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Factors Regarding Suicide Decline in Japan: A Longitudinal Study on Psychiatric Diagnosis of Serious Suicide Attempters

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Background: The number of suicides in Japan decreased during the period from 2012 through 2019. Because data on factors associated with this decline are limited, we conducted a retrospective longitudinal study of psychiatric diagnoses of serious suicide attempters before 2012 and after 2019.

Methods: Serious suicide attempters admitted to the critical care medicine (CCM) department of Nippon Medical School Hospital between 2006 and 2017 were included and classified as those before and after the suicide decline in 2012. Chi-square test and residual analysis were used to analyze changes in the proportion of suicide attempters among all patients admitted to CCM and to examine differences in the proportion of psychiatric diagnoses.

Results: The proportion of suicide attempters among CCM hospitalized patients decreased overall ($\chi^2(1)=18.29$, $p<.01$). The proportion of psychiatric diagnoses changed significantly ($\chi^2(8)=62.21$, $p<0.001$); specifically, it decreased for schizophrenia (residual: −2.28), depressive disorders (residual: −5.39), persistent mood disorders (residual: −3.58), and reaction to stress disorders (residual: −2.73). Depressive disorders decreased and had a large contribution ratio in both sexes.

Conclusions: The decrease in the proportion of attempted suicides among patients admitted to CCM was consistent with the decline in suicides in Japan. Analysis by psychiatric diagnosis confirmed a significant decrease in the proportion of suicide attempts associated with depressive disorders, schizophrenia, and reaction to stress disorders, which were the most common disorders associated with attempted suicide. Depressive disorders made the greatest contribution to the reduction in suicide attempts.

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Key words: psychiatric diagnosis, suicide decline in Japan, serious suicide attempter, depression, longitudinal study

Introduction

The suicide rate in Japan had risen greatly from 19.3 in 1997 to 26.0 in 1998. Since then, approximately 30,000 people have died by suicide every year for 14 consecutive years[1]. The Basic Act for Suicide Prevention, the basic law against suicide, was implemented in 2006, and then the General Principles of Suicide Prevention Policy (2007) clarified the suicide prevention measures in Japan[2]. The latter included several simultaneously launched suicide prevention measures, together with methods for raising public awareness, training gatekeepers, and establishing a medical care coordination system by which primary care providers can refer depressive patients to a psychiatrist[2–4]. The number of suicides in Japan decreased to less than 30,000 in 2012, and the suicide rate decreased from 24.0 in 2011 to 21.8 in 2012, which was then followed by a continuous annual decrease until 2019[5]. However, among G7 countries, the suicide rate in Japan remains comparatively high[6]. Then, during the COVID-19 pandemic, the number of suicides increased again in

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2020[5,7,8]. Thus, identifying factors involved in the decline of suicides is critically important for promoting suicide prevention in Japan.

Changes in suicide rates have been explained as the composite result of various factors, such as socioeconomic and health problems[1,3]. The relationship between unemployment rate and suicide rate has been reported[3,9], and it may explain the large increase in the suicide rate in 1998 and the subsequent increasing trend, which may have been caused by socioeconomic factors such as the recession. In contrast, few studies have attempted to explain the decline in suicides in Japan[10].

Numerous studies have highlighted the importance of psychiatric evaluation[11] and treatment for the prevention of suicidal behavior[12–14]. Bertolote and Fleischmann (2002) reported that 96.8% of suicide completers had a psychiatric disorder[12]. Hirokawa et al (2012) reported that 81.8% of suicide completers had reached the level of a psychiatric disorder, according to psychological autopsy assessments in Japan[15]. Several psychiatric treatments such as drug therapy and cognitive behavior therapy are reportedly effective for preventing suicides[16–19]. Therefore, to prevent suicides, it is very important to connect individuals requiring psychiatric treatment with adequate medical services[1].

Longitudinal data, including psychiatric assessments such as psychiatric diagnoses of suicides, are needed to examine the contribution of mental health to the suicide decline. The National Police Agency of Japan reported that the number of suicides presumed to be due to "health problems of depression" is decreasing, as are those due to socioeconomic problems[5]. However, these classifications are not based on evaluations by psychiatrists and instead utilize indirect analyses based on suicide victims' notes or information obtained from victims' families. Psychological autopsy studies reported detailed information on suicide deaths, including psychiatric evaluations[15,20,21]. However, it is difficult to conduct long-term surveys in Japan, and there has been no longitudinal survey of psychological autopsies[15]. Therefore, the period from before the suicide decline to after the decline has not been adequately investigated from a psychiatric perspective.

Serious suicide attempters have been defined as a population that has experienced significant physical injury requiring substantial intensive medical treatment[22]. They are known as populations that have some similarities with suicide completers. Thus, study of serious suicide attempters is thought to be an alternative and promising methodology for investigating suicide[22,23]. A direct survey of suicide attempters allows for evaluation of psychiatric assessments when they attempted suicide[22,24,25] and may be helpful in investigating differences in the characteristics of serious suicide attempters before and after the suicide decline, in order to identify reasons for the change in the number of suicide completers in Japan.

In this study, we investigated serious suicide attempters admitted to the emergency department both before and after the decrease in suicides in order to examine factors contributing to the decrease. We focused on the proportion of serious suicide attempters among emergency admissions and changes in psychiatric diagnoses.

Materials and Methods

Ethics

The present study was approved by the Ethics Committee of Nippon Medical School Hospital (B-2020-113) and conforms to the provisions of the Declaration of Helsinki. It was clarified in the opt-out section of the website that research participants were guaranteed the opportunity to refuse to join and that the research would be conducted anonymously.

Patients

We analyzed data from patients who had been admitted to the department of critical care medicine (CCM), the emergency care unit of Nippon Medical School hospital, between January 2006 and December 2017. A suicide attempt was defined as an action associated with an intent/desire to die, which is the definition used in the Columbia-Suicide Severity Rating Scale[26]. Patients with multiple admissions were counted each time they were admitted. Patients without sufficient information were classified as "other than suicide".

In this study, we regarded 2012 as the turning point for suicide decline in Japan. Patients were classified by time period, namely, the 6-year period before the suicide decline ("2006-2011": admitted between January 2006 and December 2011) and the period after the decline ("2012-2017": admitted between January 2012 and December 2017).

Data Collection

Data on sex and psychiatric diagnosis were retrospectively collected from patients' medical records. Psychiatric diagnoses were classified according to three-digit ICD-10 criteria by two or more experienced psychiatrists[27]. If the patient had comorbidities, only the dominant one was included. Depressive episode (F32) and recurrent depressive disorder (F33) were evaluated by con-

firming the existence of a depressive episode at the time of the suicide attempt, and were combined as depressive disorders (F32/33). In cases of disagreement regarding the psychiatric diagnosis, a decision was reached by mutual consent after discussion. We combined psychiatric disorders with frequencies below 10 into the "other" category for both periods.

Statistical Analysis

Chi-square test and residual analysis were used to test whether there was a change in the proportion of suicide attempters among all patients admitted to CCM and whether there was a difference in the proportion of psychiatric diagnoses between the two periods. In addition, the contribution ratio was calculated by dividing change in the number of suicide attempters for each psychiatric diagnosis by change in the total number of suicide attempters. We performed subgroup analysis by sex in the analysis of the proportions of serious suicide attempters, psychiatric diagnoses, and contribution ratios.

A two-sided p value of <0.05 was considered to indicate statistical significance. We judged significance as a greater than 1.96 absolute value in each residual. The statistical package SPSS version 24 was used for all analyses.

Results

In total, 21,271 patients were admitted to CCM during the study period: 11 inpatients were hospitalized repeatedly (3 during 2006-2011, 8 during 2012-2017). The total number of suicide attempters was 942 (4.42% of all CCM patients), after excluding 12 suspected suicide attempters because of missing data. The following diagnostic categories were included in "other diagnoses": dementia in Alzheimer disease (F00), other mental disorders due to brain damage and dysfunction and to physical disease (F06), mental and behavioral disorders due to use of sedatives or hypnotics (F13), mental and behavioral disorders due to use of other stimulants, including caffeine (F15), mental and behavioral disorders due to multiple drug use and use of other psychoactive substances (F19), persistent delusional disorders (F22), schizoaffective disorders (F25), other anxiety disorders (F41), dissociative disorders (F44), somatoform disorders (F45), habit and impulse disorders (F63), mild mental retardation (F70), pervasive developmental disorders (F84), hyperkinetic disorders (F90), and none.

The proportion of suicide attempters among CCM hospitalized patients decreased overall (573 of 10,944 during 2006-2011, 369 of 9,448 during 2012-2017; $\chi^2(1)=18.29$, $p<.01$, residuals: −4.311). A decrease in the proportion of suicide attempters was observed in males (242 of 6,781 during 2006-2011, 141 of 5,930 during 2012-2017; $\chi^2(1)=14.08$, $p<.01$, residuals: −3.80) and females (331 of 4,163 during 2006-2011, 228 of 3,518 during 2012-2017; $\chi^2(1)=5.08$, $p<.05$, residuals: −2.30) (**Table 1**).

Overall, the most common psychiatric diagnoses among suicide attempters were F32/33, F20, and F41, in that order in both sexes. The proportion of psychiatric diagnoses changed overall ($\chi^2(8)=62.21$, $p<0.001$). There was a significant decrease in F32/F33 (residual: −5.39), F43 (residual: −2.73), F34 (residual: −3.58), and F20 (residual: −2.28) and a relative increase in "other than suicide" (residual: 4.31). This trend was also observed in the sex subgroups, with a significant decrease in F32/33 for both sexes (residual: −4.17 in males and −3.40 in females) and an increase in "other than suicide" (residual: 3.80 in males and 2.30 in females). In males, F20 and F43 decreased significantly (residual: −2.28 in F20 and −2.32 in F43). In females, F34 decreased significantly (residual: −3.08) (**Table 1**).

The contribution of a diagnosis to the reduction in the number of suicide attempts was greatest for F32/F33 (47.5%), followed by F43 (22.1%) and F34 (20.6%) (**Fig. 1**). When examining the results by sex, F32/33 (25.5%), F20 (12.7%), and F43 (11.3%) had the largest contribution to the decrease in males. In females, F32/33 (22.1%), F34 (16.7%), and F43 (10.8%) had the largest contribution, in that order (**Fig. 1**).

Discussion

The proportion of suicide attempters among all patients admitted to CCM significantly decreased overall as well as in both sexes. These findings are consistent with a report by the Fire and Disaster Management Agency of Japan, which found a reduction in the number of self-inflicted medical emergencies in the country[28]. Their data showed that, as the number of suicides declined, so did the number of serious suicide attempts. The trends we noted in serious suicide attempts are useful for analyzing changes that occurred in suicide victims.

The proportions of psychiatric diagnoses among serious suicide attempters changed: there were decreases in diagnoses of depressive episode/recurrent depressive disorder, schizophrenia, reaction to severe stress, persistent mood disorders, and adjustment disorders overall. In its report on suicides, the National Police Agency of Japan noted that suicides due to various psychiatric disorders such as "depression problems" and "schizophrenia

Table 1 Changes in proportions of psychiatric diagnoses (overall, male, female)

Overall χ^2 (8) =62.21, p<.001	2006-2011	2012-2017	Residuals
Mental and behavioral disorders due to use of alcohol (F10)	15	20	1.322
Schizophrenia (F20)	103	61	–2.275*
Bipolar affective disorder (F31)	19	23	1.138
Depressive episode/Recurrent depressive disorder (F32/33)	159	62	–5.385*
Persistent mood disorders (F34)	68	26	–3.579*
Reaction to severe stress, and adjustment disorders (F43)	97	52	–2.732*
Specific personality disorders (F60)	37	40	1.049
Other diagnosis	75	85	1.811
Other than suicide	10,944	9,448	4.311*

Males χ^2 (8) =34.27, p<.001	2006-2011	2012-2017	Residuals
Mental and behavioral disorders due to use of alcohol (F10)	10	12	0.770
Schizophrenia (F20)	52	26	–2.315*
Bipolar affective disorder (F31)	5	9	1.345
Depressive episode/Recurrent depressive disorder (F32/33)	82	30	–4.173*
Persistent mood disorders (F34)	12	4	–1.715
Reaction to severe stress, and adjustment disorders (F43)	44	21	–2.278*
Specific personality disorders (F60)	5	5	0.231
Other diagnosis	32	34	0.841
Other than suicide	6,781	5,930	3.804*

Females χ^2 (8) =30.16, p<.001	2006-2011	2012-2017	Residuals
Mental and behavioral disorders due to use of alcohol (F10)	5	8	1.165
Schizophrenia (F20)	51	35	–0.892
Bipolar affective disorder (F31)	14	14	0.483
Depressive episode/Recurrent depressive disorder (F32/33)	77	32	–3.399*
Persistent mood disorders (F34)	56	22	–3.075*
Reaction to severe stress, and adjustment disorders (F43)	53	31	–1.583
Specific personality disorders (F60)	32	35	1.119
Other diagnosis	43	51	1.722
Other than suicide	4,163	3,518	2.299*

*statistically significant, >1.96

problems" decreased during the same period[6]. That report was based on information from police officers and non-professional members of the public, so it is likely that "depression" actually encompassed various other mental disorders that are included in our report. Interestingly, the results of our analysis of serious suicide attempters in relation to psychiatrists' clinical diagnoses were similar to those reported for suicides. These results may reflect a reduction in serious suicide attempts associated with these psychiatric disorders during the period of suicide decline.

Some sex differences in changes in the proportions of diagnoses were noted, but only depression (F32/F33) showed a decrease and made a large contribution in both sexes. Mood disorders are reported to be the most frequent psychiatric diagnosis in suicides[12], and mood disorders such as depression are an important risk factor for suicides[29,30]. As noted above, a reduction in this diagnostic category was previously found to contribute to a reduction in suicides[6]. The present results showed that a decrease in the number of serious suicide attempts in the context of depression was associated with a decline in the number of suicide attempters.

The fact that mood disorders decreased among serious suicide attempters during the period of suicide decline, as was reported for suicides, suggests a relationship between a decrease in mood disorders and a decline in suicidal behavior. Although the reasons for this could not be examined in the present study, the following hypotheses should be considered. From a psychiatric point of view, depression may have been adequately treated by improved quality of and access to psychiatric treatment. Depression can improve with appropriate treatment[31], and suicide prevention plans in Japan have consistently in-

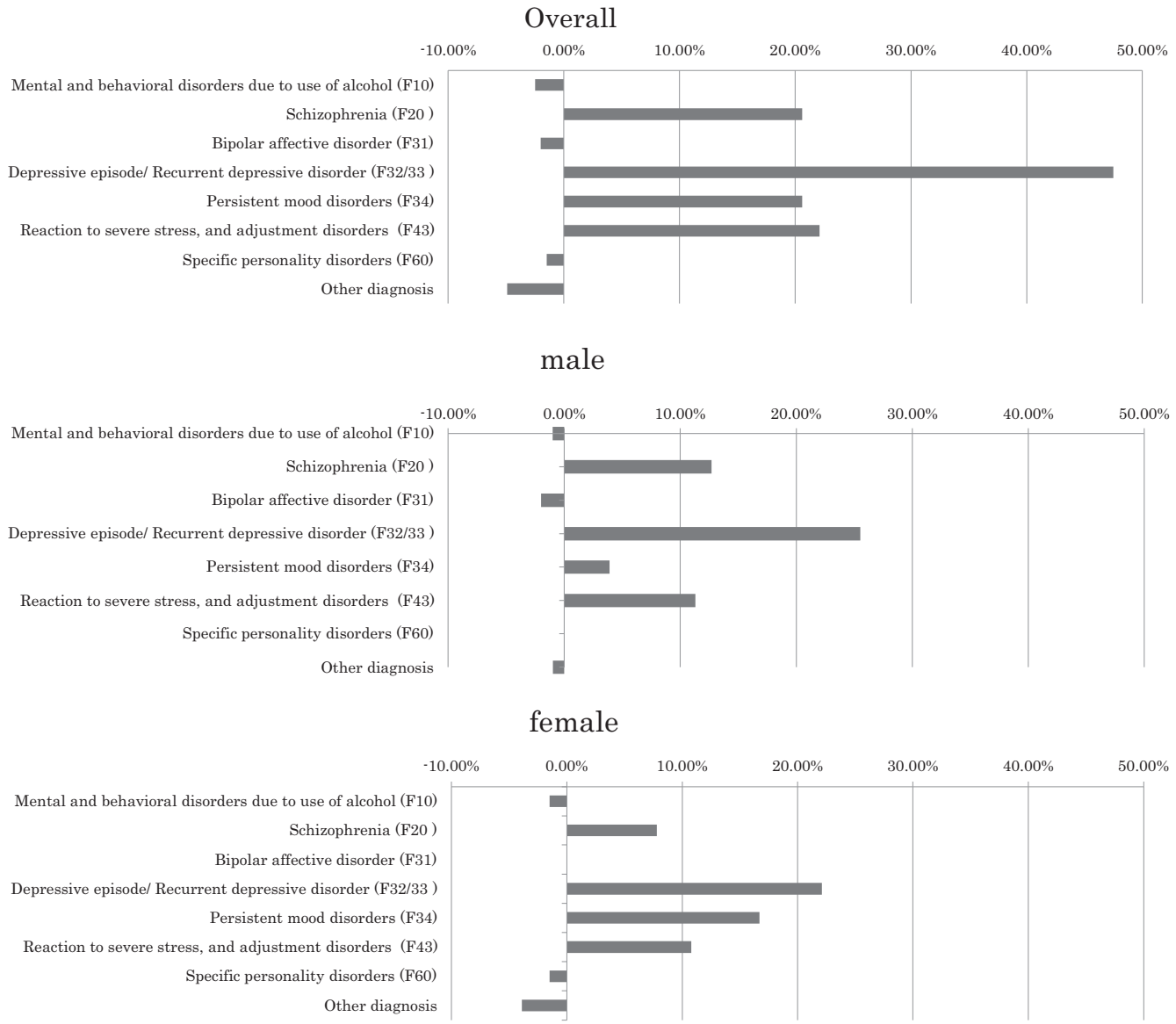

Fig. 1 Contribution ratios in the decline of suicide attempters

The contribution ratio was calculated by dividing change in the number of suicide attempters for each category of psychiatric diagnosis by change in the total number of suicide attempters.

volved measures to improve access to psychiatric treatment. Japan's national statistics, the Patient Survey, showed an increase in the number of patients with mood disorders visiting psychiatric institutions during the corresponding period (from 1,041,000 in 2008 to 1,276,000 in 2017), suggesting that Japan's suicide prevention efforts improved access to psychiatric care[32]. Other diseases found to have declined in this study, such as schizophrenia, reaction to severe stress, persistent mood disorders, and adjustment disorders, also decreased in a similar fashion. Alternatively, social changes, such as changes in economic conditions and improvements in unemployment, might have reduced the number of depressed people who attempted suicide. Future studies should examine these hypotheses regarding the decline in suicides in Japan.

This study only evaluated psychiatric diagnoses; however, suicide is inherently a multifactorial outcome. Therefore, other important factors (e.g., social factors such as unemployment rate, economic stress, and natural disasters) should be investigated in future studies. Our study was conducted as a single site survey, which limits the generalizability of the data when used to develop future suicide countermeasures. In addition, other categories of psychiatric diagnosis contained several heterogeneous diseases, but because of the small sample size of each, we were unable to examine these diseases/disorders in detail. Thus, surveys of broad areas and multi-

center collaborative studies with larger numbers of subjects are needed to overcome these limitations. Finally, we classified psychiatric diagnoses based on clinical assessments. Evaluation by structured interviews is necessary for more accurate estimation.

Conclusion

This study examined changes in psychiatric diagnoses among serious suicide attempters during a period of suicide decline. There was a reduction in the number of serious suicide attempters admitted to CCM and an overall decrease in suicide attempts by depressive disorders, schizophrenia, and reaction to stress. In particular, the reduction of suicides by depressive disorders was common in both males and females, and the contribution rate was large. These results reflect the fact that serious suicide attempts associated with these psychiatric disorders decreased during the period of suicide decline in Japan.

Author Contributions: YOt and RN designed the study and wrote the protocol. YOt and RN contributed to data acquisition and clinical review. YOt, YOk, and RA analyzed the data. YOt and YOk wrote the first draft of the manuscript. RA, RN, YOk, and AT assisted in revising the manuscript. All authors contributed to and have approved the final manuscript.

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Conflict of Interest: Ryosuke Arakawa received speaker's honoraria from Dainippon Sumitomo Pharma and Pfizer during the past 3 years. Yoshiro Okubo received grants or speaker's honoraria from Dainippon Sumitomo Pharma, GlaxoSmithKline, Janssen Pharmaceutical, Otsuka, Pfizer, Eli Lilly, Astellas, Yoshitomi, and Meiji during the past 3 years. Amane Tateno received speaker's honoraria from Dainippon Sumitomo Pharma and Otsuka during the past 3 years. The remaining authors declare no conflict of interest.

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