BJPsych | The British Journal of Psychiatry (2025)
1–8. doi: 10.1192/bjp.2025.10431

Original Article

Implementation of an integrated community-based suicide prevention programme, Gujarat, India: cluster randomised controlled trial

Lakshmi Vijayakumar*, Soumitra Pathare*, Nikhil Jain, Deepa Pandit, Isha Lohumi, Jasmine Kalha and Laura Shields-Zeeman

Background

In low- and middle-income countries (LMICs), suicide is a major problem. Research on the effectiveness of large-scale suicide prevention interventions is limited.

Aims

To test the effectiveness of an integrated intervention (school-based prevention; reducing access to means of suicide; increased identification and management of suicide risk) in reducing deaths by suicide and suicide attempts; and to evaluate the implementation and effectiveness of sub-interventions.

Method

In this pragmatic cluster randomised controlled trial, 124 villages from Mehsana, India, were randomly assigned to either intervention or control arm. The intervention comprised school-based awareness intervention, community pesticide storage and training of community health workers (CHWs) to recognise, support, refer and follow up people at risk. Intention-to-treat analysis using mixed-effects Poisson regression tested the primary outcome (suicide attempts plus deaths by suicide), and multilevel linear models assessed sub-interventions. The primary outcome was captured through a novel suicide surveillance system.

Results

There was no statistically significant difference in the primary outcome between the intervention (54 of 62 consenting villages) and control (62 villages) arms. Separately, the intervention arm showed a 43% reduction in risk of death by suicide at 12 months (suicide rate 30.7 versus 43.6 per 100 000 person-years in intervention versus control arm; incidence rate ratio 0.57, 95% CI: 0.32–1.02, adjusting for baseline and clustering). Most students (≥90%, $n = 2330/2560$) from 47 schools received the intervention and had lower depression and suicidal ideation than controls at month 3. Nearly all villages (52/54, 96.2%) provided pesticide lockers ($n = 8370$ households, 88.83% uptake). Compared with controls, CHWs in the intervention arm had significantly higher knowledge, confidence and skills, and identified 108 at-risk individuals.

Conclusions

The intervention increased identification without significantly reducing suicide attempts, but reduced suicide deaths. This trial, involving 116 villages and a multicomponent intervention implemented at scale, advances suicide prevention and complex intervention research, especially in LMICs.

Keywords

Suicide prevention; reducing access to means; gatekeeper training; youth mental health promotion; community health workers.

Public health problem

Suicide is a public health challenge worldwide,[1] particularly in India. In 2020, India's suicide rate increased by 10% and in 2021 by 7.2%, reaching 12.4 per 100 000 in 2022, its highest ever recorded rate.[2–4] India has the highest number of suicide deaths in the world,[5] with age-standardised rates among males and females of 11.1 and 14.7, respectively, compared wth global rates of 5.4 and 12.6.[6] India recently released its first National Suicide Prevention Strategy,[5] but its realisation is impeded by the lack of data on the real-world implementation of evidence-based interventions to prevent suicides.

Need for integrated intervention

There is consensus that stand-alone interventions are unlikely to achieve reductions in suicide rates.[7] Nonetheless, individual suicide prevention strategies, shown to be effective globally, can inform the design of integrated interventions to be tested at scale.[8,9] Priority areas, informed by epidemiological data about suicide attempts and deaths, also need to be considered. In India, suicide rates are highest among youth aged 15–29 years,[10,11] requiring action at the school and community level. India's youth suicide rates are among the highest globally.[12] Pesticide self-poisoning contributes to 14.9% of suicides in India,[4] necessitating strategies to reduce access to pesticides as recommended by the World Health Organization (WHO).[13] In rural settings in low- and middle-income countries (LMICs) like India, primary, community and lay health workers are a critical part of the health workforce and can help identify and manage persons at risk for suicide if trained.

Our solution

A suicide prevention intervention combining multiple strategies for their synergistic impacts has not yet been implemented at scale and tested for its effectiveness in any LMIC context. Addressing this evidence gap, the Suicide Prevention Implementation and Research Initiative (SPIRIT) integrated strategies including promotion of mental health in schools, reduction of access to lethal means and internationally recognised suicide prevention strategies, such as promoting mental health and well-being in schools and enhancing community capacity to identify and manage suicidal behaviour.[13] SPIRIT conducted a cluster randomised controlled trial[14] of an

*Joint first authors.

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

integrated suicide prevention intervention in a rural district of India, which is identified by the government as a priority region for suicide prevention, given its high rates of suicide (particularly among women and farmers) and poisoning (including by pesticides).[15] The integrated intervention included strategies for adolescents in public schools, central pesticide storage and community health worker (CHW) training for identification and referral of people at risk, as well as management and follow-up support.

A cluster randomised controlled trial was chosen for its ability to yield robust conclusions, unlike traditional randomised controlled trials, which are unsuitable for village-level interventions. This trial aimed to test the integrated package's effectiveness by comparing intervention and control villages on deaths by suicide and suicide attempts. Given that no previous study has implemented these interventions at such a large scale, we also assessed the extent to which this package could be feasibly implemented and the effectiveness of each of the three sub-interventions on outcomes identified *a priori*.

Our wider objective was to generate quality, high-impact evidence on processes involved in, and outcomes of, integrated, multilevel suicide prevention interventions to guide policymakers and researchers looking to implement similar interventions at scale in India and other underserved contexts.

Method

Trial design

We conducted a pragmatic cluster randomised controlled trial in Mehsana district in the state of Gujarat in western India, with villages as the primary sampling unit/clusters. Mehsana is a rural district with a 1.52 million population spread over ten subdistricts.[15] The trial followed Consolidated Standards of Reporting Trials (CONSORT) guidelines for cluster randomised controlled trials[16] and was delivered according to protocol,[14] with timeline modifications due to COVID-19. All procedures contributing to this work comply with the ethical standards of national and institutional committees on human experimentation, and with the Helsinki Declaration of 1975 as revised in 2013. Ethical approval has been obtained from the Institutional Review Board of the Indian Law Society (no. ILS/36/2017) for all procedures involving human subjects. Written informed consent was obtained from all participants prior to the study's commencement. All adverse events protocols were maintained (Supplementary File 1 available at https://doi.org/10.1192/bjp.2025.10431). As seen in Supplementary File 1, the study had 3 phases: the baseline period of 12 months without any interventions in villages (November 2018–October 2019); the intervention phase (November 2019–January 2022), when all 3 interventions were rolled out in the villages in a staggered manner; and a post-intervention follow-up phase of 12 months following rolling out of the final intervention out in the last village (February 2022–January 2023). For the control arm, the same time frames were used. This approach was chosen to account for the staggered roll-out period (different start and end dates for all 54 intervention villages). The study protocol was registered on 7 April 2017 in India's Clinical Trial Registry (no. CTRI/2017/04/008313).

Participants

Villages were eligible according to the following criteria: the village council agreed; a high school with ≥35 students; a population of ≤6000; and farming as the primary occupation.

For sub-intervention 1, data were collected from adolescents in grade 9 (13–17 years of age) from public high schools in the villages included in the trial, and for sub-intervention 3, from CHWs working in study villages.

Randomisation

Of 273 villages in Mehsana with government high schools, 255 schools consented, of which 161 had a population of ≤6000 and were potential clusters for randomisation. Villages were randomly allocated in a 1:1 ratio to either the intervention or control arm by an independent statistician using a code designed for Stata version 14.2 for Windows (Copyright 1985-2015 StataCorp LLC. Windows based, 4905 Lakeway Drive College Station, Texas 77845 USA, 800-STATA-PC, http://www.stata.com).

Intervention villages

The intervention arm was exposed to all three interventions, detailed in the protocol.[14]

Sub-intervention 1: school-based intervention

A locally adapted version of the evidence-based Youth Aware of Mental Health (YAM), a universal mental health promotion intervention effective in multiple national contexts.[17] Adaption involved translation and back-translation, contextual tailoring and piloting.[14] The intervention aims to prevent depression, reduce suicidal ideation and promote mental well-being among adolescents. It is a 5 h programme consisting of 3 h of role-play sessions and 2 h of interactive lectures and discussions about mental health, in addition to educational materials. YAM was delivered within the classrooms by trained community volunteers.

Sub-intervention 2: lockers for pesticides in central storage facilities (CSF)

Previous feasibility studies have shown that storage facilities for pesticides reduced suicide rates in Tamil Nadu, South India.[18] A storage facility was installed in each village at a central location identified by the village council, with lockers resourced through study funding. Each farming household was offered a locker free of charge to store pesticides. Facility spaces were either provided free by the village council or were rented from local community members. A trained facility manager, appointed following the facility's opening, monitored the checking in and out of pesticides.

Sub-intervention 3: training CHWs in the identification and management of suicidal risk

In intervention villages, CHWs (accredited social health activists, Aanganwadi [rural child care centre] workers, auxillary nurse midwives, multipurpose health workers and community health officers) employed by the Department of Health and Family Welfare and the Ministry of Women and Child Development in Gujarat were trained in the identification, management (including referral to specialised care) and follow-up of persons at risk of suicide and/or self-harm. Adapting the self-harm/suicide module of the WHO Mental Health Gap Action Programme intervention guide[19] used in 100+ countries,[20] the training covered an overview of suicide; risk and protective factors; suicide risk assessment; psychosocial interventions such as psychoeducation, behavioural activation, stress management and problem-solving; and introduction to, and networking with, mental health services. Using a train-the-trainer model, ten instructors were first selected and trained, who then trained other CHWs in the local language, Gujarati, supervised by the local research team. Training involved two-day workshops comprising interactive lectures, group discussions, role-play and skills practice, followed by a reminder application and resource materials.

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

Throughout the intervention period, promotional strategies were used including street plays/movies, posters, jingles, fortnightly meetings, printouts of a religious calendar with information on resources where help could be sought, etc.

Control villages

Residents in the control villages received enhanced usual care, which involved the provision of brochures with information on mental health services and other resources for seeking help, such as emergency helpline numbers and contact details of public and non-governmental healthcare services.

Procedures

Data were collected in intervention and control villages from July 2018 to February 2023. Due to limitations in official suicide data (including underreporting by the National Crime Report Bureau [the official government agency in charge of collecting data about suicides]), lack of a coroner-based health inquiry system, social stigma and legal consequences,[21] a surveillance system was developed using community informants and record reviews. Specifically, data on suicides and attempted suicides were collected from community-based informants (e.g. CHWs, local religious and political leaders etc.), and we performed manual examination of the records of all medico-legal cases from hospitals and the police. The development and methodology of the surveillance system are published elsewhere,[22] and the manual used is now a WHO manual serving as a model for other LMICs.[23]

Outcomes

Primary outcomes

For the overall integrated intervention, the primary outcome was a reduction in the number of suicides and suicide attempts (combined) in intervention villages compared with controls, 12 months following implementation of the 3 interventions in intervention villages.

For sub-intervention 1, the primary outcome was a reduction in self-reported depression and suicidal ideation among school-going adolescents in intervention villages compared with controls, at 3 and 12 months after receiving the school-based intervention. Depressive symptoms were assessed using Patient Health Questionnaire 9 (PHQ-9),[24] comprising 9 items rated 0–3 for possible totals of 0–27, with higher scores indicating greater depression. We used the clinical cut-off (score of $\geq$10 indicating moderate or higher levels of depression) and the cut-off for community studies (score of $\geq$5 indicating mild or higher levels).[24,25] Suicidal ideation was assessed using the Suicidal Ideation Attributes Scale (SIDAS).[26] We used the first item on SIDAS, where a score of 0 indicates no suicidal ideation and $\geq$1 indicates some level of suicidal ideation in the past month.

For sub-intervention 2, there was no additional outcome other than the primary outcome.

For sub-intervention 3, the primary outcome was the number of people with suicidal ideation detected and referred by trained CHWs to mental health professionals for support and care provision in intervention villages.

Secondary/process outcomes

For each sub-intervention, we examined reach and uptake. For sub-intervention 1, process outcomes were the proportion of schools agreeing to implement, and which implemented, the intervention, and the proportion of adolescents in participating schools who received the intervention. For sub-intervention 2, process outcomes included the proportion of villages that agreed to establish a CSF and provided space for its construction, and the frequency of use of the lockers. For sub-intervention 3, process outcomes were the proportion of CHWs trained in intervention villages and their knowledge, confidence, skills and attitudes 6 and 12 months following training compared with CHWs in control villages.

Sample size and power calculations (details in protocol[14])

To detect an absolute difference of at least 20% in the incidence of suicide and attempted suicide following the intervention, a sample size of 60 901 was needed (significance level 0.05, power 80%). Accounting for design effect, clustering effect and potential attrition (20%), the required sample size was 146 184 individuals (73 092 in control, 73 092 in intervention), spread across 124 villages (62 per arm).[10] Sample sizes were also estimated to test sub-intervention 1 ($N = 4557$ across arms) and sub-intervention 3 ($N = 836$ across arms).

Statistical analysis

An intention-to-treat analysis was performed for the primary outcome. A random effect Poisson regression model was used to allow for variation between the clusters in primary outcome incidence as a gamma distribution. Because a negative binomial regression model resulted in similar estimates, we report a random effect Poisson regression model with robust standard error correction accounting for overdispersion. This analysis was adjusted for independent effects of allocation to intervention or control arm, period and the interaction between arm and period. Estimates are presented as an incidence rate ratio. Incidence is calculated per 100 000 person-years (defined as the number of years that the person has contributed to the data). For primary and process outcomes pertinent to the sub-interventions (change in depression and change in knowledge, skills and attitude levels), differences between continuous and categorical outcome variables were calculated using an appropriate multilevel linear and logit effect model, adjusting for clustering by villages as a random effect. Estimates are presented as adjusted mean differences for continuous and adjusted odds ratios for categorical outcomes. All hypothesis testing was carried out at the 5% (two-sided) significance level; Bonferroni correction was further used for adjusting the statistical level. Missing data were assumed to be randomly missing, and no imputation was performed. Analyses were performed using Stata version 14.2 for Windows.

Results

Please refer to Fig. 1 for the CONSORT diagram. Of 161 eligible villages, 62 were randomised to each arm. All 62 control villages consented to participate in the trial and collected data. Of the 62 villages allocated to the intervention, 8 refused participations, resulting in 54 intervention villages. There were no significant differences in baseline characteristics between villages that refused versus those that agreed to participate in the trial. Primary outcome data (from the surveillance system) were collected for 116 villages (62 control, 54 intervention). Baseline demographic data, including age, gender distribution, population size and occupation, were not significantly different between intervention and control villages. Details on the number of students (sub-intervention 1), the number of villages with CSFs (sub-intervention 2) and the number of CHWs (sub-intervention 3) are shown in Fig. 1.

Table 1 summarises the results for the overall primary outcome (suicide attempts and deaths combined) and its two components.

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

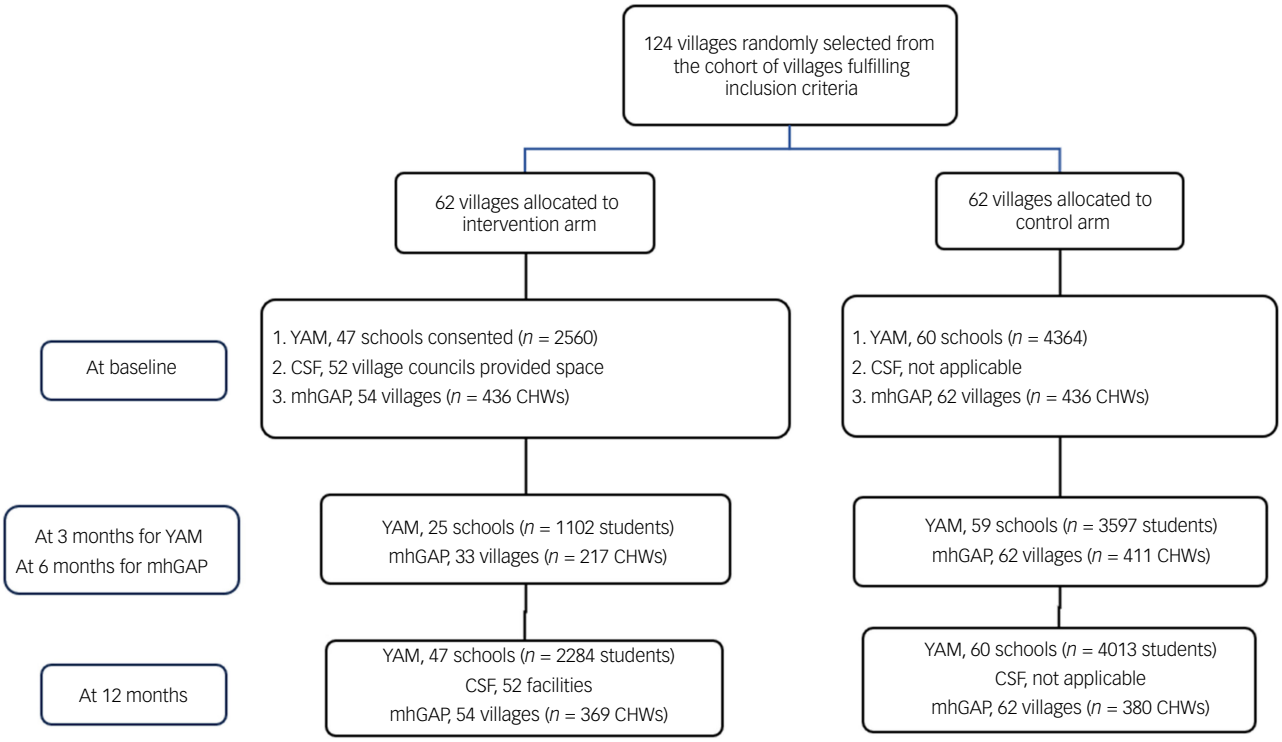

Fig. 1 Trial profile/Consolidated Standards of Reporting Trials (CONSORT) diagram. YAM, Youth Aware of Mental Health; CSF, central store facility; mhGAP, Mental Health Gap Action Programme; CHWs, community health workers.

Table 1 Absolute number of events (suicides and suicide attempts) and calculated suicide and attempted suicide rates based on the population size of control and intervention villages

		Pre-intervention period			Post-intervention period				
Events	Trial arms	Events	Person-years of follow-up	Incidence/ 100 000 person-years	Events	Person-years of follow-up	Incidence/ 100 000 person-years	[a]Rate ratio (95% CI)	*P*-value
Total events (suicides and attempted suicides)	Intervention	110	143 220	76.80	136	143 220	94.96	0.89 (0.62–1.27)	0.521
	Control	106	151 055	70.17	147	151 055	97.32		
Suicides	Intervention	44	143 220	30.72	44	143 220	30.72	0.57 (0.32–1.02)	0.061*
	Control	38	151 055	25.16	66	151 055	43.69		
Attempts	Intervention	66	143 220	46.08	92	143 220	64.25	1.17 (0.74–1.83)	0.492
	Control	68	151 055	45.02	81	151 055	53.62		

Pre-intervention period is November 2018 to October 2019; post-intervention period is February 2022 to January 2023; robust s.e. 0.9.
a. The estimated rate ratio is adjusted for the random effect of clusters/villages and the fixed effect of the period (baseline rate of pre-intervention period). Surveillance data collection was a continuous process from July 2018 to March 2023. A rate ratio of 0.57 (1.00 – 0.57 = 0.43) denotes a relative risk difference of 43% for a reduction in suicides between control and intervention arms.
*Marginally significant.

There was no statistically significant difference in the overall combined outcome between the two arms. During the 12 month follow-up period there were fewer deaths by suicide in the intervention arm ($n = 44$) than in the control arm ($n = 66$), and more suicide attempts in the intervention arm ($n = 92$) than in the control arm ($n = 81$). The incidence rate ratio for death by suicide was 0.57 (95% CI 0.32–1.02, $P = 0.061$), indicating a 43% lower risk of death by suicide in the intervention arm compared with the control, with a marginally significant difference between the arms. Regarding suicide attempts, there was no significant difference between the arms.

Among school-going adolescents ($n = 2560$ in intervention, $n = 4364$ in control), there were significant differences between the two arms at baseline in the proportions of those with mild or higher levels (≥5) of depression (31% in control versus 24% in intervention), and of those with suicidal ideation (7.9% in control versus 5.2% in intervention). At the 3 month follow-up (Table 2) both arms had improved, with the intervention arm having significantly lower proportions of those with mild or higher levels of depressive symptoms (odds ratio 1.59, 95% CI 1.04–2.41, $P = 0.031$) and suicidal ideation (odds ratio 3.7, 95% CI 1.6–8.9; $P = 0.003$). While there were further reductions in these proportions in both arms at the 12 month follow-up, the difference between the arms was no longer significant (Table 2).

Regarding the primary outcome for sub-intervention 3, CHWs identified 108 individuals at risk for suicide in the intervention villages over the 12 month follow-up period. Of these, 88 (81.48%) had a history of suicide attempts and 20 (18.51%) had suicidal thoughts when meeting with the CHW. CHWs referred 78 (72.2%) individuals of the 108 to mental health professionals, and

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

Table 2 Regression estimates for depression and suicidal ideation in adolescents at 3 and 12 month follow-up

Variables	Control arm $n = 25$ schools $n = 1102$ students	Intervention arm $n = 59$ schools $n = 3597$ students	Estimates (95% CI)	*P*-value
3 month follow-up				
PHQ-9 score			Mean difference	
Median (Q1, Q3)	0 (0, 3)	0 (0, 1)	−0.44 (−0.9 to 0.06)	0.081
PHQ-9 scores using 5 as a cut-off for depression				
<5	3037 (84.4%)	980 (88.9%)	Odds ratio	
≥5	560 (15.6%)	122 (11.1%)	1.59 (1.04–2.41)	0.031
PHQ-9 scores using 10 as a cut-off for depression				
<10	3440 (95.6%)	1060 (96.2%)	Odds ratio	
≥10	157 (4.4%)	42 (3.8%)	1.12 (0.64–1.94)	0.672
SIDAS				
Without ideation	3467 (96.4%)	1089 (98.8%)	Odds ratio	
With ideation	130 (3.6%)	13 (1.2%)	3.7 (1.6–8.9)	0.003*
Variables	Control arm $n = 47$ schools $n = 2284$ students	Intervention Arm $n = 60$ schools $n = 4013$ students	Estimates (95% CI)	*P*-value
12 month follow-up				
PHQ-9			Mean difference	
Median (Q1, Q3)	0 (0, 1)	0 (0, 1)	−0.13 (−0.4 to 0.13)	0.331
PHQ-9 with 5 cut-offs for depression				
<5	3678 (91.7%)	2113 (92.5%)	Odds ratio	
≥5	335 (8.2%)	171 (6.7%)	1.30 (0.92–1.83)	0.132
PHQ-9 with 10 cut-offs for depression				
<10	3924 (97.8)	2229 (97.6%)	Odds ratio	
≥10	89 (2.2%)	55 (2.4%)	0.96 (0.57–1.61)	0.893
SIDAS				
Without ideation	3941 (98.2%)	2253 (98.6%)	Odds ratio	
With ideation	72 (1.8%)	31 (1.4%)	1.5 (0.8–3.1)	0.223

Regression estimates are presented as adjusted mean differences for Patient Health Questionnaire 9 (PHQ-9), a continuous variable, and adjusted odds ratios for PHQ-9 and the Suicidal Ideation Attributes Scale (SIDAS) when presented as categorical variables.
Q1, first quartile; Q3, third quartile.
*Statistically significant. Bonferroni correction was applied, and significance level was set at 0.01.

63 (58.33%) were followed for at least 6 months. Thirty individuals were lost to follow-up.

Implementation process/secondary outcomes

School-based sub-intervention 1

Regarding reach, a total of 47 (87.03%) of the 54 schools that were approached (each village in the intervention arm had one school) agreed to roll out YAM. The seven schools that declined stated that the academic schedule was too hectic to accommodate a new intervention, primarily because their academic activities had already been disrupted by two consecutive waves of the pandemic. Regarding uptake, in 11% of schools (5 of 47), more than 90% of YAM participants received the full intervention. In 88% of schools, 51–90% of participants completed the full intervention; only one school had less than 50% of students completing all 5 sessions; 72.81% of participants (1864 of the 2560 who consented) attended an average of 4 of 5 YAM sessions.

Central storage for pesticides, sub-intervention 2

Regarding reach, of the 54 villages that consented to participate and that were part of the intervention arm, 52 (96.2%) village councils provided space for community storage facilities for pesticides. Based on formative research, we estimated that approximately 50% of households engaged in agricultural practices that required pesticides. Accordingly, 8370 lockers were made available across these 52 CSFs. Of the lockers provided, 88.83% were used at least once and 82.53% were used frequently (more than twice in 12 months) to store pesticides.

Training of CHWs, sub-intervention 3

There were no significant differences between the control and intervention arms in demographic variables or CHWs' knowledge, confidence, attitudes and skills at baseline ($n = 436$ CHWs in intervention, $n = 436$ CHWs in control). CHWs in the intervention group showed significantly higher levels of knowledge and confidence at the 6 month follow-up ($P = 0.001$), and higher levels of knowledge, confidence, attitudes and skills at the 12 month follow-up ($P < 0.05$; Table 3).

Discussion

Our trial evaluated the effectiveness of an integrated suicide prevention programme comprising three evidence-based interventions in rural India. India contributes significantly to global suicide deaths, characterised by high rates among youth, women and rural communities.[27] Implementing community-based interventions in India is challenging due to sociocultural stigma, limited rural health infrastructure, fragmented governance and logistical complexities.[28,29] Understanding these factors is key to evaluating and scaling suicide prevention strategies.[29]

The integrated intervention did not have a statistically significant effect on the combined outcome of suicide attempts and deaths. However, when analysed separately, the intervention villages had a 43% lower risk of suicide deaths at 12 months. This reduction is noteworthy in LMICs such as India, where suicide rates are high and rising – up by 11.6% in Gujarat and 15.3% nationwide from 2020 to 2021.[2,3] Suicide attempts increased in both arms, slightly more so in the intervention arm. This may be due to improved surveillance capturing data for the first time and greater help-seeking behaviours due to awareness-raising activities. Enhanced CHW capacity may have led to the identification of more cases. It is also possible that the intervention reduced fatal outcomes, resulting in more non-fatal attempts being reported.

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

Table 3 Regression estimates of knowledge, attitude and skills among community health workers (CHWs) at the end of 6 and 12 months

Variables	Control arm $n = 62$ villages $n = 411$ CHWs	Intervention arm $n = 33$ villages $n = 217$ CHWs	Adjusted mean difference (95% CI)	*P*-value
At 6 months				
Knowledge score				
Mean ± s.d.	7.7 ± 2.1	10.0 ± 1.9	2.57 (2.13–3.01)	0.001*
Median (Q1, Q3)	8 (6, 8)	11 (8, 12)		
Confidence score				
Mean ± s.d.	5.7 ± 1.7	7.2 ± 1.6	1.64 (1.27–2.01)	0.001*
Median (Q1, Q3)	6 (4, 7)	7 (6, 9)		
ATSP				
Mean ± s.d.	43.1 ± 5.5	42.2 ± 6.6	−0.95 (−2.08 to 0.16)	0.09
Median (Q1, Q3)	43 (40, 47)	42 (37, 47)		
Skills score				
Mean ± s.d.	3.2 ± 1.3	3.4 ± 1.7	−0.006 (−0.32 to 0.31)	0.96
Median (Q1, Q3)	3 (2, 4)	3 (2, 5)		
Variables	**Control arm $n = 62$ villages $n = 380$ CHWs**	**Intervention arm $n = 54$ villages $n = 369$ CHWs**	**Adjusted mean difference (95% CI)**	***P*-value**
At 12 months				
Knowledge score			1.76 (1.28–2.23)	0.001*
Mean ± s.d.	8.2 ± 2.1	9.8 ± 2.0		
Median (Q1, Q3)	8 (7, 10)	10 (8, 12)		
Confidence score			1.12 (0.75–1.49)	0.001*
Mean ± s.d.	6.2 ± 1.7	7.2 ± 1.5		
Median (Q1, Q3)	6 (5, 7)	7 (6, 9)		
ATSP				
Mean ± s.d.	43.2 ± 5.8	41.7 ± 6.3	−1.31 (−2.53 to −0.09)	0.03*
Median (Q1, Q3)	43 (39, 47)	41 (38, 46)		
Skills score				
Mean ± s.d.	3.4 ± 1.4	3.7 ± 1.5	0.32 (0.04–0.59)	0.021*
Median (Q1, Q3)	3 (3, 4)	4 (3, 5)		

Regression estimates are presented as adjusted mean differences and 95% confidence interval.
ATSP, attitude towards suicide prevention; Q1, first quartile; Q3, third quartile.
*Statistically significant.

Comparisons with existing evidence

Few large-scale randomised trials of multilevel suicide prevention interventions exist in LMICs.[7,30] Our findings add to mixed results globally: some trials showed reduced deaths or attempts while others did not. Differences in interventions, populations, designs and contexts make direct comparisons difficult. Notably, none included means restriction as in our study.

Results of the few published trials of multilevel interventions have been mixed, with one having reduced suicide deaths among police officers in Canada;[31] one having reduced attempts among ninth-graders in the USA;[32] one having reduced a similar composite outcome of deaths by suicide and suicide attempts in rural areas, but not in metropolises, in Japan;[33] and one reporting no impact on such a composite outcome in New Zealand.[34] These trials differ in various ways – the interventions were integrated (e.g. unlike our study, none of the four trials restricted access to means of suicide); the populations were targeted; design (e.g. unlike our study, the regions were not randomly assigned to intervention and control arms in the Japanese study[33]); the health service and cultural and historical contexts in which the trial was based; the details reported in their publications; and their duration. Sri Lankan studies on safe pesticide storage showed limited effectiveness,[35,36] prompting a national ban – a feasible approach due to centralised governance and limited local manufacturing. However, similar bans face significant hurdles in India due to extensive pesticide production, federal governance and bureaucratic constraints. SPIRIT therefore introduced centrally managed pesticide lockers, supervised by trained facility managers, aligned with local governance structures and supported by prior research in Tamil Nadu.[18] While bans remain a critical long-term goal, community storage offers a feasible short-term strategy in India while advocacy for regulation continues.

More trials across contexts with consistent, detailed reporting are needed to advance definitive conclusions about the effectiveness of multilevel interventions, including dimensions such as components tested, populations, context etc. Multilevel suicide prevention interventions may require longer follow-up to show effects. Our 12 month window may have been too short. In contrast, trials in Hungary and Japan found positive outcomes after 2–3.5 years.[33]

Sub-intervention outcomes

All three sub-interventions were implemented as planned, with high reach and uptake – despite differing levels (schools versus communities) and the disruption resulting from the pandemic. This is notable given our study's almost unprecedented large scale (students in 47 out of a possible 54 schools; 52 of 54 villages established central storage facilities to house 8370 lockers, with nearly 90% of these in use; 436 CHWs in all 54 villages trained); and because these interventions were at different levels (schools in sub-intervention 1 versus entire communities in sub-interventions 2 and 3).

Few multilevel interventions have targeted youth in LMICs, despite growing concerns about their mental ill-health and suicide rates.[30,37,38] Our results are promising in terms of the acceptability of a preventative intervention among schools, students and parents who consented to their children receiving the intervention and data collection. The intervention was also effective in reducing depression and suicidal ideation at the 3 month follow-up; however, this effect was not sustained 12 months later. These findings are consistent with studies showing that school-based

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

universal mental health promotion interventions often show effects but are not sustained in the long term.[39] There was a higher number of students in the control arm compared with the intervention arm, primarily because recruitment and data collection for the control group were completed before COVID-19 restrictions disrupted intervention delivery and participation. Future studies should explore booster sessions or dose–response effects. Training of CHWs led to sustained (1 year) improvements in knowledge, confidence, skills and practices, and they identified, provided support and followed up with over 100 individuals at risk.

Limitations and strengths

COVID-19 delayed implementation of the interventions, which contributed to variation in exposure duration, a common finding for all non-COVID trials conducted during the pandemic. The trial interventions were planned for roll-out in a staggered manner over 6 months from November 2019, but roll-out took place over 26 months, being completed by January 2022. The 3 interventions were therefore not all introduced in intervention villages at the same time or within the same 6 month period, and villages had different periods of exposure to each of the 3 interventions. Another limitation is that we are unable to evaluate the individual effects of each of the three interventions, because we looked at combined effects at the village level. Although there was a clear trend suggesting that the integrated intervention reduced deaths by suicide, the trial was not powered to detect statistical differences in suicide deaths because it focused on suicide attempts and deaths by suicide combined as an aggregate indicator. Fourth, there are no reliable state- or national-level data on suicide attempts in India; our community-based surveillance, later endorsed by WHO and an important contribution of this trial to the field, helped fill this gap but may have missed some cases.[22,23]

Despite challenges, the trial demonstrates the feasibility of delivering complex interventions on a scale in low-resource settings. The randomisation of regions enhanced internal validity. Thoughtful, sustained engagement of leaders, the health and educational sectors and other key stakeholders in participating villages increased the acceptability of the randomisation, the implemented interventions and the surveillance system. Our trial adds to the scarce evidence base on multilevel suicide prevention interventions implemented in LMICs, and its findings can inform future suicide prevention efforts in underserved areas of LMICs.

Lakshmi Vijayakumar, MD, PhD, SNEHA and Head of the Psychiatry Department, Voluntary Health Services, Chennai, India; and Melbourne School of Population and Global Health, University of Melbourne, Australia; **Soumitra Pathare**, PhD, Centre for Mental Health Law and Policy, Indian Law Society, Pune, India; **Nikhil Jain**, MPH, Centre for Mental Health Law and Policy, Indian Law Society, Pune, India; **Deepa Pandit**, PhD, Centre for Mental Health Law and Policy, Indian Law Society, Pune, India; **Isha Lohumi**, MA, Centre for Mental Health Law and Policy, Indian Law Society, Pune, India; **Jasmine Kalha**, MPhil, Centre for Mental Health Law and Policy, Indian Law Society, Pune, India; **Laura Shields-Zeeman**, PhD, Department of Mental Health and Prevention, Trimbos Institute, Utrecht, The Netherlands; and Department of Interdisciplinary Social Sciences, Utrecht University, The Netherlands

Correspondence: Lakshmi Vijayakumar. Email: lakshmi@vijayakumars.com

First received 19 Sep 2024, final revision 28 Aug 2025, accepted 9 Sep 2025

Supplementary material

The supplementary material is available online at https://doi.org/10.1192/bjp.2025.10431

Data availability

Following the data-sharing policies of the institute, deidentified data will be made available on request to one of the principal investigators, S.P., and to the institutional head, V. Joshi, via the corresponding author.

Acknowledgements

We thank Dr Anant Bhan, Prof. Dr Jacquleen Joseph, Prof. Dr Lakshmanan Jeyaseelanan, Dr Santosh K. Chaturvedi and Dr Thara Rangaswamy, members of the Data Safety Monitoring Board (DSMB), for their invaluable contributions to this trial. We thank Dr Camilla Wasserman and Dr Vladimir Carli for helping with adaptation of the YAM intervention in the Indian context. We also thank Mohammad Shahjahan (BCCP), Dr Holly Cambell-Rosen (US National Institute of Mental Health, NIMH) and the other dedicated members of the Advisory Committee, along with Prof. Dr Michel Wensing, Dr Bethany Hipple Walters, Dr Soumya Swaminathan, Raj Mariwala, the late Keshav Desiraju, N. Ram, Akhileshwar Sahay, Dr Nikhil Gupte and Dr Wouter den Hollander; and Dr Frederiek Schouten, who played an instrumental role in the successful completion of this research trial. Finally, we thank Prof. Srividya Iyer for her detailed and helpful comments and suggestions for improving this manuscript.

Author contributions

S.P., L.V. and L.S.-Z. have full access to all data in the trial, and take responsibility for the integrity of the data and the accuracy of data analysis. Concept and design: L.S.-Z., L.V. and S.P. Acquisition, analysis and interpretation of data: L.S.-Z., L.V., S.P., N.J., D.P. and I.L. Drafting of the manuscript: L.S.-Z., L.V., S.P., N.J., D.P. and I.L. Critical revision of the manuscript for important intellectual content: all authors. Statistical analysis: D.P. and N.J. Funding acquisition: L.S.-Z., L.V. and S.P. Administrative, technical and material support: N.J., I.L. and S.P. Supervision: L.S.-Z., L.V. and S.P.

Funding

The SPIRIT Project is funded by NIMH (grant no. 5U19MH113174- 03 Revised), to S.P., L.V. and L.S.-Z. (principal investigators).

Declaration of interest

None.

Analytic code availability

Access to analytical code will be provided at reasonable request for the purpose of reproducing results or replicating procedures.

References

1 World Health Organization. *Suicide*. WHO, 2023.

2 National Crime Records Bureau. *Accidental Deaths & Suicides in India 2020*. NCRB, 2021.

3 National Crime Records Bureau. *Accidental Deaths & Suicides in India 2021*. NCRB, 2022.

4 National Crime Records Bureau. *Accidental deaths & suicides in India 2022*. NCRB, 2023.

5 Vijayakumar L, Chandra PS, Kumar MS, Pathare S, Banerjee D, Goswami T, et al. The national suicide prevention strategy in India: context and considerations for urgent action. *Lancet Psychiatry* 2022; **9**: 160–8.

6 World Health Organization. *Suicide Worldwide in 2019: Global Health Estimates*. WHO, 2021.

7 van der Feltz-cornelis CM, Sarchiapone M, Postuvan V, Volker D, Roskar S, Grum AT, et al. Best practice elements of multilevel suicide prevention strategies. *Crisis* 2011; **32**: 33–9.

8 Gask L, Dixon C, Morriss R, Appleby L, Green G. Evaluating STORM skills training for managing people at risk of suicide. *J Adv Nurs* 2006; **54**: 739–50.

9 Kawanishi C, Aruga T, Ishizuka N, Yonemoto N, Otsuka K, Kamijo Y, et al. Assertive case management versus enhanced usual care for people with mental health problems who had attempted suicide and were admitted to hospital emergency departments in Japan (ACTION-J): a multicentre, randomised controlled trial. *Lancet Psychiatry* 2014; **1**: 193–201.

10 Phillips MR, Cheng, HG. The changing global face of suicide. *Lancet* 2012; **379**: 2318–19.

11 Dandona R, Kumar GA, Dhaliwal R, Naghavi M, Vos T, Shukla D, et al. Gender differentials and state variations in suicide deaths in India: the Global Burden of Disease Study 1990–2016. *Lancet Public Health* 2018; **3**: e478–89.

12 Balaji M, Mandhare K, Nikhare K, Shah AK, Kanhere P, Panse S, et al. Why young people attempt suicide in India: a qualitative study of vulnerability to action. *SSM Ment Health* 2023; **3**: 100216.

13 World Health Organization. *Live Life: An Implementation Guide for Suicide Prevention in Countries*. WHO, 2021.

14 Pathare S, Shields-Zeeman L, Vijayakumar L, Pandit D, Nardodkar R, Chatterjee S, et al. Evaluation of the SPIRIT Integrated Suicide Prevention Programme:

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press

study protocol for a cluster-randomised controlled trial in rural Gujarat. *India Trials* 2020; **21**: 572.

15 Gujarat GSIDS-Go. *District Human Development Report - Mehsana*. Gujarat GSIDS-Go, 2016.

16 Schulz KF, Altman DG, Moher D. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *J Pharmacol Pharmacother* 2010; **1**: 100–7.

17 Wasserman D, Hoven CW, Wasserman C, Wall M, Eisenberg R, Hadlaczky G, et al. School-based suicide prevention programmes: the SEYLE cluster-randomised, controlled trial. *Lancet* 2015; **385**: 1536–44.

18 Vijayakumar L, Jeyaseelan L, Kumar S, Mohanraj R, Devika S, Manikandan S. A central storage facility to reduce pesticide suicides-a feasibility study from India. *BMC Public Health* 2013; **13**: 850.

19 World Health Organization. *Intervention Guide for Mental, Neurological and Substance Use Disorders in Non-Specialized Health Settings: Mental Health Gap Action Programme (mhGAP)* version 2.0. WHO, 2016.

20 World Health Organization. *Mental Health Gap Action Programme (mhGAP) Guideline for Mental, Neurological and Substance Use Disorders*. WHO, 2023.

21 Arya V, Page A, Armstrong G, Kumar GA, Dandona R. Estimating patterns in the under-reporting of suicide deaths in India: comparison of administrative data and Global Burden of Disease Study estimates, 2005–2015. *J Epidemiol Community Health* 2021; **75**: 550–5.

22 Vijayakumar L, Pathare S, Jain N, Nardodkar R, Pandit D, Krishnamoorthy S, et al. Implementation of a comprehensive surveillance system for recording suicides and attempted suicides in rural India. *BMJ Open* 2020; **10**: e038636.

23 World Health Organization. *Training manual for surveillance of suicide and self-harm in communities via key informants.* WHO, 2023.

24 Ganguly S, Samanta M, Roy P, Chatterjee S, Kaplan DW, Basu B. Patient health questionnaire-9 as an effective tool for screening of depression among Indian adolescents. *J Adolesc Health* 2013; **52**: 546–51.

25 Mohta A, Malhotra S, Gupta SK, Mani K, Patra BN, Nongkynrih B. Depression among adolescents in a rural area of Haryana, India: a community-based study using Patient Health Questionnaire-9. *Cureus* 2021; **13**: e18388.

26 van Spijker BA, Batterham PJ, Calear AL, Farrer L, Christensen H, Reynolds J, et al. The suicidal ideation attributes scale (SIDAS): community-based validation study of a new scale for the measurement of suicidal ideation. *Suicide Life Threat Behav* 2014; **44**: 408–19.

27 Patel V, Ramasundarahettige C, Vijayakumar L, Thakur J, Gajalakshmi V, Gururaj G, et al. Suicide mortality in India: a nationally representative survey. *Lancet* 2012; **379**: 2343–51.

28 Kaur A, Kallakuri S, Mukherjee A, Wahid SS, Kohrt BA, Thornicroft G, et al. Mental health related stigma, service provision and utilization in Northern India: situational analysis. *Int J Ment Health Syst* 2023; **17**: 10.

29 Rappai R, Cherian AV, Lukose A, Vijayakumar L. Suicide research in India: an overview of four decades. *Asian J Psychiatry* 2020; **53**: 102191.

30 Hofstra E, van Nieuwenhuizen C, Bakker M, Özgül D, Elfeddali I, de Jong SJ, et al. Effectiveness of suicide prevention interventions: a systematic review and meta-analysis. *Gen Hosp Psychiatry* 2020; **63**: 127–40.

31 Mishara BL, Martin N. Effects of a comprehensive police suicide prevention program. *Crisis* 2012; **33**: 162–8.

32 Schilling EA, Aseltine RH, James A. The SOS suicide prevention program: further evidence of efficacy and effectiveness. *Prev Sci* 2016; **17**: 157–66.

33 Ono Y, Awata S, Iida H, Ishida Y, Ishizuka N, Iwasa H, et al. A community intervention trial of multimodal suicide prevention program in Japan: a novel multimodal community intervention program to prevent suicide and suicide attempt in Japan, NOCOMIT-J. *BMC Public Health* 2008; **8**: 315.

34 Collings S, Jenkin G, Stanley J, McKenzie S, Hatcher S. Preventing suicidal behaviours with a multilevel intervention: a cluster randomised controlled trial. *BMC Public Health* 2018; **18**: 140.

35 Pearson M, Metcalfe C, Jayamanne S, Gunnell D, Weerasinghe M, Pieris R, et al. Effectiveness of household lockable pesticide storage to reduce pesticide self-poisoning in rural Asia: a community-based, cluster-randomised controlled trial. *Lancet* 2017; **390**: 1863–72.

36 Konradsen F, Pieris R, Weerasinghe M, van der Hoek W, Eddleston M, Dawson AH. Community uptake of safe storage boxes to reduce self-poisoning from pesticides in rural Sri Lanka. *BMC Public Health* 2007; **7**: 13.

37 Doty B, Bass J, Ryan T, Zhang A, Wilcox H. Systematic review of suicide prevention studies with data on youth and young adults living in low-income and middle-income countries. *BMJ Open* 2022; **12**: e055000.

38 van der Feltz-Cornelis CM, Sarchiapone M, Postuvan V, Volker D, Roskar S, Grum AT, et al. Best practice elements of multilevel suicide prevention strategies. *Crisis* 2011; **32**: 319–33.

39 Wells J, Barlow J, Stewart-Brown S. A systematic review of universal approaches to mental health promotion in schools. *Health Educ* 2003; **103**: 197–220.

https://doi.org/10.1192/bjp.2025.10431 Published online by Cambridge University Press