Title: Effect of Name Change of Schizophrenia on Mass Media Between 1985 and 2013 in Japan : A Text Data Mining Analysis

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Additional information(追加情報)：

Effect of name change of schizophrenia on mass media

between 1985 and 2013 in Japan: A text data mining analysis

Running title: Name change of schizophrenia and mass media (43 characters)

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Text: 2,963 words
References: 24
Tables: 4
Figures: 1

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Abstract (245 / 250 words)

Background: Mass media such as newspapers and TV news affect mental

health-related stigma. In Japan, the name of schizophrenia was changed in 2002 for the

purposes of stigma reduction; however, little has been known about the effect of name

change of schizophrenia on mass media.

Method: Articles including old and new names of schizophrenia, depressive disorder,

and diabetes mellitus (DM) in headlines and/or text were extracted from 23,169,092

articles in four major Japanese newspapers and one TV news program (1985–2013).

The trajectory of the number of articles including each term was determined across

years. Then, all text in news headlines was segmented as per part-of-speech level using

text data mining. Segmented words were classified into six categories and in each

category of extracted words by target term and period were also tested.

Results: Total 51,789 and 1,106 articles including target terms in newspaper articles and

TV news segments were obtained, respectively. The number of articles including the

target terms increased across years. Relative increase was observed in the articles

published on schizophrenia since 2003 compared with those on DM and between 2000

and 2005 compared with those on depressive disorder. Word tendency used in headlines

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was equivalent before and after 2002 for the articles including each target term. Articles

for schizophrenia contained more negative words than depressive disorder and DM

(31.5%, 16.0%, and 8.2%, respectively).

Conclusions: Name change of schizophrenia had a limited effect on the articles

published and little effect on its contents.

<u>**Keywords**</u>

Stigma, terminology, stereotyping, prejudice, news

Text (3,380 / 4,000 words)

Introduction

Mass media (such as newspaper articles and TV news segments) play a crucial role in

mental health-related stigma because mass media broadly provide information and

impressions about mental illness to the public and patients.[1-3] Many studies have

reported that approximately half of the articles representing mental illness appear in

negative contexts, such as criminal and violent cases and provide inaccurate and

stereotyped information.[4-7] Such articles are published at a higher rate than that for

physical illness.[8] Of these, schizophrenia and psychosis are focused on stigmatization

from mass media articles,[9-12] and had the highest rate of negative contexts compared

with other psychiatric diseases.[9, 11] As schizophrenia is thought to be one of the most

stigmatized diseases compared with physical and psychiatric diseases, more appropriate

information along with positive and recovery-oriented impressions through mass media

are mandatory to promote early detection and care for young people suffering from

schizophrenia and psychosis.[13]

Name change is one strategy for the reduction of stigma. In Japan, the name of

schizophrenia was changed in 2002 for the purposes of stigma reduction, from

"Seishin-Bunretsu-Byo" (mind-split disease) to "Togo-Shitcho-Sho" (integration

disorder).[14] Since the old name of schizophrenia itself can provide a negative and

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pessimistic image linked with the Kraepelinian "dementia praecox," the National

Federation of Families with Mentally Ill in Japan requested the Japanese Society of

Psychiatry and Neurology to replace with a less stigmatizing name.[14, 15] The name

change has been reported to reduce stigma towards schizophrenia in an increasing

number of individuals who were informed that they suffer from schizophrenia. The

change has also led to an increase in the number of patients and family members who

accepted the disease name.[14-16] In terms of long-term effect, we previously reported that,

through a survey performed 12 years after the name change, the new name given to

schizophrenia in Japan resulted in significantly less stigma than the old name, but still

greater than depressive disorder and diabetes mellitus (DM).[17] Although more than half

of young people recognized the old and new names of schizophrenia as different

conditions, which partly contributes to reducing the stigma toward schizophrenia,[17] the

effect of the name change could disappear if mass media continue to broadcast more

negative contents related to the new name. Although there are limited findings reported

in longitudinal investigations regarding whether mass media broadcast about mental

illness and schizophrenia,[10, 11] a report using newspapers in the UK demonstrated that

articles for schizophrenia sustained a higher rate of negative impact between 1992 and

2008 than those for mental illness.[11] To the best of our knowledge, there has been no

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study exploring the difference of mass media articles before and after the name change

of schizophrenia, as well as between schizophrenia and other mental illnesses, and

between mental and physical illness such as diabetes mellitus (DM).

In this study, we explored the trajectory of the number of articles including

disease names in Japanese major newspapers and TV news segments between 1985 and

2013 using a data library. Furthermore, we segmented and extracted the words that

would be more likely to be used in headlines in these articles using a text data mining

method. This method provides a novel approach to illustrate the word tendency and

linkage of specific terms in texts.[18] The hypothesis is that the articles in Japanese major

newspapers and TV news segments would improve after the name change of

schizophrenia in: (1) increasing the relative number of articles published and (2)

increasing the relative number of positive contexts in which schizophrenia is described,

when compared with all articles published as well as articles on depressive disorder or

DM.

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Materials and methods

Data source

We acquired article headlines from a data storage service for newspapers and television news (G-search Limited, Tokyo, Japan). The service can search article headlines and texts including a specific term from data sources in over 150 Japanese newspapers (including four nationwide newspapers) and TV news sources since 1984. Of these, we used article data sources from four nationwide newspapers (Asahi, Mainichi, Sankei, and Yomiuri) issued as printed versions and one television station (Japan Broadcasting Corporation) from January 1, 1985 to December 31, 2013 (Table 1). Each nationwide newspaper is independently edited and issued, and the number of issues in four newspapers covers approximately 50% of all newspaper circulation in Japan. Japan Broadcasting Corporation is a non-commercial broadcaster, and the audience rate for NHK news is approximately 15%. We searched all articles in which target terms were used in headline and/or text from 22,221,697 newspaper articles and 944,395 television news pieces and counted the numbers of articles for each year and target term. Furthermore, we obtained the text of the headlines on all articles using the target terms.

Table 1 around here.

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Target terms

In accordance with previous studies,[11, 17] we used "Seishin-Bunretsu-Byo" (mind-split

disease, the old name of schizophrenia in Japan), "Togo-Shitcho-Sho" (integration

disorder, the new name of schizophrenia), and "utsu-byou" (depressive disorder) as

target search terms. Moreover, we used "tounyou-byou" (DM) as a representative of

chronic physical diseases to compare between psychiatric and physical disease names.[17]

Text mining

A text data mining method was used for headlines to illustrate word tendencies of the

articles used in each search term. All text in headlines were segregated at morpheme

level, the smallest grammatical unit in a language. For example, a sentence "Mass

media such as newspapers and TV news considerably affect mental health-related

stigma." has 15 morphemes: "mass," "media," "such," "as," "newspapers," "and,"

"TV," "news," "considerable,"-ly," "affects," "mental," "health," "-related," "stigma."

The morphemes were segmented to part-of-speech level (e.g., noun, verb, adjective,

adverb, article) using IPADIC version 2.7.0—the public part-of-speech based dictionary

defined by the Information-technology Promotion Agency, Japan.[19] Word segregation in

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text mining was conducted using RMeCab package version 0.9996 in R version 3.1.0.[20, 21] The process of word segregation for all articles was completed in 60 minutes. As most of the extracted words with significant meanings are nouns and verbs in Japanese newspapers and TV news headlines, all nouns and verbs were used in further analyses. Next, the number of each extracted word was counted by each target term and period (old or new name of schizophrenia, and before 2001 or after 2002 for depressive disorder and DM) to indicate the differences in word tendencies before and after the name change of schizophrenia.

To determine word tendencies for articles, including each target term, two authors (S.K and S.A.) further extracted the words from the target term itself and non-meaning words (such as numerals, units, conjunctions, proper nouns, or words often used as a specific headline in each newspaper or TV news segment; details in supplementary materials). Interrater reliability using 274 words for the initial extraction was robust (kappa coefficients = 0.97, p < .001).

As the extracted meaning words were still numerous, 1% of all meaning words were randomly extracted and randomized by S.K. Furthermore, two independent raters (S.Y. and Y.O.) classified 1,888 words, without any information provided regarding the words used in each target term, into six categories: (1) criminal or violent (legal term

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only, e.g., "hanko" (penetration), "jiken" (case), "kiso" (prosecution), "jyokoku" (appeal

to the Supreme Court), "sikei" (death penalty)); (2) suicide or self-harm ("jisatu" or

"jishi" (suicide) and "jisyou" (self-harm)); (3) medical or psychological (technical term

only, e.g., "chiryo" (treatment), "sibou" (death), "nou" (brain), PTSD, "gan" (cancer));

(4) other negative (e.g., "kyo-fu" (fear), "hitei" (deny), "sabetsu" (discrimination),

"henken" (prejudgement), "karou" (overwork)); (5) other positive (e.g., "kaifuku"

(recovery), "kaizen" (improvement), "naoru" (cure), "kansya" (thanks)); and (6) other

neutral (all words expect for coded as (1)―(5)). The words categorized into (1)–(5)

were not used for general and/or bi-directional meanings categorized into other

categories. When words were applicable to both categories and the usage depended on

the context, the words were categorized as (6). When the category of the word was

mismatched for the categorization, the words were categorized by the third rater (K.O.),

and then the category was determined after discussion by the three raters.

Statistical analysis

The trajectory of the number of articles including each term and relative number to total

articles was determined across years. A chi-square test was conducted to investigate

whether the numbers of articles, including target terms, would be different across years

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using the number of the articles not including any target term as a reference. For further

analysis to compare the numbers, including those for depressive disorder and

schizophrenia and for DM, and to compare between numbers, including depressive

disorder and schizophrenia, the numbers for DM and depressive disorder were used as

respective references. As the data source of newspapers in the first five search years and

TV news sources had a relatively small total number of articles, standardized residuals

were tested using the numbers of newspaper articles after 1991 and TV news segments

every two years.

The rate of articles that contained each target term in their headlines were

compared among the target terms and periods using a chi-square test. In this analysis,

because headlines often use abbreviated words in Japanese newspapers and TV news

sources, the numbers for "utsu" (depression) and "utsu-byou" (depressive disorder) in

depressive disorder, and those of "tounyou" (glycosuria) and "tounyou-byou" (diabetes

mellitus) in diabetes mellitus were included. Next, the top 20 words were fully listed to

show the major words used in each target term and period. Finally, the number in each

category of extracted words by target term and period were also tested using a

chi-square test.

All analyses were conducted using SPSS Statistics 22 (IBM Corp., Chicago,

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USA) and significance levels were set at $p < .05$.

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Results

Number of articles including target terms between 1985 and 2013

For newspapers, 51,789 articles were obtained in the initial search using the target terms,

out of a total of 22,221,697 eligible articles (Table 2). Total articles used in this study

and the articles including the target terms increased across years (Supplementary Table

s1). Of these, DM yielded the greatest number of articles included across years,

followed by depressive disorder and schizophrenia (Figure 1a and Supplementary Table

s1). The number of articles including the target terms increased across years compared

with the articles not including any target term ($\chi^2 = 5.9 \times 10^3$, df $= 66$, p $< .001$).

Articles including schizophrenia in each year since 2001 had a significant relative

increase compared with 1991, and continued increasing until 2009. For depressive

disorder, the number of articles relatively increased from 2003, with this trend lasting

until 2010. In contrast, the relative increase in the number of articles, including DM,

was evident since 1993, especially between 2006 and 2009.

Within target-term comparison, the increase in the number of articles published

including schizophrenia was greater from 2003 when compared with those of DM

(Figure 1b and Supplementary Table s1), and was greater when compared with

depressive disorder in 1996–1997, 2000–2005, and 2009. The increase in the number of

articles including depressive disorder was smaller in 1993–2000 but greater from 2003, compared with those of DM. Between 2010 and 2011, a larger number of articles on depressive disorder were published, when compared with those on schizophrenia.

For TV news segments, 1,106 articles were extracted in the initial search using the target terms, out of a total of 944,395 eligible articles (Table 2). Similar to the tendency in newspapers, DM had the greatest number of presented TV segments included across years ($\chi^2 = 235$, df = 39, p < .001; Figure 1c and Supplementary Table s2). However, the relative increase in segments on schizophrenia and DM remained stable across years. In contrast, the numbers of segments on depressive disorder had a significant relative increase between 2004–2005, even when compared with those on DM and schizophrenia (Figure 1d and Supplementary Table s2).

Table 2 and Figure 1 around here.

Difference in number of articles after the name change

The first newspaper article arguing in favor of name change of schizophrenia was in 1995, and was followed by four articles in 2000. In 2002, 38.9% (148/380) and 40.0% (4/10) of articles in newspapers and TV news sources, respectively, included both the

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Japanese names of schizophrenia. After 2002, 97.0% of articles in newspapers

(4,587/4,728, Table 2) and 96.6% in TV news segments (56/58) only used the new name

of schizophrenia. Only three newspaper articles and no TV news sources used the old

name exclusively after 2004.

Difference in the frequency of words used in headlines after the name change

The new names for schizophrenia ($Z = 4.7$, $p < .001$) and depressive disorder ($Z = 6.3$, p

$< .001$) had increased rate of usage in headlines after 2002 compared to before 2001,

while DM showed little change (Table 3). There was no difference in the rates between

depressive disorders and schizophrenia ($Z = 1.6$, $p = .12$).

Text data mining segregated 11.0 morpheme level words per single newspaper

article (573,331/52,025, Supplementary Table s3). The top 20 words used in the articles

seem to be characterized only by target terms rather than by periods (Table 3 and

Supplementary Table s4 in Japanese). In the articles for schizophrenia, "seishin"

(mind/mental) was the most frequently used word, and 12 out of the top 20 words were

categorized into crime or violence. For depressive disorder, "jisatsu" (suicide) was used

the most, and 8 out of the top 20 words were categorized into medicine or psychology.

For DM, "kenko" (health) or "iryou" (medical care/treatment) were the most-used

words, and 12 out of the top 20 words were categorized into medicine or psychology.

Table 3 around here.

Similar to the top 20 words used in the articles, the results of categorization

using 1% resampling yielded words that were different among diseases but that did not

differ before and after the name change (or 2002) (Table 4). A chi-square test indicated

that there was no difference in word categorization for schizophrenia before and after

the name change ($\chi^2 = 2.1$, df $= 5$, p $= .84$), and no difference between 2001 and after

2002 for depressive disorder ($\chi^2 = 8.9$, df $= 5$, p $= .11$) or DM ($\chi^2 = 3.1$, df $= 5$, p $= .68$).

Word categorization significantly differed among diseases ($\chi^2 = 334$, df $= 10$, p $< .001$).

The articles for schizophrenia had the most frequent use of criminal or violent words

and the least use of positive words. The articles for depressive disorder had the greatest

use of suicide or self-harm words but the least use of medical or psychological words.

Overall negative words (criminal or violent, suicide or self-harm, and other negative

words) were the most likely to be used in articles for schizophrenia when compared

with those for depressive disorder and DM (31.5%, 16.0%, and 8.2%, respectively).

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Discussion

This study found that the number of articles including disease names have increased

since 1985 and those that make reference to schizophrenia and depressive disorder have

also increased since 2003, when compared with those including DM. The relative

increase of articles including schizophrenia compared with depressive disorder was

evident between 2000 and 2005, concomitant with the change in the name of

schizophrenia in Japan in 2002. After the name change, only a few articles used the old

name of schizophrenia, while most used both names around 2002. However, the articles

including schizophrenia were more likely to be used with criminal or violent words,

irrespective of the name change.

To the best of our knowledge, this is the first study to analyze the trajectory of

articles including physical and psychiatric disease names from more than 23 million

articles in major Japanese newspapers and TV news segments and investigate word

tendencies in the articles using a text data mining method—a novel approach to easily

and more objectively illustrate global tendencies from a huge text data set. The results

exhibited a limited effect of name change of schizophrenia on the number of articles and

there was little difference in its contents after the name change, which is in line with

previous studies exploring article types.[10, 11]

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Several limitations should be taken into consideration. First, as we were unable

to distinguish the degree of importance and attention paid to each article in newspapers

and TV news segments, the actual impact of these news items on readers could not be

considered. Analysis using the placing and size of articles within newspapers and TV

news segments could clarify the actual impact of the name change of schizophrenia on

readers and viewers. Second, since the text mining approach segmented words

irrespective of anteroposterior relationship in various contexts, a possible difference

should be considered between the present findings and the actual meaning of articles,

such as the possibility of metaphoric use. Related to this is the fact that we only used the

headline of each article, which could result in findings differing from the actual

meanings of the news items themselves. Third, the Internet could change the role and

meaning of mass media articles, since most of the articles can be seen via websites, and

young people mostly see and discuss issues on the web that could alter the effect of

mass media on stigma.

With respect to the primary hypothesis, there was a significant increase in the

number of articles for schizophrenia between 1985 and 2013. However, the articles

including depressive disorder and DM in this study also increased when compared with

other articles. These results suggest that public interest and awareness for medical

information has grown over the past three decades. Considering the significant

increased number of articles published on schizophrenia compared with those on

depressive disorder around the time of the name change, the effect of the name change

can be seen to have been limited to within several years.

Articles on schizophrenia and depressive symptoms have increased since 2003

compared with those for DM. Furthermore, the terms used to describe schizophrenia

and depressive disorder themselves have been used in headlines. One of the reasons for

this may be that a promotion campaign for depression and mental illness occurred

around 2000, partially due to the economic recession and a rapid increase in the number

of suicides occurring since 1998.[22] Similar findings were seen in the increased number

of articles for DM published between 2006 and 2009 and in "metabolic" as the 16th

most frequently used word, which may be due to great public concern about the revision

of the annual medical checkup that is especially focused on metabolic syndrome.[22]

Overall, the articles related to the specific disease could change in a short or long term

by multiple factors, including governmental policy, health promotion campaigns, and

public health awareness and event-related interests, which might relate to the change in

socioeconomic status and educational achievement.

Contrary to the second hypothesis, word tendencies in headlines for disease

names slightly differed across the name change of schizophrenia, irrespective of

successful media control for the use of terms according to the name change in

newspapers and TV news segments. The contents for schizophrenia still frequently

focus on criminal and violent cases and rarely invoke positive terms after the name

change. This is similar to results indicating that schizophrenia is still predominantly

used in negative news stories in UK newspapers, when compared with other mental

illnesses,[11] and with metaphorical usage in US newspapers.[10] Articles for criminal,

violent, and suicidal cases involving people with mental illness are too focused on

disease names, but pay little attention to socio-economic background, family adversity,

and alcohol and substance problems, which are shared risk factors.[23, 24]

Mass media have a great influence on mental health-related stigma.[1-3] The

name change of schizophrenia is a successful event for the increase in media exposure

and switch to using only the new name in articles. This may contribute to reducing

stigma lasting in the long term, since less than half of young people identified the old

and new names for schizophrenia as the same condition.[17] However, article contents in

mass media may change slightly over 30 years, which may be associated with still

existing stigma toward schizophrenia compared with depressive disorders and DM, and

may result in a reduced effect for the name change.[17] To continue the effect, articles for

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schizophrenia should be more focused on medical information and recovery-orientated

messages. Articles for criminal and violent cases featuring schizophrenia should be

more focused on the environmental background.

Conflict of Interest

The authors have no conflicts of interest relating to this study.

Contributors

SK and SY contributed to writing the draft manuscript and the statistical analysis in this

study. SK, SY, YO, and SA contributed to the conception, design, and management of

the study. All authors contributed to treatment of extracted words and have approved the

final version of the manuscript.

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Figure legend

Figure 1. Article rates between 1985 and 2013.

Article rates in newspapers including the old name of schizophrenia (gray line with gray

circle dots), new name (black line with black circles), both names (black line with gray

circle dots), depressive disorder (black line), and diabetes mellitus (gray line) were

illustrated via: (a) 10,000 total articles and (b) by the number of articles including DM.

Article rates in TV news segments for every two-year period are also illustrated in

Figures 1c and 1d, respectively.
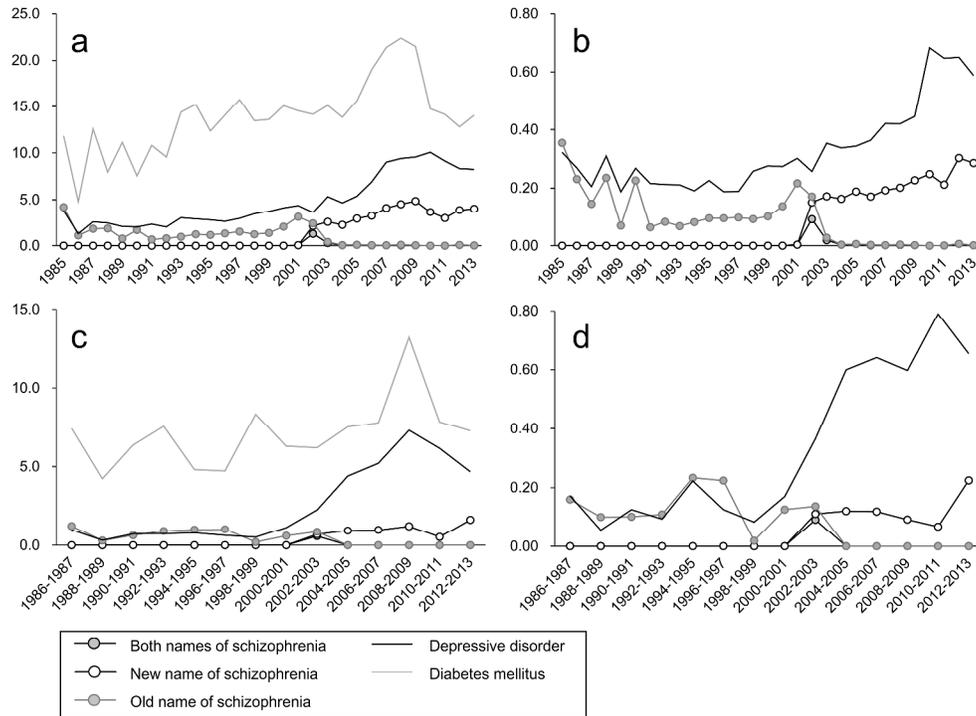
Koike et al., Figure 1

Figure 1. Article rates between 1985 and 2013.
Numbers of articles in newspapers including the old name of schizophrenia (gray line with gray circle dots), new name (black line with black circles), both names (black line with gray circle dots), depressive disorder (black line), and diabetes mellitus (gray line) were illustrated via: (a) 10,000 total articles and (b) by the number of articles including DM. Numbers of articles in TV news segments for every two-year period are also illustrated in Figures 1c and 1d, respectively.

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Table 1. Data sources.

	Publisher	Source available from	To	Number of articles Total	Before 2001	After 2002
Newspapers	Asahi	January 1, 1985	December 31, 2013	7,214,291	3,399,393	3,814,898
	Mainichi	January 1, 1987	December 31, 2013	6,037,737	2,451,699	3,586,038
	Sankei	January 1, 1993	December 31, 2013	2,643,272	947,637	1,695,635
	Yomiuri	January 1, 1987	December 31, 2013	6,326,397	2,245,070	4,081,327
TV news	NHK news	January 17, 1985	December 31, 2013	944,395	385,755	558,640

Table 2. Number of newspaper and TV news articles.

Source	Period	Total	Schizophrenia			Depressive	Diabetes
			Old name	New name	Both names	disorder	mellitus
Newspapers	Before 2001, n (/10,000 total articles)	9,043,799	1,391 (1.5)	0 (0.00)	6 (0.01)	2,735 (3.0)	11,365 (12.6)
	After 2002, n (/10,000 total articles)	13,177,898	141 (0.10)	4,357 (3.3)	230 (0.17)	10,882 (8.3)	20,682 (15.7)
	Total, n (/10,000 total articles)	22,221,697	1,532 (0.69)	4,357 (2.0)	236 (0.11)	13,617 (6.1)	32,047 (14.4)
TV news	Before 2001, n (/10,000 total articles)	385,755	27 (0.70)	0 (0.00)	0 (0.00)	28 (0.73)	247 (6.4)
	After 2002, n (/10,000 total articles)	558,640	2 (0.04)	52 (0.93)	4 (0.07)	282 (5.1)	464 (8.3)
	Total, n (/10,000 total articles)	944,395	29 (0.31)	52 (0.55)	4 (0.04)	310 (3.3)	711 (7.5)

Table 3. Top 20 words used in article headlines by disease names.

	Schizophrenia			Depressive disorder			Diabetes mellitus		
	Total	Old name	New name	Total	Before 2001	After 2002	Total	Before 2001	After 2002
	(n = 6,361)	(n = 1,768)	(n = 4,593)	(n = 13,617)	(n = 2,735)	(n = 10,882)	(n = 32,047)	(n = 11,365)	(n = 20,682)
Total[1]	72,823	19,708	53,115	149,749	28,346	121,403	341,759	118,475	223,284
Target term[2]	540 (8.5%)	103 (5.1%)	437 (9.0%)	2,312 (17.0%)	354 (12.9%)	1,958 (18.0%)	4,132 (12.9%)	1,424 (12.5%)	2,708 (13.1%)
Ranking, n[3]									
1	mental, 1214	mental, 414	mental, 800	suicide, 2409	suicide, 385	suicide, 2024	health, 2967	health, 1098	medical care, 1911
2	distinct court, 893	case (affair), 379	distinct court, 692	mental, 986	mental, 255	distinct court, 821	medical care, 2824	medical care, 913	health, 1869
3	judgement, 782	defendant, 228	judgement, 611	heart, 959	heart, 223	heart, 736	hospital, 2209	treatment, 554	hospital, 1690
4	disability, 740	disability, 203	disability, 537	distinct court, 938	overwork, 175	mental, 731	patient, 1670	patient, 521	patient, 1149
5	defendant, 726	distinct court, 201	defendant, 498	judgement, 636	medical care, 257	judgement, 550	treatment, 1536	hospital, 519	treatment, 982
6	case (affair), 691	homicide, 175	killing, 455	medical care, 590	stress, 147	consultation, 461	lives, 1248	lives, 379	lives, 869
7	killing, 520	judgement, 171	imprisonment, 439	disability, 552	health, 142	hospital, 456	prevention, 1173	medicine, 377	prevention, 804
8	imprisonment, 504	stabbing, 157	justice, 371	hospital, 548	disability, 133	medical care, 433	information, 1009	prevention, 369	information, 697
9	homicide, 502	appraisal, 146	homicide, 327	consultation, 543	lives, 123	killing , 423	medicine, 897	transplant, 316	new type, 604

10	responsibility, 397	responsibility, 138	case (affair), 312	overwork, 503	distinct court, 117	disability, 419	transplant, 857	decease, 315	habit, 576
11	public trial, 392	capability, 119	public trial, 277	authorization, 493	hospital, 92	authorization, 406	research, 805	information, 312	death, 549
12	justice, 382	public trial, 115	responsibility, 259	killing , 469	death, 91	action, 394	habit, 771	lifestyle-related diseases, 278	transplant, 541
13	capability, 361	succession, 115	medical care, 255	health, 438	authorization, 87	prevention, 376	death, 757	research, 268	research, 537
14	hospital, 357	hospital, 103	hospital, 254	action, 408	judgement, 86	imprisonment, 366	medical doctor, 718	gene, 235	medicine, 520
15	medical care, 354	suspicion, 100	capability, 242	prevention, 403	consultation, 82	bereaved person, 334	disease, 647	medical doctor, 233	medical doctor, 485
16	appraisal, 341	medical care, 99	fatal stabbing, 233	imprisonment, 392	patient, 78	overwork, 328	new type, 609	obesity, 226	metabolic, 443
17	stabbing, 298	patient, 93	accept, 208	bereaved person, 384	treatment, 78	support, 326	obesity, 591	old age, 222	disease, 438
18	heart, 293	prosecution, 93	heart, 203	patient, 382	medicine, 77	lawsuit, 311	examination, 583	food, 219	food, 432
19	suspicion, 286	heart, 90	appraisal, 195	workman's compensation, 380	notice (guide), 74	workman's compensation, 308	exercise, 567	examination, 218	blood draw, 424
20	patient, 283	$x^{4)}$, 84	innocence, 194	lawsuit, 367	workman's compensation,	patient, 304	lecture, 565	nursing care, 210	exercise, 381

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1) Total meaning words extracted in the headlines using a text data mining.

2) The number and rate of the articles using each target term itself in headline. In depressive disorder, the numbers of "utsu" (depression) and "utsu-byou" (depressive disorder), and in diabetes mellitus, those of "tounyou" (glycosuria) and "tounyou-byou" (diabetes mellitus) were counted.

3) The word in English and the number of the articles using the word on headlines. Supplementary Table s4 shows the terms in Japanese language.

4) This term could be associated with a specific case and is represented by "x."

Table 4. Tendency of word category used in article headlines by disease names.

	Schizophrenia			Depressive disorder			Diabetes mellitus			Difference among diseases[1]
	Total	Old name	New name	Total	Before 2001	After 2002	Total	Before 2001	After 2002	
Criminal or violent	24.5%	26.8%	23.6%	7.9%	8.5%	5.5%	3.0%	3.3%	2.6%	Sch > Dep > DM
Suicide or self-harm	0.2%	0.0%	0.3%	2.2%	2.4%	1.6%	0.1%	0.0%	0.1%	Dep > Sch > DM
Medical or psychological	15.0%	16.3%	14.5%	14.1%	13.0%	18.1%	23.9%	24.3%	23.3%	DM > Sch > Dep
Other negative	6.8%	7.3%	6.6%	5.8%	6.3%	3.8%	5.1%	4.9%	5.4%	Sch > DM
Other positive	1.8%	2.4%	1.6%	3.6%	4.1%	1.6%	4.8%	4.7%	4.8%	DM > Sch
Other neutral	51.7%	47.2%	53.5%	66.4%	65.7%	69.2%	63.2%	62.8%	63.8%	Dep, DM > Sch

1) Significance among the articles using disease names during total search period was shown using standardized residuals of chi square test (p < .05).

Abbreviations: Sch, schizophrenia; Dep, depressive disorder; DM, diabetes mellitus.

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Supplementary materials

Criteria for extraction of words from non-meaning words

Words are excluded if:

1. The target term itself ("seishin-bunretsu-byo" (old name for schizophrenia),
"togo-shitcho-sho" (new name for schizophrenia), "utsu-byou" (depressive disorder),
and "tounyou-byou") or relevant terms often used as the target term itself ("utsu"
(depression) and "tounyou" (glycosuria));

2. They lack meaning in and of themselves (e.g., "ken" (often used as prefecture), "hito"
(often used as person, human, etc.), "san" (often used as Mr., Mrs., Miss, etc.), "mono"
(often used as person), "suru" (do));

3. They include a numeral or an unit (e.g., "1," "tyu-3" (9th grade), "wari" (rate, ratio),
"hi" (day), "seiki" (century));

4. They are used as a conjunction (e.g., "igai" (except), "tokoro" (when));

5. They form a proper noun (e.g., "Osaka," "Nihon" (Japan), "mori" (often used as a
given name)); or

6. They are often used as a specific headline in each newspaper or TV news (e.g.,
"rensai" (series publication), "jitsuryoku" (capability), "runessansu" (the Renaissance)).

Supplementary Table s1. Number of articles including target terms in newspapers.

	Schizophrenia	Depressive disorder	Diabetes mellitus	Reference[1)]
1991	25	85	388	376,033
1992	40	102	474	415,171
1993	50	134[c]	642[a]	470,370
1994	64	150[c]	787[a]	566,378
1995	67	143[c]	690	602,438
1996	82[d]	152[c]	825[a]	651,305
1997	111[d]	201[c]	1,076[a]	801,236
1998	94	262[c]	1,059[a]	831,879
1999	134	358[c]	1,318	1,028,686
2000	205[d]	433[c]	1,571[a]	1,091,205
2001	354[a,d]	455	1,568[a]	1,134,474
2002	380[a,d]	456	1,558[a]	1,182,598
2003	329[a,b,d]	690[a,b]	1,633[a]	1,209,718
2004	270[a,b,d]	590[a,b]	1,502	1,175,935
2005	344[a,b,d]	683[a,b]	1,619[a]	1,148,031
2006	360[a,b]	879[a,b]	1,897[a]	1,126,229
2007	449[a,b]	1,130[a,b]	2,173[a]	1,094,729
2008	494[a,b]	1,144[a,b]	2,407[a]	1,079,277
2009	539[a,b,d]	1,135[a,b]	2,197[a]	1,045,924
2010	407[a,b,e]	1,201[a,b]	1,540[a]	1,039,252

2011	$337^{a,b,e}$	$1,080^{a,b}$	$1,459^{a}$	1,033,995
2012	$419^{a,b}$	$971^{a,b}$	$1,315^{a}$	1,020,292
2013	$400^{a,b}$	$923^{a,b}$	$1,382^{a}$	985,626

1) The number of articles not including any target term.

a) The increase of articles from 1991 was greater than the reference ($p < .05$).

b) The increase of articles from 1991 was greater than DM ($p < .05$).

c) The increase of articles from 1991 was smaller than DM ($p < .05$).

d) The increase of articles from 1991 was greater than for depressive disorder ($p < .05$).

e) The increase of articles from 1991 was smaller than for depressive disorder ($p < .05$).

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Supplementary Table s2. Number of articles including target terms in newspapers.

	Schizophrenia	Depressive disorder	Diabetes mellitus	Reference[1]
1986–1987	4	3	24	31,603
1988–1989	1	1	14[b]	33,435
1990–1991	2	2	21	32,516
1992–1993	5	4	41	54,197
1994–1995	5	4	24[b]	50,074
1996–1997	5	3	23[b]	48,646
1998–1999	1[b,d,e]	3	45	54,775
2000–2001	4	8	44	69,416
2002–2003	7	17	47	75,995
2004–2005	9[d]	42[a,c]	72	95,560
2006–2007	9[d]	48[a,c]	72	92,368
2008–2009	11[d]	66[a,c]	119[a]	90,166
2010–2011	5[b,d,e]	60[a,c]	78	99,122
2012–2013	17	49[a,c]	76	104,625

1) The number of articles not including any target term.

a) The increase of articles from 1986—1987 was greater than the reference (p < .05).

b) The increase of articles from 1986—1987 was smaller than the reference (p < .05).

c) The increase of article from 1986—1987 was greater than for DM (p < .05).

d) The increase of article from 1986—1987 was smaller than for DM (p < .05).

e) The increase of article from 1986—1987 was smaller than for depressive disorder (p < .05).

Supplementary Table s3. The number of words extracted in newspaper articles using text data mining.

	Schizophrenia		Depressive disorder		Diabetes mellitus	
	Old name	New name	Before 2001	After 2002	Before 2001	After 2002
Article, n	1,768	4,593	2,735	10,882	11,365	20,682
Segregated number, n	19,708	53,115	28,346	121,403	118,475	223,284
Segregated words, n	3,624	6,346	5,755	11,132	14,217	17,355

Supplementary Table s4. Top 20 words used in article headlines by disease names in Japanese.

	Schizophrenia			うつ病			糖尿病		
	Total	精神分裂病	統合失調症	Total	Before 2001	After 2002	Total	Before 2001	After 2002
	(n = 6,361)	(n = 1,768)	(n = 4,593)	(n = 13,617)	(n = 2,735)	(n = 10,882)	(n = 32,047)	(n = 11,365)	(n = 20,682)
Total[1]	72,823	19,708	53,115	149,749	28,346	121,403	341,759	118,475	223,284
Target term[2]	540 (8.5%)	103 (5.1%)	437 (9.0%)	2,312 (17.0%)	354 (12.9%)	1,958 (18.0%)	4,132 (12.9%)	1,424 (12.5%)	2,708 (13.1%)
Ranking, n[3]									
1	精神, 1214	精神, 414	精神, 800	自殺, 2409	自殺, 385	自殺, 2024	健康, 2967	健康, 1098	医療, 1911
2	地裁, 893	事件, 379	地裁, 692	精神, 986	精神, 255	地裁, 821	医療, 2824	医療, 913	健康, 1869
3	判決, 782	被告, 228	判決, 611	心, 959	心, 223	心, 736	病院, 2209	治療, 554	病院, 1690
4	障害, 740	障害, 203	障害, 537	地裁, 938	過労, 175	精神, 731	患者, 1670	患者, 521	患者, 1149
5	被告, 726	地裁, 201	被告, 498	判決, 636	医療, 257	判決, 550	治療, 1536	病院, 519	治療, 982
6	事件, 691	殺人, 175	殺害, 455	医療, 590	ストレス, 147	相談, 461	生活, 1248	生活, 379	生活, 869
7	殺害, 520	判決, 171	懲役, 439	障害, 552	健康, 142	病院, 456	予防, 1173	薬, 377	予防, 804
8	懲役, 504	殺傷, 157	裁判, 371	病院, 548	障害, 133	医療, 433	情報, 1009	予防, 369	情報, 697
9	殺人, 502	鑑定, 146	殺人, 327	相談, 543	人生, 123	殺害, 423	薬, 897	移植, 316	新型, 604
10	責任, 397	責任, 138	事件, 312	過労, 503	地裁, 117	障害, 419	移植, 857	死去, 315	習慣, 576
11	公判, 392	能力, 119	公判, 277	認定, 493	病院, 92	認定, 406	研究, 805	情報, 312	死亡, 549
12	裁判, 382	公判, 115	責任, 259	殺害, 469	死, 91	対策, 394	習慣, 771	成人病, 278	移植, 541
13	能力, 361	連続, 115	医療, 255	健康, 438	認定, 87	予防, 376	死亡, 757	研究, 268	研究, 537
14	病院, 357	病院, 103	病院, 254	対策, 408	判決, 86	懲役, 366	医師, 718	遺伝子, 235	薬, 520
15	医療, 354	容疑, 100	能力, 242	予防, 403	相談, 82	遺族, 334	病気, 647	医師, 233	医師, 485
16	鑑定, 341	医療, 99	刺殺, 233	懲役, 392	患者, 78	過労, 328	新型, 609	肥満, 226	メタボリック,

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17	殺傷, 298	患者, 93	認める, 208	遺族, 384	治療, 78	支援, 326	肥満, 591	高齢, 222	病気, 438
18	心, 293	起訴, 93	心, 203	患者, 382	薬, 77	訴訟, 311	調査, 583	食, 219	食, 432
19	容疑, 286	心, 90	鑑定, 195	労災, 380	案内, 74	労災, 308	運動, 567	調査, 218	採血, 424
20	患者, 283	x[4], 84	無罪, 194	訴訟, 367	労災, 72	患者, 304	講座, 565	介護, 210	運動, 381

Table 3 shows the terms in English language.

1) Total meaning words extracted in the headlines using a text data mining.

2) The number and ratio of articles using the target term itself in headline. In depressive disorder, the numbers of "うつ" (depression) and "うつ病" (depressive disorder), and in diabetes mellitus, those of "糖尿" (glycosuria) and "糖尿病" (diabetes mellitus) were counted.

3) The word in English and the number of the articles using the word on headlines.

4) This term could be associated with a specific case and is represented by "x."