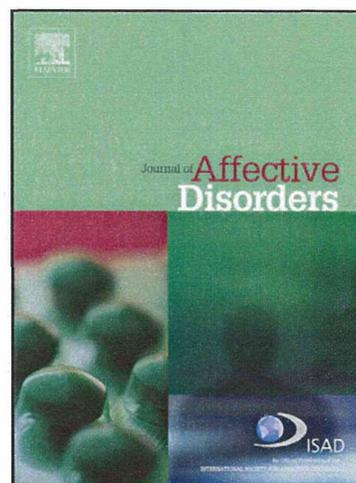


Author's Accepted Manuscript

Prevalence of suicide attempters in emergency departments in Japan: a systematic review and meta-analysis

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Effectiveness of a Multimodal Community Intervention Program to Prevent Suicide and Suicide Attempts: A Quasi-Experimental Study

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Abstract

Background: Multilevel and multimodal interventions have been suggested for suicide prevention. However, few studies have reported the outcomes of such interventions for suicidal behaviours.

Methods: We examined the effectiveness of a community-based multimodal intervention for suicide prevention in rural areas with high suicide rates, compared with a parallel prevention-as-usual control group, covering a total of 631,133 persons. The effectiveness was also examined in highly populated areas near metropolitan cities (1,319,972 persons). The intervention started in July 2006, and continued for 3.5 years. The primary outcome was the incidence of composite outcome, consisting of completed suicides and suicide attempts requiring admission to an emergency ward for critical care. We compared the rate ratios (RRs) of the outcomes adjusted by sex, age group, region, period and interaction terms. Analyses were performed on an intention-to-treat basis and stratified by sex and age groups.

Findings: In the rural areas, the overall median adherence of the intervention was significantly higher. The RR of the composite outcome in the intervention group decreased 7% compared with that of the control group. Subgroup analyses demonstrated heterogeneous effects among subpopulations: the RR of the composite outcome in the intervention group was significantly lower in males (RR = 0.77, 95% CI 0.59–0.998, $p = 0.0485$) and the RR of suicide attempts was significantly lower in males (RR = 0.39, 95% CI 0.22–0.68, $p = 0.001$) and the elderly (RR = 0.35, 95% CI 0.17–0.71, $p = 0.004$). The intervention had no effect on the RR of the composite outcome in the highly populated areas.

Interpretation: Our findings suggest that this community-based multimodal intervention for suicide prevention could be implemented in rural areas, but not in highly populated areas. The effectiveness of the intervention was shown for males and for the elderly in rural areas.

Trial Registration: ClinicalTrials.gov NCT00737165 UMIN Clinical Trials Registry UMIN000000460

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Introduction

Suicide is a devastating event for individuals, families, and communities. The World Health Organization estimates that nearly 1,000,000 people worldwide die from suicide every year. [1] Several reviews have indicated that multilevel and multimodal interventions would be the strategy of choice for suicide prevention in the community. [2–4] A synergistic effect between interventions would be theoretically possible. [4] However, the low rate of suicide in the general population has made it difficult for trials to detect differences between groups with statistical power. Indeed, there are few studies that have reported the effect of interventions on suicide rates. [2–4].

We examined the effectiveness of a community-based multimodal intervention for suicide prevention in rural areas where the suicide rate was high, with a non-randomised comparative intervention trial using parallel prevention-as-usual control. The effectiveness was also examined in highly populated areas near metropolitan cities. In the study, a large population size and an appropriate observational period to observe enough suicidal behaviour, and thus to obtain enough statistical power, were used. In addition, preplanned subgroup analyses were performed to detect effects of the intervention in specific subpopulations.

Methods

Study Designs

We set two areas, rural areas and highly populated areas, as the study targets (Figure 1). Rural areas with a high suicide rate were the primary targets, because these were the areas of focus in the previous community interventions in Japan, which are the basis of

the interventions in the present study. [5–7] The entire population was the target of the intervention. The study matched pairs of intervention groups and control groups with past suicide rates and population size. The participants in the rural areas were the inhabitants living in four matched pairs of intervention groups and control groups (consisting of 17 communities, Figure 2). Highly populated areas near metropolitan cities were another target in this study because the suicide rate in these areas had increased prior to the present study. [8] In highly populated areas, two neighbouring communities were designated as the intervention and control groups, respectively. The participants in the highly populated areas were the inhabitants living in three matched pairs of intervention group and control group (consisting of six communities, Figure 2).

A community-based multimodal intervention for suicide prevention was developed [9] by extending the findings from previous studies focused on depressive elderly living in rural areas of Japan. [5–7] The intervention intended to reinforce human relationships and connectedness in the community by focusing on building social support networks within the general public and the health-related resources. The essential components are listed in Table 1. As shown here, the intervention was multilevel and multimodal, targeting the entire population in the participating communities. Leadership involvement was an important factor for the effective implementation of long-term programs by creating society commitment at multiple levels and establishing community support networks. Education and awareness programs aimed to reduce the stigmatisation of mental illness and suicide. The programs also aimed at improving the recognition of suicide risk and facilitating help-seeking and access to mental health services through improved understanding of the causes and risk factors for suicidal behaviour. Training programs targeting gatekeepers and care providers aimed to facilitate their roles in early detection within potentially vulnerable populations and to increase preventive functions. The screening programs aimed to identify at-risk individuals in the community and direct them to treatment. In addition, the program recommended that the local health authorities provide appropriate care for suicide survivors to support their grief work, if necessary.

Local governments and the local health authorities collaborated and implemented the intervention programs in accordance with the manual (in Japanese; www.mhlw.go.jp/seisakunitsuite/bunya/hukushi_kaigo/shougai-shahukushi/jisatsu/index.html), developed by the program committee of the NOCOMIT-J group. They implemented the intervention with their own budgets. The participants were not blind to the intervention, which started in July 2006. As short duration interventions did not seem to have any detectable effect [2], the intervention continued for 3.5 years. The intervention in the control group was suicide prevention activities as usual. The list of the programs was opened to the control group when the heads of the local governments agreed to participate in this trial. However, we did not show them the detailed intervention manual. The study monitoring and the data collection were conducted in both the intervention group and control group.

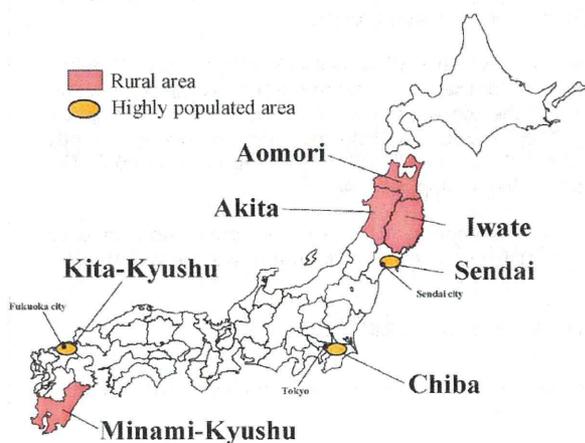


Figure 1. Location map of the study areas. Pink-coloured areas indicate rural study areas. Orange-coloured areas indicate highly populated study areas.
doi:10.1371/journal.pone.0074902.g001

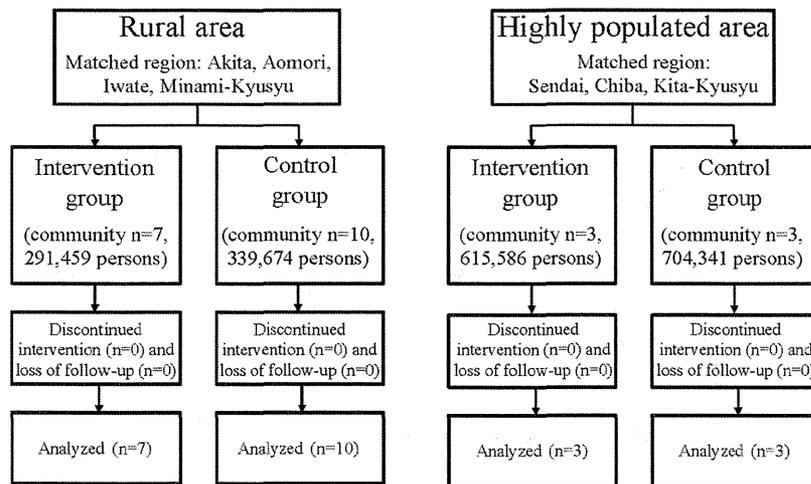


Figure 2. Flow chart of the study.
doi:10.1371/journal.pone.0074902.g002

The primary outcome was the incidence of composite outcome, consisting of completed suicides and suicide attempts that required admission to an emergency ward for critical care. Secondary outcomes were as follows: 1) incidence of completed suicides, 2) incidence of suicide attempts that required admission to an emergency ward for critical care, and 3) proportion of adherence with the required components of the intervention described in the manual. For the adherence assessments, information regarding the implementation of the programs described in the manual was collected every 6 months from the month when the study started in all participating regions. The binary questions for the adherence items were prepared based on the essential components listed in Table 1 and were collected from the local health authorities. The reporters of events were not blind to the intervention. Death certificates from the Vital Statistics Records (Ministry of Health, Labour, and Welfare, Japan) for the participating regions from 2003 to 2009 were used every year to collect the following data items: International Classification of Diseases 10th Revision code for intentional self-harm (ICD-10 codes X60–X84), sex, age, and region code. In this study, a suicide attempt patient was defined as a self-harmed individual transported by regional ambulance service and admitted to an emergency ward for critical care. In Japan, fees for ambulance services are covered by the National Health Insurance System, which allows virtually all suicide attempters access to emergency medicine when requested. The following information was collected from the Regional Ambulance Services every 6 months from 2003 to 2009: type of transportation, date of notification, region code, severity, sex and age. Therefore, the data on suicide attempts systematically collected in this study were reliable. The total population numbers by the community, sex and age groups were collected every year from the National Basic Resident Registration System.

Statistical Analysis

In the primary analysis, we compared the rate ratios (RRs) of incidence of the composite outcome as adjusted by covariates for the effect of the intervention. Marginal models (link function; log, distribution; Poisson) with generalised estimating equations [10] were used to examine the effect of the intervention adjusted by sex,

age group (under 25, 25–65, over 65 years), region, period (6-month) and interaction terms (interventions \times periods). These variables are well known risk factors from past epidemiological studies and they serve as effect modifications in interventional studies. [11] On the other hand, it takes some time to set up and implement the intervention programs in the community. Therefore, the effects of the intervention would be time-dependent. The 6-month periods were chosen to minimise varying populations. The analysis calculated RRs and their 95% confidence intervals (CI). We conducted an interim analysis 2 years after starting to evaluate the achievement of the primary objective. Therefore, the significance level in the final analysis was set at 0.0492 for the two-sided test based on the method of O'Brien and Fleming. [12].

Sample sizes to be used in the study were calculated based on the assumptions of the suicide rates from 2002 to 2004 in the participating regions. Although the estimated sample sizes were not adjusted for sex, age groups and regions, if all assumptions were met, the statistical power would be over 80%. [9].

Secondary outcomes were analysed to examine whether the rates of completed suicides and suicide attempts were significantly reduced in the intervention group when compared with those of the control group, respectively. Adherence to the interventions was also examined.

Preplanned subgroup analyses of the primary and secondary outcomes by sex and age groups (under 25, 25–65, over 65) were performed. Because these variables were the known risk factors and effect modifications, we also used them for the modelling in the primary analysis. No multiplicity adjustments were made, given the exploratory nature of the analyses.

All analyses were done on an intention-to-treat basis. Statistical analyses were performed using SAS version 9.2 software (SAS Institute Inc., Cary, North Carolina).

The study protocol was approved by the Central Research Ethics Committee of Japan Foundation for Neuroscience and Mental Health. The protocol was also approved by the local Ethics Committees of affiliated universities or institutes in the participating regions. (Aomori region: Kuroishi General Hospital Ethics Committee (<http://hospital-kuroishi.jp/>) and Hirosaki University Ethics Committee (<http://www.hirosaki-u.ac.jp/>), Akita region: Akita University Ethics Committee (<http://www.akita-u.ac.jp/>).

Table 1.

Intervention Level	Target	Objectives and Actions
1	Leadership involvement Local government	Leadership involvement is a key to effectively implementing long-term programs that utilize a commitment of society at multiple levels and succeed in establishing community support networks. Messages from the mayor have a strong impact on the efficiency of community development and community networking. a) Publicizing messages from the mayor to all officials and citizens reminding them of the importance of suicide prevention. b) Establishing a regional committee dedicated to suicide prevention chaired by the mayor to promote organization-wide awareness of mental health and suicide prevention and facilitate the collaboration of different sections of the local government. c) Formalizing the roles of each service section and promoting pathways to build social support networks within the public and health-related resources, intending to reinforce human relationships and connectedness in the community.
2	Education and awareness programs Public	The education and awareness programs aim to reduce stigmatization of mental illness and suicide and to improve recognition of suicide risk and facilitation of help seeking. a) Waging a campaign for general public education (public events, posters, websites, placards, leaflets and brochures with information about help available locally, self-tests, warning signals and treatment options and announcements of regional educational activities like lectures and seminars). b) Providing regional educational opportunities like lectures and seminars to improve understanding of the causes and risk factors for suicidal behavior, particularly mental illness. The programs also cover awareness of availability of social resources and referral procedures for people potentially at risk.
3	Gatekeeper training Community or organizational gatekeepers	Training programs targeting gatekeepers (community leaders, priests, telephone hotlines, social services, youth workers, geriatric care providers, police, physicians, nurses, pharmacists, mental health providers, and those employed in institutional settings, such as schools) aimed to facilitate their playing important roles in early detection within potentially vulnerable populations and increasing preventive functions. These programs also promote organization-wide awareness of mental health and suicide and facilitate access to mental health services. a) Training community or organizational gatekeepers to provide them with an opportunity to identify at-risk individuals within different target populations and direct them to appropriate social and/or mental health services.
4	Supporting individuals at high risk Individuals at high risk	Home visiting and regional social gatherings aim to reinforce human relationships and connectedness in the community. Screening aims to identify at-risk individuals and direct them to treatment. a) Home visiting by regional public health nurses and psychiatrists. b) Setting up regional social gatherings. c) Screening to identify at-risk individuals and direct them to treatment or follow-up care providers. The focus may be on suicidal behavior directly or on risk factors, such as depression or substance abuse. d) Support for self-help activities for high-risk groups, i.e., suicide attempters, to facilitate access to professional help.

*The intervention programs focused on building social support networks within the general public and in health-related resources, intending to reinforce human relationships and connectedness in the community.

**A suicide leaves behind more victims than just the individual, as family, friends, co-workers, and the community can be impacted in many different and unique ways following a suicide. In this study, the program recommended that the local government provide appropriate care for suicide survivors (a person who survives a suicide complete; a suicide griever) to support their grief work, if necessary. Support the activities of self-help groups for suicide survivors and other related organizations. doi:10.1371/journal.pone.0074902.t001

honbu/), Iwate region: Iwate University Ethics Committee (<http://www.iwate-med.ac.jp/>), Minami-Kyusyu region: Keio University Ethics Committee (<http://www.med.keio.ac.jp/>), Sendai region: Tohoku Bunka Gakuen University Ethics Committee (<http://www.tbgu.jp/univ/>) and Sendai City Hospital Ethics Committee (<http://hospital.city.sendai.jp/>), Chiba region: National Center Of Neurology And Psychiatry Ethics Committee (<http://www.ncnp.go.jp/>), Kita-Kyusyu region: University of Occupational And Environmental Health Ethics Committee (<http://www.uoeh-u.ac.jp/JP/index.html>). We did not directly contact all participants and collect data from all individuals (all data were anonymous) in this study. Therefore, we did not obtain written informed consent from individuals living in the participating regions. Instead, the regional investigators obtained the written authorisation to conduct the study from the head of the local governments on behalf of all inhabitants and announced it as verbal consent in all by public publications in the participated

regions. The processes approved the Central Research Ethics Committee and the local Ethics Committees and complied with the Ethical Guidelines for Epidemiology Research (published by the Ministry of Health, Labour, and Welfare, Japan, <http://www.niph.go.jp/wadai/ekigakurinri/guidelines.pdf>).

The present study is in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) statement [13,14] and the trial protocol was registered at ClinicalTrials.gov (NCT00737165) and UMIN-CTR (UMIN000000460).

Role of the Funding Source

The study was conceived and developed by the NOCOMIT-J group, and was funded by the Ministry of Health, Labour, and Welfare of Japan. The Japan Foundation for Neuroscience and Mental Health was the sponsor. Neither the funder nor the sponsor had any role in study design, data collection, data analysis,

data interpretation, or writing of the report. YO made the final decision to submit for publication.

Results

Demographic Information of the Participating Regions

The trial flow chart is shown in Figure 2. Population characteristics of the participating areas at baseline are shown in Table 2. In the rural study areas, the total population was 631,133 in 2006. In the highly populated study areas, the total population was 1,319,972 in 2006. Numbers of completed suicides, suicide attempts requiring admission to an emergency ward for critical care, and populations from 2003 to 2009 in the rural areas and the highly populated areas are listed in Table 3 and Table 4, respectively.

The adherence to the suicide prevention programs implemented in the participating areas is shown in Figure 3 and 4. In rural areas, the overall median adherence of the intervention group was 0.65 and significantly higher than that obtained from the control group ($\beta = 0.42$, 95% CI 0.12–0.72, $p = 0.0056$). On the other hand, in highly populated areas, the overall median adherence of the intervention group was 0.55, not different from that of the control group ($\beta = 0.35$, 95% CI -0.01 –0.71, $p = 0.0552$).

The interim analysis conducted 2 years after the start of the intervention demonstrated that the incidence rates of the composite outcome were similar between the intervention group and control group in the rural areas (RR = 0.99, 95% CI 0.79–1.06, $p = 0.257$). As the result, the study was continued until the end of the planned period.

As shown in Figure 5, in the rural areas the incidence rates of the composite outcome in the intervention group were slightly lower than those obtained from the control group (RR = 0.93, 95% CI 0.71–1.22, $p = 0.598$). A subgroup analysis

demonstrated that the incidence rates in the intervention group were significantly lower in males (RR = 0.77, 95% CI 0.59–0.998, $p = 0.0485$). Also, the analysis demonstrated that the incidence rates in the intervention group were lower in the elderly over 65 years old (RR = 0.76, 95% CI 0.57–1.01, $p = 0.062$), while the incidence rates were higher in females (RR = 1.34, 95% CI 0.87–2.15, $p = 0.174$) and in participants younger than 25 years old (RR = 1.44, 95% CI 0.63–3.31, $p = 0.386$).

In the highly populated areas, the incidence rates of the composite outcome were similar between the intervention group and control group (RR = 1.00, 95% CI 0.85–1.19, $p = 0.961$).

As shown in Figure 6, in the rural areas the incidence rates of completed suicides were similar between the intervention group and control group (RR = 1.09, 95% CI 0.82–1.45, $p = 0.550$). A subgroup analysis demonstrated that the incidence rates in the intervention group were higher in females (RR = 1.44, 95% CI 0.85–2.43, $p = 0.177$).

As shown in Figure 7, in the rural areas, the incidence rates of suicide attempts requiring admission to an emergency ward for critical care in the intervention group were slightly lower than those obtained from the control group (RR = 0.86, 95% CI 0.55–1.36, $p = 0.524$). A subgroup analysis demonstrated that the incidence rates in the intervention group were significantly lower in males (RR = 0.39, 95% CI 0.22–0.68, $p = 0.001$) and the elderly over 65 years old (RR = 0.35, 95% CI 0.17–0.71, $p = 0.004$). The subgroup analysis demonstrated that the incidence rates in the intervention group were lower in participants younger than 25 years old (RR = 0.74, 95% CI 0.24–2.31, $p = 0.605$), while the incidence rates were higher in females (RR = 1.56, 95% CI 0.80–3.04, $p = 0.193$).

Table 2. Population characteristics at baseline (2006.1–6) in rural and highly populated areas N (%).

	Group 1		Group 2	
	(Rural areas)		(Highly populated areas)	
	Intervention	Control	Intervention	Control
	n = 7	n = 10	n = 3	n = 3
All	291,459	339,674	615,586	704,341
Sex				
Male	136,399 (47)	159,380 (47)	310,301 (50)	348,153 (49)
Female	155,060 (53)	180,294 (53)	305,285 (50)	356,188 (51)
Age				
under 25	47,892 (16)	52,867 (16)	103,218 (17)	119,512 (17)
25–64	157,887 (55)	181,153 (53)	407,801 (66)	448,270 (64)
65 and over	85,680 (29)	105,654 (31)	104,567 (17)	136,559 (19)
Region				
Aomori	35,668 (12)	60,695 (18)	–	–
Akita	59,237 (20)	66,678 (20)	–	–
Iwate	55,416 (19)	61,589 (18)	–	–
Minami-Kyushu	141,138 (48)	150,712 (44)	–	–
Sendai	–	–	160,368 (26)	197,915 (28)
Chiba	–	–	411,025 (67)	425,177 (60)
Kita-Kyushu	–	–	44,193 (7)	81,259 (12)

doi:10.1371/journal.pone.0074902.t002

Table 3.

		Intervention						Control								
		Combined		Completed suicide		Suicide attempt		Population		Combined		Completed suicide		Suicide attempt		Population
		N	Rate	N	Rate	N	Rate	N		N	Rate	N	Rate	N	Rate	N
Before	2003.1-6	128	86.1	68	45.7	60	40.4	297,397		131	75.3	77	44.2	54	31.0	348,092
	2003. 7-12	91	61.4	68	45.9	23	15.5	296,447		95	54.8	74	42.7	21	12.1	346,639
	2004.1-6	126	85.2	105	71.0	21	14.2	295,655		94	54.4	69	40.0	25	14.5	345,415
	2004. 7-12	70	47.5	49	33.3	21	14.3	294,665		122	71.0	73	42.5	49	28.5	343,825
	2005.1-6	77	52.5	57	38.8	20	13.6	293,589		80	46.7	56	32.7	24	14.0	342,382
	2005. 7-12	102	69.8	51	34.9	51	34.9	292,467		138	81.0	69	40.5	69	40.5	340,927
Reference	2006. 1-6	91	62.4	62	42.5	29	19.9	291,459		139	81.8	76	44.7	63	37.1	339,674
Study period	2006. 7-12	98	67.6	72	49.6	26	17.9	290,122		89	52.7	57	33.8	32	19.0	337,668
	2007. 1-6	89	61.6	56	38.8	33	22.8	288,882		103	61.3	62	36.9	41	24.4	335,894
	2007. 6-12	66	45.9	41	28.5	25	17.4	287,276		103	61.8	57	34.2	46	27.6	333,409
	2008. 1-6	73	51.1	49	34.3	24	16.8	285,773		92	55.6	60	36.2	32	19.3	331,133
	2008. 7-12	71	49.9	44	30.9	27	19.0	284,379		128	77.8	80	48.6	48	29.2	328,951
	2009. 1-6	93	65.7	61	43.1	32	22.6	283,090		90	55.0	61	37.3	29	17.7	326,977
	2009. 6-12	72	51.1	54	38.3	18	12.8	281,763		114	70.1	70	43.1	44	27.1	325,146

Combined: Completed suicide and suicide attempt.
 Rate: per 10,000 persons, per year.
 doi:10.1371/journal.pone.0074902.t003

Table 4.

Highly populated areas															
		Intervention						Control							
		Combined		Completed suicide		Suicide attempt		Population	Combined		Completed suicide		Suicide attempt		Population
		N	Rate	N	Rate	N	Rate	N	N	Rate	N	Rate	N	Rate	N
Before	2003.1-6	147	48.3	71	23.3	76	25.0	608,545	176	50.2	99	28.3	77	22.0	700,674
	2003.7-12	154	50.5	74	24.3	80	26.2	609,571	212	60.5	101	28.8	111	31.7	701,360
	2004.1-6	134	43.9	66	21.6	68	22.3	610,644	168	47.9	79	22.5	89	25.4	702,094
	2004.7-12	136	44.5	70	22.9	66	21.6	611,912	171	48.7	84	23.9	87	24.8	702,467
	2005.1-6	160	52.2	75	24.5	85	27.7	613,223	199	56.6	94	26.7	105	29.9	702,882
Reference	2006.1-6	166	53.9	70	22.7	96	31.2	615,586	197	55.9	97	27.5	100	28.4	704,341
Study period	2006.7-12	202	65.5	80	25.9	122	39.5	617,137	208	59.0	83	23.5	125	35.5	705,159
	2007.1-6	164	53.0	68	22.0	96	31.0	618,734	208	58.9	89	25.2	119	33.7	706,016
	2007.6-12	154	49.6	74	23.8	80	25.8	620,562	190	53.7	91	25.7	99	28.0	707,088
	2008.1-6	148	47.6	81	26.0	67	21.5	622,435	202	57.0	89	25.1	113	31.9	708,205
	2008.7-12	165	52.9	67	21.5	95	30.4	624,319	222	62.6	87	24.5	135	38.0	709,661
	2009.1-6	156	49.8	80	25.5	76	24.3	626,250	190	53.4	86	24.2	104	29.2	711,167
	2009.6-12	137	43.7	51	16.3	86	27.4	626,963	208	58.4	92	25.8	116	32.6	711,837

Combined: Completed suicide and suicide attempt.
Rate: per 10000 persons, per year.

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As shown in Figure 6 and 7, in the highly populated areas, the RRs of suicide attempts and completed suicide demonstrated heterogeneous effects.

Discussion

In the present study, the intervention had unclear effects on the overall rate ratio of the composite outcome in rural areas where

the suicide rate was high. The overall rate ratio of the composite outcome in the intervention group was 7% lower than that obtained from the control group. This was possibly because the intervention had some heterogeneous effects on different subpopulations. Indeed, the RR in males was significantly lower. It was also demonstrated that the RR in the elderly was lower, while it was higher in females and in younger participants. Interestingly, our secondary analysis suggested that the effects were more

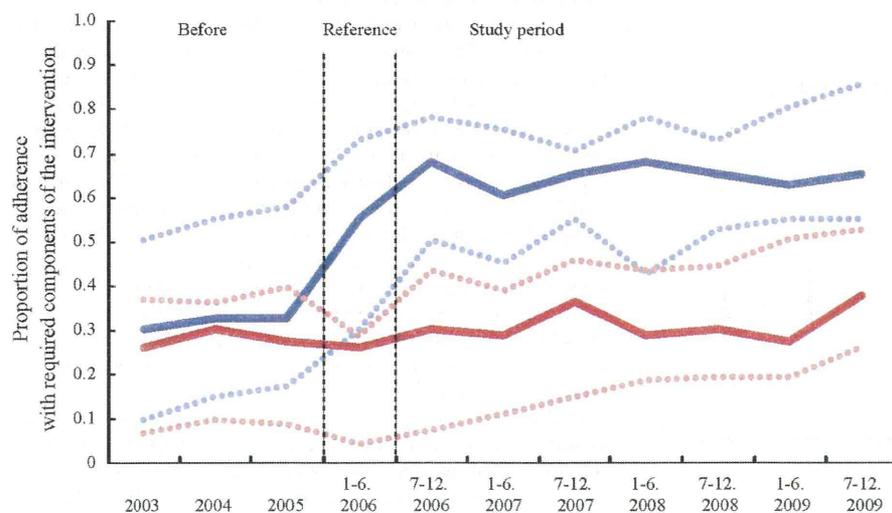


Figure 3. Figure 3 shows the proportion of adherence with required components of the intervention in the rural areas. The blue line indicates the proportion of the intervention group, and the red line indicates that of the control group. The dotted lines indicate interquartile ranges. The proportion is shown for the 3.5 years before the start of the study period. The six-month period before the start of the study period was the reference period.

doi:10.1371/journal.pone.0074902.g003

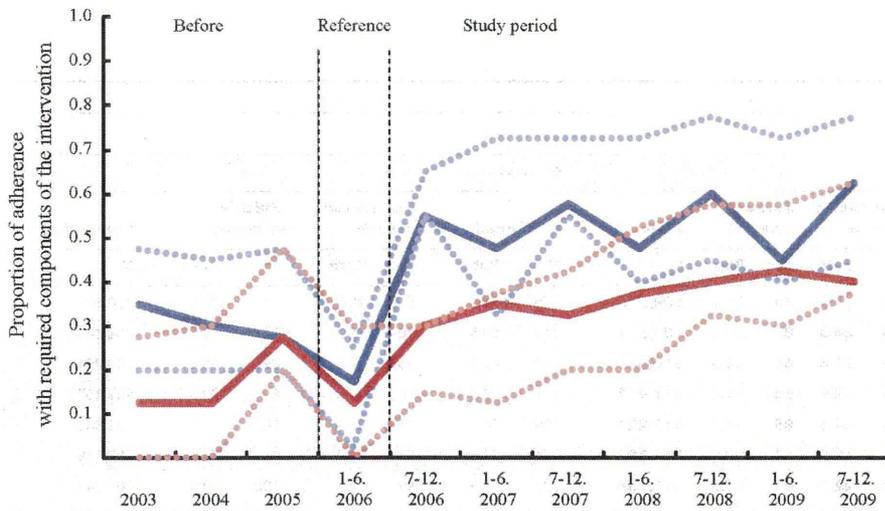
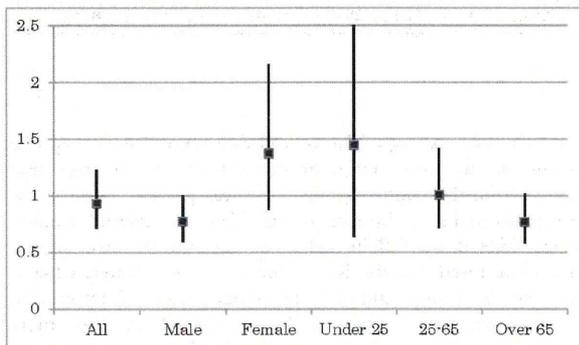


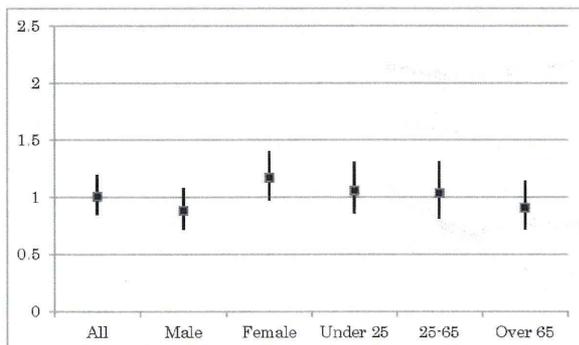
Figure 4. Figure 4 shows the proportion of adherence with required components of the intervention in the highly populated areas. The blue line indicates the proportion of the intervention group, and the red line indicates that of the control group. The dotted lines indicate interquartile ranges. The proportion is shown from the 3.5 years before the start of the study period. The six-month period before the start of the study period was the reference period.
doi:10.1371/journal.pone.0074902.g004

Primary outcome at all and subgroups (sex and age) in Group 1



■ Rate Ratio, — 95%CI

Primary outcome at all and subgroups (sex and age) in Group 2



■ Rate Ratio, — 95%CI

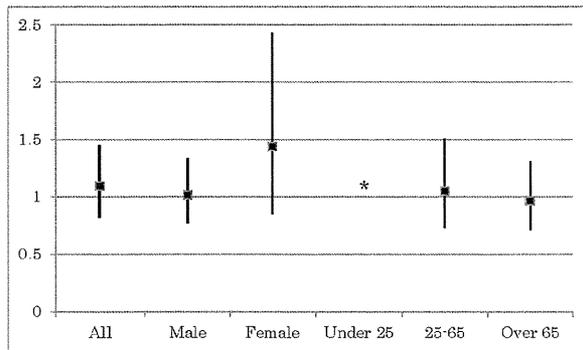
Figure 5. Primary outcome (composite outcome, consisting of completed suicides and suicide attempts requiring admission to an emergency ward for critical care) for all and for subgroups (sex and age) in rural areas and in highly populated areas.
doi:10.1371/journal.pone.0074902.g005

apparent in the incidence of suicide attempts than that of completed suicides. It was demonstrated that the RR of suicide attempts in the intervention group was significantly lower in males and in the elderly. Thus, this study apparently demonstrated the heterogeneous effects of the intervention on the different subpopulations.

The beneficial effect of the intervention in males is consistent with a previous report showing a significant reduction of suicide rate through a community-based intervention in the US Air Force, in which about 84% of participants were males.¹³ Interventions used in the study aimed to establish a seamless system of services across multidisciplinary human services with very strong and vertical leadership involvement. From another point of view, it is well known that about 90% of suicides are associated with mental illness, i.e., depression and other affective disorders, schizophrenia, substance/alcohol-related disorders and personality disorders. [16,17] The interventions in the US Air Force study covered not only depression but also a range of psychosocial risk factors for suicide, and thus were multilevel and multimodal. Although the sample size was quite large, the US Air Force study was a quasi-experimental pre-post design conducted in a single organisation (Table 5). In the present study, we conducted a parallel comparative trial in multiple regions to examine the effectiveness of a similar approach. Therefore, our study has reproduced and extended the findings of the US Air Force study. Here, it is concluded that a community-based multimodal intervention would be recommended for males. It is still unclear which component of the complex intervention programs is especially important for males.

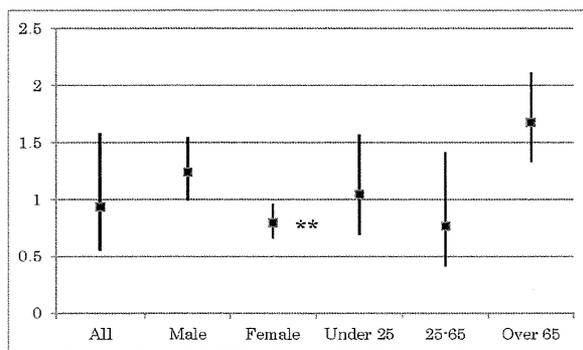
In this study, we developed our intervention by extending the findings from previous studies, focusing especially on elderly. [5–7] As we expected, beneficial effects of the intervention in the elderly were consistent with these previous observations. [5–7] In their interventions, psychiatrists and public health nurses tried to reinforce human relationships and connectedness in their community by home visiting and regional social gatherings. However, these previous studies were retrospective pre-post designs with one or a few communities. Therefore, our study confirmed the findings

Secondary outcome (Suicide completed) at all and subgroups in Group1



■ Rate Ratio, — 95%CI
* Not calculated

Secondary outcome (Suicide completed) at all and subgroups in Group2



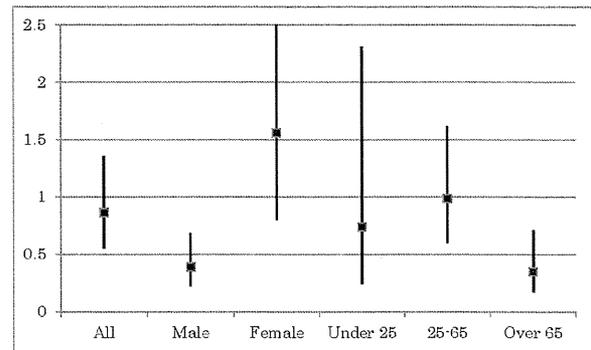
■ Rate Ratio, — 95%CI
** Interaction (intervention × year) was significant, p=0.0270

Figure 6. Secondary outcome (completed suicides) for all and for subgroups in rural areas and in highly populated areas.
doi:10.1371/journal.pone.0074902.g006

for elderly and concluded that the effect would be significant in this group.

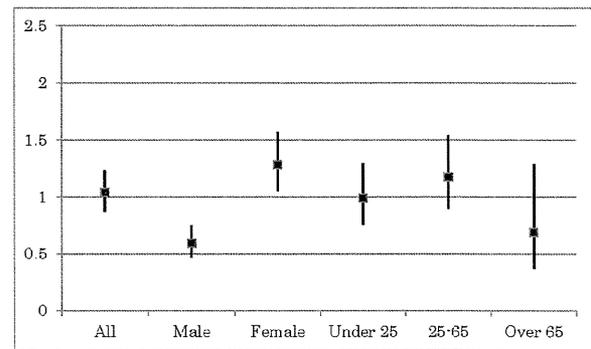
As shown in Table 5, there are some reports of multilevel interventions focusing on depression care. [18,19] These interventions aimed to introduce untreated depressed patients to appropriate care by public awareness campaigns, educating general practitioners and supporting them with mental health professionals, and encouraging collaborative care. A German study, the Nuremberg Alliance Against Depression, reported a reduction in nonfatal suicide attempts in an intervention region compared with a control region but no difference in effect on the rate of completed suicides. [18] In the report from Hungary, the rate of completed suicides in the intervention region was not different from that in the control region. [19] Although the type of our intervention was different from these two studies, the absence of the effect on the rate of completed suicides in the intervention region was also observed in our NOCOMIT-J. On the contrary, as described above, the US Air Force study, which covered various risk factors, showed a significant reduction of the rate of completed suicides. [15] A high rate of adherence to the intervention (over 80%) might help to achieve the objective of lowering completed suicide rates (Table 5).

Secondary outcome (Suicide attempted) at all and subgroups in Group1



■ Rate Ratio, — 95%CI

Secondary outcome (Suicide attempted) at all and subgroups in Group2



■ Rate Ratio, — 95%CI

Figure 7. Secondary outcome (suicide attempts) for all and for subgroups in rural areas and in highly populated areas.
doi:10.1371/journal.pone.0074902.g007

The incidences of suicidal behaviour were similar between the intervention group and control group in the highly populated areas near metropolitan cities, not unexpected as adherence of the intervention group to the suicide prevention programs was not different from that of the control group. In addition, adherence of the intervention group in highly populated area was relatively low, suggesting the difficulties of implementing the intervention in these areas. Further improvement of the intervention programs would be necessary to make the intervention feasible in the highly populated areas.

There are several limitations of the present study. 1) The study was not a randomised trial. Therefore, we used a matched pair design and a model adjusted for possible confounding factors in the analysis. However, some unmeasured and residual confounders may still persist. We need to perform randomised trials confirming our insights. 2) The study participants, investigators and the reporters of events were not blind to the intervention. Although the outcomes were systematically collected from official records, the study might have some misclassification bias. 3) Adherence to the intervention was limited. The adherence would be improved by investing sufficient budgets and resources.

In conclusion, our findings suggest that the community-based multimodal intervention for suicide could be implemented in the all areas. However, the effectiveness of the intervention are shown

Table 5. Related studies.

Study	Population	Study Size, Sites	Sex, Age	Study Design	Intervention	Pre suicide rate	Duration	Compliance	Outcome	Analysis	Results
Knox et al., BMJ. 2003 Dec 13; 327(7428):1376.	US Air Force personnel	5,260,292	About 84% men	(Quasi-experimental) pre-post design	Multimodal (10 initiatives)	1990–6 (median 13.1)	5 years	Over 80%	Completed suicides, homicide, accidental death, family violence	χ^2 test for linear trend with the Mantel-Haenszel, and relative-risk (RR), (No adjustment for sex and age)	Significant 33% reduction of suicide (RR 0.67, 0.57–0.80) compared to control
Hegerl et al., Psychol Med. 2006; 36(9): 1225–33.	Inhabitants living in the city	720,000	No data (no differences between pre-post)	(Non-randomised) concurrent comparative (a city vs. a city) design	4 levels; Training of primary care physicians, public campaign for depression, corporation with facilitators and self-help activities support	Intervention (about 18) vs. control (about 15)	2 years	Unknown percentage (details of activities only)	Completed suicide, suicide attempted, And combined (suicide acts)	Change rate and χ^2 test (stratified sex and years, but not adjusted)	19.4% to 24% reduction suicide acts rate (p=0.082, 0.004) compared to control
		Intervention: Nuremberg, 480,000									
		Control: Wurzburg 270,000									
Szanto et al., Arch Gen Psychiatry. 2007; 64(8): 914–20.	A region with a high suicide rate in Hungary	127,000	48% were men, 22% were over age 60	(Non-randomised) concurrent comparative (a region vs. a region) design	Training of primary care physicians and nurse, plus telephone psychiatrist consultation	Intervention (median 57.5) vs. control (median 56)	5 years	About 60% (39–90%)	Completed suicides (from police), prescription of anti-depressants, alcohol related death and unemployment	Poisson log-link function, Mixed linear models with repeated measures (adjusted years, stratified sex, but not adjusted age)	No significant difference between intervention and control overall, but female suicide decreased by 34% in intervention and increased by 90% in control; significant decrease compared to county and country (Hungary) levels.
		Intervention: Kiskunhalas, 73,000 (44,000 in villages and 29,000 in a town) with 28 GPs									
		Control: Bacs-Kuskun, 54,000 (22,000 in villages and 32,000 in a town)									
NOCOMIT-J	Inhabitants living in high suicide-rate areas in Japan	631,133 (rural area)	47% were men, 30% were 65 over aged	(Non-randomised) controlled (matched) concurrent comparative (2 areas and 4 regions) design	Multimodal (4 levels)	Intervention (median 42.5) vs. control (median 42.5) in rural areas	3.5 years	About 70% in rural areas, About 55% in highly populated areas	Completed suicides from government), suicide attempts, and combined	Poisson log-link function, Marginal models in repeated measures with GEE (adjusted sex, age and years)	9% reduction, not significant, but men 23% (p=0.0485), over 65 24%(p=0.062) reduction compared to concurrent control

Table 5. Cont.

Study	Population	Study Size, Sites	Sex, Age	Study Design	Intervention	Pre suicide rate	Duration	Compliance	Outcome	Analysis	Results
		7 intervention vs. 10 control									
		1,319,927 (highly populated area)				Intervention (median 22.9) vs. control (median 26.7) in highly populated areas					
		4 interventions vs. 4 controls									

doi:10.1371/journal.pone.0074902.t005

for males and for the elderly in rural area. Therefore, it would be recommended for males and for the elderly in rural areas.

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deepest sorrow for the loss of Dr. Toshiharu Fujita, who greatly contributed to the design of this trial.

Author Contributions

Conceived and designed the experiments: YO AS NI HS NY. Performed the experiments: KO HU SA YI HI YK YM JN NN NW TY AN YS MT ET. Analyzed the data: NI HS NY. Contributed reagents/materials/analysis tools: KO HU HO. Wrote the paper: YO AS NY.

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複合的地域自殺対策プログラムの自殺企図予防効果を研究

— 予防効果は、性別・世代、地域の特性によって異なることが明らかに —

ポイント

- 複合的地域自殺対策プログラムの自殺企図予防効果を検討しました。
- 予防効果は、性別・世代、地域の特性によって異なることが示されました。
- 地域の特性に根ざした自殺対策の立案と実践に役立つものと期待されます。

国立精神・神経医療研究センター認知行動療法センターの大野裕センター長は、岩手医科大学医学部神経精神科学講座の酒井明夫教授らとともに、研究グループを全国で組織し、複合的地域自殺対策プログラムの自殺企図予防効果を検討しました。本研究では、自殺死亡率が長年にわたって高率な地域において、一次から三次までの自殺予防対策を複合的に組み合わせた自殺予防対策プログラムを導入地区で実施し、通常の自殺予防対策を行った対照地区と比較して、自殺企図の発生に効果があるかどうかを検討しました。その結果、3.5年間の地域介入により、対照地区と比較して、自殺企図の発生率が、男性で約23%、65才以上の高齢者で約24%減少しました。一方、近年自殺が増加している都市部地域においても同様の検討を行いました。自殺企図の発生率は対照地域と比較して同等でした。本研究により、自殺企図予防効果は、性別・世代、地域の特性によって異なることが示されました。これらの結果は、我が国における地域の特性に根ざした自殺対策の立案と実践に役立つものと強く期待されます。

<研究の背景と経緯>

厚生労働省「人口動態統計」によれば、平成23年における死亡順位では、20～39才の日本人の死因の第1位が自殺であり、40～49才で第2位、50～54才で第3位となっています。また、我が国の自殺死亡者数は平成9年まで2万5千人前後で推移していたが、平成10年に急騰した。平成24年には3万人を下回ったものの、現在も高い水準で推移しています。

自殺の背景には、健康問題、経済・生活問題、家庭問題の他、人生観・価値観や地域・職場のあり方の変化等様々な社会的要因が複雑に関係しており、予防対策の実施に当たっては多角的な検討と包括的な対策が必要となります。しかし、これまでは対象地域に限られていたり、対象に偏りがあったり、活動の事後評価が行われなかったりするなど、効果的な複合的自殺予防対策のあり方に注目した科学的研究及び施策は甚だ不十分な状況でした。そこで、全国で実施されていた先駆的な取り組みを踏まえて本研究を実施し、今後の政

策立案に役立てることが必要と考えられました。

なお、国際的に見ても、本研究のような大規模な地域研究で効果を示すことは困難であり、研究も数が限られており、本研究は、実施中から世界的にも注目され成果が期待されています。

<研究の内容>

本研究の課題名は「複合的自殺対策プログラムの自殺企図予防効果に関する地域介入研究」です。国立精神・神経医療研究センター認知行動療法センターの大野裕センター長(研究実施時は慶應義塾大学教授)は、岩手医科大学医学部神経精神科学講座の酒井明夫教授らとともに、研究グループを全国で組織し、関連する自治体等の協力を得て複合的地域自殺対策プログラムの自殺企図予防効果を検証しました。このプログラムは、過去の研究成果をもとに、一次から三次までの効果的とされる自殺予防対策を複合的に組み合わせたものです(参考表1)。

本研究では、自殺死亡率が長年にわたって高率な地域において、このプログラムを介入地区で実施し、通常の自殺予防対策を行った対照地区と比較して、自殺企図の発生(自殺死亡者及び自損行為(重症ないし中等症)による救急搬送者の頻度)に効果があるかどうかを検討しました。加えて、近年、自殺が増加している都市部地域においても同様の検討を行いました。自殺企図は出現頻度が低くバラツキが大きいいため、介入前後の比較ではなく、事象の rate ratio (率比)を地区、性別、年齢、期間で調整した後に、研究班とは独立した専門の統計家が intention-to-treat 分析(「介入の意図」による分析)を用いて、対照地区と比較しました。なお、効果の評価と同時に、各地におけるプログラム実施率についても解析しました。実施期間は2006年7月からの3年半で、解析期間は実施開始前3年間と、実施開始後の3.5年間になります。研究途中で参加を中止した地域はありませんでした(参考図1)。

なお、本研究は、厚生労働科学研究費補助金による「自殺対策のための戦略研究」の一環として実施されました。

<研究の成果>

本研究の結果、複合的自殺予防対策プログラムを実施すると、自殺死亡率が長年にわたって高率な地域(青森地域、秋田地域、岩手地域、南九州地域の11地区:人口631,133)では、当初期待されていた約20%の自殺企図の減少効果が、男性および65才以上の高齢者で明確となり、強い予防効果が得られることが明らかとなりました。その一方で、女性および若年者では、はっきりとした効果が認められませんでした(参考図2)。これらの地域でのプログラム実施率は、対照地区よりも明らかに高いことがわかりました(参考図3)。一方、近年自殺が増加している人口規模の大きな都市部(仙台地域、千葉地域、北九州地域の6地区:人口1,319,972)の自殺企図の発生率は対照地域と比較して同等でした(参考図4)。これらの地域でのプログラム実施率は対照地区と有意な差がなく(参考図5)、そのことが今回の結果に影響している可能性が示唆されました。本研究で示唆された複合的介入プログラムを都市部で実施する際の困難さには、都市部における人的資源や地域におけるネットワークの不足など地域の特性が影響している可能性が考えられますが、こうした点についてはさらに研究を進めて課題を解明していく必要があると考えます。また、近年自殺者が増えている女性および若年者に対しては、これまでの自殺対策の効果が期待できないことが明らかになりました。このことは、啓発活動が女性および若年者に対しては自殺を誘発するリスクを伴う可能性への考慮などの、従来の知見を踏まえた、新しい対策の検討が必要であることを示唆しています。

以上のように、本研究により、自殺企図予防効果は、性別・世代、地域の特性によって異なることが明らかになり、科学的根拠に基づく自殺対策の政策立案の必要性が示されました。

なお、本研究参加地域において、地域自治体、民間団体、自殺対策研究者らにより築き上げられたネットワークは、自殺対策に留まらず地域の社会作りに貢献しています。平成23年の震災の際には東北地方の研究参加地域において、直後の危機介入から、その後の復興に際しての地域住民の心の健康の維持のために、大きく役立ちました。

<論文タイトルとリンク>

本研究の成果は、平成 25 年 10 月 9 日（米国東部標準時間午後 5 時）発行の国際的オンライン科学誌「PLOS ONE」に、下記のタイトルにて掲載されました。

Effectiveness of a multimodal community intervention program to prevent suicide and suicide attempts: a quasi-experimental study（複合的地域自殺対策プログラムの自殺企図予防効果：準実験デザインによる検討）

<http://dx.plos.org/10.1371/journal.pone.0074902>

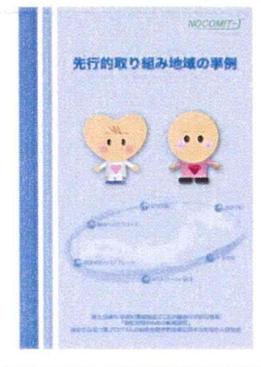
<施策化に向けたこれまでの取り組み>

厚生労働省では、下記の施策を既に実施し、複合的自殺対策プログラムを全国各地の地域自治体において提供するための基盤整備を図っています。

- 平成 21 年度より実施された自殺対策緊急強化基金（内閣府）を背景に地域介入に不可欠な地域連携のための人材が育成されつつあります。
- 本研究の成果物である、「地域における自殺対策プログラム」、「視聴覚教材テキスト：地域における自殺対策プログラム」、「先行的取り組み地域の事例」、の 3 つの資料は、既に厚生労働省：自殺対策 WEB において公開しており、既に全国の各自治体により利用可能となっています。

（参照 URL）

http://www.mhlw.go.jp/stf/seisakunitsuite/bunya/hukushi_kaigo/shougaisahukushi/jisatsu/index.html



「地域における自殺対策プログラム」

「視聴覚教材テキスト：地域における自殺対策プログラム」 「先行的取り組み地域の事例」

<今後の展開>

本研究により、複合的自殺対策プログラムに基づく取り組みの展開が、地域の自殺対策として有効であることが強く示唆されたことから、今後の自殺対策の企画、立案、実施において参考になる可能性が高いと考えられます。その一方で、性別や世代によって効果に違いがあり、とくに都市部で効果に限界があることが示唆されたことから、今後は、従来以上に詳細な自殺の現状の調査分析を行い、人的資源や地域特性などの課題について科学的に検討した上で、新たな視点から取り組んでいくことが重要であることを示しています。現時点の自殺対策は、自殺者の背景についての情報が警察庁統計や限られた背景情報にほぼ限られており、活動も啓発が中心になっていますが、今後は、自殺者全員を対象として、警察情報だけでなく、自治体情報など入手可能な背景情報を収集し、高齢、若年、男性、女性などのサブグループごとに介入のポイントを明らかにするなど、客観的な情報に基づききめの細かい対策の立案が必要だと考えます。

以上のように、貴重な国費を使って自殺対策の施策を立案していく際には、啓発活動など実施可能性が高い施策や注目度の高い施策だけでなく、質の高い研究の成果に基づいて、施策の利点とリスクを慎重に検討し、丁寧に実施していく必要があることが明らかになりました。このように、本研究は、医薬品や医療機器の開発に加えて、厚生労働省が実施しなければならない重要な健康科学研究の好例であり、政策立案に直結する研究のモデルとなったと考えられ、本研究の成果は、我が国における地域の特性に応じた自殺対策の立案と実践に役立つものと強く期待できます。

【お問い合わせ先】

<研究に関すること>

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<報道に関すること>

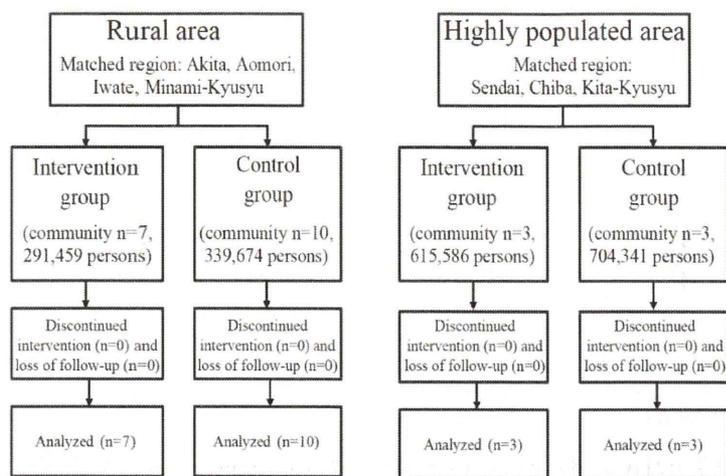
国立精神・神経医療研究センター
広報係
Tel : 042-341-2711 Fax : 042-344-6745

参考表1 介入プログラム項目

項目名
1. こころの健康づくりネットワーク
1.1 都道府県レベルでの関係部署・機関等のネットワーク会議の設置・開催
1.2 地域におけるこころの健康づくり・自殺予防連絡会の設置・開催
1.3 社会システムへのアプローチ
2. 一次予防
2.0 地域づくり*
2.1 普及啓発活動の方法
①パンフレット（全戸配布，年1回以上／各種健康教育・健康相談時の配布）
②ポスター，カード，カットバン，ティッシュ，メモ帳等のグッズ
③市区町村広報誌
④講演会用スライド
⑤ホームページ
⑥こころのケアバッジ等
2.2 一般住民向け普及啓発
(1)健康祭り等のイベントにおける普及啓発
(2)市区町村単位（対象地域全体）での講演会や市民講座
(3)地区（対象地域内の小地域ごと）の講演会や講話
(4)各種集団検診・健診等の会場における普及啓発
(5)介護予防教室における普及啓発
(6)病態別健康教室等の保健事業における普及啓発
(7)学校等教育機関における普及啓発
(8)ストレスマネジメント教室等の開催
(9)住民参加型生きがいサークル等の実施
(10)こころの健康度調査の実施と調査結果の公表
(11)マスコミの活用（新聞・雑誌社，テレビ局等への情報提供）
2.3 地域のキーパーソン向け普及啓発
(1)講話：保健推進員，民生児童委員，在宅福祉アドバイザー，ケアマネージャー等を対象とした講話
(2)研修会
①保健所，こころの健康づくり連絡会のメンバーを対象とした研修会
②保健推進員，民生児童委員，在宅福祉アドバイザー，ケアマネージャー等を対象とした研修会
③こころの悩み相談員の養成講座
④役場職員，農業協同組合，商工会，中小企業等，地域の団体を対象とした健康教室の開催
⑤新聞，雑誌，テレビ等マスコミ従事者を対象とした研修会
⑥公共交通機関の職員を対象とした研修会
(3)医療従事者向け研修会
(4)こころのケアナース養成事業
3. 二次予防
3.1 ハイリスク者のスクリーニング
(1)各種集団検診・健診等を活用したスクリーニング
(2)介護予防健診を活用したスクリーニング
(3)介護家族教室・健康教室を活用したスクリーニング
(4)健康保険，年金窓口における離職者に対するスクリーニング
(5)中小企業，JA，商工会議所等における職域でのスクリーニング
(6)民生児童委員や保健推進員等の訪問時におけるスクリーニング
(7)家庭配布用パンフレットによる自己チェック
3.2 スクリーニング後のケースカンファレンス
3.3 相談や訪問等の支援
(1)相談窓口（電話相談体制窓口，専門相談窓口）の設置・運用
(2)家庭訪問
(3)専門医を交えた地域カンファレンス
(4)専門医と保健師による同伴訪問や巡回相談
(5)精神疾患による医療機関受診者への支援
(6)身体疾患による医療機関受診者への支援
(7)二次スクリーニング結果に基づく医療機関との連携

3.4	地域見守り活動
3.5	こころのケアナース事業
4.	三次予防（ポストベンション）
4.1	自死遺族の把握
	(1) 地域のキーパーソンによる自死遺族の情報提供
	(2) 事例発生時の自死遺族の把握と早期ケア
4.2	自死遺族の支援
	(1) 普及啓発媒体の配備
	(2) 相談窓口の設置・運用
	(3) 市区町村・保健所保健師の訪問相談
	(4) 自死遺族の組織運営の支援
	(5) 地域交番や地域住民による見守り
5.	物質関連障害（アルコール関連障害等）、統合失調症等の精神疾患による自殺の予防
5.1	物質関連障害（アルコール関連障害等）へのアプローチ
	(1) 社会資源の把握・連携
	(2) アルコール問題をテーマとするイベントの開催
	(3) 地域や職域での健康教育
	(4) 専門職を対象とした研修会
	(5) ゲートキーパー（ケアマネージャー、民生児童委員、各種ボランティア等）に対する教育
	(6) 学校における未成年者に対する飲酒教育
	(7) 紙媒体（リーフレットやポスター）や電子媒体（ホームページ）による情報提供
	(8) 医療機関、地域包括支援センター、職域でのスクリーニング
	(9) 相談窓口の設置・運用
	(10) 訪問指導
5.2	統合失調症等へのアプローチ
	(1) 社会資源の把握・連携
	(2) 地域でのイベント
	(3) ボランティア養成講座の開催
	(4) 紙媒体（リーフレットやポスター）や電子媒体（ホームページ）を用いた情報提供
	(5) 相談窓口の設置・運用
	(6) 訪問指導
	(7) ケースマネジメントのためのケース検討会
	(8) 当事者によるピアカウンセリングの実施
	(9) 回復者クラブまたはサロンの設置・運営
6.	職域へのアプローチ
6.1	勤労者へのアプローチ
	(1) 支援体制の強化
	(2) 地域産業保健センターの窓口の整備
	(3) 事業場への普及啓発媒体（パンフレット、DVD等）の配布
	(4) 事業場への調査の実施
	(5) 講演会の実施
	(6) 嘱託産業医に対する調査、教育
6.2	離職者へのアプローチ
	(1) 健康保険、年金の担当窓口、ハローワーク等でのパンフレットの配布
	(2) ハイリスク者のスクリーニング

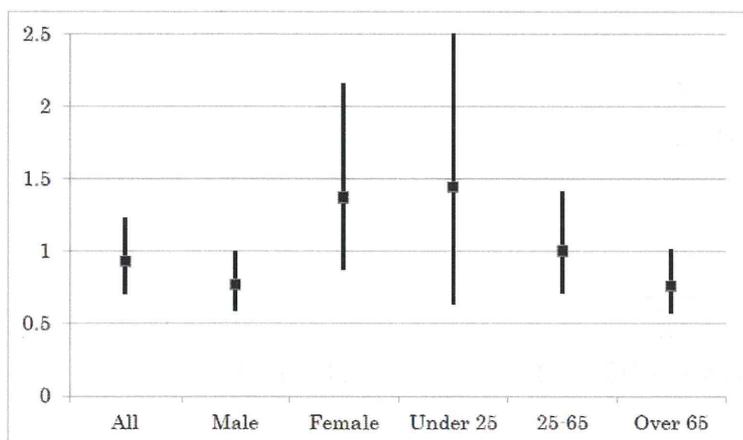
参考図 1 : 地域介入研究の概略



(Ono et al., 2013 <http://dx.plos.org/10.1371/journal.pone.0074902>)

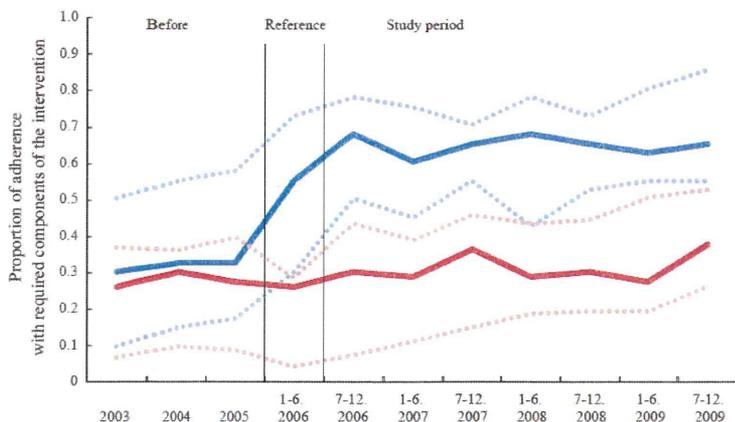
参考図 2 : 自殺既遂および未遂の率比 (自殺死亡率が長年にわたって高率な地域)

Primary outcome at all and subgroups (sex and age) in Group1



(Ono et al., 2013 <http://dx.plos.org/10.1371/journal.pone.0074902>)

参考図 3 : プログラム実施率 (自殺死亡率が長年にわたって高率な地域)



(Ono et al., 2013 <http://dx.plos.org/10.1371/journal.pone.0074902>)