

Munich Alliance Against Depression

Effects of a Community-Based Four-Level Intervention Program on Suicide Rates

Roland Mergl¹ , Ines Heinz², Antje-Kathrin Allgaier¹, and Ulrich Hegerl^{2,3}

¹Institute of Psychology, Universität der Bundeswehr München, Neubiberg, Germany

²German Depression Foundation, Leipzig, Germany

³Department of Psychiatry, Psychosomatics, and Psychotherapy, Goethe-Universität, Frankfurt am Main, Germany

Abstract: *Background:* A four-level community-based intervention aiming simultaneously to improve the care for depression and to prevent suicidal behavior has been implemented in the German city Munich. *Aims:* Changes in suicide rates in Munich during 2009–2014 were analyzed with respect to a 10-year baseline. The same was true for a control region (Cologne) and Germany minus Munich. *Method:* The interventions included training of primary care providers, a public awareness campaign, training of community facilitators, and support for patients and relatives. Analyses included repeated-measures, generalized linear models. *Results:* In Munich, the suicide rate significantly decreased during the intervention period compared to baseline (percentage change = -15.0% ; $p < .001$, 198 compared to 222 suicides per year). Differences in the change for Munich and the change for the control locations (Cologne; -1.7% ; $p = .71$) and Germany minus Munich (-6.2% ; $p = .09$) were not significant. *Limitations:* Data on suicide attempts were unavailable. *Conclusion:* In Munich, a clinically and statistically significant decrease in suicide rate was found. This change was numerically but not significantly larger than in the control regions. The results are promising, however. Because of low suicide base rates and limited power, no strong conclusions can be drawn concerning suicide preventive effects of the intervention.

Keywords: depression, suicide, Munich Alliance Against Depression

The risk of suicidal behavior is strongly increased in patients with mental disorders, especially depressive disorders (Chesney et al., 2014). Improving the treatment of depressive disorders should therefore be an important element in suicide prevention programs. In this context, community-based interventions are of special interest because they are promising tools for both prevention of suicidal behavior and improvements regarding the care of patients with depression (Hegerl et al., 2013, 2021; World Health Organization, 2012; Zalsman et al., 2016). So far, many suicide prevention studies focus on changes of knowledge and awareness of depression, and far fewer studies examine with sufficient statistical power whether corresponding campaigns have significant effects on the number of suicides (Pirkis et al., 2019).

Multifaceted community-based interventions have been shown to be the most promising approach to reduce suicidal acts (suicides and suicide attempts); in this context, the most broadly implemented and evaluated concept is the four-level intervention approach of the European and the German Alliance Against Depression (GAAD; Hegerl

et al., 2021). Intervention effects of such programs were studied using suicidal acts (suicides and suicide attempts) as the primary outcome. Suicides and suicide attempts were combined in these studies to increase the statistical power and to reduce the risk of overlooking clinically relevant effects. Compared to control regions, significant effects were found in several, although not all, studies (Hegerl et al., 2006, 2010, 2019).

Suicide rates were used as the primary outcome in other regions where data on attempted suicides were not available. Significant reductions compared to baseline and control regions were reported for the cities Regensburg (Germany; Hübner-Liebermann et al., 2010) and Szolnok (Hungary; Székely et al., 2013).

Because of the promising findings from the model project in Nuremberg (Hegerl et al., 2006, 2010), similar community-based interventions have been implemented in other German cities and regions (to date, in more than 85 German cities and communities). Among these is Munich, the third largest German city. The aim of this study is to analyze changes of suicide rates in Munich

during 6 years of four-level interventions in Munich compared to a 10-year baseline. These changes were then compared to those in the fourth largest German city (Cologne) and to those in Germany without Munich. The latter analysis, however, was performed bearing in mind that the statistical power is low and the risk is high of overlooking even highly relevant antisuicidal effects. According to an effect size analysis even for a 6-year intervention period and cities of this size, differences between the intervention region (Munich) and a control region (Cologne) regarding the decline of suicides being smaller than 28.84% are likely not to become statistically significant (Faul et al., 2007; for details, see Text E1 in Electronic Supplementary Material 1 [ESM 1]). Therefore, data are presented in a more descriptive manner.

Through exploratory analyses, we investigated effects of the Munich Alliance Against Depression on the suicide rates for several subgroups (males, females, and four age groups: <25; 25–44; 45–64; > 64 years), too.

Materials and Methods

Regions

The intervention region (city of Munich) is a large city in the south of Germany and the capital of the federal state Bavaria with 1,562,096 inhabitants (time point: December 31, 2020; Rzehak, 2021). Munich is characterized by a comprehensive psychiatric and psychotherapeutic care system including Departments of Psychiatry and Psychotherapy at

two university medical centers. These institutions are supplemented by outpatient care provided by more than 400 psychotherapists and more than 140 psychiatrists.

The control region (Cologne) is a large city in the German federal state North Rhine-Westphalia with 1,088,040 inhabitants (time point: December 31, 2020; Reker, 2021). So far, Cologne is the only German city of over one million inhabitants without a local alliance against depression. Psychiatric care in Cologne is provided by three psychiatric hospitals which are supplemented by a day clinic and further outpatient care provided by both psychiatrists and psychotherapists. The distance between the intervention region (Munich) and the control region (Cologne) is about 456 km.

Suicide and population data for Munich, Cologne, and Germany were collected by using freely available online data files of the Central Statistical Office of Germany (Statistisches Bundesamt, 2017).

Table 1 shows that the mean annual unemployment rate in the observation period (2009–2014) at Cologne (9.83%) was clearly higher than the corresponding rate in Germany as a whole (7.22%). In contrast, the average annual unemployment rate in Munich (2009–2014; 5.33%) was markedly lower than the aforementioned unemployment rates in Cologne and Germany as a whole. The proportion of females in Cologne in the observational period was very similar to that in Germany (51%). In Munich, it was higher (53.50%). Although the mean proportion of inhabitants being younger than 25 years in the observational period were similar in all three regions (23–24%), the corresponding percentage of the elderly (older than 64 years) was lower in Munich and Cologne (17.9%) than in Germany as a whole (20.8%).

Table 1. Characteristics of the intervention region (city of Munich) and two control regions (city of Cologne, Germany minus Munich) in the observation period 2009–2014

Variable	City of Munich % M (SD)	City of Cologne % M (SD)	Germany minus Munich % M (SD)
Annual unemployment rate	5.33 (0.40)	9.83 (0.43)	7.22 (0.56)
Proportion of females	53.50 (5.51)	51.23 (0.58)	51.02 (0.09)
Age groups, years			
<25	23.16 (0.21)	24.21 (0.04)	24.29 (0.37)
25–64	58.92 (0.15)	57.87 (0.34)	54.95 (0.23)
>64	17.92 (0.10)	17.91 (0.32)	20.77 (0.17)
Annual rate of immigration	80.48 (6.67)	58.95 (1.62)	45.75 (4.87)
Mean household income (€ for each inhabitant)	2,172 (146.18)	1,676 (52.99)	1,666.17 (78.89)
Mean number of hospital beds per 1,000 inhabitants	8.31 (0.18)	7.14 (0.09)	6.18 (0.05)

Note. Unemployment rate for Munich taken from <https://de.statista.com/statistik/daten/studie/1107314/umfrage/entwicklung-der-arbeitslosenquote-in-muenchen>; for Cologne, from <https://de.statista.com/statistik/daten/studie/1120362/umfrage/entwicklung-der-arbeitslosenquote-in-koeln>; for Germany, from <https://de.statista.com/statistik/daten/studie/1224/umfrage/arbeitslosenquote-in-deutschland-seit-1995/>; proportion of females/age groups from <https://www.genesis.destatis.de/genesis/online>; and rate of immigration, household income, and number of hospital beds per 1,000 inhabitants from <https://www.inkar.de>.

Table 2. Intensity of the interventions realized in the first 6 years of the Munich Alliance Against Depression

Year	Trained general practitioners per 100,000 inhabitants	Flyers per 100,000 inhabitants	Posters per 100,000 inhabitants	Public events per 100,000 inhabitants	Trained gatekeepers per 100,000 inhabitants
2009	0.00	904.43	113.05	2.11	5.28
2010	7.89	901.96	112.74	3.16	65.77
2011	7.76	886.80	73.90	3.18	121.56
2012	5.13	879.17	0.00	2.27	53.92
2013	5.04	864.36	72.03	1.94	80.67
2014	4.97	852.37	0.00	1.35	57.18

The annual rate of immigration in the observational period was much higher in Munich (80.5%) than in Cologne (59%) and Germany (46%). The same was true for the mean household income (Munich: 2,172 €; Cologne and Germany: <1,700 €).

Regarding the health service access in the observational period as measured by the mean number of hospital beds per 1,000 inhabitants, it was best in Munich (8.31) and worst in Germany as a whole (6.18), with this number being in between for Cologne (7.14).

Intervention Activities Within the Multilevel Suicide Prevention Program

In the GAAD concept, suicide prevention is aimed via activities implemented simultaneously at four levels (Hegerl et al., 2006, 2013). The GAAD program is manualized and includes a step-by-step guide on how to be active on each of the four levels of the GAAD program and how to coordinate the simultaneous implementation of these activities.

Level 1: Primary care physicians are trained by using materials such as patient screening questionnaires, brochures for educational purposes, and tools to support the recognition and treatment of depressive disorders in primary care.

Level 2: Targeting the general public, a professional awareness campaign concerning depression is implemented with the key messages: “Depression can hit everybody,” “Depression has many faces,” and “Depression can be treated.”

Level 3: Training is provided to gatekeeper and community facilitators such as geriatric care givers, pharmacists, teachers, police officers, clergy, and social workers. Further activities include the implementation of a media guide for journalists to improve media coverage of suicide and to reduce the risk of imitation suicides.

Level 4: This level comprises support for patients with depression and their relatives. A variety of information materials were provided, self-help groups were supported,

leisure activities were organized, crisis lines were implemented, and online discussion forums for patients with depressive disorders and their relatives were offered.

Table 2 summarizes the intensity of the interventions targeting suicide prevention and an optimized care for depression in Munich in the first 6 years after the foundation of the Munich Alliance Against Depression.

Outcomes

The outcome variable was the annual rate of suicides as provided by the Federal Statistical Office of Germany (Statistisches Bundesamt, 2017). Suicides were defined as intentional self-harm, resulting in death according to the International Classification of Diseases and related health problems, 10th revision (World Health Organization, 1992), categories X60–X84. In this context, suicide rates were defined as the number of suicides per 100,000 inhabitants for Munich, Cologne, and Germany minus Munich.

Statistical Analysis

For pre–post comparisons, the mean suicide rates per year in the 6-year intervention period for the Munich Alliance Against Depression (2009–2014) and the 10-year baseline period (1998–2007) were calculated and compared by using Mann–Whitney *U* tests (due to the small sample size). To estimate the incidence ratio of the annual suicide rate between the intervention and baseline periods, a negative binomial regression for modeling count variables was chosen. Using the negative binomial regression model that is appropriate for the analysis of rare events and has less restrictions than the Poisson regression model, the incidence ratios for the suicide rate and the resulting percentage changes (PCs; $PC = [incidence\ ratio - 1] \times 100$) could be computed.

Moreover, changes in suicide rates in Munich compared to baseline were compared to corresponding

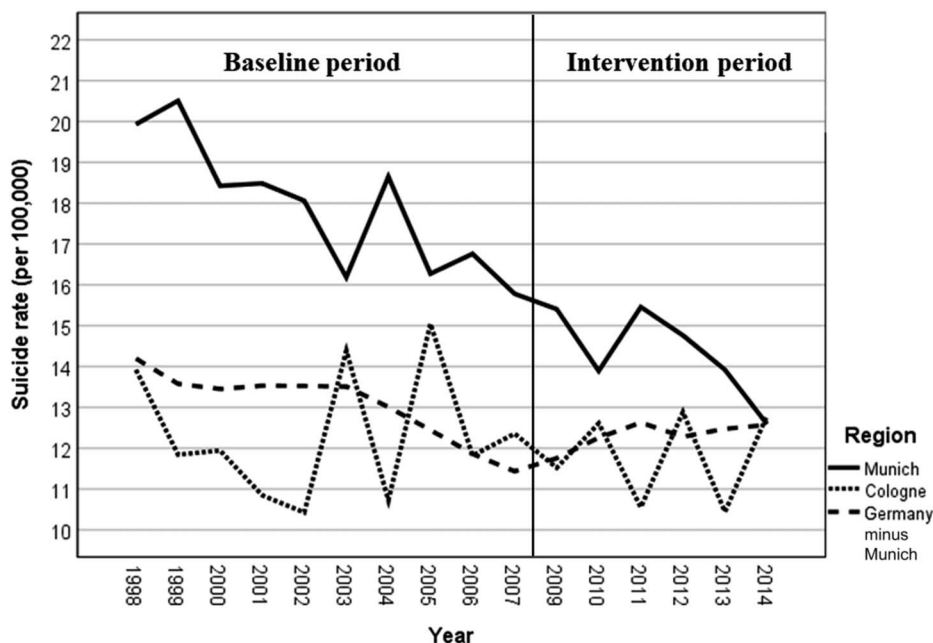
Table 3. Suicide frequencies and rates in the intervention region (Munich), the control region (Cologne), and Germany minus Munich regarding the 10-year baseline period and the 6-year intervention period

Group	Intervention region (city of Munich) <i>M (SD)</i>	Control region (city of Cologne) <i>M (SD)</i>	Germany minus Munich <i>M (SD)</i>
Total population			
Baseline period			
Suicide frequencies	221.90 (14.30)	120.00 (15.85)	10,527.60 (706.12)
Suicide rates	17.91 (1.62)	12.33 (1.61)	12.98 (0.87)
Intervention period			
Suicide frequencies	197.50 (11.78)	120.50 (12.05)	9,795.17 (220.01)
Suicide rates	14.34 (1.10)	11.80 (1.12)	12.29 (0.33)
Females			
Baseline period			
Suicide frequencies	74.60 (8.37)	36.40 (6.00)	2,779.40 (233.32)
Suicide rates	11.61 (1.43)	7.25 (1.20)	6.70 (0.55)
Intervention period			
Suicide frequencies	68.50 (5.51)	35.17 (7.06)	2,474.33 (86.54)
Suicide rates	9.65 (0.85)	6.69 (1.32)	6.09 (0.24)
Males			
Baseline period			
Suicide frequencies	147.30 (12.04)	83.60 (11.88)	7,748.20 (480.04)
Suicide rates	24.69 (2.70)	17.76 (2.48)	19.54 (1.23)
Intervention period			
Suicide frequencies	129.00 (11.61)	85.33 (9.75)	7,320.83 (171.77)
Suicide rates	19.33 (2.07)	17.24 (1.93)	18.76 (0.52)
Age: <25 years			
Baseline period			
Suicide frequencies	10.30 (3.92)	6.40 (4.06)	692.00 (78.27)
Suicide rates	3.65 (1.44)	2.71 (1.73)	3.23 (0.30)
Intervention period			
Suicide frequencies	11.83 (4.36)	4.67 (1.86)	566.33 (38.65)
Suicide rates	3.72 (1.44)	1.89 (0.76)	2.92 (0.17)
Age: 25–44 years			
Baseline period			
Suicide frequencies	64.30 (10.12)	40.00 (5.75)	2,917.90 (422.02)
Suicide rates	15.12 (2.70)	12.16 (1.71)	12.08 (1.30)
Intervention period			
Suicide frequencies	44.83 (8.84)	30.33 (5.01)	2077.33 (80.99)
Suicide rates	9.56 (1.95)	9.36 (1.53)	10.26 (0.22)
Age: 45–64 years			
Baseline period			
Suicide frequencies	74.50 (9.22)	37.70 (6.73)	3,579.40 (233.57)
Suicide rates	22.87 (2.56)	15.48 (2.86)	16.96 (1.28)
Intervention period			
Suicide frequencies	71.33 (3.98)	48.17 (7.25)	3,632.33 (142.67)
Suicide rates	20.82 (1.35)	18.05 (2.45)	15.47 (0.28)

(Continued on next page)

Table 3. (Continued)

Group	Intervention region (city of Munich) M (SD)	Control region (city of Cologne) M (SD)	Germany minus Munich M (SD)
Age: >64 years			
Baseline period			
Suicide frequencies	72.80 (9.57)	35.90 (8.27)	3,338.30 (99.25)
Suicide rates	35.34 (4.45)	21.83 (4.32)	23.07 (1.67)
Intervention period			
Suicide frequencies	69.50 (10.43)	37.33 (5.72)	3,519.17 (134.41)
Suicide rates	28.13 (4.22)	20.45 (3.24)	21.22 (0.81)

**Figure 1.** Trend plots for annual suicide rates in the city of Munich, the city of Cologne, and Germany minus Munich in the baseline period (1998–2007) and the intervention period (2009–2014).

changes in Cologne and in Germany without Munich by applying repeated-measures, generalized linear models with a negative binomial distribution and a log-link function. The independent variables in the full model were “region” (Munich vs. Cologne; Munich vs. Germany minus Munich), “period” (0 = *baseline period*, 1 = *intervention period*), and the interaction of the factors region and period. A significant interaction between region and period would mean that the dependent variables (suicide rate) differentially change over time between the two regions.

Analogous analyses were performed for the following subgroups: males, females, and four age groups: <25; 25–44; 45–64; >64 years.

All statistical tests were two-tailed, and the significance level was set at $\alpha = .05$.

Results

Mann-Whitney U tests revealed that the suicide rate significantly decreased during the 2009–2014 intervention period compared with the baseline period (1998–2007) in Munich (PC = –15.0%; $U = 0$; $p < .001$), but not in the control region (Cologne: PC = –1.7%; $U = 26$; $p = .71$) and Germany minus Munich (PC = –6.2%; $U = 14$; $p = .09$).

The same was true for suicide rates in males (PC = –16.6%; $U = 4$; $p = .003$) and the elderly (minimum age: 65 years: PC = –11.7%; $U = 7$; $p = .011$).

Regarding suicide rates in females, they significantly decreased in Munich during the intervention period as compared to the baseline period (PC = –12.1%; $U = 4$; $p = .003$) and Germany minus Munich (PC = –10.2%; $U = 11$; $p = .042$),

Table 4. Percentage changes for the rates for suicides in the intervention period (2009–2014) including the 95% CI as compared to the corresponding rates in the baseline period (1998–2007)

Group	IR (Munich)	CR (Cologne)	GmM	IR–CR (%)	IR–GmM (%)	Effect in the expected direction
Total population	–15.0% (–69.2%; 134.5%)	–1.7% (–64.4%; 171.7%)	–6.2% (–65.9%; 158%)	–13.3	–8.8	Yes
Males	–16.6% (–69.8%; 130.4%)	–0.1% (–63.9%; 176.5%)	–4.9% (–65.4%; 161.8%)	–16.5	–11.7	Yes
Females	–12.1% (–68.3%; 143.7%)	–5.3% (–66.1%; 164.2%)	–10.2% (–67.4%; 147.1%)	–6.8	–1.9	Yes
Age						
<25 years	9.1% (–62.1%; 213.7%)	–28.5% (–76.3%; 115.9%)	–14.5% (–69.0%; 135.4%)	+37.6	+23.6	No
25–44 years	–33.2% (–75.9%; 85.8%)	–23.7% (–72.7%; 113.2%)	–23.2% (–72.1%; 111.5%)	–9.5	–10.0	Yes
45–64 years	–6.3% (–66.2%; 159.5%)	22.8% (–55.9%; 241.7%)	–3.1% (–64.8%; 166.6%)	–29.1	–3.2	Yes
>64 years	–11.7% (–68.1%; 144.6%)	–0.6% (–64.4%; 177.3%)	–0.6% (–63.9%; 173.6%)	–11.1	–11.1	Yes

Note. CR = control region; GmM = Germany minus Munich; IR = intervention region. The numbers were derived from negative binomial regression analyses regarding the intervention region (Munich), the control region (Cologne), and Germany minus Munich for the total population.

whereas the corresponding decline in Cologne was not statistically significant (PC = –5.3%; $U = 25$; $p = .64$).

For younger individuals (age: <25 years), significant changes in suicide rates during the intervention period as compared to the baseline period did not occur in any region.

In contrast, the suicide rates for individuals aged 25–44 years significantly decreased during the intervention period compared with baseline in all three selected regions (PC: –23.2% to –33.2%; $U \geq 3$; $p \leq .031$).

A corresponding significant change of suicide rates in individuals aged 45–64 years was restricted to Germany minus Munich (PC = –3.1%; $U = 9$; $p = .022$).

Suicide frequencies and rates are shown in Table 3, and the corresponding trend plots for the total population are presented in Figure 1.

The PCs of suicide rates during the intervention period as compared to the baseline period are summarized in Table 4. In this context, the absolute value for the difference in the change in suicides for Munich and the change for Cologne (13.3%) was lower than the critical cutoff value derived from the corresponding effect size estimation (28.84%).

A numerically more pronounced decline in annual rates for suicides in Munich compared with corresponding changes for the control regions Cologne and Germany minus Munich was found. For five of six subgroups, effects in the expected direction (more pronounced decrease in suicide rates in Munich in the intervention period as compared to the control regions) were found. Only for younger individuals (age < 25 years),

a paradoxical trend (increase in suicide rates in Munich during the intervention period vs. decrease of suicide rates in the control regions in this period) was present. However, according to the generalized linear models with the predictors *region* and *period*, there were no significant region \times period interactions regarding suicide rates (see Table E1 in ESM 1).

Discussion

Overall Effects of the Interventions on Suicide Rates in Munich

A clinically and statistically significant reduction in suicide rates (PC = –15.0%) was observed during the 6-year four-level intervention in Munich compared to a 10-year baseline. The effect was clinically significant in view of 24 fewer suicides in Munich compared to baseline (mean baseline frequency: 222; see Table 3). In the same time period, no significant decline in suicide rates was observed in the control regions Cologne and Germany without Munich. This reduction was observed despite the fact that the interventions within the Munich Alliance Against Depression in the 6-year intervention period were not performed with sufficient intensity at all four levels: In the first intervention year (2009), general practitioners had not been trained in Munich at all, and in the intervention years (2012 and 2014), posters had not been distributed in Munich.

As expected by the power analysis, this decline did not significantly differ from corresponding changes in the control regions (city of Cologne [PC = -1.7%] and Germany minus Munich [PC = -6.2%]). The same was true for subgroup analyses focusing on age and gender. Thus, the corresponding findings have to be interpreted with much caution.

It could be argued that the implementation of all four levels of our multicomponent community-based intervention was not necessary to be effective regarding suicide prevention. In this context, it has to be emphasized that Harris et al. (2016) could show for a similar multilevel community-based intervention program implemented in the context of the OSPI-Europe research project that all four countries which had conducted suicide prevention according to this program had been able to achieve synergistic effects adding value beyond the sum of separate intervention levels (see also Hegerl et al., 2019). Thus, it can be concluded (see Hegerl & Kohls, 2016, p. 179) that “the complexity of the synergistic causal chains in multi-level community-based interventions makes it rather unfeasible to single out the specific size of the contribution to the suicide preventive effect of a certain measure in the entirety of the multi-level intervention.”

Methodological Strengths and Limitations

One strength of the Munich Alliance Against Depression is the fact that it refers to a well-established multilevel intervention model (Hegerl et al., 2021) and enabled the evaluation of a complex community-based suicide prevention program with a 6-year intervention period. The intervention and control region consisting of two large German cities was a further strength of our study.

Several limitations should also be mentioned:

1. A major shortcoming is that data on attempted suicides were not available. Using suicides and suicide attempts combined as the primary outcome would have clearly increased the statistical power. Without attempted suicide data, the statistical power was too low to detect even clinically highly relevant anti-suicidal effects.
2. The selection of the control region *Germany minus Munich* could be criticized in view of the fact that a variety of suicide prevention activities were ongoing in a high number of German regions in the intervention and baseline period (see Köhler et al., 2021; National Suicide Prevention Program: <https://www.suizidpraevention-deutschland.de/>). However, their intensity is not well-documented, and therefore, we refrained from excluding these regions from the control region

Germany. We excluded only Munich (*Germany minus Munich*).

3. Other possible metrics and markers of effectiveness were not analyzed in view of limited resources. For example, it would have been very interesting to address the question whether the positive effects of the Munich Alliance Against Depression regarding the reduction of the number of suicides had been associated with higher prescription rates of antidepressant drugs, improved attitudes toward patients with depressive disorders, treatment of depression and suicide prevention, lower personal depression stigma, and enhanced confidence in general practitioners regarding the clinical management of depression and suicidality (Hegerl et al., 2019).

Conclusions

The Munich Alliance Against Depression was associated with a significant and clinically relevant decrease in the general suicide rates in the 6-year intervention period (2009–2014; -15%). This provides further support for the antisuicidal effect of the four-level intervention concept, as shown in previous studies (Hübner-Liebermann et al., 2010; Székely et al., 2013).

However, statistical power was low due to the fact that data on attempted suicides were not available. Therefore, an overall decline in suicide rates compared to control regions (Cologne, Germany minus Munich) could not be shown.

Electronic Supplementary Material

The electronic supplementary material is available with the online version of the article at <https://doi.org/10.1027/0227-5910/a000870>

ESM 1. Text E1 presents a post hoc effect size calculation, and Table E1 shows the results of analyses regarding suicide rates for a 10-year baseline period and a period of 6 years during the interventions of the Munich Alliance Against Depression for the intervention region (city of Munich) versus control region (city of Cologne) and Germany minus Munich.

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Conflict of Interest

We declare the following competing interests: Ulrich Hegerl reported receiving personal fees from Janssen Pharmaceutica, Servier, Bayer Pharma, and Medice outside and independent of the submitted work. The other authors have nothing to declare.

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Antje-Kathrin Allgaier and Ulrich Hegerl contributed equally to this article.

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ORCID

Roland Mergl

 <https://orcid.org/0000-0002-2829-6283>

Roland Mergl

Institute of Psychology
Universität der Bundeswehr München
Werner-Heisenberg-Weg 39
85577 Neubiberg
Germany
roland.mergl@unibw.de

Roland Mergl, PhD, studied psychology at the Ludwig-Maximilians-Universität München (LMU), Germany. Dr. Mergl was a research assistant at the LMU Department of Psychiatry and Psychotherapy

between 1997 and 2006 and at the Department of Psychiatry and Psychotherapy at University of Leipzig between 2007 and 2019. Since April 2019, he has been working as a research assistant at the Institute of Psychology, Universität der Bundeswehr München, Germany.

Ines Heinz, MSc Psychol, studied psychology at the University of Leipzig and was project coordinator of the German Alliance Against Depression in Leipzig between 2009 and 2020. Since 2021, she has been working as a senior consultant for the German Depression Foundation.

Antje-Kathrin Allgaier, PhD, studied psychology at the Otto-Friedrich-Universität Bamberg, Germany. She was a research assistant at LMU

between 2001 and 2011, visiting professor of clinical developmental psychology at LMU in 2011, and visiting professor for clinical psychology at the Universität der Bundeswehr München between 2014 and 2017. Since 2017, she has been working as a professor of clinical psychology and psychotherapy there.

Ulrich Hegerl, MD, PhD, studied medicine in Erlangen and Rennes. He was a research assistant at Freie Universität Berlin between 1980 and 1994, professor for psychiatry at LMU between 1998 and 2006, and medical director of the Department of Psychiatry and Psychotherapy at University of Leipzig between 2006 and 2019. Since 2019, Prof. Hegerl has been holding the Johann Christian Senckenberg Distinguished Professorship at Goethe-Universität Frankfurt, Germany.