). There is an upward trend in death in both years (1980 and 2019, suggesting that for every increase in the number of deaths in 1980 (x), there is an expected increase of 1.01 deaths in 2019 (y). The Coefficient of Determination (R² value) of 0.897 indicates that approximately 89.7% of the variance in the number of deaths in 2019 can be explained by its linear relationship with the number of deaths in 1980(Fig. 9).

In conclusion, the mean number of deaths across all age groups in the United States has increased from 1980 to 2019, with the most significant increase observed in the "65 years and over" category. This could be due to various factors, including changes in population size, advances in medical technology, changes in lifestyle and health behaviors, and more. Please note that this is an interpretation based on the data presented in the graph, and additional context may be necessary for a more comprehensive understanding.
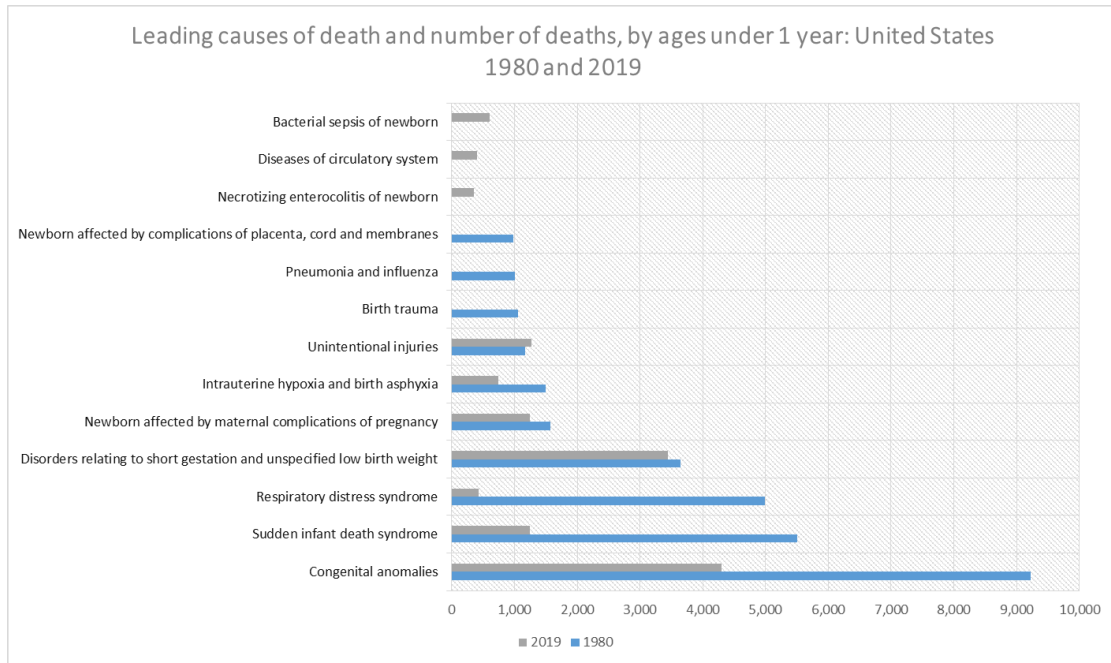
Fig. 1. The chart above illustrates the leading causes of death for children under one year in the United States for the years 1980 and 2019

I. *Congenital Anomalies: In both 1980 and 2019, congenital anomalies were the leading cause of infant death. However, there was a significant reduction in the number of deaths, dropping from 9,220 in 1980 to 4,301 in 2019.*

II. *Sudden Infant Death Syndrome (SIDS): SIDS was the second leading cause of death in 1980, with 5,510 deaths. By 2019, the number of deaths had significantly declined to 1,248.*

III. *Respiratory Distress Syndrome: Deaths due to respiratory distress syndrome decreased dramatically, from 4,989 in 1980 to only 424 in 2019, reflecting improved neonatal care.*

IV. *Disorders Relating to Short Gestation and Low Birth Weight: This category remained relatively consistent over the years, with 3,648 deaths in 1980 and 3,445 in 2019.*

V. *Newborns Affected by Maternal Complications of Pregnancy: In 1980, 1,572 deaths were attributed to maternal complications, compared to a slightly lower number of 1,248 in 2019.*

VI. *Intrauterine Hypoxia and Birth Asphyxia: There was a notable decline in deaths due to hypoxia and asphyxia, from 1,497 in 1980 to 742 in 2019.*

VII. *Unintentional Injuries: Deaths from unintentional injuries saw a slight increase from 1,166 in 1980 to 1,266 in 2019.*

VIII. *Birth Trauma: Data for birth trauma was reported in 1980, with 1,058 deaths, but no data is available for 2019.*

IX. *Pneumonia and Influenza: In 1980, pneumonia and influenza caused 1,012 infant deaths, but no comparable data is available for 2019.*

X. *Other Causes (Necrotizing Enterocolitis, Circulatory Diseases, and Bacterial Sepsis): These causes were not recorded in 1980 but appear in 2019 data, with 354 deaths from necrotizing enterocolitis, 406 from circulatory diseases, and 603 from bacterial sepsis.*

Summary: *Infant mortality rates have improved significantly from 1980 to 2019, with declines in most causes of death. Advances in neonatal care, medical technology, and preventive measures have contributed to this overall reduction in infant mortality.*
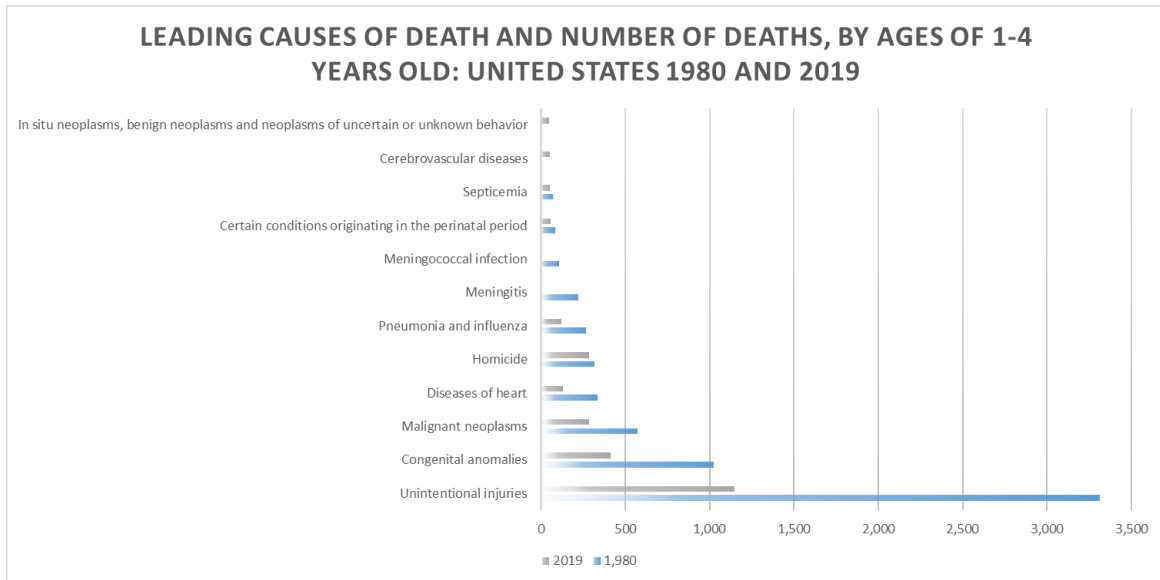
Fig. 2. The chart titled "Leading causes of death and number of deaths, by ages of 1-4 years old in the United States [compares data from two different years, 1980 and 2019]

I.   *Unintentional Injuries: In both 1980 and 2019, unintentional injuries were the leading cause of death for children aged 1-4 years. However, the number of deaths significantly decreased from 3,313 in 1980 to 1,149 in 2019.*

II. *Congenital Anomalies: Deaths from congenital anomalies also saw a substantial reduction, declining from 1,026 deaths in 1980 to 416 in 2019.*

III. *Malignant Neoplasms: The number of deaths due to malignant neoplasms (cancers) decreased from 573 in 1980 to 285 in 2019, showing improvements in early detection and treatment.*

IV. *Diseases of the Heart: There was a notable decline in deaths related to heart diseases, from 338 in 1980 to 133 in 2019.*

V.   *Homicide: Deaths due to homicide remained relatively stable, with 319 deaths in 1980 compared to 284 in 2019.*

VI. *Pneumonia and Influenza: Deaths from pneumonia and influenza were reduced by more than half, from 267 deaths in 1980 to 122 in 2019, reflecting advances in vaccines and treatment.*

VII. *Meningitis and Meningococcal Infection: In 1980, meningitis caused 223 deaths and meningococcal infection caused 110 deaths. However, no comparable data is available for these causes in 2019, likely reflecting medical advances and vaccines.*

VIII. *Certain Conditions Originating in the Perinatal Period: Deaths from perinatal conditions slightly decreased, from 84 in 1980 to 57 in 2019.*

IX. *Septicemia: The number of deaths due to septicemia declined from 71 in 1980 to 53 in 2019.*

X.   *Other Causes (Cerebrovascular Diseases and Neoplasms of Uncertain Behavior): These causes appear in 2019 data but not in 1980, with 52 deaths from cerebrovascular diseases and 49 from benign neoplasms or neoplasms of uncertain behavior.*

Summary: *The mortality rate for children aged 1-4 years has decreased significantly between 1980 and 2019, especially for unintentional injuries, congenital anomalies, and infectious diseases. Advances in medical care, vaccinations, and prevention strategies have contributed to the overall decline in childhood deaths.*
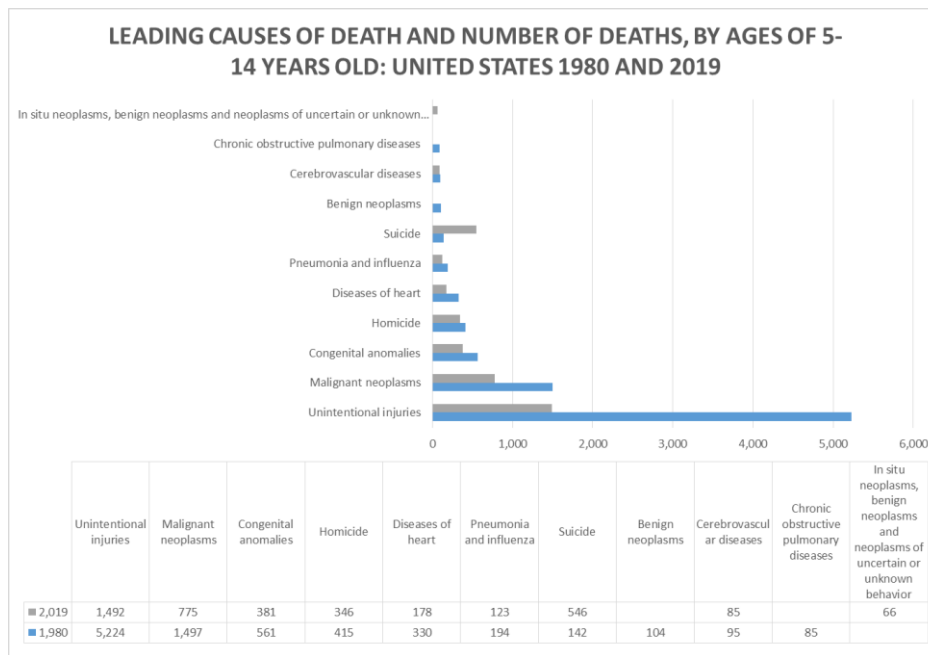
Fig. 3. The chart is titled "Leading causes of death and number of deaths, by ages of 5-14 years: United States, 1980 and 2019". It compares the number of deaths in the United States for children aged 5-14 years due to various causes in the years 1980 and 2019

I.   *Unintentional Injuries: In both 1980 and 2019, unintentional injuries were the leading cause of death among children, but the number of deaths significantly dropped from 5,224 in 1980 to 1,492 in 2019.*

II. *Malignant Neoplasms: The number of deaths due to malignant neoplasms decreased from 1,497 in 1980 to 775 in 2019, reflecting advances in cancer treatment and early detection.*

III. *Congenital Anomalies: Deaths from congenital anomalies declined from 561 in 1980 to 381 in 2019, indicating improvements in medical intervention for birth defects.*

IV. *Homicide: Homicide deaths remained somewhat stable, with 415 in 1980 and 346 in 2019, showing only a slight decrease over the years.*

V.   *Diseases of the Heart: There was a notable reduction in deaths due to heart diseases, falling from 330 in 1980 to 178 in 2019.*

VI. *Pneumonia and Influenza: Deaths from pneumonia and influenza decreased from 194 in 1980 to 123 in 2019, thanks to improved healthcare and vaccination efforts.*

VII. *Suicide: Unlike other causes, suicide deaths rose significantly, increasing from 142 in 1980 to 546 in 2019, highlighting growing concerns about mental health in this age group.*

VIII. *Benign Neoplasms: In 1980, 104 deaths were attributed to benign neoplasms, but no equivalent data was recorded for 2019.*

IX. *Cerebrovascular Diseases: Deaths related to cerebrovascular diseases remained relatively stable, with 95 deaths in 1980 and 85 in 2019.*

X.   *Other Causes (COPD, In Situ Neoplasms, Benign Neoplasms): Chronic obstructive pulmonary disease (COPD) caused 85 deaths in 1980, but no data is available for 2019. In 2019, 66 deaths were attributed to in situ neoplasms, benign neoplasms, and neoplasms of uncertain behaviour.*

Summary: *From 1980 to 2019, childhood mortality rates from most leading causes, such as unintentional injuries, malignant neoplasms, and heart diseases, have decreased significantly. However, the rise in suicide deaths during this period raises concerns about mental health. Advances in medical care, public health initiatives, and preventive measures have contributed to the overall decline in mortality.*
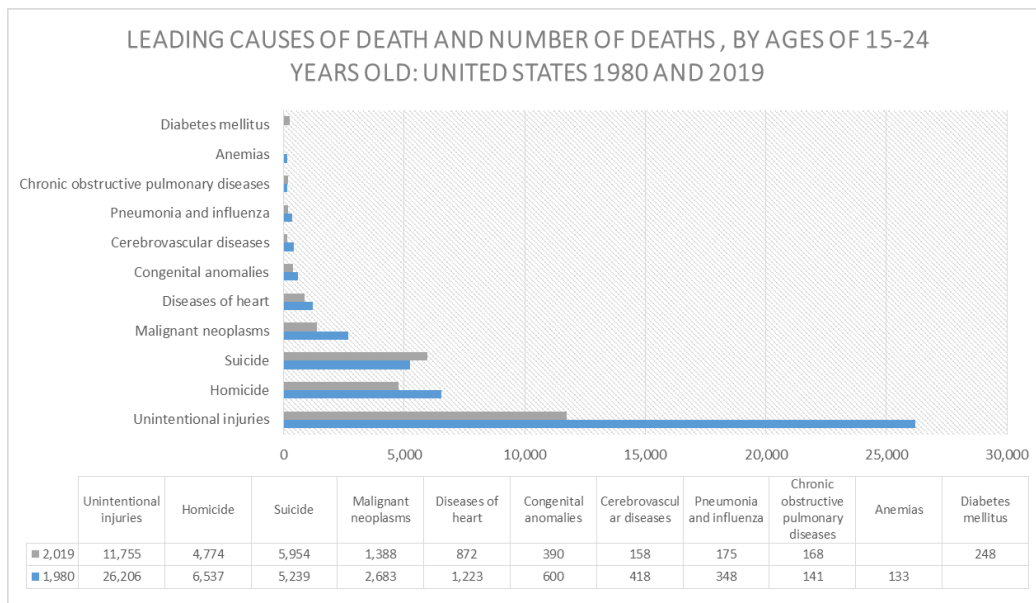
LEADING CAUSES OF DEATH AND NUMBER OF DEATHS , BY AGES OF 15-24 YEARS OLD: UNITED STATES 1980 AND 2019

	Unintentional injuries	Homicide	Suicide	Malignant neoplasms	Diseases of heart	Congenital anomalies	Cerebrovascular diseases	Pneumonia and influenza	Chronic obstructive pulmonary diseases	Anemias	Diabetes mellitus
2,019	11,755	4,774	5,954	1,388	872	390	158	175	168		248
1,980	26,206	6,537	5,239	2,683	1,223	600	418	348	141	133	

Fig. 4. The chart is titled "Leading causes of death and number of deaths, by ages of 15-24 years: United States, 1980 and 2019." It compares the number of deaths in the United States for children aged 5-14 years due to various causes in the years 1980 and 2019

I. *Unintentional Injuries: Unintentional injuries were the leading cause of death for individuals aged 15-24 in both 1980 and 2019. However, the number of deaths saw a significant decline, from 26,206 in 1980 to 11,755 in 2019.*

II. *Homicide: Homicide deaths decreased from 6,537 in 1980 to 4,774 in 2019, showing some improvement but remaining a serious issue for this age group.*

III. *Suicide: Suicide rates slightly increased over time, rising from 5,239 deaths in 1980 to 5,954 in 2019, reflecting growing concerns about mental health among young adults.*

IV. *Malignant Neoplasms: Deaths due to malignant neoplasms decreased significantly, from 2,683 in 1980 to 1,388 in 2019, indicating progress in cancer treatment and early detection.*

V. *Diseases of the Heart: Heart disease-related deaths dropped from 1,223 in 1980 to 872 in 2019, likely due to improvements in healthcare and awareness of heart health.*

VI. *Congenital Anomalies: Deaths from congenital anomalies declined from 600 in 1980 to 390 in 2019, reflecting advancements in medical care for birth defects.*

VII. *Cerebrovascular Diseases: There was a significant reduction in deaths from cerebrovascular diseases, from 418 in 1980 to 158 in 2019.*

VIII. *Pneumonia and Influenza: Deaths from pneumonia and influenza were nearly halved, decreasing from 348 in 1980 to 175 in 2019, showing progress in treatment and vaccination.*

IX. *Chronic Obstructive Pulmonary Diseases (COPD): Deaths from COPD remained relatively stable, with 141 deaths in 1980 and 168 in 2019.*

X. *Other Causes (Anemias, Diabetes Mellitus): In 1980, 133 deaths were attributed to anemias, but no data is available for 2019. Conversely, diabetes mellitus was reported with 248 deaths in 2019 but was not recorded in 1980.*

Summary: *Over the four decades from 1980 to 2019, there has been a notable decline in deaths from unintentional injuries, homicide, malignant neoplasms, and heart diseases among individuals aged 15-24. However, suicide rates increased, highlighting a growing concern for mental health in young adults. Advances in medical treatments, preventive care, and safety initiatives have contributed to the overall reduction in mortality for most causes.*
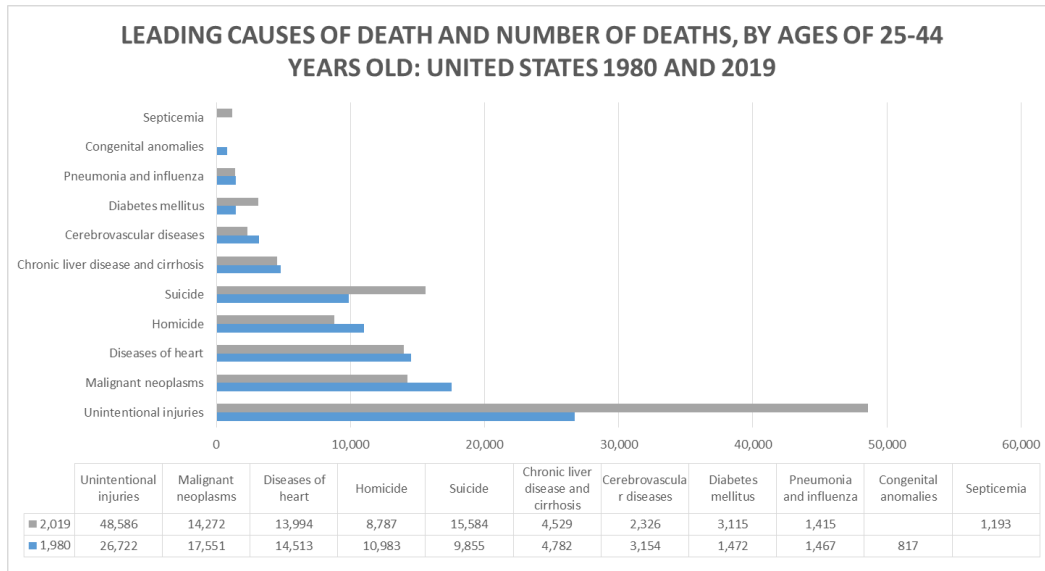
LEADING CAUSES OF DEATH AND NUMBER OF DEATHS, BY AGES OF 25-44 YEARS OLD: UNITED STATES 1980 AND 2019

	Unintentional injuries	Malignant neoplasms	Diseases of heart	Homicide	Suicide	Chronic liver disease and cirrhosis	Cerebrovascular diseases	Diabetes mellitus	Pneumonia and influenza	Congenital anomalies	Septicemia
■2,019	48,586	14,272	13,994	8,787	15,584	4,529	2,326	3,115	1,415		1,193
■1,980	26,722	17,551	14,513	10,983	9,855	4,782	3,154	1,472	1,467	817	

Fig. 5. The chart is titled "Leading causes of death and number of deaths, by ages of 25-44 years: United States, 1980 and 2019." It compares the number of deaths in the United States for children aged 5-14 years due to various causes in the years 1980 and 2019"

I.   *Unintentional Injuries: The leading cause of death in both 1980 and 2019, with a significant increase from 26,722 deaths in 1980 to 48,586 in 2019.*

II. *Malignant Neoplasms: Deaths from malignant neoplasms decreased slightly, from 17,551 in 1980 to 14,272 in 2019, reflecting improvements in cancer treatment and early detection.*

III. *Diseases of the Heart: Deaths related to heart diseases slightly decreased from 14,513 in 1980 to 13,994 in 2019, possibly due to better management of heart conditions.*

IV. *Homicide: Deaths from homicide declined from 10,983 in 1980 to 8,787 in 2019, though it remains a significant cause of death in this age group.*

V.   *Suicide: Unlike many other causes, suicide rates increased significantly, from 9,855 deaths in 1980 to 15,584 in 2019, highlighting mental health as a growing concern.*

VI. *Chronic Liver Disease and Cirrhosis: Deaths from chronic liver disease and cirrhosis remained relatively stable, with 4,782 deaths in 1980 and 4,529 in 2019.*

VII. *Cerebrovascular Diseases: Deaths from cerebrovascular diseases decreased from 3,154 in 1980 to 2,326 in 2019.*

VIII. *Diabetes Mellitus: Diabetes-related deaths more than doubled, from 1,472 in 1980 to 3,115 in 2019, indicating a rise in diabetes prevalence or complications.*

IX. *Pneumonia and Influenza: Deaths from pneumonia and influenza remained nearly the same, with 1,467 deaths in 1980 and 1,415 in 2019.*

X.   *Congenital Anomalies: Congenital anomalies accounted for 817 deaths in 1980, but no comparable data is available for 2019 in this chart.*

XI. *Septicemia: Septicemia appeared as a new cause of death in 2019, with 1,193 deaths recorded.*

Summary: *The overall trend for the 25-44 age group from 1980 to 2019 shows a significant increase in deaths from unintentional injuries and suicide. However, deaths from malignant neoplasms, heart diseases, and cerebrovascular diseases have decreased. This data highlights the importance of mental health and injury prevention, while chronic health conditions such as diabetes and liver disease continue to impact mortality in this age group.*

LEADING CAUSES OF DEATH AND NUMBER OF DEATHS, BY AGES OF 45-64 YEARS OLD: UNITED STATES 1980 AND 2019

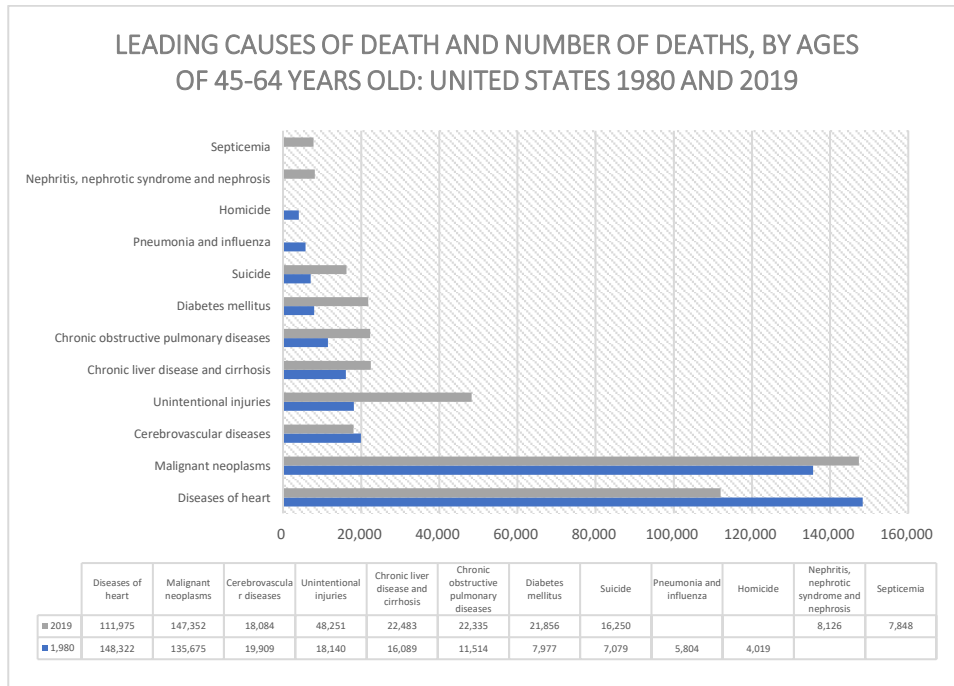|	Diseases of heart	Malignant neoplasms	Cerebrovascular diseases	Unintentional injuries	Chronic liver disease and cirrhosis	Chronic obstructive pulmonary diseases	Diabetes mellitus	Suicide	Pneumonia and influenza	Homicide	Nephritis, nephrotic syndrome and nephrosis	Septicemia
2019	111,975	147,352	18,084	48,251	22,483	22,335	21,856	16,250			8,126	7,848
1,980	148,322	135,675	19,909	18,140	16,089	11,514	7,977	7,079	5,804	4,019		

Fig. 6. The chart above is a bar chart that compares the leading causes of death for individuals aged 45-64 in the United States between 1980 and 2019

I. *Diseases of the Heart: In 1980, heart disease was the leading cause of death in this age group with 148,322 deaths, which decreased to 111,975 in 2019. This reduction reflects progress in heart health awareness, prevention, and treatment.*

II. *Malignant Neoplasms: Deaths from malignant neoplasms (cancers) increased slightly from 135,675 in 1980 to 147,352 in 2019, showing that cancer remains a leading cause of death for this age group despite advances in treatment.*

III. *Cerebrovascular Diseases: Deaths from cerebrovascular diseases decreased marginally, from 19,909 in 1980 to 18,084 in 2019.*

IV. *Unintentional Injuries: Deaths from unintentional injuries more than doubled, rising from 18,140 in 1980 to 48,251 in 2019, indicating the growing impact of accidents and injuries in middle-aged adults.*

V. *Chronic Liver Disease and Cirrhosis: The number of deaths from chronic liver disease and cirrhosis increased from 16,089 in 1980 to 22,483 in 2019, likely reflecting lifestyle-related health risks.*

VI. *Chronic Obstructive Pulmonary Disease (COPD): Deaths from COPD also nearly doubled, rising from 11,514 in 1980 to 22,335 in 2019.*

VII. *Diabetes Mellitus: Deaths due to diabetes nearly tripled, from 7,977 in 1980 to 21,856 in 2019, indicating a significant increase in diabetes-related complications in middle-aged adults.*

VIII. *Suicide: Deaths by suicide more than doubled, from 7,079 in 1980 to 16,250 in 2019, highlighting a growing mental health crisis.*

IX. *Pneumonia and Influenza: In 1980, pneumonia and influenza caused 5,804 deaths, though no comparable data is provided for 2019.*

X. *Homicide: In 1980, 4,019 deaths were attributed to homicide, but no data is available for 2019.*

XI. *Other Causes (Nephritis, Septicemia): In 2019, nephritis, nephrotic syndrome, and nephrosis accounted for 8,126 deaths, and septicemia caused 7,848 deaths. These causes were not recorded in the 1980 data.*

Summary*: Between 1980 and 2019, deaths from heart disease and cerebrovascular diseases decreased, while unintentional injuries, diabetes, liver disease, COPD, and suicide saw significant increases. Malignant neoplasms remained a major cause of death, with a slight rise in deaths. The data reflects the growing impact of lifestyle-related diseases and mental health challenges among middle-aged adults.*
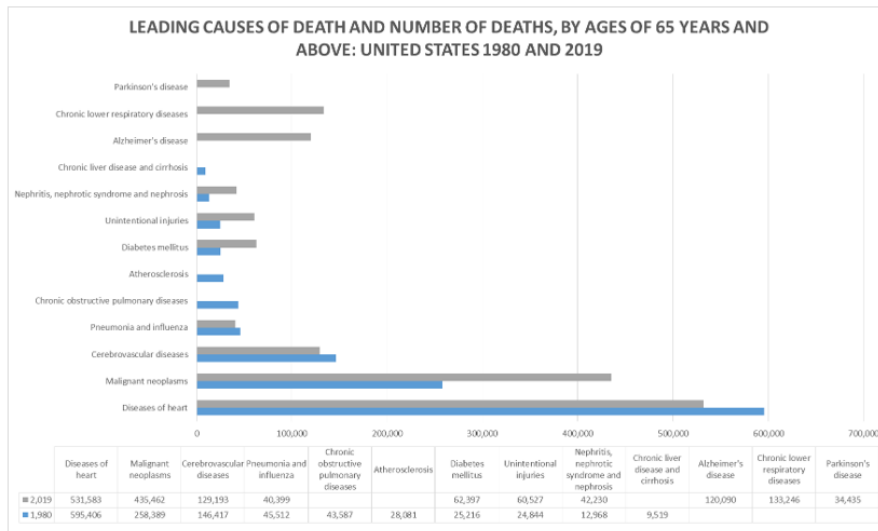
Fig. 7. The chart compares the leading causes of death among individuals aged 65 and above in the United States between 1980 and 2019

I.   *Diseases of the Heart: While heart disease remained the leading cause of death for individuals aged 65 and above, the number of deaths decreased from 595,406 in 1980 to 531,583 in 2019. This reduction reflects progress in managing cardiovascular health, although it still remains a significant concern.*

II. *Malignant Neoplasms (Cancers): Deaths from malignant neoplasms increased substantially, from 258,389 in 1980 to 435,462 in 2019, reflecting the growing burden of cancer among the elderly despite advancements in treatment.*

III. *Cerebrovascular Diseases: The number of deaths due to cerebrovascular diseases, such as strokes, decreased from 146,417 in 1980 to 129,193 in 2019, showing some improvement in stroke prevention and treatment.*

IV. *Pneumonia and Influenza: Deaths from pneumonia and influenza slightly declined from 45,512 in 1980 to 40,399 in 2019, possibly due to better vaccination programs and healthcare.*

V.   *Chronic Obstructive Pulmonary Disease (COPD): In 1980, 43,587 deaths were attributed to COPD, though more specific data for chronic lower respiratory diseases is provided for 2019, which reached 133,246 deaths. This suggests an increasing burden from chronic respiratory diseases.*

VI. *Atherosclerosis: Atherosclerosis caused 28,081 deaths in 1980, but there is no equivalent data in 2019, possibly because related conditions (like heart disease) are categorized differently today.*

VII. *Diabetes Mellitus: Deaths from diabetes more than doubled, from 25,216 in 1980 to 62,397 in 2019, reflecting the growing prevalence of diabetes and its complications in older adults.*

VIII.*Unintentional Injuries: Deaths from unintentional injuries more than doubled, from 24,844 in 1980 to 60,527 in 2019, highlighting increasing risks related to falls and other accidents in older populations.*

IX. *Nephritis, Nephrotic Syndrome, and Nephrosis: Deaths from kidney-related diseases increased significantly, from 12,968 in 1980 to 42,230 in 2019, underscoring the growing impact of renal disease in the elderly.*

X.   *Other Causes (Chronic Liver Disease, Alzheimer's, Parkinson's): Chronic liver disease and cirrhosis accounted for 9,519 deaths in 1980, but Alzheimer's disease (120,090 deaths) and Parkinson's disease (34,435 deaths) appeared as new major causes of death by 2019. This reflects the rising incidence of neurodegenerative diseases in an aging population.*

Summary*: From 1980 to 2019, there was a decrease in deaths from heart disease and cerebrovascular diseases among individuals aged 65 and older. However, deaths from cancer, diabetes, unintentional injuries, kidney diseases, and neurodegenerative conditions such as Alzheimer's and Parkinson's disease have significantly increased. The data reflects an evolving pattern of chronic and age-related conditions affecting the elderly.*
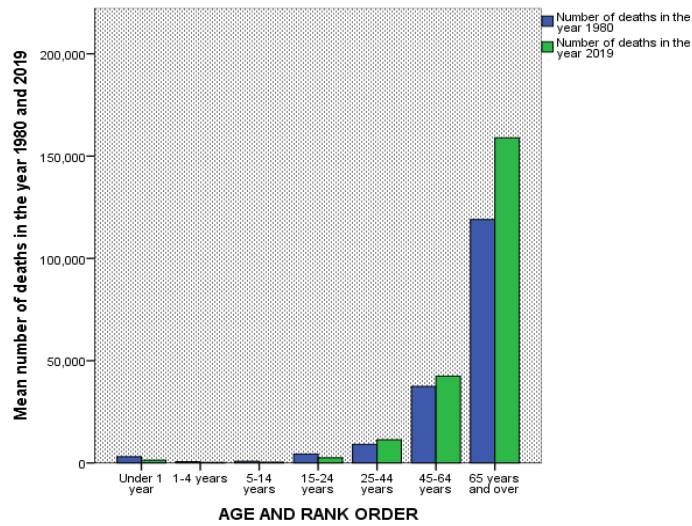
Fig. 8. This image is a bar graph comparing the mean number of deaths across different age groups between 1980 and 2019

The image shared is a bar graph comparing the mean deaths between 1980 and 2019 across different age groups. Here are some key observations:

I.   **Under one year:** *A slight increase in the mean number of deaths in 2019 compared to 1980.*

II.   **1-4 years:** *The mean number of deaths in 2019 is slightly higher than in 1980.*

III. **5-14 years:** *The mean number of deaths in 2019 is slightly higher than in 1980.*

IV.   **15-24 years:** *The mean number of deaths in 2019 is slightly higher than in 1980.*

V.   **25-44 years:** *The mean number of deaths in 2019 is significantly higher than in 1980.*

VI.   **45-64 years:** *The mean number of deaths in 2019 is significantly higher than in 1980.*

VII. **65 years and over:** *The mean number of deaths in 2019 is significantly higher than in 1980, with the most noticeable increase observed in this category.*

Table 1. Summary of descriptive statistical finding

Statistics		Age and Rank Order	Causes of Death	Number of Deaths in the year 1980	Number of Deaths in the Year 2019	Causes_of_Death_2019 > 1 & Causes_of_Death > 1 (Filter)	Causes of Death in the year 2019
N	Valid	70	70	70	70	70	70
	Missing	0	0	0	0	0	0
Mean		4.00	14.69	24927.70	31065.44	1.00	20.20
Median		4.00	13.00	3233.50	1401.50	1.00	19.00
Mode		1[a]	8[a]	1497	49[a]	1	8
Std. Deviation		2.014	8.075	80724.366	85788.632	.000	9.106
Variance		4.058	65.204	6516423307.981	7359689406.743	.000	82.916
Kurtosis		-1.253	-.628	37.633	23.144		-1.107
Std. Error of Kurtosis		.566	.566	.566	.566	.566	.566
Sum		280	1028	1744939	2174581	70	1414
a. Multiple modes exist. The smallest value is shown							

Age and Rank Order (Years):

- **Mean:** *The rank order is 4.00, corresponding to the age group of 15–24 years.*
- **Median:** *The value of the data falls within the 15–24 years age group.*
- **Mode:** *The mode is 1ª, which suggests that they have equal S modes or perhaps multiple modes.*
- **Standard Deviation:** *The standard deviation is 2.013, indicating that the age distribution has relatively low variability around the mean.*

The dataset's mean and median age of individuals is falls between 15-24 years. The mode indicates that there are multiple modes, i.e., equal frequencies. The negative kurtosis value suggests a distribution with lighter tails than a normal distribution, indicating fewer extreme values.

Table 2. Pearson Correlations (Year)

		Number of deaths in the year 1980	Number of deaths in the year 2019
Number of deaths in the year 1980	Pearson Correlation	1	.947[**]
	Sig. (2-tailed)		.000
	N	70	70
Number of deaths in the year 2019	Pearson Correlation	.947[**]	1
	Sig. (2-tailed)	.000	
	N	70	70

[**]. Correlation is significant at the 0.01 level (2-tailed)

By using Pearson's to describe the relationship between two variables. Its results range between -1 and +1; 0 indicates no relationship, while values greater than 0.5 indicate a strong correlation, and results lower than 0.5 indicate a low correlation. The Pearson correlation analysis indicates a strong positive linear trend (r = 0.947, p < 0.01) between the fatalities in 1980 and 2019. This indicates that whether the number of fatalities in 1980 rises or decreases, the number of deaths in 2019 will follow accordingly. The statistical significance of the correlation shows that it is unlikely to be due to chance alone.

Table 3. Pearson Correlation (Gender)

Correlations			
		All causes (Male)	All causes (Female)
Pearson Correlation	All causes (Male)	1.000	.996
	All causes (Female)	.996	1.000
Sig. (1-tailed)	All causes (Male)	.	.000
	All causes (Female)	.000	.
N	All causes (Male)	20	20
	All causes (Female)	20	20

I. **Pearson Correlation**: *There is a strong positive correlation between the number of deaths attributed to all causes for males and females, indicated by the Pearson correlation coefficient of 0.996. This suggests that as the number of deaths increases for males, there is a corresponding increase in the number of deaths for females, and vice versa.*

II. **Significance (1-tailed)**: *The p-value for the correlation coefficient is significant (p < 0.001), indicating that the observed correlation is unlikely to have occurred by chance.*

III. **Sample Size (N)**: *The correlation analysis is based on 20 male and female observations.*

The descriptive statistics reveal that, on average, males have more deaths attributed to all causes than females, with more significant variability in the number of deaths among males. Additionally, the strong positive correlation coefficient suggests a consistent pattern between the number of deaths for males and females across different causes. This information provides valuable insights into mortality patterns and may inform further research or public health interventions to address disparities in mortality rates between genders.

Table 4. Regression analysis

Descriptive Statistics			
	Mean	Std. Deviation	N
All causes (Male)	930.440	74.4855	20
All causes (Female)	662.225	44.4044	20

I. **Mean:** *The number of deaths attributed to all causes is higher for males (930.440) than for females (662.225).*

II. **Standard Deviation:** *The variability in the number of deaths is higher among males (74.4855) than females (44.4044).*

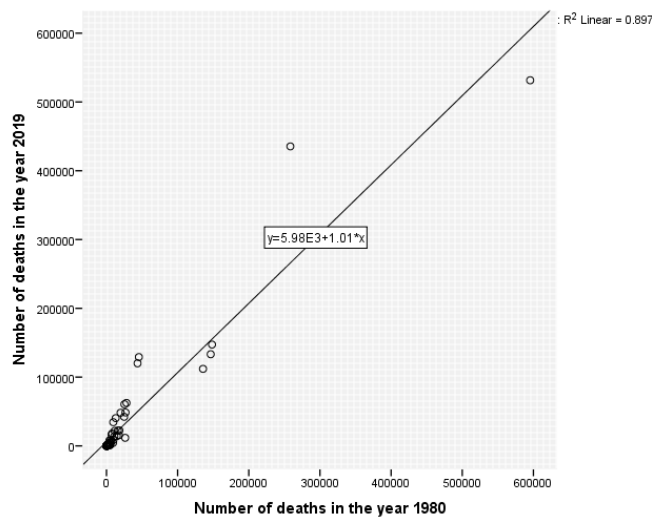III. *Both datasets consist of 20 observations each.*

Fig. 9. The scatter plot depicts a relationship between the number of deaths in 1980 and 2019

The scatter plot depicts a relationship between the number of deaths between 1980 and 2019. Specifically showing

    I.   Strong Positive Correlation: The scatter plot shows a strong positive correlation between the deaths in 1980 and 2019. This is evident from the upward trend of the data points and the line of best fit, indicating that as the number of deaths in 1980 increases, so does the number of deaths in 2019.

    II.   Regression Equation: The regression equation displayed on the chart (y = 5.98E3 + 1.01x) provides a mathematical representation of this relationship. It suggests that for every increase in the number of deaths in 1980 (x), there is an expected increase of 1.01 deaths in 2019 (y), with an intercept of 5.98E3.

    Coefficient of Determination (R^2): The R^2 value of 0.897 indicates that approximately 89.7% of the variance in the number of deaths in 2019 can be explained by its linear relationship with the number of deaths in 1980. This suggests that the regression model fits the data well and effectively captures the association between the two variables.

4. DISCUSSION

Life expectancy for the U.S. population in 2019 was 78.8 years, an increase of 0.1 years from the previous year. The age-adjusted death rate decreased in 2019 by 1.2% in the previous year. In 2019, the ten leading causes of death (heart disease, cancer, unintentional injuries, chronic lower respiratory diseases, stroke, Alzheimer's disease, diabetes, kidney disease, influenza and Pneumonia, and suicide) remained almost the same in adulthood as in 1980 [2,7,8]. Congenital disease, unintentional injuries, homicide, and suicide are the leading causes of death before the age of 45 in 1980 and 2019, with a higher incidence in 1980. Kidney disease became the ninth leading cause in 2019 and was not directly among the first ten leading causes in 1980. The ten leading causes of death accounted for 73.4% of all deaths in the United States in 2019[9]. In 2019, 2,854,838 resident deaths were registered in the United States, almost a million more than in 1980(1,989,841 deaths). The age-adjusted death rate for the total population decreased by

1.2%, and life expectancy at birth increased by 0.1 years [2][7].

Age-adjusted death rates decreased for seven leading causes and increased for one. Life expectancy at birth increased by 0.1 years from 78.7 years in 2018 to 78.8 in 2019, mainly because of decreases in Mortality from cancer, chronic lower respiratory diseases, influenza and Pneumonia, suicide, and stroke. In 2019, a total of 20,921 deaths occurred in children under one year, which was fewer infant deaths than in 1980. The IMR decreased for 1 (low birth weight) of the ten leading causes of infant death and increased for 2 (unintentional injuries and necrotizing enterocolitis of newborns).

As earlier discussed, the most frequent age rank is 1 (mode), corresponded to the "Under 1 year" group. The average described by both mean and median indicates that the central group consists of those people aged 15-24 years of age, and the most frequent age group to which mortality takes place is infants under 1 year of age; in this

case replacing the use of mean age with mode.

The study reports a high Coefficient of Determination (R^2 = 0.897), indicating that the model used showed a significant portion of the variability in the data and a strong linear relationship between the deaths in both years under review; meaning that deaths in 1980 can be used to predict deaths in 2019 with a good degree of accuracy. Also, the regression equation displayed on the regression scatterplot (y = 5.98E3 + 1.01x) provided a mathematical representation of their relationship earlier highlighted. Although the data analysis indicated increased in both the total number of deaths and the mortality rate, but the population growth needs to be further analysed in both years based on demographic trend and socioeconomic situations to properly relate to detailed public health implications.

The Pearson's correlation coefficient was used to measure the relationship between the number of deaths for males and females across different causes of death. A value of 0.996 indicated there that males have higher mortality, and greater variability might be indicating that there are some specific factors that plays a role on both genders. For example, the lifestyle differences like men engage on high-risk jobs or behaviours like smoking, alcohol consumption more than females.

The analysis of mortality trends over the past few decades in the United States reveals both progress and areas for continued focus:

Improvements in Survival: We have seen significant improvements in infant survival rates, with fewer babies dying from conditions like congenital anomalies and sudden infant death syndrome (SIDS). This shows that medical care for babies has gotten better.

Positive Trends in Child Health: Overall, fewer children are dying from various causes like accidents and diseases compared to years ago. This suggests that efforts to keep kids safe and healthy have been working.

Concerns for Young Adults: Unfortunately, there has been a rise in deaths among young adults, especially from things like suicide. This highlights the need for better mental health and wellbeing support, especially for young people.

Mixed Picture for Middle-Aged and Older Adults: While some diseases like heart disease have become less deadly, others like cancer and diabetes have become more common causes of death. This tells us that we still have work to do in managing chronic diseases as people get older.

In summary, the examination of mortality rates across several decades highlights achievements and ongoing difficulties in public health. Even if the rates of newborn and child Mortality have decreased, it is still critical to address the alarming increase in the fatalities of young people, especially those caused by suicide. The inconsistent patterns shown in middle-aged and older persons further highlight the continuous requirement for all-encompassing approaches to prevent chronic illnesses and advance general wellbeing in all age groups. To significantly improve people's health outcomes in the U.S., ongoing initiatives in prevention, better access to healthcare, and mental health assistance are essential. In hindsight, there has been progress in saving lives, but we still have challenges to overcome. There is need to increase our focus on prevention, better healthcare access, and support for mental health across all age groups [10]. We can continue to improve the health and wellbeing of people in the United States by adequate funding and more intense collaboration and engagement of stakeholders like health care providers, researchers, policy makers, and the patients in order to ensure we take care of the socioeconomic determinants of health in a wholistic manner.

5. CONCLUSION

There were more deaths in 2019 than in 1980. The common cause of death in 1980 from birth to the age of 24 remains higher, with unintentional injuries, malignancy, congenital anomaly, homicide, and suicide taking the lead. In infancy, the most common cause of death is congenital anomaly for both years, followed by sudden infant death syndrome (SIDs), but unintentional injuries are the most common by age 1-4. 15 -24 years show a higher rate of homicide and suicide than malignancy as the second most common cause of death, and the pattern is the same for both years. The highest mortality rates for ages 45-65 remained cardiovascular disease.

The Pearson correlation has a positive linear trend (r = 0.947, p < 0.01). There is a strong positive correlation between the number of

deaths attributed to all causes for males and females, indicated by the coefficient is significant ($p < 0.001$). The variability in the number of deaths is higher among males (74.4855) than females. Male deaths are higher, and female is barely over 40% of total deaths. There is a positive, upward trend in deaths in both years, meaning that we expected an increase in death by 1.01 units with a Coefficient of Determination (R^2 value) of 0.897 in 2019 for ever deaths observed in 1980. This serves as a reliable **predictor tool** that can be used to predict number of deaths in 2019 based on number of deaths in 1980.

6. LIMITATIONS, DATA AVAILABILITY STATEMENT AND SOURCE

These are secondary data and records have few missing segments and variations from other sources. The raw data supporting the conclusions of this article will be made available by the authors without undue reservation. NOTE: For cause-of-death codes based on ICD–9 in 1980 and ICD–10 in 2019, see Sources and Definitions, Cause of death; Cause-of-death ranking; International Classification of Diseases (ICD).

SOURCE: National Center for Health Statistics, National Vital Statistics System; Vital Statistics of the United States, 1980. Volume II—Mortality, part A. 1985; public-use 2018 Mortality File; and Xu JQ, Murphy SL, Kochanek KD, Arias E. Deaths: Final data for 2019. National Vital Statistics Reports; vol 70 no 8. Hyattsville, MD: National Center for Health Statistics. 2021. Available:https://www.cdc.gov/nchs/data/nvsr/nvsr70/nvsr70-08-508.pdf. See Sources and Definitions, National Vital Statistics System (NVS}

Table LCODAge. Leading causes of death and number of deaths by age: United States, 1980 and 2019

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS DISCLAIMER

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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