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RESEARCH ARTICLE

Suicide trends in Türkiye by gender and suicide methods (2003-2022): A joinpoint regression analysis*

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Abstract

Suicide, which broadly signifies "the act of intentionally causing one's own death," necessitates analysis within socio-psychological cause-and-effect relationships. Suicide is a multidimensional public health issue that needs to be addressed at both individual and societal levels. Approaching suicide as a public health problem requires the continuous and systematic collection, analysis, and dissemination of accurate information about the counts, crude and standardized rates, incidence, prevalence, and characteristics of fatal and non-fatal suicidal behaviors. In this ongoing and systematic process, the examination of the changing trend of suicide cases holds a significant place. This research utilizes joinpoint regression analysis (JRA) to examine the crude rate focusing on overall and gender-specific; and annual percent change of suicide methods in Türkiye, recorded between 2003 and 2022. The findings indicate that the crude suicide rate has increased over a 20-year period, with 2018 being a noteworthy point in the upward trend. While males have shown a consistent increase over the years, females exhibited a decreasing trend until 2017, after which they started to rise. The study also reveals diverse trends in suicide methods over the years. The obtained findings are interpreted in the context of the current situation, and limitations and recommendations are considered.

Keywords: Suicide, Epidemiology, Trend Analysis, Joinpoint Regression, Mental Health

JEL Codes: C46, C88, I18, J11, J19

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1. INTRODUCTION

According to the World Health Organization (WHO) (2021) data, approximately 703,000 individuals die by suicide each year. Based on the 2020 data, around 1.5% of global deaths occurred due to suicide. When examining global causes of death, suicide appears to rank higher than causes such as malaria, HIV-AIDS, various cancer types, and war. In Türkiye, according to the mortality statistics for the year 2022, deaths resulting from suicide constitute less than 1% among the general causes of death. In the data on causes of death in Türkiye, suicide is ranked lower compared to all other causes (Turkish Statistical Institute 2023a). In suicidology research, suicide is emphasized as one of the leading causes of death worldwide. While the rates in Türkiye appear relatively low, the fact that suicide has an impact across all sociodemographic levels indicates that it is a multidimensional public health issue. From this perspective, analyzing the phenomenon of suicide in socio-psychological terms and in terms of cause-and-effect relationships, both individually and collectively, and determining its trajectory over time to make future projections is a necessity.

When global data are examined based on sociodemographic variables, it is observed that males worldwide have a suicide rate 2.3 times higher than females. 58% of suicides occur in age groups under 50, and the highest age-standardized suicide rate is recorded in the group aged 70 and above. According to global data, hanging is the most frequently used method of suicide, followed by self-poisoning and the use of firearms (World Health Organization 2021).

In terms of economic classifications, approximately 77% of deaths are recorded in low- and middle-income countries. Regarding age-standardized suicide rates, high-income countries rank highest at 10.9 per 100,000. Across WHO regions, the highest age-standardized suicide rate is recorded in Africa at 11.2 per 100,000, while the lowest rate is in the Eastern Mediterranean region at 6.4. On a country-specific level, Lesotho ranks highest with 72.4 per 100,000. According to an assessment by the Organization for Economic Co-operation and Development (OECD) (2023) in 2020, South Korea had the highest suicide rate at 24.1 per 100,000. In an epidemiological study conducted in 17 countries, the prevalence of suicidal ideation was found to be 9.2%, suicide plan prevalence was 3.1%, and nonfatal suicide attempt prevalence was 2.7% (Nock et al. 2009: 9-10). While prevalence estimates can vary significantly between countries, it is known that certain characteristics, such as the age of onset of suicide cases and the rate at which suicidal thoughts turn into attempts, overlap across countries.

According to the WHO rankings encompassing data from 179 countries, Türkiye ranks 169th with a suicide rate of 2.4 per 100,000. Among the 42 OECD countries, Türkiye is placed 40th (OECD 2023, World Population Review 2023). In Turkish Statistical Institute (TURKSTAT) suicide database, there were 4,146 recorded suicide cases in 2022 and crude suicide rate is 4.88 per 100,000. Among provinces, Tunceli has the highest crude suicide rate (14.28 per 100,000), while Gümüşhane has the lowest (0.68 per 100,000). It is observed that most suicide cases occur in metropolitan areas. Istanbul having the highest number at 508, followed by Ankara with 277 and İzmir with 206 recorded suicides (Turkish Statistical Institute 2023b).

According to TURKSTAT (Turkish Statistical Institute) data (2023b), 75% of those who die by suicide are male (3,111 individuals), and 25% are female (1,035 individuals). Male suicides occurred most frequently in the 25-29 age group, both in terms of numbers and crude rates, while female suicides were most prevalent in the 15-19 age group. Unlike the global gender trend in suicide cases, in Türkiye, men have a suicide rate three times higher. The age-specific suicide rate, calculated by gender in 2022, is higher in men at 7.31 per 100,000. When examining marital status, 44% of suicide cases were married, 41.2% were never married, 10.2% were divorced, and 4.4% were widowed. In terms of education, the highest suicide rate is observed in the group with a high school diploma or equivalent at 27.8%. For 58% of suicide cases, the reason is recorded as unknown or other. Another significant percentage of suicide cases is recorded due to illness (Turkish Statistical Institute 2023b).

The TURKSTAT data (2023c) indicates that there has been an overall population increase of approximately 11% during the decade from 2013 to 2022. In the same ten-year period, there is a 27.5% increase in the number of suicide cases, with a 19% increase in female suicides and a 31% increase in male suicides. It is known that the main contributing factors to suicide rates include mental health disorders, macroeconomic conditions, economic insecurity and crisis, seasonality, employment and living conditions, isolation, and various social issues such as discrimination (Mann et al. 2005: 2064-2065; Blüml et al. 2013: 4-5; Turecki and Brent 2016: 8-9).

When unusual conditions such as war, pandemics, and economic crises are excluded, societal suicide rates tend to follow a stable trajectory over extended periods. It is accepted that proportional stability facilitates the explanation and comparison of differences between countries and societies. Additionally, suicide rates can vary regionally and between countries by up to tenfold. While regional and country-level variability is partly assumed to be associated with economic and sociocultural differences, it is also thought to stem from the detection and recording of suicide cases in terms of reliability, transparency, ease, or content (Zalsman et al. 2016: 648-650). Examining the data trend, there are independent fluctuations in regions and countries. For example, a decreasing trend in suicide-related deaths has been observed in many European countries and the United States after 1990 (Thomas and Gunnell 2010: 1472-1473; Puzo et al. 2016: 7-9). This decreasing trend has been confirmed for the last two decades, particularly concerning adolescents considered a high-risk group (Kõlves and De Leo 2016: 76). In the middle-aged and older age groups, however, an upward trend in suicide-related deaths has been predominantly identified among men after 1990 (Fond et al. 2016: 3-4; Brazinova et al. 2017: 165-166).

In the Turkish literature, numerous studies conducted in various scientific disciplines on the phenomenon of suicide with different samples can be observed. However, research using comprehensive suicide data is relatively less common. In a study analyzing the trend of suicide cases by age, gender, and method between the years 2002 and 2015 using joinpoint regression analysis, it was found that there was a 2.3% increase in men and a 3.1% decrease in women during the specified years. An increasing trend was observed in all age groups except for the male group aged 65 and over. This study also reveals the method and age groups that show both increasing and decreasing trends over time (Göktaş and Metintaş 2019: 198-202). In another research covering the period between 2002-2015, statistically significant correlations and differences were found between various sociodemographic variables and suicide. Research findings show that men and the urban population had a higher tendency to suicide during the relevant years. It has been revealed that the number of suicides varies according to age and education level (Özcan et al. 2018: 17-32). In a research examining the count and characteristics of suicides between 1974-2013, regional distribution rates were examined using correlation and variance analysis and the findings were shown with thematic maps (Yakar et al. 2017). In another study examining the same dates, time series analysis, unit root and stationarity tests were used. Findings have shown that shocks resulting from economic problems lead to permanent and long-lasting effects on female suicide rates (Akyuz et al. 2020: 1188-1190).

In the relevant literature, there are articles focusing on different year ranges such as 1987-2011, 2007-2019, 2015-2019, 1983-2013, and 1995-2019. Doğan and Toprak (2019) examined the potential effects of age, period and cohort on the trend of suicide between 1983-2013 using a nonlinear regression model and natural spline smoothing functions. In another research covering the years 1987-2011, Doğan et al. (2015: 360-361) used joinpoint regression analysis to examine the change trend over time, the decreases and increases in suicide mortality, and the distribution of suicide methods and age ranges by gender. It was found that the age-standardized suicide rate of men was higher than that of women in the relevant year range. A significant increase was observed in men in all age groups. It has been determined that the most commonly used suicide methods are hanging, poisoning, firearms and jumping. Kartal et al. (2022: 1859-1860) examined suicides between 1995-2019 to identify at-risk populations; comparisons between groups were made using two proportions Z test. An increase in the suicide rate of men was detected between the relevant years, and the most important risk factor was seen to be illness. In an observational-analytical study covering the years 2015-2019, nonparametric comparisons between groups were made based on sociodemographic variables. It has been observed that the suicide rate and rate are higher in men (Emiral et al. 2022: 3-5). Teker (2011: 190) examined suicide mortality rates between 2007-2019 using joinpoint regression analysis. Suicide mortality rate increased in men during this year; decreases in women; observed that there was no statistically significant change in the total rate. However, no research covering the years 2020, 2021, and 2022 could be found.

Suicide is largely a preventable action and a crisis that can be managed with strategic planning. Therefore, effective suicide prevention strategies should be an integral part of public health policies. The precursor to prevention strategies is understanding the current and evolving situation over time. In this study, joinpoint regression analysis (JRA) is used to examine the changes in suicide-related deaths in Türkiye over the decade from 2003 to 2022, focusing on crude suicide rates by gender and the percentage of suicides by method. In the first section, global and Türkiye-specific suicide statistics and current research are included. The second section contains information and descriptive statistics, tables and figures regarding the TURKSTAT data used in the research. Subsequently, the methodology is explained in detail, theoretical information about the joinpoint model is given, and the equations for the APC and AAPC values included in the research are presented. The findings obtained as a result of the JRA were explained with tables and figures and discussed.

2. DATA AND METHOD

2.1. Data

The research utilizes the TURKSTAT suicide statistics database for the years 2003-2022. The selected data year range includes economic crisis and pandemic periods. Since the impact of these phenomena already exists, the last 20 years were examined, considering the sufficient number of observations, in order to exclude the impact of the 2001 crisis. Data on "suicide incidents resulting in death" are sourced from records of the Ministry of Interior General Directorate of Security, Gendarmerie General Command, Ministry of Justice General Directorate of Prisons and Detention Houses, and the General Staff of the Turkish Armed Forces. Additionally, TURKSTAT cause of death data is consulted. The scope of suicide statistics has expanded over time. Data were obtained from records kept by the General Directorate of Security and the Gendarmerie General Command until 2012. From 2012 onwards, records obtained from death certificates, along with those from the Ministry of Justice General Directorate of Prisons and Detention Houses and the General Staff, are included in the database. The database provides access to statistical tables on suicide counts, crude rates, and specific suicide rates based on gender, legal marital status, age group, cause and method, administrative regions, provinces, residence, and educational status.

The suicide statistics are annually published according to the TURKSTAT data publishing calendar. Since the data are publicly available via the TURKSTAT official website[1], it is not required to provide an official permission. As the mass dataset does not contain direct personal content, and there is no researcher-participant contact, such as experimental methods or data collection from samples, ethical committee approval has not been necessary.

The data obtained from TURKSTAT were organized by years, gender, method, number, percentage, total suicide count, and population, making it ready for analysis. Both female and male gender groups, along with various methods such as hanging, taking chemicals, throwing from a high place, drowning, firearms, burning, using a sharp instrument, using natural gas or LPG etc., throwing off a train or another motorized vehicle, and other methods were included in the analysis.

Descriptive statistics of crude suicide rate by gender and percentage by suicide method are presented (Tables 1 and 2). According to the descriptive statistics, the overall crude suicide rate in the general population ranges from 3.58 to 4.95 (. The lowest crude suicide rate was observed in 2011, while the highest crude suicide rate was identified in 2021. The crude suicide rate observed in women ranges from 0.89 to 1.72 . The lowest crude suicide rate in women was recorded in 2017, whereas the highest was observed in 2003. In men, the crude suicide rate ranges from 2.39 to 3.85 . The lowest crude suicide rate in men occurred in 2003, and the highest was recorded in 2021. The average crude suicide rate for men is approximately 2.5 times higher than that of women (Figure 1).

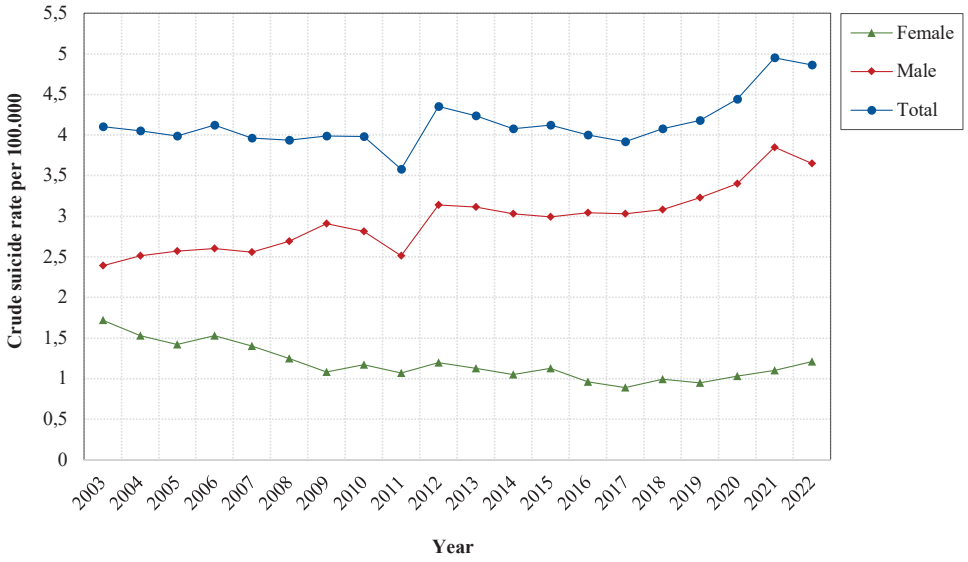

Figure 1. Crude Suicide Rate, 2003-2022

Table 1. Descriptive Statistics of Crude Suicide Rate by Gender, 2003-2022

	2003-2022			
Group	**Min.**	**Max.**	$\bar{x}$	**SD**
Female	0.89	1.72	1.19	0.22
Male	2.39	3.85	2.95	0.39
Total	3.58	4.95	4.14	0.31

Note: $\bar{x}$: Mean; SD: Standard deviation.

According to the descriptive statistics of suicide methods, it is evident that hanging has the highest percentile value average, while gas or LPG etc. has the lowest average . Hanging has consistently been the most frequently used method throughout the relevant years, followed by firearms. In the third position, taking chemicals was prevalent until 2009, after which it was replaced by throwing from a high place . Upon comprehensive examination across all year range, the highest percentile averages were identified sequentially for hanging, firearms, and throwing from a high place. Other methods tend to have relatively lower percentages (Table 2, Figure 2).

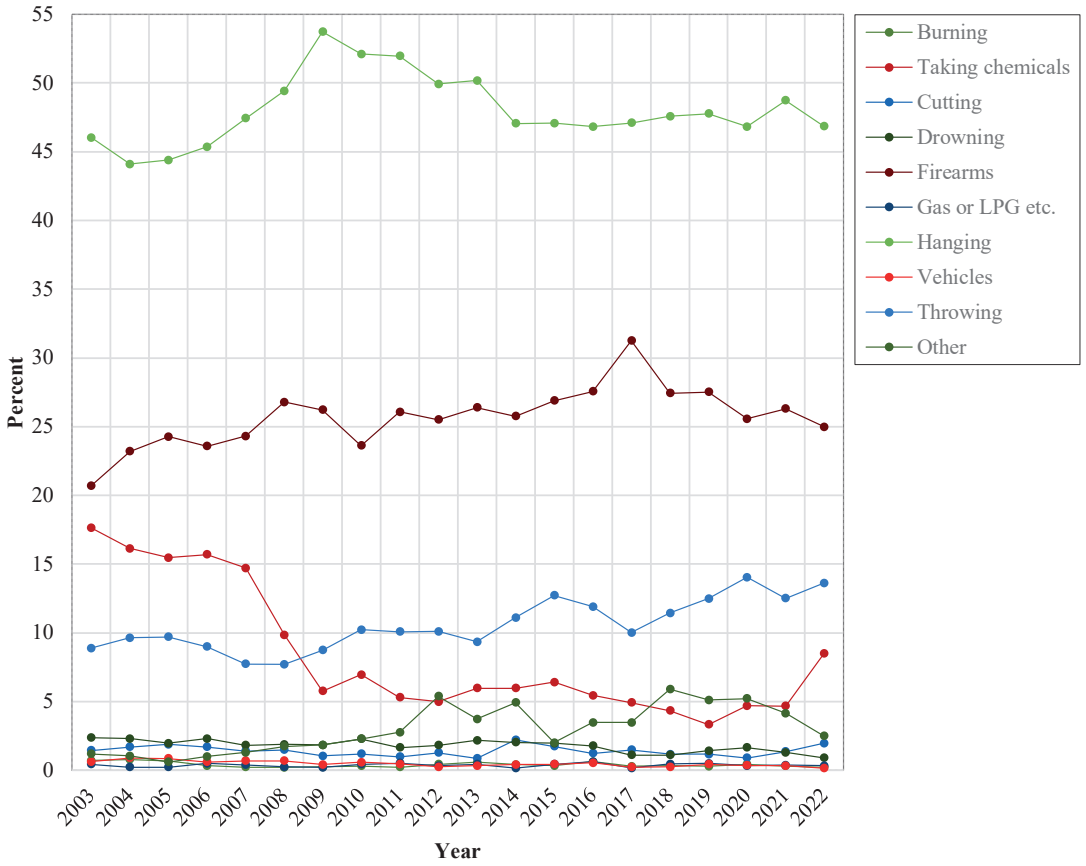

Figure 2. Suicide Method Percentage, 2003-2022

Table 2. Descriptive Statistics of Suicide Method Percentage, 2003-2022

	2003-2022			
Suicide method	**Min.**	**Max.**	$\bar{x}$	**SD**
Burning	0.21	0.77	0.39	0.17
Taking chemicals	3.31	17.63	8.33	4.74
Cutting	0.86	2.20	1.40	0.36
Drowning	0,89	2.36	1.78	0.43
Firearms	20,70	31.25	25.69	2.16
Gas or LPG etc.	0.15	0.62	0.36	0.13
Hanging	44.10	53.72	48.02	2.54
Throwing from a high place	7.70	14.04	10.54	1.85
Throwing off a train or motorized vehicle	0.14	0.88	0.47	0.20
Other	0.59	5.89	2.97	1.68

Note: $\bar{x}$: Mean; SD: Standard deviation.

2.2. Method

The data have been analyzed using joinpoint regression analysis (JRA), a technique particularly useful for modeling time trends in incidence, prevalence, percentage, mortality, and survival statistics etc. JRA used in the analysis of significant changes in various indicators over time due to situations such as health policies, social regulations, crisis situations and states of emergency. In this examination, JRA was conducted using the Joinpoint Regression Software, version 5.0.2, developed by the Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute. Starting from the assumption that there is no statistically significant joinpoint in the trend over time, the software tests the possibilities of one or more breakpoints and incorporates them into the model. Additionally, Statistical Package for the Social Sciences (SPSS) version 25 was used for descriptive statistical analysis of the data. Time series are examined with the assumption that the trend for a certain period will be constant on an annual basis. In social changes, a single model is not sufficient as structural breaks will be seen in the trend. Structural breaks are called piecewise regression, broken line regression, and joinpoint regression.

The theoretical foundations of JRA have been compiled into articles by Kim et al. (2020). JRA is a statistical modeling approach that elucidates the correlation between two variables through a segmented linear regression, which is constrained to maintain continuity throughout, especially at points where the slope of the regression function undergoes changes. Joinpoint regression model fits a series of straight lines to the crude rate, percentage, or values, determining the joinpoints where the trend changes substantially. The joinpoints and location of these are decided by the model and data. Suppose that the data observe $(x_1, y_1), \ldots, (x_n, y_n)$ is crude suicide rate at time x_i and $y_i = \log(y_i)$. The joinpoint model proposed by Kim et al. (2000: 336) assumes:

$$y_i = \log(y_i) = \alpha_1 + \beta_1 x_i + \delta_1 (x_i - \tau_1)^+ + \cdots + \delta_k (x_i - \tau_k)^+ + \epsilon_i, \; i = 1, \ldots, n, \qquad (1)$$

where are indepedent errors, the notation $\alpha^+ = \alpha$ if $\alpha > 0$, and $\alpha^+ = 0$ otherwise. The mean function of y_i is linear segments connected at change-points $\tau_1 < \cdots < \tau_k$ in the model. The undetermined positions of change-points, denoted as τ_1 , and the unspecified quantity of change-points, denoted as k, necessitate estimation based on the available data. In the event that the number of change-points is presumed to be a known value, denoted as $\kappa = K$, the determination of the locations of K joinpoints, represented as $\tau_1, \cdots, \tau_k$, is accomplished through either the grid search approach elucidated by Lerman (1980).

The joinpoints are tested using a series of Monte Carlo permutation tests and Bonferroni correction in multiple comparisons. Operation starts from $k_0 = 0$ (or the minimum value) and continues until the maximum point of k_1. The comprehensive least squares estimations of the regression coefficients are subsequently computed utilizing the determined joinpoints. Following the acquisition of the least squares fit for a model with $\kappa = K$, an iterative process is implemented to ascertain whether the inclusion of joinpoints significantly diminishes the residual sum of squares. The iterative procedure scrutinizes the null hypothesis positing K_0 joinpoints against the

alternative hypothesis proposing K_1 joinpoints, where $K_1 > K_0$. Typically, the iteration commences with K_0 and K_1 being the predefined minimum and maximum number of allowable joinpoints.

In consideration of the non-applicability of classical asymptotic theory in this context, a Monte Carlo permutation test is employed to establish the *p*-value of the test. The initial step involves permuting the residuals derived from fitting the model under the null hypothesis. Subsequently, for each permutation, the permuted residuals are reintegrated into the fitted values, and the permuted data are refitted under the alternative hypothesis. *F*-statistics are then obtained as a measure of goodness-of-fit. The *p*-value for the test is computed based on the distribution of the goodness-of-fit statistics.

Should the null hypothesis be rejected, the test scenario compares H_0: $\kappa = K_0 = k_a + 1$ versus H_1: $\kappa = K_1 = k_b$; otherwise, it compares H_0: $\kappa = K_0 = k_a$ versus H_1: $\kappa = K_1 = K_b - 1$. The testing process is reiterated until, for a certain *K*, the examination of H_0: $\kappa = K$ versus H_1: $\kappa = K + 1$ is executed. Given the multiple testing nature of the procedure, the significance level for each test is adjusted to uphold the overall level under α, representing the probability of overfitting the model. In lieu of the permutation test, model selection methodologies grounded in the Bayes Information Criterion (BIC) or a modified BIC are considered expedient alternatives. Significance level is,

$$\alpha(k_a; k_b) = a/(MAX - k_a) \tag{2}$$

In the final, addressing autocorrelation and heteroscedasticity issues, a series of linked log-linear segments is found between significant joinpoint locations, each segment indicating a short-term trend (APC). A negative APC indicates a decreasing trend, while a positive APC indicates an increasing trend. APC serves as a method for delineating trends in rates over temporal sequences. In this context, the assumption is made that suicide rates undergo alteration at a consistent percentage of the rate observed in the preceding year. Rates exhibiting a uniform percentage change annually manifest linear changes on a logarithmic scale. Hence, to ascertain the APC for a given data series, $\log(Ry) = b_0 + b_1 y$; $\log(Ry)$ is the natural log of the rate in year *y,* the following regression model is employed:

$$\begin{aligned} &\text{From year y to year } y+1 = \left[\frac{R_{y+1} - R_y}{R_y}\right] \times 100 \\ &= \frac{\left\{e^{b_0 + b_1(y+1)} - e^{b_0 + b_1(y)}\right\}}{e^{b_0 + b_1(y)}} \times 100 \\ &= (e^{b_1} - 1) \times 100 \end{aligned} \tag{3}$$

Additionally, the long-term trend (AAPC) and confidence intervals for these trends are calculated. AAPC is computed through an initial estimation of the optimal underlying joinpoint model tailored to suit the data. The AAPC over a designated fixed interval is then determined through a weighted average of the slope coefficients derived from the underlying joinpoint regression model. The weights assigned to each slope coefficient correspond to the length of the respective segment within the specified interval. The conclusive phase of the computation involves transforming this weighted average of slope coefficients into an annual percent change. If we denote as the slope coefficient for the ith segment, with the index *i* referencing the segments within the desired range of years, and ω_i as the length of each segment in the range of years, the calculation is expressed as follows:

$$\left\{exp\left(\frac{\sum \omega_i b_i}{\sum \omega_i}\right) - 1\right\} \times 100 \tag{4}$$

At the first analysis, the calculated crude suicide rate, as the dependent variable, was evaluated with specific to gender over a decade-long period using the total count of suicides and the population of Türkiye as references. Secondly, official rates of suicide methods, as the dependent variable, were assessed over a decade, considering both overall trend and specific to genders. Gender groups were compared by crude rate and methods.

At the analysis process, the grid search method was utilized. Logarithmic transformation was applied to the data. Weighted Bayesian Information Criterion (WBIC), one of the data driven BIC methods, was used in model selection. While the internal application of data dependent selection (DDS) relies on either BIC or BIC3 determined by empirically established cut-off values for the selection statistics, the weighted BIC integrates BIC and BIC3 through a weighted penalty term determined by the data characteristics. Hereby, WBIC was intended to prevent the risk of overfitting. Based on the data points, a minimum of 0 and a maximum of 3 joinpoints were determined.

3. RESULTS

According to the JRA results, a statistically significant AAPC in the crude suicide rate in Türkiye between 2003 and 2022 was identified (AAPC = 1.13, $p < 0.01$). There was an AAP increase of 1.13% over the 20-year period (Table 3). A joinpoint was observed in the year 2018 during this period (Figure 3). The change in the first segment covering the years 2003-2018 was not statistically significant. However, the change in the second segment covering the years 2018-2022 was statistically significant (APC = 5.39, $p < 0.01$). This suggests that the crude suicide rate increased by 5.39% annually between 2018 and 2022 (Table 4).

Table 3. AAPC in Crude Suicide Rate, 20-Years Period Between 2003-2022

Endpoints	AAPC	Lower CI	Upper CI	Test Statistic	*p*-value
2003-2022	1.1367	0.2980	1.9824	2.6602***	0.0078

Note: *: 10%; **: 5%; ***: 1%.

Table 4. APC in Crude Suicide Rate Segments

Segment	APC	Lower CI	Upper CI	Test Statistic	*p*-value
2003-2018	0.0306	-0.5354	0.5998	0.1150	0.9099
2018-2022	5.3946	1.5271	9.4093	2.9955***	0.0090

Note: *: 10%; **: 5%; ***: 1%.

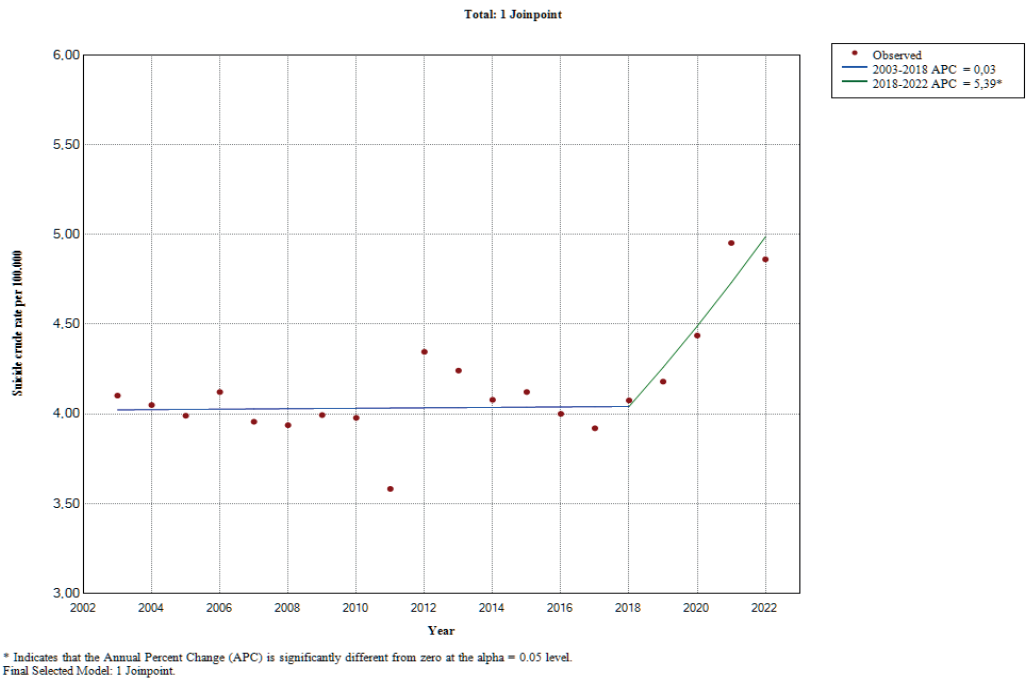

Figure 3. Crude Suicide Rate by Year

As stated in the results obtained from the JRA conducted to determine the changes in crude suicide rates over a 20-year period by gender groups, statistically significant changing in the AAP was identified for females (AAPC = -1.66, p < 0.05) and males (AAPC = 2.07, p < 0.001). It was observed that the crude suicide rate for females experienced a decline of 1.66% in the AAP over the 20-year period. Conversely, for males, there was an increase of 2.07% in the AAP of crude suicide rates over the same timeframe (Table 5).

Table 5. AAPC in Crude Suicide Rate By Gender, 20-Years Period Between 2003-2022

Gender	Endpoints	AAPC	Lower CI	Upper CI	Test Statistic	*p*-value
Female	2003-2022	-1.6654	-2.9346	-0.3796	-2.5337**	0.0112
Male	2003-2022	2.0703	1.6115	2.5311	9.5561***	<0.0001

Note: *: 10%; **: 5%; ***: 1%.

In the JRA graph, a joinpoint in the crude suicide rate for females was observed in 2017 (Graph 3). The APC between 2003-2017, constituting the first segment of the line, and 2017-2022, forming the second segment, are statistically significant. According to the slope of the first segment, the crude suicide rate decreased annually by 3.87% between 2003-2017 (APC = -3.87, $p < 0{,}001$) (Table 6). In contrast, the slope of the second segment indicates that the crude suicide rate increased by 4.78% annually between 2017-2022 (APC = 4.78, $p < 0{,}001$). No joinpoint has been observed in the crude suicide rate for males (Figure 4). According to the results, there has been an annual increase of 2.07% in the crude suicide rate for males between 2003 and 2022 (APC = 2.07, $p < 0{,}001$) (Table 6).

Table 6. APC in Crude Suicide Rate Segments by Gender

Gender	Segment	APC	Lower CI	Upper CI	Test statistic	*p*-value
Female	2003-2017	-3.8701	-4.7883	-2.9431	-8.7657***	< 0.0001
	2017-2022	4.7804	0.0221	9.7652	2.1416**	0.049
Male	2003-2022	2.0703	1.6115	2.5311	9.5561***	< 0.0001

Note: *: 10%; **: 5%; ***: 1%.

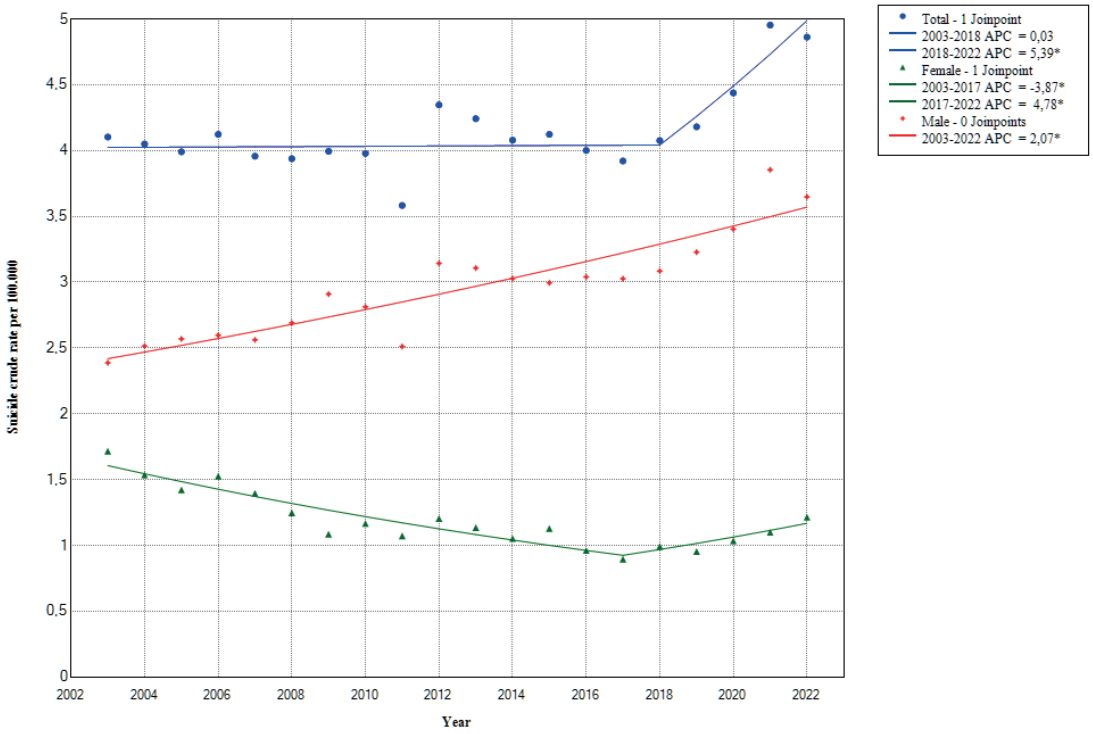

Figure 4. Crude Suicide Rate by Gender

JRA findings indicate statistically significant in AAPC of suicide methods, including drowning (AAPC = -3.16, $p < 0.001$), throwing from a high place (AAPC = 2.54, $p < 0.001$), and throwing off a train or another motorized vehicle (AAPC = -5.53, $p < 0.001$), during the period from 2002 to 2023. Over the 20-year period, there was a 3.16% decrease in the AAP of drowning, a 5.53% decrease in the AAP of throwing off a train or another motorized vehicle, and a 2.54% increase in the AAP of throwing from a high place. The AAPC in the other methods is also statistically significant, with a found increase of 10.28% (AAPC = 10.28, $p < 0.01$) (Table 7).

Table 7. AAPC of Suicide Method Percentage, 20-Years Period Between 2003-2022

Method	Endpoints	AAPC	Lower CI	Upper CI	Test Statistic	*p*-value
Burning	2003-2022	-5.8447	-14.5056	3.6936	-1.2233	0.2212
Taking chemicals	2003-2022	-3.8208	-9.4730	2.1843	-1.2607	0.2074
Cutting	2003-2022	-0.3728	-2.4242	1.7216	-0.3772	0.7104
Drowning	2003-2022	-3.1685	-4.5212	-1.7966	-4.8085***	0.0001
Firearms	2003-2022	0.5613	-0.1716	1.2996	1.4997	0.1336
Gas or LPG etc.	2003-2022	0.5174	-2.3151	3.4321	0.3793	0.7088
Hanging	2003-2022	0.2685	-0.7734	1.3213	0.5032	0.6148
Throwing from a high place	2003-2022	2.5477	1.7693	3.3321	6.9365***	< 0.0001
Throwing off a train or motorized vehicle	2003-2022	-5.5300	-7.5305	-3.4862	-5.5840***	< 0.0001
Other	2003-2022	10.2832	3.6732	17.3145	3.1039***	0.0019

Note: *: 10%; **: 5%; ***: 1%.

In the JRA graph, joinpoints for burning are observed in 2008 and 2013, with 2 joinpoints; for taking chemicals, in 2006, 2009, and 2020, with 3 joinpoints; for firearms, in 2017, with 1 joinpoint; for hanging, in 2006, 2009 and 2015, with 3 joinpoints; and for other methods, in 2012, with 1 joinpoint (Figure 5).

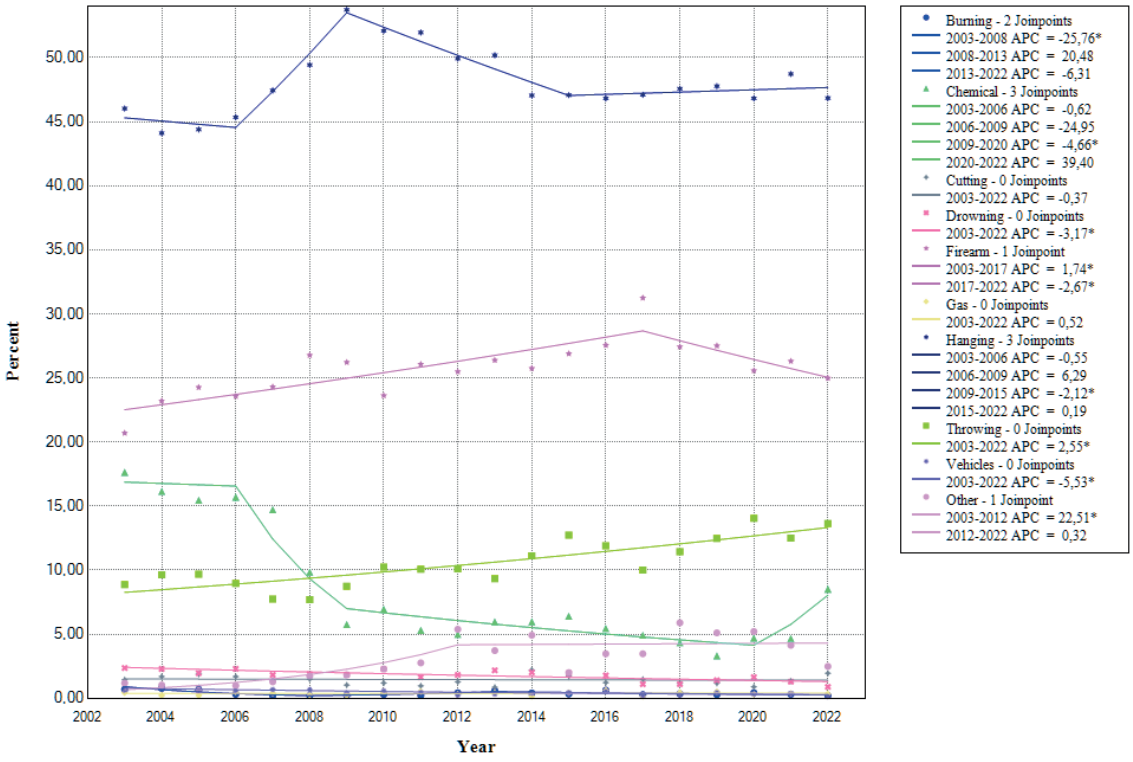

Figure 5. Suicide Method Percent by Year

In burning, the APC during the first segment of the line, covering the years 2003 to 2008, is statistically significant (APC = -25.76, $p < 0.01$). According to the slope value of the first segment, the percentage of burning decreased annually by 25.76% from 2003 to 2008. The APCs for the second segment (2008-2013) (APC = 20.48, $p > 0.05$) and the third segment (2013-2022) (APC = -6.30, $p > 0.05$) were not statistically significant. For taking chemicals, based on the slope value of the third segment, there was a statistically significant annual decrease of 4.66% from 2009 to 2020 (APC = -4.66, $p < 0.05$). The APCs for the first (2003-2006) (APC = -0.61, $p > 0.05$), second (2006-2009) (APC = -24.94, $p > 0.05$), and fourth (2020-2022) (APC = 39.39, $p > 0.05$) segments were not statistically significant. For firearms, the APCs for the first (2003-2017) (APC = 1.74, $p < 0.001$) and second (2017-2022) (APC = -2.66, $p < 0.05$) segments were statistically significant. In the first segment (2003-2017), there was an annual increase of 1.74%, while in the second segment, there was an annual decrease of 2.66%. For hanging, the APCs for the first (2003-2006) (APC = -0.55, $p > 0.05$), second (2006-2009) (APC = 6.29, $p > 0.05$), and fourth (2015-2022) (APC = 0.18, $p > 0.05$) segments were not statistically significant. In the third segment (2009-2015) (APC = -2.12, $p < 0.001$), there was a statistically significant annual decrease of 2.12%. For other methods, the APC for the first segment (2003-2012) (APC = 22.51 $p < 0.01$) was statistically significant, indicating an annual increase of 22.51%. In the second segment (2012-2022), there was no statistically significant change (APC = 0.32, $p > 0.05$) (Table 8).

There is no joinpoint found in drowning, throwing from a high place, and throwing off a train or motorized vehicle methods (Graph 5). Between 2003 and 2022, there was an annual decrease of 3.16% in drowning (APC = -3.16, $p < 0.001$), 5.53% in throwing off a train or motorized vehicle (APC = -5.53, $p < 0.01$), and an increase of 2.54% in throwing from a high place (APC = 2.54, $p < 0.01$). All three APC values are statistically significant (Table 8).

Table 8. APC in Suicide Method Segments

Method	Segment	APC	Lower CI	Upper CI	Test Statistic	*p*-value
Burning	2003-2008	-25.7626	-39.8463	-8.3814	-3.0855***	0.0094
	2008-2013	20.4829	-12.2066	65.3443	1.2827	0.2238
	2013-2022	-6.3083	-13.6732	1.6850	-1.7341	0.1084
Taking chemicals	2004-2006	-0.6165	-12.8631	13.3514	-0.1064	0.9176
	2006-2009	-24.9494	-45.1698	2.7278	-2.0682	0.0685
	2009-2020	-4.6603	-8.1304	-1.0590	-2.9117**	0.0172
	2020-2022	39.3997	-3.9545	102.3235	2.0171	0.0744
Cutting	2003-2022	-0.3728	-2.4242	1.7216	-0.3772	0.7104
Drowning	2003-2022	-3.1685	-4.5212	-1.7966	-4.8085***	0.0001
Firearms	2003-2017	1.7403	1.1188	2.3656	6.0019***	< 0.0001
	2017-2022	-2.6677	-5.0602	-0.2149	-2.3157**	0.0351
Gas or LPG etc.	2003-2022	0.5174	-2.3151	3.4321	0.3793	0.7088
Hanging	2003-2006	-0.5543	-3.8134	2.8154	-0.3773	0.7146
	2006-2009	6.2944	-0.0315	13.0206	2.2505	0.0509
	2009-2015	-2.1214	-3.3673	-0.8595	-3.7864***	0.0043
	2015-2022	0.1880	-0.5507	0.9322	0.5742	0.5799
Throwing from a high place	2003-2022	2.5477	1.7693	3.3321	6.9365***	< 0.0001
Throwing off a train or motorized vehicle	2003-2022	-5.5300	-7.5305	-3.4862	-5.5840***	< 0.0001
Other	2003-2012	22.5140	8.0914	38.8609	3.4556***	0.0035
	2012-2022	0.3230	-5.5218	6.5294	0.1145	0.9103

Note: *: 10%; **: 5%; ***: 1%.

4. CONCLUSION

The aim of the study, which examines suicide cases in Türkiye over the last 20 years in the context of gender and method, is statistically elucidate potential trend changes between 2003 and 2022. No research based on official data for the specified years was found in the literature. Therefore, it is believed that the findings will give rise to new research questions.

Upon examining the results, it can be observed that the crude suicide rate has followed an increasing trend over the 20-year period. The year 2018 particularly stands out with a dramatic rise in the crude suicide rate within this 20-year timeframe. The ongoing economic crisis, initiated in 2018 and compounded by the subsequent pandemic, has been a prominent feature in this 20-year period. The economic crisis that commenced in 2018 was characterized by the rapid depreciation of the Turkish lira (TRY), high inflation, an excessive current account deficit, substantial foreign currency-denominated debt, escalating borrowing costs, and the consequent increase in credit defaults.

When examining global suicide rates and Turkish statistics, it is imperative to additionally consider the pandemic process. COVID-19, declared a pandemic by the WHO in March 2020, starting in China at the end of 2019, rapidly spread to more than 200 countries. As of April 2023, it has been recognized as one of the deadliest pandemics in human history, with approximately 762 million confirmed cases and over 6.5 million deaths (World Health Organization 2023). The intensity and duration of the pandemic varied, but almost all countries implemented measures such as international and/or domestic travel restrictions, temporary closure of educational institutions at all levels with a transition to remote learning, limiting or blocking social and physical interactions, temporary closure of workplaces by transitioning almost all professional groups, implementation of home quarantine and isolation, testing, and mandatory vaccination.

During economic downturns, job loss, economic contraction, and financial difficulties are known to contribute to 13% of suicide-related deaths (Coope et al. 2015: 102-103). Comparable to the COVID-19 pandemic, the past pandemic of the Spanish flu has been associated with an increase in epidemic suicide-related deaths. The fear of illness, coupled with a decrease in social interaction and integration during the disease period, has resulted in an elevation of suicide rates (Wasserman 1992: 250-252; Centers for Disease Control and Prevention 2020; Ornell et al. 2020: 232-235). Research on the COVID-19 pandemic, dominated by social isolation and fear of illness similarly to the Spanish flu period, indicates that the disease significantly affects not only the physical health but also the mental health of individuals and society. Numerous studies have reported an increase in lower psychological well-being, higher anxiety and depression scores, prevalence of anxiety and depression, loneliness, despair, alcohol and substance use, rise in indicators of family conflict and violence, exacerbation of pre-existing psychiatric disorders, self-harm behavior, and an increase in suicide cases (Cullen et al. 2020: 311-312; Asahi et al. 2021: 8-9; Breslau et al. 2021: 2-3; Kumar and Nayar 2021: 1-2). COVID-19-related suicide cases have been reported in various countries, including the United States, the United Kingdom, Italy, Germany, Bangladesh, India (Sher 2020: 708-709).

In Türkiye, the first COVID-19 case was announced on March 11, 2020, with the number of cases rising to 191 within a week. The first death due to COVID-19 occurred on March 17, 2020. A month after the initial announcement, the number of cases rose to 947, with 21 deaths. After one year, 2,835,989 cases and 29,290 deaths were recorded. During this period, nationwide lockdowns were implemented, and the controlled normalization process was initiated. According to the TURKSTAT data, the crude suicide rate, which was 4.21 in 2019, increased to 4.45 in 2020, and in 2021, it reached 4.98, the highest level in the last 20 years. The highest number of suicides recorded between 2001 and 2021, 4194 cases, also coincided with the pandemic period in 2021.

The crude suicide rate for males has consistently followed an upward trend between 2003 and 2022. On the other hand, the crude suicide rate for females declined between 2003 to 2017 but started to rise in 2017. In any case, the crude rate for males is higher than that for females. The higher suicide rate for males compared to female is consistent with global suicide-gender trend and current research findings.

The average annual percentage change in burning, taking chemical, cutting, and firearms methods has shown a statistically significant negative trend. Drowning (with a decreasing trend), throwing off a train or motorized vehicle (with a low trend), and throwing from a high place (with an increasing trend) have undergone changes

in the 20-year average percentage. Other methods not classified in the categories also show a dramatic increase. It is observed that the joinpoints of methods are not clustered in a specific year. The highest percentage is in hanging, followed by firearms. Taking chemical were the third-largest percentage among methods until 2006, after which they declined. Throwing from a high place took its place after 2006 when it began to show an upward trend. Although taking chemical have started to rise again as of 2020, still rank fourth. Across the globe, the most common suicide methods are hanging, poisoning, and firearms. In Türkiye's data, hanging and firearms differ from global methods as throwing from a high place is also prominent. All subsequent methods have smaller percentages and have shown minimal changes.

The research has certain limitations, particularly challenges in accessing historical data, the absence of age-specific standardized rates, and issues encountered in establishing a compatible database system for the Joinpoint Regression Software. Another limitation can be attributed to the quality of TURKSTAT data. WHO (2020) reports highlight that out of 183 member states for which estimates were made between 2000-2019; approximately 60% have high-quality vital data records. It is emphasized that especially low and some middle-income countries have low data quality, sparse data, or distortions, misinterpretations, or careless coding of suicide incidents due to reasons such as stigma, illegality, and the level of development of government services. For countries with low-quality vital data, modeling methods are employed in making estimates. However, the type, complexity, group criteria, and applications of models can lead to significant differences and inconsistencies. Consistent results can be obtained from high-quality vital data. For instance, it is known that suicide incidents in Belgium, ranked 11th with a rate of 18.3 per 100,000, include legally sanctioned euthanasia procedures in the country. On the other hand, countries experiencing internal conflicts and civil war such as Afghanistan (4.1), Iraq (3.6), and Syria (2) have significantly lower suicide rates compared to other countries. The nature of suicide incidents underlying these rates (such as sociopolitical conflicts, terminal illnesses, mental health issues, suicide attacks) is uncertain. In the WHO database, Türkiye is classified as a source of moderately high-quality vital data with a note of insufficient trend data (World Health Organization 2020). Specifically for Türkiye, there is inconsistency between suicide data reported by the TURKSTAT and WHO data.

Another limitation arises from suicides categorized as unknown cause or coded as other in terms of method. The prevalence of suicides labeled as unknown or other among various causes and methods can be attributed to the inability to interview the families and close associates of the deceased, relying on contradictory suicides. Official suicide rates and related statistics disclosed in Türkiye and other countries are calculated based on events documented in administrative records. Factors such as age and method constitute the objective components of the suicide incident: "However, the manner in which suicide is carried out and the choice of suicide methods are only the external and superficial aspects of the event, perhaps the most objectively and concretely graspable in suicide. When the tableau of reasons is presented to us, we may suspect that we are faced with the interpretation of observers or witnesses; however, there is no doubt about the statistics of the methods chosen for committing suicide. At least, we cannot be mistaken about the manner in which the suicide chooses to kill oneself." (Durkheim, 2022: XXXIII-XXXIV; Halbwachs, 2002: 31-32). The reason for suicide is often based on post-mortem data, frequently relying on subjective information. Especially, the tendency of the deceased's close associates to conceal the incident and its reasons for various motives complicates obtaining the data on the cause and method of suicide.

Furthermore, the consideration of variables such as age, income, poverty, economic confidence, and others by the TURKSTAT in the context of suicide (e.g., cause) will provide important findings. We would like to suggest that exploring the media-highlighted suicides in recent years through a thorough examination of statistical trends could provide clear insights. This approach offers the opportunity to assess risk factors, protective factors, establish cause-and-effect relationships, measure suicide risk, predict suicide probability, and gain significant insights into historically recurring patterns.

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We declare that all ethical rules were followed during the study's preparation processes. In the event that a contrary situation is discovered, Journal of Applied Microeconometrics accepts no responsibility, and all responsibility rests with the study's author(s).

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Endnotes

[1] data.tuik.gov.tr

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