### Original article

Increase in Suicide during the COVID-19 Pandemic in Japan: Possible link between Contingent Employment and Suicide by VAR Time-Series Analysis

Yutaka Motohshi<sup>1)</sup>, Masashi Kizuki<sup>1)</sup>, and Sayaka Yoshino<sup>1)</sup>

# Abstract

**Background:** The COVID-19 pandemic has had a serious impact on Japan's socio-economic activities and suicide. The purpose of this study was to clarify whether the impact of the COVID-19 pandemic on the number of suicides was dependent on employment type categories (regular or contingent employment). **Methods:** We analyzed monthly time-series data of suicide number and the number of contingent workers (men and women) from 2013 to 2020, using the vector autoregression analysis (VAR) and the Granger causality Walt tests. **Results:** The results showed statistically significant Granger causality between monthly the number of suicides and contingent workers for longitudinal time-series data from 2013 to 2019. It was also found that the number of contingent workers aged 15 to 64 years were the most severely affected group by the deterioration of employment. **Interpretation:** The increase in the number of suicides since July 2020 could be partly explained by a decrease in the number of contingent workers. It is necessary to take effective suicide countermeasures focusing on contingent female workers aged 15 to 64 years, the most vulnerable group for suicide during the COVID-19 pandemic.

**Keywords:** suicide, COVID-19 pandemic, contingent employment, vector autoregression analysis, Granger causality

## Introduction

The COVID-19 pandemic has had a serious impact on Japan's socio-economic activities and employment-related indicators, such as the unemployment rate, have been negatively affected since April 2020, raising concerns about an increase in the number of suicides during an economic crisis<sup>1</sup>. However, the number of suicides in Japan decreased during April–June in Japan despite the increase in the unemployment rate. The reason the number of suicides decreased in April–June 2020 was thought to be related to the increase in collective anxiety<sup>2</sup>. On the other hand, the number of suicides has increased since July 2020. Thus, the

change in the number of suicides associated with COVID-19 is likely to be dynamic. There are some background factors to be taken into consideration contributing to the increase in suicide numbers such as deterioration of labor market indicators and of mental health due to refraining from going out, among others.

In this paper, we would like to clarify whether the impact of the COVID-19 pandemic on the number of suicides is dependent on employment type categories (regular or contingent employment), because it has been reported that those most severely hurt by the COVID-19 pandemic are women, contingent workers, and low-skilled workers in the labor

<sup>1)</sup> Department of Suicide Data Analysis, Japan Suicide Countermeasure Promotion Center, Tokyo, Japan

market<sup>3</sup>. We conducted a time-series analysis using monthly data on both the number of suicides and the number of contingent workers from 2013 to 2020 and verified causality between these two sets of longitudinal data using the vector autoregression analysis (VAR) and the Granger causality test.

# Methods

Monthly numbers of suicide were provided from suicide statistics published monthly by the Ministry of Health, Labor and Welfare of Japan<sup>4)</sup>. Monthly numbers of regular/contingent workers were provided from the Labor Force Survey by the Ministry of Internal Affairs and Communications of Japan<sup>5</sup>. Monthly time-series datasets from January 2013 to October 2020 were prepared for numbers of suicide and numbers of regular/contingent workers in order to conduct time-series analyses. The vector autoregression analysis (VAR) was applied to two sets of longitudinal time-series data, and Granger causality Walt tests were also conducted to verify the causality of two sets of time-series data. In addition, the presence of significant correlation was examined using correlation analysis. All statistical analyses were performed using Stata 16 software (LightStone Inc., 2019)<sup>6</sup> with a significance level set at 5%.

### Results

Figure 1 shows the increase/decrease in the number of contingent (hiseiki or non-regular) workers from January to October 2020 compared to the number in February just before the COVID-19 pandemic began in earnest in Japan. In Japan, contingent employment includes part-time workers, temporary workers, dispatched workers, contract employees, and others. The number of contingent female workers decreased significantly by 1.08 million in April compared to February. This figure suggests that 1.08 million contingent female workers lost their jobs in April. From April to July, the decrease in the numbers of contingent female workers exceeded 1 million, but from August to October, the decrease showed a declining trend. In October, the number of contingent female workers decreased by 0.66 million. The decrease in male contingent workers was smaller than that in women, and it became clear that there is a gender gap in the impact of job losses in the labor market. Regarding the type of industry, the number of jobs in industries including "accommodation and food service," "construction," and "liferelated services and entertainment" decreased significantly, which means that contingent, lowskilled, female workers who worked in industries that employ many female workers suffered from the COVID-19 crisis.



Figure 1. Increase/decrease in the number of contingent workers from January to October 2020 compared to the number in February just before the COVID-19 pandemic began in earnest in Japan

Figure 2 showed the monthly time-series trend data of numbers of suicide and the number of contingent workers (men and women) from January 2013 to October 2020. It was shown that the number of suicides decreased as the number of contingent workers increased. The increase in the number of suicides since July 2020 could be partly explained by a decrease in the number of contingent workers. The vector autoregression

analysis (VAR) and Granger causality Walt tests<sup>5</sup> revealed statistically significant Granger causality between the number of suicides and the number of contingent workers for longitudinal time-series data from 2013 to 2019. The chi-square values were 9.2 (p<0.01) for the total (men and women), 10.2 (p<0.006) for men, and 10.9 (p<0.004) for women.



Figure 2. Monthly time-series trend data of suicide number and the number of contingent workers (men and women) from January 2013 to October 2020. The vector autoregression analysis (VAR) and Granger causality Walt tests<sup>5</sup> revealed statistically significant Granger causality between suicide number and number of contingent workers for longitudinal time-series data from 2013 to 2020 (chi-square = 9.2, p < 0.01)

Figure 3 shows the correlation between the number of contingent workers and the suicide rate. The correlation from January 2013 to February 2020 (non-crisis period) showed a statistically significant negative correlation, and it was found that the larger the number of contingent workers, the lower the suicide rate (y = -0.022x + 62.84, R<sup>2</sup> = 0.66, P < 0.001). Data from April–July 2020 during the economic crisis associated with the COVID-19 pandemic are clearly different from the non-crisis period from 2013 to 2019. Looking at the changes in the suicide rate, a phase transition was observed between March and April 2020, and the suicide rate decreased from April to June compared to

March. This period of decrease in suicide rate coincided with the period when collective anxiety increased, which was indicated by the number of Internet searches for the word "Corona" according to Google Trends<sup>2</sup>. The decrease in suicide rate seemed to also be associated with the refrain from going out due to the state of emergency. The suicide rate in July–September turned around and showed an increasing trend; this increasing trend was influenced by the deterioration of labor market indicators as indicated by the decrease in the number of contingent workers and the increase in the unemployment rate.



Figure 3. Correlation between the number of contingent workers and the suicide rate. The time period from January 2013 to February 2020 (non-crisis period) showed a statistically significant negative correlation, and it was found that the larger the number of contingent workers, the lower the suicide rate (y = -0.022x + 62.84,  $R^2 = 0.66$ , P < 0.001).

Regarding the correlation between the suicide rate and the number of workers, we further performed a correlation analysis by stratifying by gender (male/female) and age (15-64 years old/65 years old or older) according to employment-type categories (regular/contingent). The correlation between the suicide rate and the number of workers was statistically significantly negative for regular female workers (15-64 years old, 65 years old or older), contingent female workers (15-64 years old, 65 years old or older), regular male workers (15-64 years old, 65 years old or older) and contingent male workers (65 years old or older). We found that only contingent male workers aged 15-64 years had a statistically significant positive correlation with suicide rates.

### Discussion

It has been reported that there is a strong correlation between the suicide rate and the unemployment rate with regard to the negative impacts of the economic crisis on the labor market<sup>3</sup>. However, the unemployment rate is not

the employment-related indicator only associated with the increase in the number of suicides. Since the number of contingent workers has gradually increased in Japan's labor market since the 1990s<sup>7</sup>, it is necessary to consider the number of contingent workers as an employment-related indicator that affects the suicide rate. However, insufficient research has thus far been conducted. In the economic crisis associated with the COVID-19 pandemic in 2020, the gender and age of the affected populations differ from those during the 2008-2010 Lehman shock. It has been reported that contingent female workers have suffered more job losses associated with the COVID-19 pandemic<sup>3</sup>.

The results of the Granger causality test revealed that the number of contingent workers could affect the increase/decrease in the number of suicides. During the COVID-19 pandemic period, the relationship between the number of contingent workers and suicide tended to be disturbed, although they were fundamentally closely related. It is necessary to attend to the increase/decrease in the number of contingent workers as well as suicide trend data.

As already mentioned, the decrease in the number of suicides from April to June was mostly due to an increase in collective anxiety<sup>2</sup>. The data from August to October nearly returned to the linear regression equation from 2013 to 2020 during the non-crisis period, and, from the data, the trend seemed to have entered a different phase from April to June. The deterioration of employment-related indicators such as the decrease in the number of contingent workers is thought to be behind the increase in number of suicides. Furthermore, economic policies as well as employment policies such as basic employment insurance allowances, small emergency loans, and general support loans might suppress the increase in the suicide rate $^{8}$ . Regarding the increase in the number of suicides from July to September, it is possible that the policy effects of basic employment insurance allowances, small emergency loans, general support loans, and so on decreased, leading to an increase in suicides. Other factors to be taken into consideration are an increase in those who are in need of financial support due to the expiration of the basic employment insurance allowance for contingent young women and insufficient access to financial support measures, which might affect the increase in suicides. It has also been noted that the increase in female suicides may be related to the increase in domestic violence due to refraining from going out and engaging in remote work<sup>8</sup>.

The present study suggests that contingent female workers aged 15 to 64 years were the

most severely affected group by the deterioration of employment, the so-called "COVID-19 shocks.<sup>3</sup> It is necessary to take effective suicide countermeasures focusing on contingent female workers aged 15 to 64 years, the most vulnerable group for suicide during the COVID-19 pandemic.

Received: November 30, 2020; Accepted: December 15, 2020

#### Additional remarks:

The author has no reportable conflicts of interest.

#### References

1. Kawohl W and Carlos Nordt C. COVID-19, unemployment, and suicide. Lancet

www.thelancet.com/psychiatry Vol 7 May 2020.

- Motohashi Y, Kizuki M and Yoshino S. Study of the influence of collective anxiety on suicide rate under the COVID-19 pandemic in Japan. Jisatu Sogou Seisaku Kenkyu (Japanese Journal of Comprehensive Suicide Policy Research), 3(1), 7-14, 2020. (In Japanese)
- Kikuchi S, Kitao S, and Mikoshiba M. Who Suffers from the COVID-19 Shocks? Labor Market Heterogeneity and Welfare Consequences in Japan. RIETI Discussion Paper Series 20-E-064, July 2020. https://www.rieti.go.ip/ip/publications/summary/2007 0004.html
- Japanese Ministry of Health, Labour and Welfare. Trends in the number of suicides based on the National Police Agency's suicide statistics. 10 December 2020.
- Japanese Minsistry of Internal Affaires and Communication (MIC): Labor Force Survey. 2 Dec, 2020. MIC, Tokyo Japan, 2020.
- LightStone. Stata 16: Time-series Data Analysis. 2020. Tokyo.
- Japanese Ministry of Health, Labour and Welfare: Analysis of Labour Economics. In: Annual Health, Labour and Welfare Report 2012-2013. MHLW, Tokyo, 2013.
- Japan Suicide Countermeasures Promotion Center (JSCP).
  Analysis of recent trend on suicide under the COVID-19 pandemic in Japan: Urgent Report. 21 October, 2020, Tokyo.