Pesticide practices and suicide among farmers of the Sundarban region in India

Arabinda N. Chowdhury, Sohini Banerjee, Arabinda Brahma, and M. G. Weiss

Abstract

Background. *Deliberate self-poisoning by ingesting pesticides is a serious health problem among farmers, especially in low- and middle-income countries. Preventing these suicides is a priority for a public mental health agenda.*

Objective. *To examine the role of pesticide poisoning in suicide and nonfatal deliberate self-harm, and clarify awareness of risks, safe practices concerning storage and use of pesticides, and associated self-injury, both unintentional and intentional, within farmer households of the Sundarban region, India.*

Methods. *Retrospective record review of adult cases of deliberate self-poisoning at the Block Primary Health Centres of 13 Sundarban Blocks was performed to analyze the relative roles of various methods of self-harm and their lethality. Focus group discussions, questionnaires, and in-depth interviews were undertaken in a community study of farmer households to examine pesticide-related views and practices, with particular attention to storage, use, and health impact.*

Results. *Pesticide poisoning was the most common method of deliberate self-harm in both men and women. Pesticide storage in most households was unsafe and knowledge was inadequate concerning adverse effects of pesticides on health, crops, and the environment.*

Conclusions. *An intersectoral approach linking the interests of public health, mental health, and agriculture is well suited to serve the collective interests of all three agendas better than each in isolation. Such an approach is needed to reduce morbidity and mortality from unintentional and intentional self-injury in low-income agricultural communities like those of the Sundarban region.*

Key words: Community mental health, pesticide practice, suicide, Sundarban

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Suicidal behavior, both fatal and nonfatal, is recognized as a serious problem, contributing to preventable mortality and indicating serious mental health problems of communities and populations globally. The role of pesticides, however, in agricultural communities of low- and middle-income countries, has only recently begun to attract the attention this problem requires [1]. Deliberate pesticide poisoning accounts for about a third of all suicides worldwide [2]. The World Health Organization has recently identified suicide in poor agricultural communities as a mental health priority, emphasizing the challenge of this problem in low- and middle-income countries [3]. Recent studies in rural areas of Asia suggest pesticides account for more than 60% of suicides in China and Southeast Asia [4, 5], 71% in Sri Lanka [6], and more than 90% in Malaysia [7]. Gunnell and Eddleston [5] estimated that 300,000 pesticide-related suicides occur each year in China and Southeast Asia. Studies in other developing countries, including Brazil [8], Surinam [9], Portugal [10], Zimbabwe [11], Jordan [12], Iran [13], Pakistan [14], India [15-18], Taiwan [19], and Korea [20], have also found high rates of intentional pesticide-related morbidity and mortality.

Considerable attention has been focused on the problem of suicides among farmers in relation to pesticide practices in recent years in European and North American countries [21], where the situation is distinct

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from the ground realities of rural agricultural life in the developing world. Recently, suicides in farming communities in India have become a national issue because of their socioeconomic underpinnings and impact. Estimates from various official sources state that from the year 2001 to 2006 as many as 5,910 farmers committed suicide in Karnataka, 1,835 in Andhra Pradesh, 981 in Maharasthra, more than 500 in Punjab, and 201 in Kerala. Most of these suicides were accomplished by pesticide poisoning [22–24]. Although many theories have been suggested to explain the agrarian crisis that motivates these farmer suicides, which are reaching epidemic proportions, a common denominator by all accounts is intense psychological distress, and consumption of readily accessible pesticide is a constant feature of the problem.

This study examines the epidemiology of pesticide-related morbidity and mortality among patients reaching local government health services, and it also examines awareness of toxicity and pesticide practices in a community study of farmers of the Sundarban region in West Bengal, India. Farmers in this region share many similar features and vulnerabilities with their counterparts in other parts of India and other Asian countries. In the context of a rural mental health program in the Sundarban Delta, a community study had previously identified suicide as a locally recognized priority problem. The research was undertaken with reference to a framework that examined the problem of suicidal behavior in relation to contexts of health system capacities, agricultural development, and social factors relevant for establishing a community mental health program in the region. With regard to pesticide policy, it asked how appropriate policies to regulate the availability, procurement, storage, and use of pesticides may reduce the risk of harm from intentional, accidental, and routine occupational misuse.

Objective

This study aimed to document broadly the problem of suicide and suicidal behavior with reference to deliberate self-harm in the agricultural blocks of the Sundarban region, based on adult admissions at the Block Primary Health Centres (BPHCs) of 13 development blocks in the region. It also aimed to explain the level of awareness of farmers about the toxicity of pesticides and clarify pesticide practices with particular attention to recognition of hazards, safe storage, and safe use.

Methods

Retrospective data collection from BPHCs

Study areas

The Sundarban region encompasses the largest delta in the world. It is located at the southernmost part of the state of West Bengal at the confluence of the Ganges and Hooghly Rivers where they flow into the Bay of Bengal. Set in a complex system of waterways, including numerous canals and tidal creeks, 54 islands are spread over an area of 1,630 square miles. The Sundarban region is a socioeconomically underdeveloped area. Inaccessibility, recurring erosion of land, and the adverse climate are important ecohazards. The literacy rate and per capita income are much lower than the state average [25]. Approximately 88.5% of the inhabitants are dependent on agriculture for their livelihood.

The present study was confined to the 13 Sundarban community development blocks of the South 24 Parganas District (**fig. 1**) of the state of West Bengal, India. Each block, with a population ranging from approximately 100,000 to 200,000, has one BPHC as

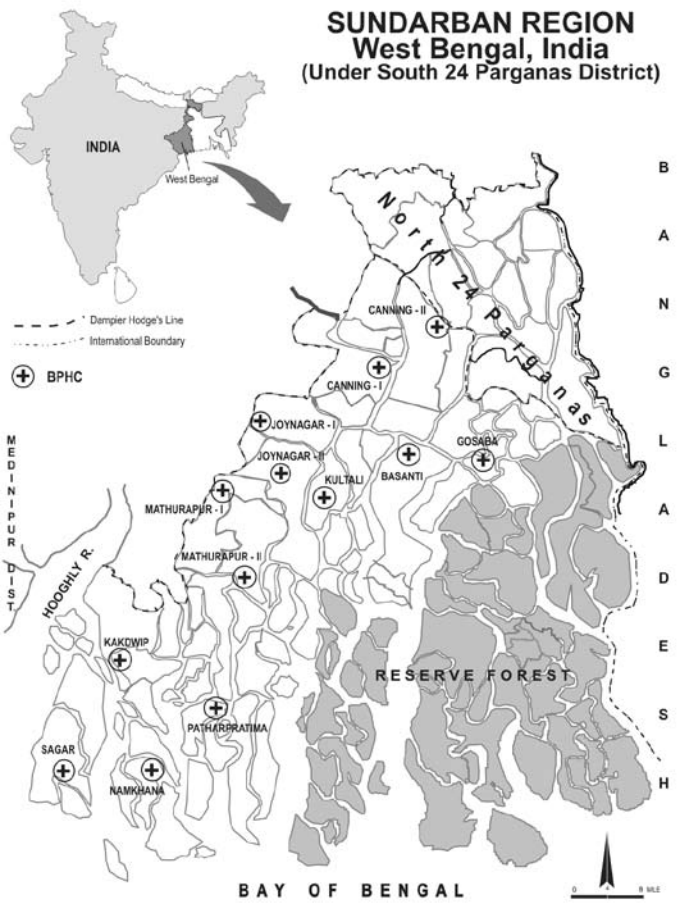

FIG. 1. The Sundarban Region of West Bengal, India

the highest-level health facility. Each of these blocks also has a locally elected community council, known as the Panchayat Samity, which is responsible for development of the villages in the block.

Study design

Retrospective data for the year 2000 were collected for all cases of intentional poisoning from the admission registers of 13 BPHCs. Data analyzed for each case included sex, age, marital status, occupation, religion, date and time of admission, method of self-harm, discharge, DORB status (discharge on risk bond), referral, and mortality. The diagnostic classification of deliberate self-harm or suicide was based on the clinical outcome with respect to mortality. Psychological motivation and intention to die were beyond the scope of this study and unavailable from the BPHC admission registers.

Survey of pesticide practices among farmers

A local language questionnaire in Bengali was developed to inquire about pesticide practices. A precoded questionnaire with a largely yes/no answer format inquired about 1) the choice of pesticides, 2) their storage, 3) knowledge about their effects on health, 4) whether pesticides had been responsible for any health problems during the past year, 5) awareness of any adverse effects of pesticides on crops, 6) knowledge about environmental adverse effects, and 7) views concerning the relationship between storage of pesticide and their use for DSH in the region. For questions 5 and 6, the source of knowledge was also asked (e.g., pesticide company, pesticide shop owner, fellow farmers, and own experience). During each BPHC visit, the Panchayat Samity of the block was asked to arrange a farmers' meeting to discuss issues related to pesticides and DSH.

In the community survey, 39 group discussions (with 10 to 14 in a group) of farmers and 69 individual in-depth interviews were conducted. At these group meetings of male farmers, participants completed the questionnaire at the beginning before the focus group discussion began. Three or four farmers from each Gram Panchayats of the respective blocks were selected by the Panchayat Samity. Usually the blocks have 7 to 15 Gram Panchayats, and under each Gram Panchayat there are 5 to 7 villages. This uniform selection adequately represents the farmer population of the block. A total of 880 questionnaires (57 for Basanti, 55 for Canning I, 110 for Gosaba, 52 for Joynagar I, 88 for Kakdweep, 63 for Kultoli, 85 for Mathurapur II, 180 for Namkhana, 64 for Patharpratima, and 126 for Sagar) were completed, of which 76 forms were discarded either because the responses were incomplete or the respondent's primary occupation was not agriculture.

This study was conducted after obtaining ethical permission from Panchayat Samity, Block Medical Officers of the BPHCs. Written informed consent was obtained from the farmers to reproduce the content of the interview materials.

Statistical analysis

The data were analyzed with Statistica software. Comparisons of categorical variables between suicide and DSH patients were made with the chi-square or Fisher's exact test, as appropriate for comparisons in which cells had small expected cell sizes. Odds ratios with 95% confidence intervals (CI) were calculated where indicated in the analysis of the risk for suicide. The proportions of responses of farmers regarding pesticide storage and health effects were compared by the two-choice same sample dependent z-test. Values of $p < .05$ were considered to indicate statistical significance.

Results

The demographic details of the BPHC cases are summarized in **table 1,** which presents the distribution of all intentional-poisoning patients classified as either DSH or suicide who were admitted during the year 2000 in all 13 BPHCs. They include 1,775 cases of DSH and 174 cases of suicide. In both categories the proportions of women were greater than those of men (DSH 62.4% and suicide 62.1%) but were not substantially different from the proportion of patients treated at the BPHCs who are female. The highest number of DSH cases was reported from the Joynagar I block, and the highest number of suicides was reported from the Canning I block.

Most of these patients were farmers. Farming was the primary occupation of 88.6% of DSH patients (51.2% landowner farmers, 22.0% sharecroppers, and 15.4% agricultural laborers). Nonfarming occupations accounted for 11.4%. Among female DSH cases, 96.2% were from farming households (43.1% landowner farmers, 27.2% sharecroppers, and 25.9% agricultural laborers), and 3.8% were from nonfarming households. Among the men who committed suicide, 89.4% were farmers (46.9% landowners, 28.8 sharecroppers, and 13.6% agricultural laborers), and 10.6% were from nonagricultural occupations. Among women who committed suicide, 93.1% were from farming households (54% landowners, 17.8 sharecroppers, and 21.3 agricultural laborers), and 6.9% were from nonfarming households. Women from farming households were engaged in some aspect of farm work.

Among male DSH patients, 44.6% were single and 54.9% were married. Among female DSH patients, 28.1% and 71.9% were single and married, respectively. For cases of suicide, 24.2% were single and 74.2% were married, but most of the female cases of suicide were

TABLE 1. Cases of deliberate self-harm and suicide in 13 Block Primary Health Centres according to sex[a]

	DSH			Suicide		
BPHC	Male	Female	Total	Male	Female	Total
Basanti	3 (33.3)	6 (66.7)	9 (0.5)	2 (33.3)	4 (66.7)	6 (3.4)
Canning I	107 (36.14)	189 (63.85)	296 (16.7)	14 (34.1)	27 (65.8)	41 (23.6)
Canning II	2 (18.2)	9 (91.8)	11 (0.6)	3 (37.5)	5 (62.5)	8 (4.6)
Gosaba	15 (38.5)	24 (61.5)	39 (2.2)	2 (66.7)	1 (33.3)	3 (1.7)
Jaynagar I	165 (36.7)	284 (63.2)	449 (25.3)	3 (50.0)	3 (50.0)	6 (3.4)
Jaynagar II	44 (45.8)	52 (54.2)	96 (5.4)	2 (22.2)	7 (77.8)	9 (5.2)
Kakdweep	70 (36.8)	120 (63.1)	190 (10.7)	6 (35.3)	11 (64.7)	17 (9.8)
Kultali	15 (27.8)	39 (72.2)	54 (3.0)	1 (25.0)	3 (75.0)	4 (2.3)
Mathurapur I	62 (39.2)	96 (60.7)	158 (8.9)	6 (50.0)	6 (50.0)	12 (6.9)
Mathurapur II	84 (44.9)	103 (55.0)	187 (10.5)	17 (50.0)	17 (50.0)	34 (19.5)
Namkhana	44 (43.1)	58 (56.9)	102 (5.8)	5 (41.7)	7 (58.3)	12 (6.9)
Patharpratima	26 (29.5)	62 (70.4)	88 (5.0)	1 (12.5)	7 (87.5)	8 (4.6)
Sagar	31 (32.3)	65 (67.7)	96 (5.4)	4 (28.6)	10 (71.4)	14 (8.1)
Total for 13 BPHCs	668 (37.6)	1,107 (62.4)	1,775 (100.0)	66 (37.9)	108 (62.1)	174 (100.0)

DSH, nonfatal deliberate self-harm; BPHC, Block Primary Health Centre

a. The number (percentage) for each site is given. The percentages of males and females with reference to the total number at that site are given. The percentages in the columns for the total at each site are with reference to the total at all sites.

married (85.2%). With respect to religion, the proportion of Hindus was higher for suicides (90.2% Hindu and 9.8% Muslim) than for DSH (77.2% Hindu, 22.6% Muslim). With respect to age group, the largest number of both DSH and suicide patients were in the 15- to 24-year-old group (49.9% and 41.4% respectively), and the next largest number were in the 25-to 34-year-old group (23.3% and 23.0%).

Among DSH patients, the mean age of men was 28.0 ± 12.6 years and the mean age of women was 23.9 ± 10.6. Among those who committed suicide, the mean age of men was 34.7 ± 14.4 years and that of women was 27.2 ± 13.2 years. More patients tended to be admitted between 12 pm and 6 pm (35.6% for DSH and 34.5% for suicide). The highest number of admissions occurred in March and April, the beginning of the hot season (19.9% of DSH admissions and 30.5% of suicides).

Table 2 shows the distribution of methods of self-harm according to sex. Poisoning was the commonest method for both DSH (97.5%) and suicide (96.6%), with no significant differences between men and women.

Table 3 identifies the various poisons used for DSH. Among suicide cases, there were no significant differences between men and women concerning their choice of poison, but among DSH cases, more men tended to use agrochemicals ($p = .02$; odds ratio, 1.46; 95% CI, 1.06-2.02).

Table 4 shows the nature of pesticide practices and knowledge of ill effects of pesticides among the farmers. When selecting a pesticide to use on their crops, most farmers depend on the advice of pesticide shop owners (67.9%), with negligible input from the local agriculture department advisors (0.74%). One-third of farmers (34.7%) acknowledged that they stored pesticides in a manner regarded as unsafe. Comparison of responses regarding pesticide storage showed that there was a statistically significant difference between the proportion storing safely enough for adults (6.62%) and those not storing safely or with uncertain storage conditions (44.31%) ($p < .01$). However, the proportions storing safely enough for children (49.06%) and not storing safely or with uncertain storage (44.31%) were

TABLE 2. Methods of DSH and suicide according to sex

	DSH			Suicide		
	Male (n = 668)	Female (n = 1,107)	Total (n = 1,775)	Male (n = 66)	Female (n = 108)	Total (n = 174)
Method	No. (%)					
Burning	10 (1.50)	15 (1.36)	25 (1.41)	2 (3.03)	3 (2.78)	5 (2.87)
Hanging	9 (1.35)	8 (0.72)	17 (0.96)	—	1 (1.08)	1 (0.57)
Drowning	—	2 (0.18)	2 (0.11)	—	—	—
Poisoning	649 (97.16)	1,082 (97.74)	1731 (97.52)	64 (96.97)	104 (61.9)	168 (96.55)

DSH, nonfatal deliberate self-harm

TABLE 3. Poisons used for DSH and suicide

	DSH			Suicide		
	Male (n = 649)	Female (n = 1,082)	Total (n = 1,731)	Male (n = 64)	Female (n = 104)	Total (n = 168)
Types of poison	No. (%)					
Agrochemical (pesticide)	586 (90.3)	935 (86.4)	1,521 (87.9)	58 (90.6)	90 (86.5)	148 (88.1)
Household chemical	11 (1.7)	36 (3.3)	47 (2.7)	3 (4.7)	2 (1.9)	5 (3.0)
Baygon spray	1 (9.1)	—	1 (2.1)	—	—	—
Bug killer	1 (9.1)	—	1 (2.1)	—	—	—
Fly killer	1 (9.1)	3 (8.3)	4 (8.5)	1 (33.3)		1 (20)
Gammaxin	1 (9.1)	4 (11.1)	5 (10.6)	1 (33.3)		1 (20)
Kerosene	2 (18.1)	11 (30.5)	13 (27.7)	1 (33.3)	1 (50)	2 (40)
Lice killer	1 (9.1)	2 (5.6)	3 (6.4)	—	—	—
Phenyl	—	2 (5.6)	2 (4.3)	—	—	—
Rat killer	4 (36.4)	11 (30.5)	15 (31.9)	—	1 (50)	1 (20)
Hair shampoo	—	1 (2.8)	1 (2.1)	—	—	—
Ujala alta (cosmetic liquid)	—	1 (2.8)	1 (2.1)	—	—	—
Tarpin oil	—	1 (2.8)	1 (2.1)	—		—
Indigenous poison	7 (1.1)	33 (3.1)	40 (2.3)	—	3 (2.9)	3 (1.8)
Dhatura	1 (14.3)	2 (6.1)	3 (7.5)	—	—	—
Yellow oleander seed	6 (85.7)	31 (93.9)	37 (92.5)	—	3 (100)	3 (100)
Other	8 (1.2)	16 (1.5)	24 (1.4)	—		
Medicine	5 (62.5)	16 (100)	21 (87.5)	—	—	—
Alcohol + unknown poison	2 (25)	—	2 (8.3)	—	—	—
Kerosene with alcohol	1 (12.5)	—	1 (4.2)	—	—	—
Unknown poison	37 (5.7)	62 (5.7)	9 9 (5.7)	3 (4.7)	9 (8.7)	8 (4.8)

comparable. Most farmers (71.7%) took no precautions during application of pesticide in the field. Only 29.7% of farmers had some knowledge about the ill effects of pesticides on their health. Although 67.9% of them experienced some sort of health effects from pesticides, only 5.3% consulted a medical facility for them. Comparison of responses regarding treatment sought following pesticide-related health hazards showed that there was a statistically significant difference between the proportion seeking hospital treatment (5.30%) and those seeking treatment from a quack doctor (20.66%) or undertaking self-treatment (15.90%) ($p < .01$ for both). The difference between the proportions seeking any sort of treatment (41.86%) and those seeking no treatment (58.14%) was also significant ($p < .01$). Among the farmers, 57.9% had no knowledge of the ill effects of pesticide on the crops. Among those who had some knowledge (42.1%), the primary source of knowledge were the pesticide shopkeepers (32.4%). Only 16.9% of farmers had some knowledge of the ill effects of pesticides on the environment; the primary source of knowledge was fellow farmers (23.5%). Nearly 70% of farmers strongly believed that unsafe pesticide storage was positively related to the DSH attempts in the region.

Box 1 presents narratives of farmers' accounts of pesticide practices. Most kept pesticides on open shelves in their homes. Their ready availability for purchase and the minimal storage precautions in the household made them easily accessible for impulsive use. Their lethality was enhanced by the long distances from the BPHCs and the lack of transport.

Discussion

The present study is notable for several findings that merit attention to support efforts to reduce pesticide-related mortality and morbidity in Asian agrarian communities. These include the predominant role of pesticides in DSH, inadequate safety concerning pesticide practices, limited knowledge about their toxicity and inadequate precautions while using them, and easy access to pesticides. The health system requires a more effective response to treating pesticide poisoning, and clinical and community mental health services to address the emotional problems and social conditions that motivate DSH. We consider the following four key points among the findings in more detail.

Poisoning, especially by pesticides, and DSH and suicide

Analysis of the health data of the developing world on DSH and suicide revealed that the most commonly used method is self-poisoning with pesticides [5].

TABLE 4. Analysis of farmers' responses to questions about pesticide knowledge and practices from 10 Sundarban Blocks (n = 806).

Issues	No. (%)
Pesticide selection (n = 806)	
Self	177 (21.9)
Pesticide shop owner	548 (67.9)
Fellow farmer	75 (9.3)
Agriculture office	6 (0.74)
Pesticide storage (n = 695)	
Safe for children	341 (49.1)
Safe for adult	46 (6.6)
Uncertain	67 (9.6)
Unsafe	241 (34.7)
Precaution while using (n = 806)	
Some precaution	228 (28.3)
No precaution	578 (71.7)
Ill effects on health (n = 806)	
Some knowledge	239 (29.7)
Experienced ill effects (last 1 yr)	547 (67.9)
Visited hospital	29 (5.3)
Visited quack doctor	113 (20.7)
Self-treatment	87 (15.9)
Not taken any treatment	318 (58.1)
Ill effects on crops (n = 806)	
No knowledge	467 (57.9)
Some knowledge	339 (42.1)
Source of knowledge	
Pesticide company	32 (9.4)
Pesticide shop owner	110 (32.4)
Agriculture department	43 (12.7)
Fellow farmer	98 (28.9)
Self-experience	56 (16.5)
Ill effects on environment (n = 806)	
No knowledge	670 (83.1)
Some knowledge	136 (16.9)
Source of knowledge	
Pesticide Shop owner	13 (9.6)
Agriculture department	7 (5.1)
Fellow farmer	32 (23.5)
Self-experience	84 (61.8)
Unsafe storage of pesticide at home is positively related with DSH (n = 806)	
Strongly agree	557 (69.1)
Moderately agree	154 (19.1)
Mildly agree	67 (8.3)
Disagree	4 (0.5)
Don't know	24 (3.0)

BOX 1. Narratives of farmers on pesticide storage and self-harm

Pesticide storage

SB, 32 years old: "I wrap it in a jute bag and keep it on a rack in my cow-shed. The rack is quite high. No, children cannot reach up there. Neither do we disclose to our children where we place the pesticides. They do not know. Yes, adults can reach up there. No, we do not keep pesticides in a separate cupboard or locked box. There is no use keeping it locked. How can I keep it secret from my wife? My wife also works in the field with me. She is also involved in spraying pesticides on our crops. So she can consume pesticide any time she wants. By God's grace nothing like that has happened yet. In this village we poor people are very busy during the time of cultivation; we have too little time to bother about box, lock, key. etc."

PP, 40 years old: "I use many types of chemicals such as phenyl, gammaxin, rat poison, thiodin, etc. There are other few types for using in the betel leaf vine. I mainly work in the betel leaf vine.… How to keep pesticides in a secret place? We use them all the time and there is no secret room in my household. I keep them at home on a wooden shelf. Yes, anybody can have access to this shelf. If anyone wants to consume it—he or she will do that. How can I prevent that (laugh)?"

Pesticide and suicide

BM, 42 years old: "Poisoning with pesticides for suicide is now increasing in our area. We are farmers and always busy with agricultural work in the field. Most of the farmers here keep pesticides in their home and very openly. We are also very poor—familial problems are a constant accompaniment in our households. So during a quarrel or mental tension people get the pesticide ready at hand and they ingest it. No—not always with a definite desire to die, but in many instances they really die. The hospital is far off; those who reach it in time are fortunate and may get the wash [treatment]."

GP, 55 years old: "Yes pesticide ingestion is a serious problem in our households in the entire Sundarban area. My daughter-in-law committed suicide by pesticide ingestion 6 years ago. One of my brother's daughters attempted twice with pesticides. Pesticide is a great danger in our homes. We cannot do without it, we have to keep pesticides for our agriculture. Yes, it is true we farmers here are not very much careful of these poisons. In a family everybody knows where the pesticides are kept. So out of anger or during a marital quarrel, some one may get the poison instantaneously. In the hit of the moment they ingest it and in many instances lose their lives.… Pesticides are available everywhere, even a child can procure them from the village grocery shop!"

Although pesticide poisoning stands as the single most contributory factor in suicidal behavior, especially in rural communities, it is mostly hidden from wider public health interest [2]. Moreover, it should be kept in mind that under-reporting of self-harm is a major problem in suicide research. In this study as well, not all DSH cases attend the designated BPHC for various reasons, such as distance and lack of transportation,

seriousness of the case, social stigma, and sometimes for fear of getting involved in complicated legal proceedings. So the present BPHC data are not reflective of the total burden of self-harm for the block. For these reasons the actual total number of self-harm cases are likely more than what is reported here.

Analysis of the admission data of the 13 BPHCs of Sundarban also shows that the traditional methods of DSH or suicide, such as burning and hanging, are largely being replaced by poisoning. Household chemicals and indigenous poisons were also used for DSH and suicide. This overwhelming preference for poison indicates the impulsivity inherent in the psychodynamics of suicidal behavior in this population, where the easy availability and accepted social modelling of poison ingestion act as facilitating factors [26]. In other words, the easy availability of pesticides makes the population vulnerable to their use for impulsive suicidal behavior. This finding has broader implications for the development of a community-based psychosocial intervention as a part of a community mental health program [27]. The most pertinent question to be addressed here is this: granted that we need pesticides for crop protection, how can we minimize the risk of intentional poisoning (and accidental and occupational exposure also). We need to develop a farmer-friendly Good Pesticide Practice (GPP) practical model relevant to the local context, inclusive of safe storage and use.

It is also interesting to note that women used pesticides more (> 60%) than men for both DSH and suicide. This issue of gender-specificity and DSH has been reported elsewhere. Organophosphorus compounds were the most common pesticide used in both groups (57% of DSH and 83% of suicide cases). Many of the unknown poisoning cases also result from pesticides, but because of the lack of evidence, the cause of death was recorded as "unknown." Indian studies from rural and semirural areas also showed that ingestion of pesticides, especially organophosphorus compounds, was the major method used by suicide victims [28–32]. One important clinical concern here is the availability of treatment facilities for poisoning. All the BPHCs are very ill equipped to offer prompt and proper poisoning management, because none of the medical officers have any training or expertise in this subject, and the proper antidotes are often unavailable. Moreover, because of the ecospecificity of the region, most of the patients reach the BPHC an average of 2.5 to 5 hours and in some cases even 6 to 8 hours after ingestion of the poison, thus enhancing the case fatality rate. Thus, the present morbidity rate could be reduced if proper and effective treatment facilities and transport logistics could be developed in these remote islands. Primary health centers in any agriculture-dependent communities should have a special team for poison prevention, both for clinical management and for a community public health program [33].

Pesticide practices among farmers of Sundarban

Agriculture is a risky procedure in terms of health, environment, and foods in developing countries and involves serious occupational hazards [34]. In recent years some focus has been given to pesticide-related suicidal behavior in the developing world, where unlike the Western world, agricultural practice is still unregulated. The pesticide health burden is huge and includes accidental poisoning in both adults and children, acute and chronic health effects of pesticides on the farmers and their families, and the dreadful influence on the agrarian ecosystem [35] and the environment. Pesticide practice in rural India is virtually an unregulated and unsupervised enterprise, where at the one end stands the provocative approach of the fertilizer and pesticide companies [36], who promote different brands even at the distant village level through their extensive networks, and on the other side are the users who are mostly illiterate and have no access to any information other than their own experiences. Irrational or faulty use of pesticides is thus the rule rather than the exception in most of the Sundarban areas. Starting from pesticide selection to storage and application, the farmers all depend on the advice of pesticide shop owners, who by any minimum standard are not agricultural experts but businessmen. This is a very common picture applicable to the farmers of all the developing countries [37]. Although the United Nations Environment Programme (UNEP), the International Labour Organization (ILO), the Food and Agriculture Organization (FAO), and the World Health Organization (WHO) [38] have formulated many precautionary measures such as safety regulations, codes for the pesticide industry, toxicity criteria and restrictions, and minimum pesticide lists, but all these are more applicable to Western farmers and appear to be of no practical significance to the poor and illiterate farmers of developing countries [39, 40] and fail to reflect the ground epidemiological realities [41].

The Sundarban farmers have their own definition of safety of storage, which only regards children. Moreover, in most households other adults are also involved in agricultural work, so hiding pesticides from them is impracticable. Most farmers are only concerned with their crop protection and have little or no concern for health or for ill effects of pesticides on crops, the environment, or even their wives. They have their own set of pesticide beliefs—"pesticide is the tonic of our crops, and crops are our bread and butter…so we don't mind accepting the health effects of pesticides"—which are far away from international standards of safety and scientific rationality. They make their own decisions about selection, mixing, and formulation of pesticides, since they have no access to information or proper pesticide education. This is a very sad state of affairs in most rural areas of India [42] and most developing

countries [43, 44].

Easy availability of pesticides is one of the most important variables in the pesticide-suicide scenario [45]. Pesticide practices vary among countries and regions. In Sundarban, where the farmers are mostly marginal and have small landholdings, different farmers have different ways of storing pesticides. There is no uniform practice among the farmers. Obviously, those who keep pesticides at home are more at risk. The perception of risks also varies between farmers and professionals. Farmers only perceive risk to children and will take some precautions to store pesticides outside the reach of children. Inspection of the households resulted in a large disparity between what the farmers perceived as safe custody and what the researcher found to be safely stored. Sundarban farmers prefer to get pesticides at their doorsteps because the main market is too far and involves the cost of transportation. Therefore a number of grocery shops in the villages keep pesticides of different kinds. These numerous illegal retail outlets enhance the easy availability of pesticides to anybody on an as and when required basis. Moreover, since in most households the wife is also an agricultural partner, she has free access to the pesticide. Who buys the pesticide and how many days before the actual application are the two other factors related to pesticide abuse. The more it is purchased by other people than the farmer himself, the less control there will be over its safe custody. Similarly, the longer it is kept in the household, the greater is the potential risk of its abuse for DSH. Lack of pesticide education and information on risk is the most important factor among the Sundarban farmers that contributes to the easy availability and access to lethal poisons of any family members at the point of emotional breakdown [46]. Similar observations have also been reported from many developing countries [47–49].

Health effects

The effects of pesticides, both acute and chronic, on health are a well-documented issue of grave concern from the developing countries and are mostly underreported [50, 51]. The present survey showed that most farmers were unaware of or careless about pesticide-related health problems, and very few of them consulted medical facilities for treatment (detailed clinical findings on pesticide-related health effects are reported elsewhere). In fact many farmers in the focus group discussions or the personal interviews said they were not bothered about the health effects and if they developed some they would manage them in the traditional way. Knowledge of pesticide risk [52] is a condition for health consciousness and health-seeking behavior, and as most of the farmers have no access to health information, they mostly practice this dangerous game in a blind way. Many said that "if somebody deliberately ingests pesticide, he or she is at liberty to do so" or "we farmers cannot live without pesticide, it is our bread and butter; we have to accept its danger." This preliminary survey produced quite alarming findings about the acute effects of pesticides on the farmers' health (more than 67% experienced some effects during the last 1-year recall period). It was also noted that no information on health risks was provided to them either at the shop level or at the BPHCs or even on the pesticide packs. Most of the directives on the packs are written in English in small, almost unreadable type. This is the standard unethical business practice prevalent in most third-world countries [53, 54]. Nobody (agriculture department, pesticide companies, or local Panchyats) shares any responsibility for the information transfer. Keeping in mind that the incidence of accidental childhood poisoning with pesticide is quite alarming in the region, it is astonishing to note that although there is a system of regular home visits by health workers in each Sundarban block, they never discuss anything with the families about pesticide exposures [55]. Public health advocacy on the prevention of poisoning is an urgent need for this entire region.

Community mental health program

Pesticide-related suicide is a serious public health issue in the entire Sundarban region [56, 57] The prevention of suicide and DSH thus becomes an integral part of the community mental health service in these rural islands. To address this problem, a program in tune with the local context [58] was framed, which conducts regular mental health clinics at the BPHCs [59], along with mental health training of multipurpose health workers and local health care providers (nonregistered medical practitioners, locally known as "quacks"), who with professional help and training conduct psychosocial intervention in the vulnerable families and help in training the farmers in safe pesticide use. This program, which is currently ongoing, follows the principles of community participation and is aimed to give the suicide prevention program a public health approach by involving local Panchayat, farmers, school teachers, women's activist groups, pesticide shop owners, nongovernmental organizations, and health staff of the blocks.

Conclusion

An intersectoral public health approach for the prevention of DSH and suicide is an important agenda for community mental health promotion. Given the complexity of factors involved in suicide, it is likely that no single prevention strategy will combat this critical problem; rather, a comprehensive and integrated joint

effort is needed involving many sectors—the individual, family, agrochemical industry, community, agriculture and health care system, and media [49].

Rational and safe pesticide use is an issue that involves local agriculture departments, pesticide regulations, and local administrative bodies of a given community. For implementation of an effective suicide prevention strategy, collaboration among all these sectors is essential [60]. Sri Lanka is actively trying to reduce pesticide-related intentional death through various programs of pesticide harm reduction. In addition to enacting legislative restrictions on pesticides and encouraging integrated pest management, the government also emphasizes the continuous pesticide education program, which includes training of farmers, retailers, distributors, and the public (including schoolchildren) in the safe handling, use, and storage of pesticides [61].

The health sector should address the issues relating to poisoning prevention, mental illness, familial stress, and psychosocial intervention in particular and physical health in general, while the agricultural sector will provide pesticide education to farmers to ensure safe storage and use of pesticides. Konradsen and colleagues [1] have suggested that in suicide prevention, protracted prevention campaigns combining social and mental health sectors with the agricultural sector may have an impact on cases of severe poisoning and excessive mortality. The administrative bodies should focus on effective control, manufacture and sale, and pesticide regulations. They are empowered to make available less poisonous pesticides and to promote alternative farming by using integrated pest management programs and strict regulations on the sale and purchase of agrochemicals. Development of an optimal poison treatment setup, a poisoning surveillance system for definite catchment areas, and health education on poisoning (such as that on HIV/AIDS or substance use) should be a continuous public health agenda for the local BPHCs [62]. Health sectors will ensure advanced poisoning treatment facilities at the hospitals (reducing the case fatality rate) and psychosocial intervention in the community (reducing DSH).

In view of the enormous burden of pesticide-related mortality and morbidity and its consequent psychosocial impact, the time has come when the mental health professionals [63] should raise their voices on proper control of pesticides and education on safe pesticide use to safeguard the health and lives of the farmers. In view of the multifaceted dimension of the issue of pesticides and health, an intersectoral global public health initiative is strongly proposed by Bertolote and colleagues [64], to include pesticide regulation, epidemiological surveillance, medical management of poisoning, training on safe use of pesticides, and development of community educative programs to minimize the risk of intentional or unintentional pesticide poisoning. A vast majority of farmers in the Third World are exposed to varieties of pesticides, including those which are restricted and banned in industrialized countries. Unsafe use of pesticides is the rule in Third World countries. National programs on safe use of pesticides are needed for this entire population. Thus, research should focus on methods of surveillance of exposure and of acute and chronic effects, and policy should aim for long-term interventions and international collaborations to address this global health problem [21, 65].

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