

## ORIGINAL RESEARCH

# Relationship between unemployment, depression, and suicide during COVID-19 among males in South Korea: based on internet search trends

Myeongsook Yoon<sup>1</sup>, Jaehee Yi<sup>2</sup>, Kyuhyoung Jeong<sup>1</sup>, Heeran J. Cho<sup>3,\*</sup>

<sup>1</sup>Department of Social Welfare, Jeonbuk National University, 54896 Jeonju, Republic of Korea

<sup>2</sup>School of Social Work, University of Victoria, Victoria, BC V8W 2Y2, Canada

<sup>3</sup>Department of Health Administration, Seoul Cyber University, 03925 Seoul, Republic of Korea

**\*Correspondence**[heerancho@yonsei.ac.kr](mailto:heerancho@yonsei.ac.kr)

(Heeran J. Cho)

**Abstract**

**Background:** The economic recession caused by the COVID-19 pandemic has led to significant increases in unemployment rates, which negatively affect mental health and contribute to higher rates of depression and suicide. Recent analyses of internet search trends indicate an increased public interest in these mental health issues, promoting efforts to implement web-based interventions. **Methods:** This study investigated the mediating effects of depression on the relationship between unemployment and suicide in South Korea during COVID-19 by analyzing internet search trends. The search volume of keywords related to unemployment, depression, and suicide during the COVID-19 period (from 21 January 2020, to 11 May 2023) was extracted from South Korea's largest online search engine data, including searches conducted on both mobile and desktop devices. The study sample included of working-age adult males between the ages of 20 and 60. The search volume data from 1207 search volume entries were extracted and analyzed using SPSS PROCESS macro (version 4.0). **Results:** The analysis revealed that suicide-related searches had the highest relative frequency, followed by depression and unemployment. Unemployment was found to significantly affect depression, and depression-related keyword searches mediated the association between unemployment- and suicide-related keyword searches. **Conclusions:** The findings suggest that government policies should prioritize both economic recovery efforts, and mental health support, including unemployment assistance, wage support and suicide prevention services. Developing web-based mental health resources and interventions could strengthen these efforts.

**Keywords**

COVID-19; Depression; Suicide; Unemployment; Internet search trend

## 1. Introduction

In 2020, the COVID-19 pandemic triggered a profound global public health crisis. The shutdowns and social distancing measures implemented to curb virus transmission led to a simultaneous slowdown in labor market demand and supply, resulting in unprecedented levels of unemployment. This situation brought attention to emerging challenges such as the increase in remote work, declining productivity, and rising wage inequality [1, 2]. The increase in stay-at-home measures and remote work due to COVID-19-related social distancing measures, along with a decrease in Gross Domestic Product (GDP) [3], financial insecurity, unemployment, and pervasive pandemic-related anxiety have significantly impacted the mental health of the population [4]. According to the International Labour Organization (ILO), working-hour losses in 2020 were approximately four times greater than those during the global financial crisis of 2009 [5]. Working-age individuals who faced acute work loss and unemployment, as well as financial

distress during the COVID-19 pandemic, were more likely to report psychological distress and poor mental and physical health [6, 7]. Notably, during the economic crisis of 1997–1998, East and Southeast Asia countries experienced a rise in suicide rates, particularly among males, which was closely linked to unemployment experiences [8]. Due to COVID-19, workplaces experienced fears of infection and uncertain economic recovery [9], resulting in increased job insecurity in industries and lower job satisfaction [10]. A study examining the relationship between financial concerns and job insecurity during COVID-19 found that [11], greater job insecurity due to COVID-19 was related to greater depressive symptoms, and greater job insecurity was indirectly related to greater anxiety due to financial concerns. Under the COVID-19 situation, job instability and job insecurity have shown a significant negative impact on workers' work satisfaction [12].

The COVID-19 pandemic, a study examining the association between losing work and mental and physical health status classified individuals who experienced work loss into three

groups: the reduced work group, off-work group and lost job group. These groups were compared with the unaffected work group, which consisted of individuals who did not experience work loss. The results indicated that individuals in the work loss groups had significantly higher odds of experiencing severe psychological distress, poor mental health, and poor physical health compared to those in the unaffected work group. Specifically, it was reported that among the lost job group, individuals with fewer financial resources were 8.4 times more likely to experience psychological distress than those in the unaffected work group [6]. Financial difficulties related to COVID-19 were also found to predict suicidal thoughts or behaviors through depression and feelings of loneliness [13]. The global economic crisis has significantly impacted suicide rates in European and American countries, particularly among men and in regions where the hardest job losses occurred [14]. Longitudinal studies conducted across various countries have identified economic crises and unemployment as significant risk factors for increased suicide mortality and suicidal behavior [15, 16]. A study analyzing the impact of unemployment on suicide mortality in Western European countries from 2000 to 2010 found a significant 0.3% overall increase in suicide rate for a 10% increase in unemployment rate [17]. Unemployment resulting from economic crises has been shown to have a significant relationship with suicide both in the short term and the long term [18]. A study spanning 18 years (2000–2017), and investigating the predictors of suicide rates in 38 Organization for Economic Co-operation and Development (OECD) countries found that unemployment had the most substantial impact on increased suicides, especially among middle-aged groups [19]. In addition, stress related to COVID-19, economic hardship, and social isolation were found to have a significant relationship with suicidal thoughts, self-harm and suicide [20, 21]. In the case of South Korea, which consistently had the highest suicide rates among the OECD countries, an unusual trend emerged in 2020, while the overall suicide rate decreased due to various suicide prevention policies, the suicide rate among men increased by 30% compared to 2017 [22]. Furthermore, depression—a major predictor of suicide—has increased in all major OECD countries since the onset of the COVID-19 pandemic [4]. Notably, South Korea ranked first (36.8%) among OECD countries, well above the mean depression level (21.8%), with a higher prevalence among women than men [23]. As such, previous empirical studies have demonstrated significant links between financial crises, job loss, job insecurity and wage reductions, and elevated rates of depression and suicide.

Recently, research using Internet search data analysis—particularly from platforms like Google—has increased as a tool for identifying and addressing public mental health issues like depression, loneliness and suicide [24]. During COVID-19, the use of free and easily accessible tools such as Google Trends data has become more prevalent for measuring changes in people’s mental health and public concerns [25, 26]. By utilizing machine learning techniques to classify suicide risk in large samples, it was revealed that depression symptoms were the most relevant for the classification of increased suicide risk [27]. According to a 2021 survey of all South Koreans over the age of 3, 91.9% of South Koreans use the Inter-

net, primarily for searching for data and information [28]. The demand for obtaining health and medical information through online searches has increased significantly due to the prolonged pandemic. However, the Internet contains both beneficial and harmful information, and search engines play a critical role in moderating access to suicide-related content. In other words, these platforms can inadvertently expose users to harmful information that may significantly influence suicidal thoughts and behaviors [29]. Studies show that the volume of Google searches for suicide-related terms has shown a positive correlation with suicide rates [30]. Additionally, a study by Fond *et al.* [31] found that the frequency of searches for “suicide” is associated with searches related to depression, indicating that search engine data could be a critical indicator for suicide prevention efforts. Thus, utilizing internet search engines like Google is increasingly recognized as effective for monitoring suicide risk, with Google search data providing a more accurate estimate of suicide rates than traditional self-reported assessments [31, 32]. Furthermore, a study on internet search trends in Taiwan identified significant associations between suicide deaths and various suicide-related search terms [33].

When conceptualizing suicidal ideation, thoughts, and attempts along a continuum of suicidality, traditional questionnaire-based methods for assessing perceptions of suicide risk may encounter issues, such as cognitive dissonance during the interview process. As a result, analyzing internet search trends for suicide-related terms has emerged as a valuable alternative [34]. Traditional quantitative research methods often struggle to capture the full scope of social phenomena [35, 36]. However, an approach of using Internet searches allows researchers to examine “collective browsing behavior” offering insight into “collective thinking”, that reflects the shared concerns and behaviors of a population [37]. Research suggests that individuals at risk of suicide are more likely to seek out websites that provide suicide-related information [38]. Therefore, in countries like South Korea, where there is a high volume of online search activity related to suicide, leveraging this data could be a practical way to identify individuals at risk [39].

The use of Internet search terms improves the predictive power of research models. Several studies have identified a significant association between the search volumes for keywords like “depression” and “suicide” and “commit suicide” on search engines and the actual suicide rates [24, 26, 30, 39]. In addition, a validated suicide prediction model links Internet searches related to suicides with actual suicide rates, further supporting the reliability of this approach [40]. Yang *et al.* [33] analyzed the association of Internet search trends with suicide death in Taipei city, between 2004 and 2009. They employed multiple linear regression analysis and found a positive correlation between the suicide-related search terms and actual suicide rates.

Research examining the relationship between internet searches and suicide has found a strong correlation between search terms such as “commit suicide”, “commit suicide without pain” and “suicide”, as well as the topic “suicide”, exhibited a high correlation with actual suicide rates [41]. Monitoring trends through internet search engines such as

Google can effectively monitor suicides, assess risks early, and serve as an effective tool for suicide prevention interventions. This framework supports the development of a predictive model aimed at preventing future suicides by utilizing trends in unemployment-, depression- and suicide-related searches during the COVID-19 pandemic.

With increased access to search volume data, a growing number of studies are exploring correlations between online search volume with other variables, assessing whether search volume can predict social phenomena. Similar to these studies, Internet search trends, such as Google Trends, are also utilized as tools for predicting and managing various issues in mental health and health care domains [24, 25, 27, 40, 42]. In particular, big data generated from internet searches offers valuable insights into health behaviors. Consequently, studies analyzing keywords through search engines like Google Trends in medical research are rapidly increasing [43, 44].

Accordingly, this study aimed to develop a predictive model of suicide risk based on online search trends (or online search volume) related to unemployment, depression and suicide during the COVID-19 pandemic. For this purpose, we used data obtained from Naver, which is Korea's most commonly used search engine [28]. Subsequently, we examined the mediating effect of the depression-related search volume on the relationship between unemployment- and suicide-related search volumes. By understanding these dynamics, we aimed to explore interventions for effective suicide prevention.

## 2. Material and methods

### 2.1 Materials: search engines and keywords for search trend data

As Naver leads the search share in South Korea, according to Nielson Korean Click (an online traffic analysis agency), it was selected to extract search volume statistics for this study [45]. Naver's Data Lab offers a big data analysis service, providing essential tools for understanding search trends. This platform allows users to access a variety of trend data. The "Search Keyword Trend" feature enables users to query how often specific topics have been searched on Naver over various time periods and demographics, including gender and age groups.

Internet searches are a valuable tool to monitor and detect the risk of suicide, and previous studies have shown that the volume of suicide-related term searches is positively correlated with actual suicides and suicidal ideation [46, 47]. The extracted data included volumes of keyword searches conducted on both mobile phones and personal computers (PCs). The targeted users were economically active adult men aged between 20 and 60 years. A total of 1207 searches were analyzed. Unlike previous studies, we set the search date as the unit of analysis. To measure the daily search volumes, we defined the period from 21 January 2020, when the first COVID-19 case was reported, until 11 May 2023, when the declaration of the end of the COVID-19 pandemic was made, and used the search date as the search period.

The main variable was the search volume of the selected search keywords. The primary keywords were unemployment, depression, and suicide. The subordinate keywords for

"unemployment" included job loss, and retirement, and the subordinate keywords for "depression" included depressive symptoms and feeling of depression. In other words, the number of searches on Naver related to unemployment was the independent variable, the search number related to depression was the mediator, the search number related to suicide was the dependent variable.

In Naver's Data Lab, similar to Google Trends, the date with the highest search volume is set to 100 points, with other dates' search volumes are quantified within a range of 0 to 100 points in proportion to that number. Additionally, when extracting more than two terms, the search volumes are made comparable within the 0 to 100-point range. In this study, we extracted search data simultaneously to compare the search levels for unemployment, depression, and suicide. The unit of analysis in this study is the date, and the data was extracted from Naver's Data Lab on 10 June 2024. This study was approved by the Institutional Review Board (IRB) of Jeonbuk National University (JBNU 2022-08-012), and the study procedures were undertaken in accordance with the Declaration of Helsinki.

### 2.2 Research model

To determine the structural relationship between the search volumes of the keywords "unemployment", "depression" and "suicide", Hayes' SPSS PROCESS Model 4 (4.2 version, Andrew F. Hayes, Calgary, AB, Canada) [48] was applied. The research model is presented in Fig. 1.

### 2.3 Statistical analysis

First, the descriptive statistics on unemployment-, depression-, and suicide-related searches were performed using SPSS 28. Second, we analyzed correlations between unemployment-, depression- and suicide-related search volumes. Third, we examined the relationship between the search volumes for the keywords "unemployment", "depression" and "suicide", using SPSS PROCESS Model 4 [48]. Thus, the relationship between unemployment, depression and suicide was confirmed through multiple regression analysis. PROCESS is widely used in the social, business and health sciences to estimate direct and indirect effects in single and multiple mediator models (parallel and serial), two- and three-way interactions in moderation models, along with simple slopes and regions of significance for probing interactions, and conditional indirect effects in moderated mediation models with a single or multiple mediators or moderators. The PROCESS macro is helpful for a comprehensive estimation of complex process models [49]. In addition, bootstrapping was used to validate the statistical significance of the indirect effect.

## 3. Results

### 3.1 Descriptive statistics and correlations of the main variables

The descriptive statistical analysis of the main variables showed that the average search volume for unemployment was 3.31 points (Standard Deviation (SD) = 1.02), while

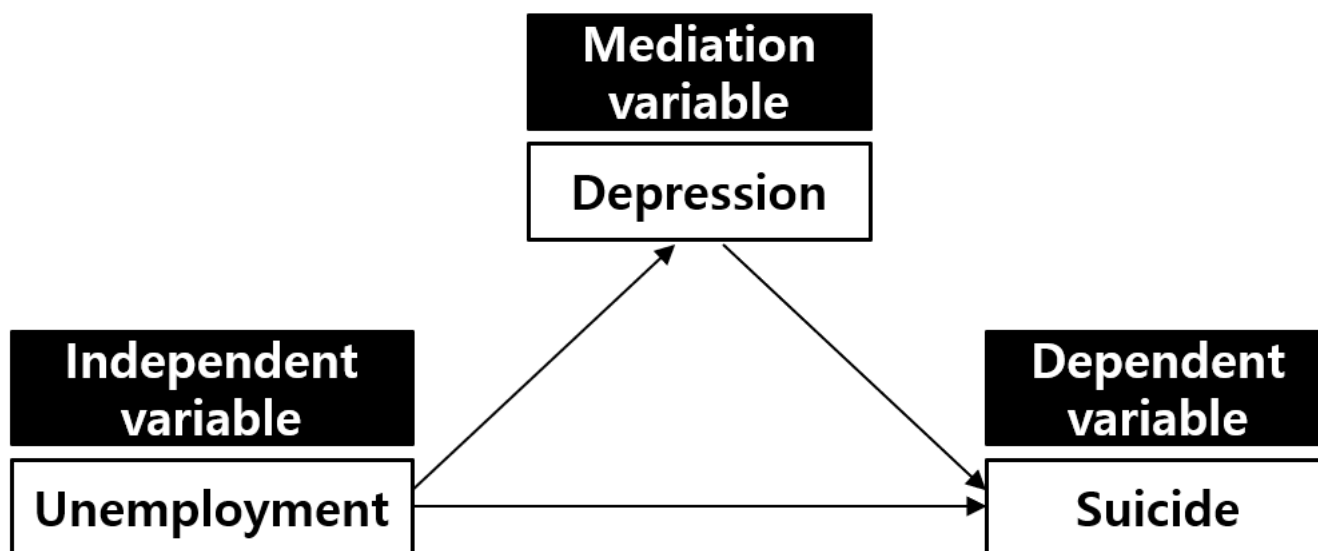


FIGURE 1. Research model.

depression was 5.34 points (SD = 1.04) (Table 1). The average search volume for suicide was found to be 11.20 points (SD = 4.51). In other words, the search volume was highest for suicide, followed by depression and then unemployment.

The normality of each variable was assessed, and the skewness did not exceed an absolute value of 2, while kurtosis did not exceed an absolute value of 4. Based on Kline's criteria [50], these values indicate that the variables are normally distributed.

Fig. 2 shows the relative change in search volume over the analyzed period by aggregating the search volumes for each keyword and setting the maximum search volume to 100. The relative search popularity of unemployment, depression, and suicide revealed that suicide had the highest search volume, followed by depression and then unemployment. Regarding the temporal changes in the search volumes for each keyword, excluding certain dates with significantly high search volumes, unemployment and depression generally maintained a stable, average level. However, searches related to suicide did not exhibit regular patterns, but there were numerous dates with a sharp increase in search volume.

To examine the correlations among the search volumes for unemployment, depression, and suicide, a correlation analysis was conducted. The correlations between unemployment and depression ( $r = 0.463, p < 0.001$ ), depression and suicide ( $r = 0.543, p < 0.001$ ) and unemployment and suicide ( $r = 0.235, p < 0.001$ ) were all positively significant at the  $p < 0.001$  level. A correlation coefficient above 0.8 among independent

variables is generally indicative of multicollinearity risk. The analysis revealed that none of the independent variables had a correlation coefficient exceeding 0.8, indicating no multicollinearity concerns. Additionally, the Variance Inflation Factor (VIF) values were assessed to confirm multicollinearity risk, and all values were found to be slightly above 1, well below the threshold of 10, confirming that multicollinearity was not an issue.

### 3.2 The relationship between unemployment-, depression- and suicide-related search volume

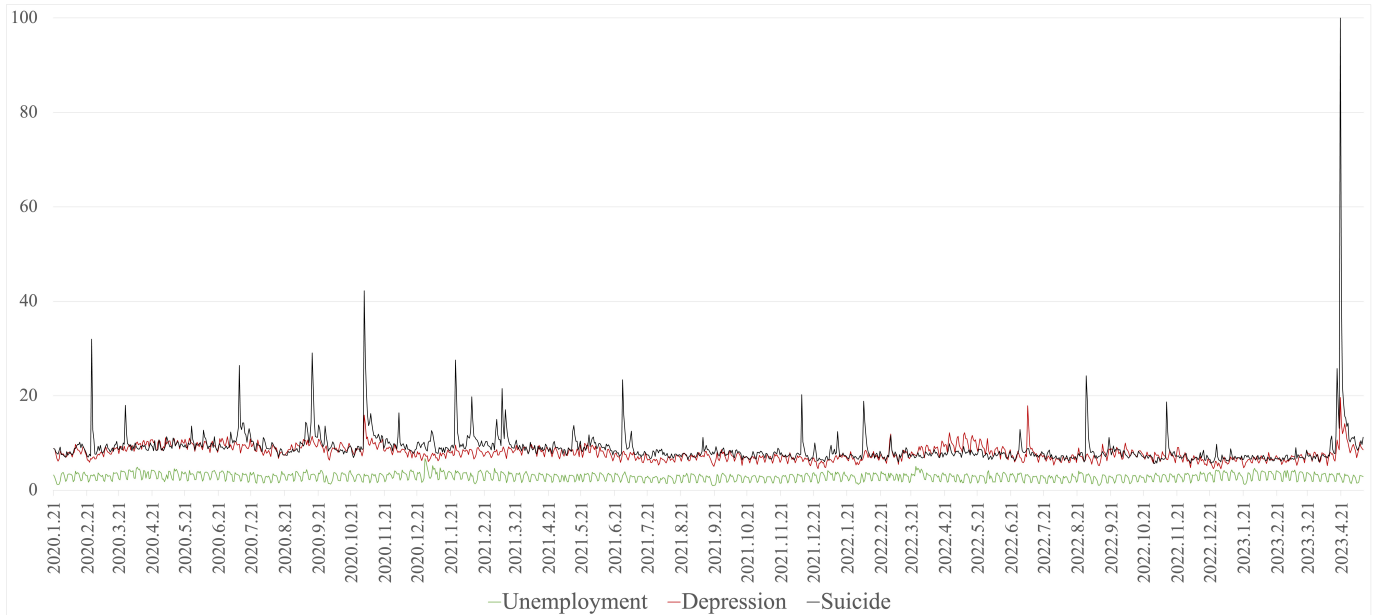
Before analyzing the research model, we verified adherence to the basic assumptions of regression analysis by examining the normality, homoscedasticity and independence of the residuals. To assess residual normality, we reviewed the Quantile-Quantile (Q-Q) plot, which showed that the residuals were generally distributed along the diagonal reference line with no substantial outliers, indicating that the normality assumption was met. Homoscedasticity was evaluated by examining a scatter plot of predicted values against residuals, which revealed no discernible pattern, thus confirming homoscedasticity. Finally, the Durbin-Watson test was conducted to assess residual independence, yielding a statistic of 1.31, closer to 2 than to 0, which confirmed that the assumption of independence was satisfied.

We used PROCESS Model 4 to validate the mediation model of the search volumes of unemployment, depression and sui-

TABLE 1. Descriptive statistics.

Variable	Min	Max	Mean	SD	Skewness	Kurtosis
Unemployment search volume	1.01	8.35	3.31	1.02	0.286	0.417
Depression search volume	3.24	13.84	5.34	1.04	1.489	2.581
Suicide search volume	6.49	100.00	11.20	4.51	1.989	3.669

Note: SD: Standard Deviation; Min: Minimum; Max: Maximum.



**FIGURE 2. Relative search volume over the analyzed period among male.** Note: Search volume: The date with the highest search volume is set at 100 points, and the search volume for other dates is quantified within a range of 0 to 100 points according to the proportion.

cide. The results are depicted in Table 2. In Step 1, the effect of the independent variable, unemployment, on the mediating variable, depression, was examined. The explanatory power for the mediating variable, depression, was found to be 21.5% ( $R^2 = 0.215$ ), and the research model was confirmed to be appropriate ( $F = 329.266$ ,  $p < 0.001$ ). The analysis showed that the independent variable, unemployment, had a significant effect on depression ( $B = 0.470$ ,  $p < 0.001$ ). In other words, the higher the search volume for unemployment, the higher the search volume for depression. In Step 2, the impact of the independent variable, unemployment, and the mediating variable, depression, on the dependent variable, suicide, was examined. The explanatory power for the dependent variable, suicide, was found to be 29.5% ( $R^2 = 0.295$ ), and the research model was confirmed to be appropriate ( $F = 69.112$ ,  $p < 0.001$ ). The analysis showed that the mediating variable, depression ( $B = 2.398$ ,  $p < 0.001$ ), had a significant effect on suicide. In other words, the higher the search volume for depression, the higher the search volume for suicide. On the other hand, the independent variable, unemployment, was found to have no significant effect on suicide.

To test the mediating effect of depression in the relationship between unemployment and suicide, 5000 bootstrapping samples were specified, and a 95% confidence interval was set (Table 3). The results showed that for the “unemployment  $\rightarrow$  depression  $\rightarrow$  suicide” pathway, the 95% confidence

interval ranged from 0.604 to 1.714, which does not include 0, indicating that the mediating effect is significant.

#### 4. Discussion

This study examined the mediating effect of depression on the relationship between online search volume related to unemployment and suicide. It was found that depression-related search volume mediates the relationship between the unemployment- and suicide-related search volumes. Specifically, the unemployment-related search volume influenced the increase in the depression-related search volume, which, in turn, affected the increase in the suicide-related search volume. These results are consistent with previous studies that have reported a statistically significant relationship between depression-related and suicide-related search volumes, as well as between the search volumes of actual suicide rates and the number of suicide victims [26, 38, 51, 52]. Furthermore, our findings align with studies that have identified the global economic crisis resulting from COVID-19 as a factor leading to wage reductions, low income, job insecurity, job instability [12], unemployment, economic insecurity and financial strains. The unemployment of workers resulting from such economic crises serves as a risk factor for depression and suicidal behavior [16, 18, 20, 21].

Although we did not analyze the correlation between actual

**TABLE 2. The relationship between unemployment-, depression- and suicide-related search volumes.**

	Independent variable	Dependent variable	B	SE	Model fit
Step 1	Unemployment	Depression	0.470***	0.026	$R^2 = 0.215$ , $F = 329.266$ ***
Step 2	Unemployment depression	Suicide	-0.093 2.398***	0.120 0.118	$R^2 = 0.295$ , $F = 69.112$ ***

Note: B: Coefficients; SE: Standardized Estimates; \*\*\* $p < 0.001$ .

**TABLE 3. Bootstrapping validation of the index of mediation.**

Pathway	Effect	Boot SE	Bootstrapping CI	
			LL	UL
Unemployment → Depression → Suicide	1.127	0.296	0.604	1.714

Note: CI: confidence interval; LL: lower limit; UL: upper limit; SE: Standard Error.

suicide rates and the number of suicide victims, our findings may help in predicting suicide risk. Previous studies that have shown that unemployment negatively affects people's mental health and increases the risk of suicide during the national economic crisis. During COVID-19, job insecurity, financial crises, and job instability have been found to impact workers' mental health, leading to anxiety, depression, and suicidal tendencies. Our research results indicate that men's employment is associated with depression, supporting the findings of Wilson *et al.* [11], which suggest that job insecurity and financial concerns influence depression and anxiety, as well as previous studies indicating correlations between working-hour losses, job insecurity, unemployment, and depression during COVID-19 [12, 16, 17].

Particularly, the findings regarding the association between unemployment, depression, and suicide among Korean men corroborate the study by Chang *et al.* [8], which investigated the economic crisis and suicide rates in Japan, Hong Kong, Korea, Taiwan, Singapore and Thailand, showing that the economic crisis had the strongest impact on suicide rates among working-age men. Consequently, it is possible to infer an increased risk of depression and suicide during the socioeconomic crisis caused by the COVID-19 pandemic. Our findings support previous studies indicating that unemployment mainly affected the mental health and suicide rates among men during previous financial crises [11, 19].

Moreover, these search volumes ultimately affected the suicide-related search volume. Although the relationship between the findings and actual suicide rates has not been demonstrated, they can be considered a reflection of the increased suicide rates among South Korean men during the pandemic. Contrary to previous studies, where the unemployment of men (typically the primary breadwinners) was highly correlated with depression, the COVID-19 pandemic created a social situation characterized by disproportionately high employment instability and disruptions in face-to-face services, including sales, healthcare and education [5].

Based on these findings, suicide prevention policy strategies should not be limited to mental health promotion measures alone. Instead, the government should establish dual-faceted policies that provide support to economically disadvantaged individuals. In addition to economic factors, such as loss of income, unemployment negatively impacts self-perception, social identity, and self-esteem. Therefore, it is necessary to enhance the comprehensiveness and continuity of national policies to simultaneously provide economic and mental health support in cases of job loss or unemployment. Currently, suicide prevention programs in South Korea are primarily run by mental health welfare centers, including a small number of suicide prevention centers, but there are limitations in reaching

people experiencing economic hardship. It will be necessary to identify government agencies with integrated services to provide support and counseling for both unemployment and mental health, especially for women.

Furthermore, considering the significant correlations between depression- and suicide-related search volumes found in this study and previous literature, as well as the actual suicide rates and the number of suicide victims, it is necessary to establish a web-based suicide prevention system by effectively responding to Internet search trends. In particular, suicide-related online search activities indicate suicide risk. In Spain, internet searches for suicide-related terms are positively related to actual suicide rates [26], and the study by Barros *et al.* [53] also found that search terms such as "suicidal", "suicide methods" and "how to commit suicide" are significantly correlated with suicide rates. Similarly, Yang *et al.* [33] reported that an analysis of 37 suicide-related search terms revealed a relationship between these search terms and actual suicide rates. Previous studies have demonstrated a significant association between suicide searches and suicide rates [26, 29]. This study's findings suggest that Internet search trends can be utilized as predictive tools to identify individuals with suicidal intentions and facilitate relatively easy access for prevention and management opportunities [31, 53]. Additionally, the research by Chandler *et al.* [46] indicates the potential of these trends to serve an online gatekeeping role in suicide prevention. Furthermore, it highlights the utility of monitoring suicide-related searches as a tool for tracking and identifying individuals at risk of depression and suicide [37]. These insights further align with existing literature that underscores the importance of understanding online behaviors related to suicide in order to address public mental health issues effectively [36, 52].

Setting up an online database to recognize accompanying signs and preemptively monitor and intervene could be effective. Additionally, it is important to identify various related search terms that can predict suicide risk, given the close relationship between depression-related keywords search volume and suicide-related search volume. By applying and utilizing Information and Communication Technology (ICT)-based services in mental health, as required by the advent of the fourth industrial revolution and the COVID-19 pandemic, this could be a valuable preventive approach. This study is significant as it developed a suicide risk prediction model using behavioral data obtained from the Internet prior to suicide, and we sought relevant alternative measures. In addition, this study addressed the limitations of existing research by focusing on the internet aspects of methodology, reflecting the situation of COVID-19 through big data analysis.

## 5. Limitation

The limitations of this study and the suggestions for future research are as follows. First, while we used Internet search volume by date of COVID-19 as the main variables in the form of time series data, this approach is limited in its ability to reflect the complex psycho-emotional factors interacting with suicide risk, such as demographic characteristics, socioeconomic circumstances (*e.g.*, social capital, duration of unemployment, number of people in the workforce, decline in real wages), and individual mental health vulnerabilities. Second, in this study quantified the search volume was quantified within a range of 0 to 100 points, with the date having the highest search volume set at 100 points, and other dates adjusted accordingly. This method presents a limitation, as the analysis was based on relative search volume rather than exact figures. Therefore, it is recommended that future research use more objective figures if accurate search volume data can be extracted. Third, while using the date as the unit of analysis may be seen as a creative and novel approach from an academic perspective, it poses challenges in analyzing the context of specific time points or setting hypotheses. Future studies should examine changes in search volume for terms like suicide over time and analyze the causes behind these trends. Furthermore, given that our study was limited to the period of the COVID-19 pandemic, future studies should examine the relationship between unemployment, depression, and suicide longitudinally by comparing the pre- and post-COVID-19 periods. Additionally, caution is needed when interpreting the results, as we did not examine actual suicide rates or the number of suicide victims. Thus, introducing official statistical data (*e.g.*, the number of suicide victims per date) into the prediction model and analyzing the relationship between the search volumes and actual suicides in future studies will provide more sophisticated, generalized results and further facilitate the discussion on effective intervention methods.

## 6. Conclusions

In modern times, Internet trends reflect the character of a particular society. In this respect, the online search trends for specific keywords also depict societal realities. This study highlights the strength of using Internet search trends to investigate the relationship between unemployment, depression, and suicide data among Korean males, particularly during the COVID-19 pandemic. For instance, online search activities using suicide-related keywords indicate a heightened suicide risk. By using Internet search trend data and considering the pandemic-driven situation, we verified the correlation volumes of terms related to unemployment, depression, and suicide during the COVID-19 pandemic. This correlation not only underscores the mental health implications of economic instability but also highlights the urgent need for targeted interventions. Although the predictive model is based on online keyword searches, the mediating effect of depression on the relationship between unemployment and suicide reflects the prevailing social structure of the time. These findings suggest that economic factors play a significant role in mental health,

particularly in crisis situations, highlighting the need for comprehensive support systems. Based on these results, we suggest the possibility of establishing a web-based suicide prevention system that monitors and utilizes the online search trends of terms that are significantly associated with suicide risk. This proactive approach could facilitate timely interventions and support for individuals experiencing heightened vulnerability due to economic and mental health challenges.

## AVAILABILITY OF DATA AND MATERIALS

The datasets used in the study are available from the corresponding author upon request.

## AUTHOR CONTRIBUTIONS

MY, JY, KJ and HJC—designed and conducted the research study. MY and KJ—collected and analyzed the data; interpreted the data; drafted the manuscript. HJC—revised the manuscript's content. All authors read and approved the final manuscript.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board (IRB) of Jeonbuk National University (JBNU 2022-08-012), and the study procedures were undertaken in accordance with the Declaration of Helsinki.

## ACKNOWLEDGMENT

Not applicable.

## FUNDING

This paper was supported by international research funds for humanities and social science of Jeonbuk National University in 2022.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## REFERENCES

- [1] Bank of Korea. Three major issues related to the COVID-19 labor market and crisis. 2020. Available at: <https://www.bok.or.kr/portal/bbs/P0002353/view.do?nttId=10060144&searchCnd=1&searchKwd=&depth2=201156&depth3=200433&date=&sdate=&edate=&sort=1&pageUnit=10&depth=200433&pageIndex=16&programType=newsData&menuNo=200433&oldMenuNo=200433> (Accessed: 29 April 2022).
- [2] Barrero JM, Bloom N, Davis SJ. COVID-19 is also a reallocation shock. *Brookings Papers on Economic Activity*. 2020; 2020: 329–383.
- [3] Forsythe E, Kahn LB, Lange F, Wiczer D. Labor demand in the time of COVID-19: evidence from vacancy postings and UI claims. *Journal of Public Economics*. 2020; 189: 104238.
- [4] Organization for Economic Co-operation and Development (OECD). Tackling the mental health impact of the COVID-19 crisis: an integrated,

- whole-of-society response. 2021. Available at: [https://www.oecd-ilibrary.org/social-issues-migration-health/tackling-the-mental-health-impact-of-the-covid-19-crisis-an-integrated-whole-of-society-response\\_0caca0b-en](https://www.oecd-ilibrary.org/social-issues-migration-health/tackling-the-mental-health-impact-of-the-covid-19-crisis-an-integrated-whole-of-society-response_0caca0b-en) (Accessed: 09 July 2021).
- [5] International Labour Organization. ILO Monitor: COVID-19 and the world of work, 8th edition. 2021. Available at: <https://www.ilo.org/resource/brief/ilo-monitor-covid-19-and-world-work-8th-edition> (Accessed: 06 September 2024).
- [6] Griffiths D, Sheehan L, van Vreden C, Petrie D, Grant G, Whiteford P, *et al.* The impact of work loss on mental and physical health during the COVID-19 pandemic: baseline findings from a prospective cohort study. *Journal of Occupational Rehabilitation.* 2021; 31: 455–462.
- [7] Arena AF, Mobbs S, Sanatkar S, Williams D, Collins D, Harris M, *et al.* Mental health and unemployment: a systematic review and meta-analysis of interventions to improve depression and anxiety outcomes. *Journal of Affective Disorders.* 2023; 335: 450–472.
- [8] Chang SS, Gunnell D, Sterne JAC, Lu T, Cheng ATA. Was the economic crisis 1997–1998 responsible for rising suicide rates in East/Southeast Asia? A time-trend analysis for Japan, Hong Kong, South Korea, Taiwan, Singapore and Thailand. *Social Science & Medicine.* 2009; 68: 1322–1331.
- [9] Béland LP, Fakorede O, Mikola D. Short-term effect of COVID-19 on self-employed workers in Canada. *Canadian Public Policy.* 2020; 46: 66–81.
- [10] Zhang SX, Liu J, Afshar Jahanshahi A, Nawaser K, Yousefi A, Li J, *et al.* At the height of the storm: healthcare staff's health conditions and job satisfaction and their associated predictors during the epidemic peak of COVID-19. *Brain, Behavior, and Immunity.* 2020; 87: 144–146.
- [11] Wilson JM, Lee J, Fitzgerald HN, Oosterhoff B, Sevi B, Shook NJ. Job insecurity and financial concern during the COVID-19 pandemic are associated with worse mental health. *Journal of Occupational and Environmental Medicine.* 2020; 62: 686–691.
- [12] Nemteanu MS, Dinu V, Davija DC. Job insecurity, job instability, and job satisfaction in the context of the COVID-19 pandemic. *Journal of Competitiveness.* 2021; 13: 65–82.
- [13] Stevenson C, Wakefield JRH. Financial distress and suicidal behavior during COVID-19: family identification attenuates the negative relationship between COVID-19-related financial distress and mental ill-health. *Journal of Health Psychology.* 2021; 26: 2665–2675.
- [14] Chang SS, Stuckler D, Yip P, Gunnell D. Impact of 2008 global economic crisis on suicide: time trend study in 54 countries. *The BMJ.* 2013; 347: f5239.
- [15] Breuer C. Unemployment and suicide mortality: evidence from regional panel data in Europe. *Health Economics.* 2015; 24: 936–950.
- [16] Nordt C, Warnke I, Seifritz E, Kawohl W. Modelling suicide and unemployment: a longitudinal analysis covering 63 countries, 2000–11. *The Lancet Psychiatry.* 2015; 2: 239–245.
- [17] Laanani M, Ghosn W, Jouglia E, Rey G. Impact of unemployment variations on suicide mortality in Western European countries (2000–2010). *Journal of Epidemiology and Community Health.* 2015; 69: 103–109.
- [18] Demirci Ş, Konca M, Yetim B, İlğün G. Effect of economic crisis on suicide cases: an ARDL bounds testing approach. *The International Journal of Social Psychiatry.* 2020; 66: 34–40.
- [19] Brenner MH, Bhugra D. Acceleration of anxiety, depression, and suicide: secondary effects of economic disruption related to COVID-19. *Frontiers in Psychiatry.* 2020; 11: 592467.
- [20] Elbogen EB, Lanier M, Blakey SM, Wagner HR, Tsai J. Suicidal Ideation and Thoughts of Self-Harm during the COVID-19 pandemic: the role of COVID-19-related stress, social isolation, and financial strain. *Depression and Anxiety.* 2021; 38: 739–748.
- [21] Kawohl W, Nordt C. COVID-19, unemployment, and Suicide. *The Lancet Psychiatry.* 2020; 7: 389–390.
- [22] Statistics Korea. Causes of death statistics 2020. 2021. Available at: [https://kostat.go.kr/board.es?mid=a20108100000&bid=11773&act=view&list\\_no=414516](https://kostat.go.kr/board.es?mid=a20108100000&bid=11773&act=view&list_no=414516) (Accessed: 20 August 2023).
- [23] Korean Society for Traumatic Stress Studies. 2021 COVID-19 National mental health survey. 2021. Available at: <http://kstss.kr/?p=2463> (Accessed: 23 May 2024).
- [24] Knipe D, Gunnell D, Evans H, John A, Fancourt D. Is Google trends a useful tool for tracking mental and social distress during a public health emergency? A time-series analysis. *Journal of Affective Disorders.* 2021; 294: 737–744.
- [25] Wang A, McCarron R, Azzam D, Stehli A, Xiong G, DeMartini J. Utilizing big data from Google trends to map population depression in the United States: exploratory infidemiology study. *JMIR Mental Health.* 2022; 9: e35253.
- [26] Lopez-Agudo LA. The association between internet searches and suicide in Spain. *Psychiatry Research.* 2020; 291: 13215.
- [27] Roza TH, Souza Seibel G, Recamonde-Mendoza M, Lotufo PA, Bensenor IM, Passos IC, *et al.* Suicide risk classification with machine learning techniques in a large Brazilian community sample. *Psychiatry Research.* 2023; 325: 115258.
- [28] National Information Society Agency. Internet usage survey 2021. 2021. Available at: [https://www.nia.or.kr/site/nia\\_kor/ex/bbs/View.do?cbIdx=99870&bcIdx=24456&parentSeq=24456](https://www.nia.or.kr/site/nia_kor/ex/bbs/View.do?cbIdx=99870&bcIdx=24456&parentSeq=24456) (Accessed: 06 June 2023).
- [29] Sueki H, Ito J. Suicide prevention through online gatekeeping using search advertising techniques: a feasibility study. *Crisis.* 2015; 36: 267–273.
- [30] Arendt F. Suicide rates and information seeking via search engines: a cross-national correlational approach. *Death Studies.* 2018; 42: 508–512.
- [31] Fond G, Gaman A, Brunel L, Haffen E, Llorca PM. Google trends: ready for real-time suicide prevention or just a zeta-jones effect? An exploratory study. *Psychiatry Research.* 2015; 228: 913–917.
- [32] Ma-Kellams C, Or F, Baek J, Kawachi I. Rethinking suicide surveillance: Google search data and self-reported suicidality differentially estimate completed suicide risk. *Clinical Psychological Science.* 2016; 4: 480–484.
- [33] Yang AC, Tsai SJ, Huang NE, Peng CK. Association of internet search trends with suicide death in Taipei City, Taiwan, 2004–2009. *Journal of Affective Disorders.* 2011; 132: 179–184.
- [34] Vaidyanathan U, Sun Y, Shekel T, Chou K, Galea S, Gabrilovich E, *et al.* An evaluation of internet searches as a marker of trends in population mental health in the US. *Scientific Reports.* 2022; 12: 8946.
- [35] Raffagnato A, Iannattone S, Fasolato R, Parolin E, Ravaglia B, Biscalchin G, *et al.* A pre-adolescent and adolescent clinical sample study about suicidal ideation, suicide attempt, and self-harming. *European Journal of Investigation in Health, Psychology and Education.* 2022; 12: 1441–1462.
- [36] Silva C, McGovern C, Gomez S, Beale E, Overholser J, Ridley J. Can I count on you? Social support, depression and suicide risk. *Clinical Psychology & Psychotherapy.* 2023; 30: 1191–1533.
- [37] Rangaswamy A, Giles CL, Seres S. A strategic perspective on search engines: thought candies for practitioners and researchers. *Journal of Interactive Marketing.* 2009; 23: 49–60.
- [38] Harris KM, McLean JP, Sheffield J. Examining suicide-risk individuals who go online for suicide-related purposes. *Archives of Suicide Research.* 2009; 13: 264–276.
- [39] Song TM. Development of suicide online prediction model through analysis of social big data. *Health and Welfare Policy Forum.* 2013; 8: 74–86.
- [40] Gunn III JF, Lester D. Using Google searches on the internet to monitor suicidal behavior. *Journal of Affective Disorders.* 2013; 148: 411–412.
- [41] Lee YS, Cha KC, Kim SH. Internet search behavior and box office performance. *Korean Management Review.* 2016; 45: 1501–1526.
- [42] Mavragani A, Gkillas K. COVID-19 predictability in the United States using Google Trends time series. *Scientific Reports.* 2020; 10: 20693.
- [43] Ahn JY, Keum GJ, Jang AR, Song JC. An analysis of key words related to traditional Korean medicine using big data of two search engines. *The Journal of Korean Medical History.* 2017; 30: 45–61.
- [44] Nuti SV, Wayda B, Ranasinghe I, Wang SS, Dreyer RP, Chen SI, *et al.* The use of Google Trends in health care research: a systematic review. *PLOS ONE.* 2014; 9: e109583.
- [45] Nielsen Media Korea. Korean click. 2021. Available at: <http://www.koreanclick.com> (Accessed: 05 December 2021).
- [46] Chandler V. Google and suicide: what can we learn about the use of internet to prevent suicides? *Public Health.* 2018; 154: 144–150.
- [47] Sedgwick R, Epstein S, Dutta R, Ougrin D. Social media, internet use and



- suicide attempts in adolescents. *Current Opinion in Psychiatry*. 2019; 32: 534–541.
- [48] Hayes AF. *Introduction to mediation, moderation, and conditional process analysis: a regression-based approach*. 2nd edn. Guilford Press: New York. 2018.
- [49] Toyama H, Mauno S. Associations of trait emotional intelligence with social support, work engagement, and creativity in Japanese eldercare nurses. *Japanese Psychological Research*. 2017; 59: 14–25.
- [50] Kline TJ. *Psychological testing: a practical approach to design and evaluation*. 1st edn. Sage Publications: Thousand Oaks, CA. 2005.
- [51] Hagihara A, Miyazaki S, Abe T. Internet suicide searches and the incidence of suicide in young people in Japan. *European Archives of Psychiatry and Clinical Neuroscience*. 2012; 262: 39–46.
- [52] Page A, Chang SS, Gunnell D. Surveillance of Australian suicidal behaviour using the internet? *The Australian and New Zealand Journal of Psychiatry*. 2011; 45: 1020–1022.
- [53] Barros JM, Melia R, Francis K, Bogue J, O’Sullivan M, Young K, *et al.* The validity of Google trends search volumes for behavioral forecasting of national suicide rates in Ireland. *International Journal of Environmental Research and Public Health*. 2019; 16: 3201.

**How to cite this article:** Myeongsook Yoon, Jaehee Yi, Kyuhyoung Jeong, Heeran J. Cho. Relationship between unemployment, depression, and suicide during COVID-19 among males in South Korea: based on internet search trends. *Journal of Men’s Health*. 2025; 21(3): 51-59. doi: 10.22514/jomh.2025.036.